Robo-ethics design approach for cultural heritage: Case study - Robotics for museum purpose

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Robo-ethics design approach for cultural heritage:
Case study - Robotics for museum purpose

by

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Politecnico di Torino 2017

Declaration

I hereby declare that, the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

Luca Giuliano

2017

* This dissertation is presented in partial fulfillment of the requirements for **Ph.D. degree** in the Graduate School of Politecnico di Torino (ScuDo).

I would like to dedicate this thesis to my Mother

Acknowledgment

I would first like to thank my thesis advisor Prof. Claudio Germak of the Architecture and Design Department at the Politecnico di Torino.

I would also like to thank the experts who were involved in the development for this research project. From the Tim JOL crab: Marco Gaspardone, Roberto Antonini, GianPiero Fici, Stefano Primatesta, Miguel Kaouk. The Polito MediaLAB, and Tonic Minds. Without their passionate participation and input, Virgil could not have been successfully conducted.

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Finally, I must express my very profound gratitude to my father Claudio and my aunt Pinuccia for providing me with unfailing support and continuous encouragement throughout my years of study. This accomplishment would not have been possible without them. Thank you.

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Abstract

The thesis shows the study behind the design process and the realization of the robotic solution for museum purposes called Virgil.

The research started with the literature review on museums management and the critic analysis of significant digital experiences in the museum field. Then, it continues analyzing the museum and its relation with the territory and the cultural heritage. From this preliminary analysis stage, significant issue related to museum management analysis comes out: nowadays many museum areas are not accessible to visitors because of issues related to security or architectural barriers. Make explorable these areas is one of the important topics in the cultural debate related to the visiting experience. This first stage gave the knowledge to develop the outlines which brought to the realization of an efficient service design then realized following robot ethical design values. One of the pillars of the robot ethical design is the necessity to involve all the stakeholders in the early project phases, for this reason, the second stage of the research was the study of the empathic relations between museum and visitors. In this phase, facilitator factors of this relation are defined and transformed into guidelines for the product system performances. To perform this stage, it has been necessary create a relation between all the stakeholders of the project, which are: Politecnico di Torino, Tim (Telecom Italia Mobile) JOL CRAB research laboratory and Terre dei Savoia which is the association in charge of the Racconiggi's Castle, the context scenario of the research.

The third stage of the research, provided the realization of a prototype of the robot, in this stage telepresence robot piloted the Museum Guide it is used to show, in real time, the inaccessible areas of the museum enriched with multimedia contents. This stage concludes with the final test user, from the test session feedback analysis, many of people want to drive themselves the robot. To give an answer to user feedback an interactive game has been developed. The game is based both on the robot ability to be driven by the visitors and also on the capacity of the robot to be used as a platform for the digital telling.

To be effective, the whole experience it has been designed and tested with the support of high school students, which are one of the categories less interested in the traditional museum visit. This experience wants to demonstrate that the conscious and ethical use of the robotic device is effectively competitive, in term of performances, with the other solutions of digital visit: because it allows a more interactive digital experience in addition to the satisfaction of the physical visit at the museum.

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Chapter 1

Design for service robotics

1.1 The mediator role of the design

The key role of design

The role of the design in the innovation process is assuming an increasing importance. One of the main ability of the designers is to portray the reality, in his book "Da cosa nasce cosa" Bruno Munari (Munari, 1981) defines that the creative process that identifies the work of the designers it can not be sustainable without a structured observation analysis apparatus. Munari explains a methodological framework that goes from a problem to a solution passing by an idea generated from the analysis of the cultural scenario and the necessities of the user. Thanks to this practice, the vision of the world that designers have makes this profession very useful in the analysis of the complex system for find a problem and resolve it. However, design means also project, therefore design discipline it has to be meant useful also for understand how a social good can communicate with an audience (user) its objective value of the product and also the system of values which that object generates in socio-cultural scenario(Verdiani, 2011).

Recently the role of the designer is assuming others meanings, the designer can actively reorganize the vision of a multidisciplinary project team to promote the transfer of knowledge, and this is ensured by the design activity that is focused on users. Flaviano Celaschi Full Professor of Industrial Design at University of Bologna (Italy), in an essay of the book "Uomo al centro del progetto Design per un nuovo umanesimo" (Germak, 2008) describe the design discipline as it follows: *"...we might consider design as a discipline that lies mid- way between four different systems of knowledge (in-put) that traditionally are unlikely to interact with each other: the humanities and technology/engineering on one axis, and art/ creativity and economics and management on an axis perpendicular to this. The fact that it is on the borderline between these fertile and ancient forms of structured, specialised knowledge - which are not in conflict but rather act as catalysts of content and synthesizers of effects - makes design an area of knowledge with huge potential that is contemporary, pervasive and effective, relational and adaptable,*

and extraordinarily capable of bridging the gap between theory and practice, and between the possible and the feasible.

- ***Form**, which is one of the most explicit effects of de- sign, takes shape when the creativity of art is combined with the feasibility of technology and engineering.*
- ***Function** appears when the development of technology and engineering meets up with the utility of economics and management.*
- ***Value** is created at the crossroads of economic profit and the humanities' search for interest.*
- ***Meaning**, lastly, arises out of the encounter between the hermeneutics of humanist culture and the intuitions of art."*

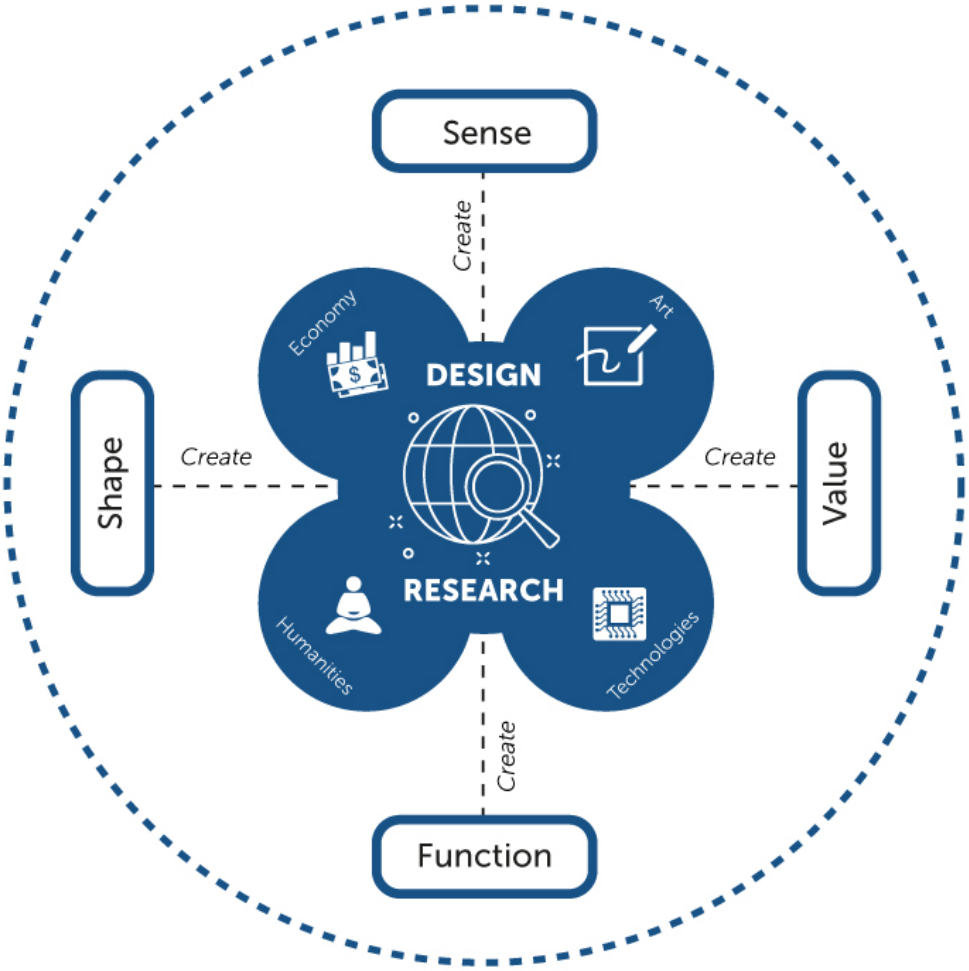


figure 1: Design framework

Recently, different competencies were conveyed in the robotic field. If robotics was firstly a primary field of mechanical and electronic engineering, nowadays many discipline and knowledge contribute to it. The evolution of robotics artifact led researchers to question themselves about different themes, such as acceptability (Salvini, et. al, 2010) and aesthetics. For this reason, it was necessary to enlarge the debate to various disciplines, among which design. Through the contemporary design discipline, in fact, roboticists extend their ability to generate value and meaning, creating relationships between human needs, technology, and contexts. The design contribution, hence, is mainly consisting of two principles: analysis of the stakeholders, and the analysis of the effects that the introduction of robotics can generate. Addressing these principles results in the creation of solutions developed around the four design assets (form, function, value, and meaning).

Those reflections are crucial because nowadays service robots are no more a science fiction dream. Altought, they are going to be used on a large scale thanks to the technological implementation related to CPU integration and sensors miniaturization process. Differently from the industrial robotics, often utilized by the companies for accomplishing repetitive, dangerous, and stressful tasks, service robotics it has been used for cohabiting with humans and for giving us an help both in the domestic environment and in the workplace.

1.2 Research amibits

Behind the Project Virgil

Following the design principles described before, the thesis shows the study behind the design process and the realization of the robotic solution for museum purposes called Virgil. The project idea started with the collaboration between the Politecnico di Torino and Tim (Telecom Italia Mobile), who funded the project, in the JOL CRAB laboratory. This collaboration has created a shared multidisciplinary working environment with the scope to design innovative cloud robotics solutions for several application fields. In this case service robotics for museum environments. Furthermore, the project it has been developed with the purpose of providing the basis for foster a design-based methodology useful for the development of robotics and interactive device with the aim of enhancing the museum exhibit experience.

Illah R. Nourbakhsh in the book Robot future (Nourbakhsh, 2013) defines that to be effective future technology solution does not have to be designed for an audience but with the audience to involve since the beginning the human needs in the design strategies, for this reason the research is structured starting from a case study scenario, the Piedmont cultural heritage.

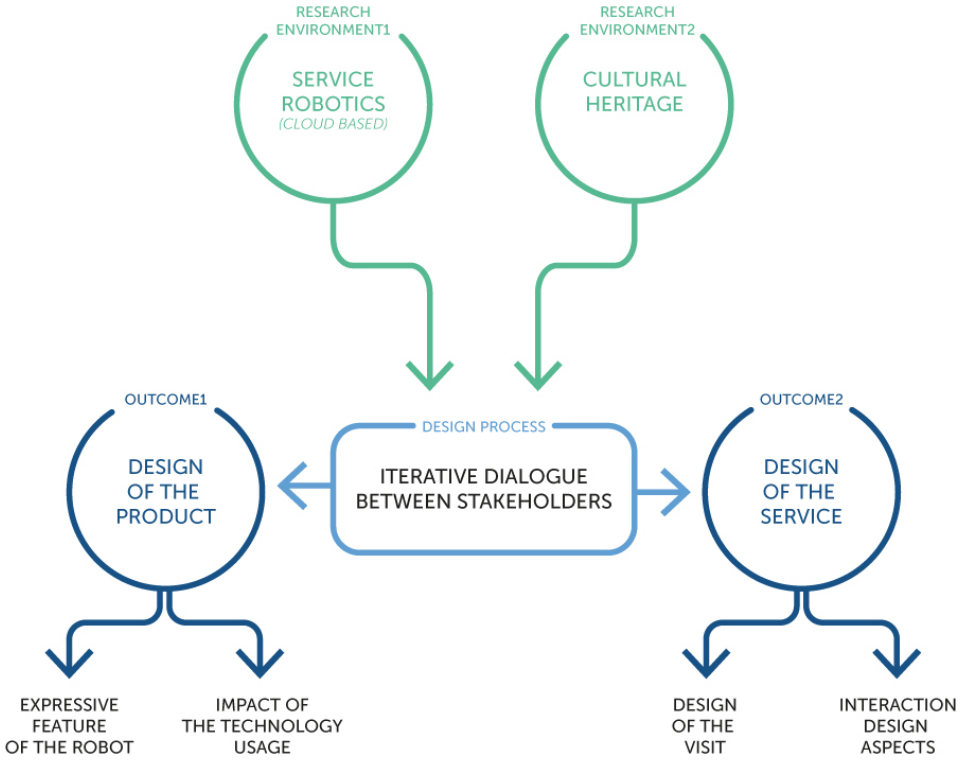


figure 2: Research enviroments and outcome

Outcomes

Figure 2 resumes in this sense which are the research ambits of the project and highlight the expected outcome. The knowledge mediator role of the design it has been set in a central position because it has to manage the information and the suggestions coming from the two research environments. Furthermore, the design process has to manage the iterative dialogue between the stakeholders, and with them give an answer in term of the design of the product and term of the design of the service. Specifically for which regard the design of the product a study on the expressive feature of the robot it has been performed and also the impact of the technology usage it has been socially evaluating. For which concern the design of the service the outcome are focused on the design of the visit and in the interaction aspect of the tour.

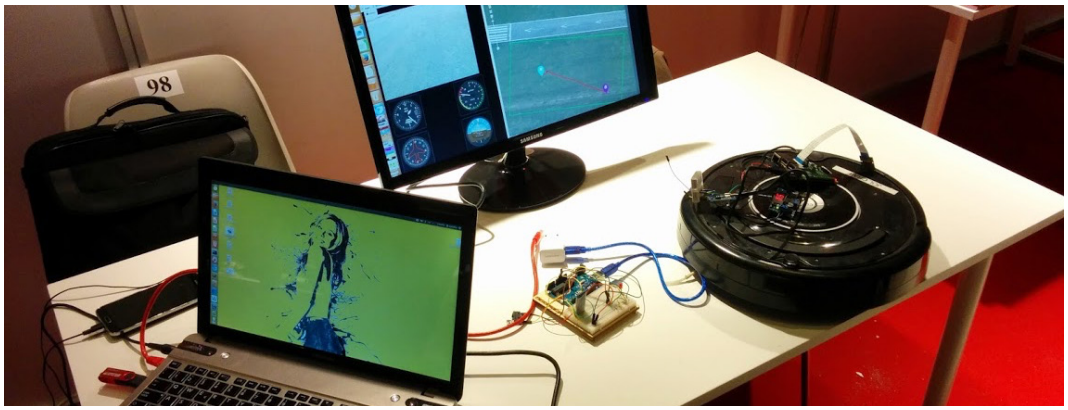
1.3 Project partners

The thesis project is based on the collaboration between two principal partners. A telecommunication company and a cultural association created the cultural environment and economic intentions for promoting the research, which the Politecnico di Torino has managed it.

1- project partner: TIM JOL CRAB

- *Technological expert*
- *Funder*

Tim Jol Crab is a research cluster inserted in the research program of Tim market leader in the communication field. Main objective of the Crab is to investigate of technologies and develop service concepts where the focus is mainly placed on the relationship between robots and the cloud computing, addressing issues that arise from the use of robotic services in public/enterprise environments not only of technological, legal, economic, sociological or psychological kind, but also related to ergonomics, cognitive perception, and relational experience



2- project partner: TERRE DEI SAVOIA

- Cultural heritage expert

The Association Le Terre dei Savoia, based at the Castle of Racconigi, is a non-profit organization recognized by the Region of Piedmont. It manages del cultural heritage included in a large area in the provinces of Cuneo, Asti, and Turin characterized by major urban and agricultural settlements, rich cultural, environmental and productive resources.The association operates for local the community and promote the territory through the development of services that become precious for the growth of the cultural, natural and productive aspect of the territory.

1.4 Methodology

This thesis is developed following the design methodological framework taught in the design faculty of the Politecnico of Turin. This approach is mainly divided into two crucial parts: Metadesign part and Design part. Metadesign includes the scenario analysis and also the performance system; starting from a brief, a short statement that clarify reasons and objective that the designer wants to reach, Metadesign phase is structured around a scenario description. Defining a scenario is the first meta project operation. The scenario should include information about the state of the art, the market, users, history and future innovation. Inside the design process context analysis, designers highlight the system of values and the design opportunity. The final output of the scenario analysis is the concept, consisting in the main idea behind the project which defines the system of values and principles to be pursued in the development of the project.

After the definition of the scenario is possible to analyze the performance system. The performance system analysis highlights the needs of all the stakeholders involved in the project:

- **End user:** who finally have to use the product
- **Production user:** who have to produce the object
- **Management user:** related to transportation and maintenance
- **Environmental user:** related to the product sustainability.

The performance system is composed by:

- **Requirements:** The project is configured as a series of possible answers to a series of conditions, the user needs, which are different for each project to project.
- **Performances:** Performances are the next step after the definition of the requirements. In this phase, the pieces of information gathered are transformed into specific and quantified data. The specification is the translation of data into something comprehensible and operative. It is possible that for satisfying one requirement only, it will be necessary to develop several performances or vice versa.

The Design part begins with the draft project meaning the modeling. The model is a three-dimensional representation of the project in progress. It is not necessarily definitive it can be used for testing the object in the aspects of usability and ergonomy. It could be realized with different purposes, for example, have a check inside the working team or with the client. The model could be real, a natural formalization of the project in different scales, or virtual, a formal model that is the abstractions of the physical model. The last part of the design phase is the executive part that includes the possible project, the engineering, prototyping, pre-production and the product communication.

For this thesis, the project it has been developed until the draft project phase, the production phase and the finalization of the project are introduced as a future purpose of the project. Over the classical design approach for this thesis relevant interaction design principles have been followed. Interaction design is an applied art useful for understanding and resolve issues related to the communication between two human beings or between human and artificial intelligence. The main principles to follow regarding the interaction design practices are (Saffer, 2010):

- **Focus on the user:** set the user in the center of the project and make him able to complete the required task easily.
- **Finding alternatives:** analyze all the opportunity and find the most appropriate for reach the prefixed scope
- **Prototype:** create model of the solution designed and try them with the final user
- **Collaborate:** Share the knowledge between all the stakeholders involved in the process to find innovative solutions
- **Create solutions:** try to solve all the problems and the issues
- **Think about emotions:** involve the user emotion in the design solutions increase the empathy between the object developed and the consumer.

Thesis description

Following the methodology described before, the research division is partitioned into four parts. The first part, outlined in chapters two, three, and four, present the literature review. Those chapters represent the Metadesign phase. The first part of the research introduces the context of the project. The context describes the current, existing situation, with a focus on social and intentional elements such as new technologies, new practices, and new objectives. In the end, first part concludes with the guidelines and the requirements/ performances statement.

The second part of the research outline the robotic framework and the codesign phase. The second part, described in chapter five, includes the description of the main components of the robot (cloud platform, robot aesthetic, interface) and the description of the service developed in collaboration with the project partners. The third part is strictly related to part two and describes the design evaluation of the project. Tests are described, including the analysis of the data associated with the usability and the acceptability, in the last part of chapter five.

The final part of the research is the improvement phase. After the data analysis, the project research it has been enhanced through an innovative solution based on the user experience. This part is described in Chapter six.

The thesis concludes with a critical analysis of the project result and with the future perspective of the project describing possible services related to robotics and museum.

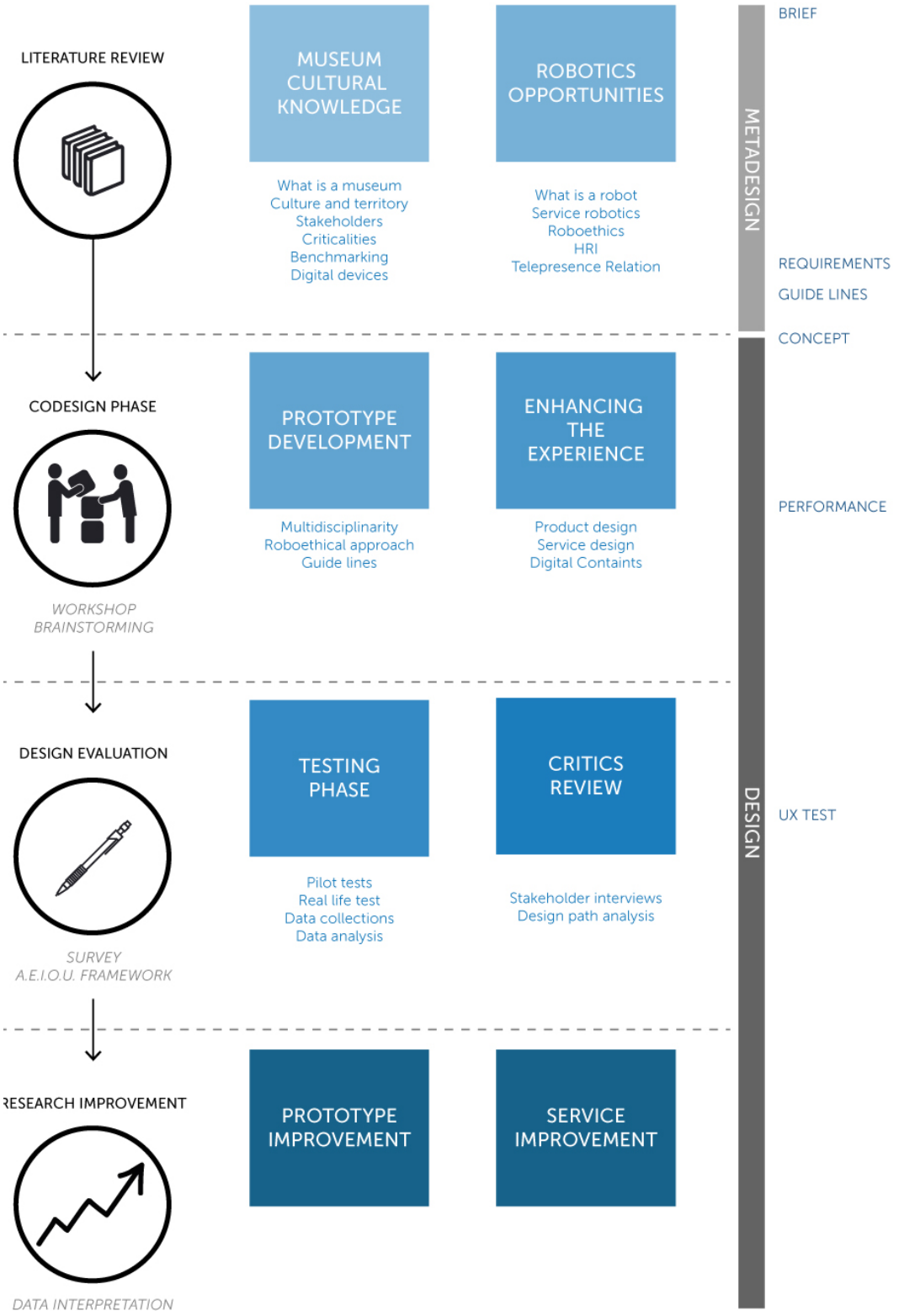
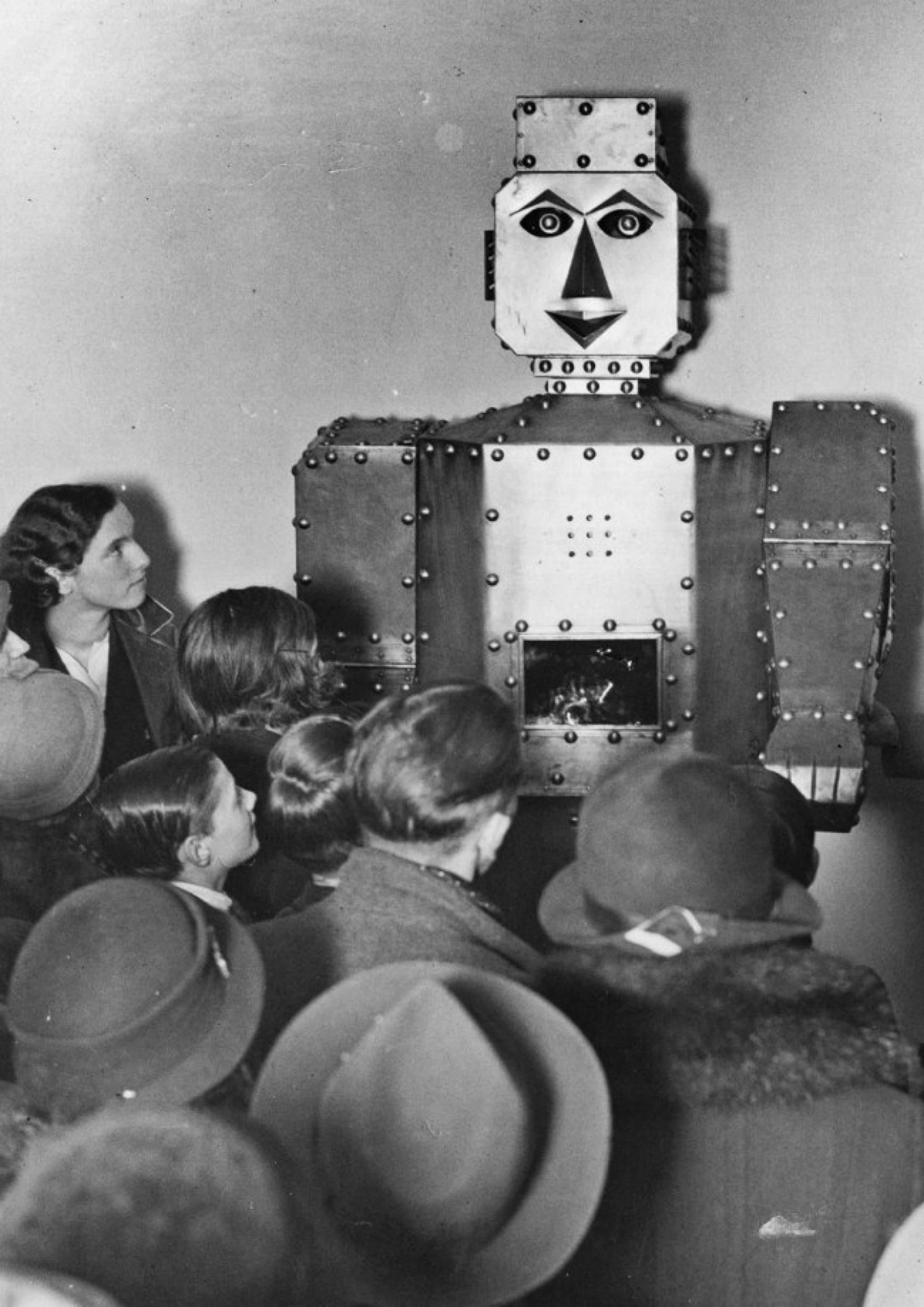


figure 3: Methodology



Chapter 2

Looking at the robot

2.1 What is a robot

Economists, sociologists, philosophers and informatics expert have predicted that the next robotics revolution it will change our life forever. Robots Evolution will have a profound impact on our habits and our daily life, and this it will be possible because of the last three decades technology push that has allowed to technological devices to reach results unimaginable.

Definition of robot

The robot is defined by Robotics Industry Association as a reprogrammable, multifunctional manipulator designed to move material, parts, or tools through variable programmed motion and in possession of certain anthropomorphic characteristics, like mechanical arm sensors (RIA, 2015). RIA definition defines it as a multifunctional programmable manipulator. A different view of robotics is the one gave by Japanese Robot Association JARA who define robots "Any device that can replace the human work." (JARA, 2004). Japanese cultural vision of robotics is entirely different in respect of the Occidental one. For Asian people, it is easy to be empathic with the robot because it is part of their Shintoist religion believe that a machine is more acceptable the more is closer to look like a living being (human or animal); therefore the way the people look at these artifacts is entirely different. For Occidentals researchers, robots are more a sort of technological fetishes. McKerrow in his book introduction to robotics (Bonifati, 2010) defines them as "Devices programmed to perform different tasks in the same way of a computer." The Italian national agency for new technology and the sustainable economic development ENEA (ENEA, 2011), it confirms that it is difficult to have a universal definition of robotics. Probably, the most appropriate are the one of Professor Michael Brady founder of the "Robotics Research Group" the University of Oxford "Robotics is the intelligent connection between perception and action." In other words, a robot is something that responds intelligently to an environmental situation that detects through a system of sensors and that his reaction is used to achieve a particular purpose.

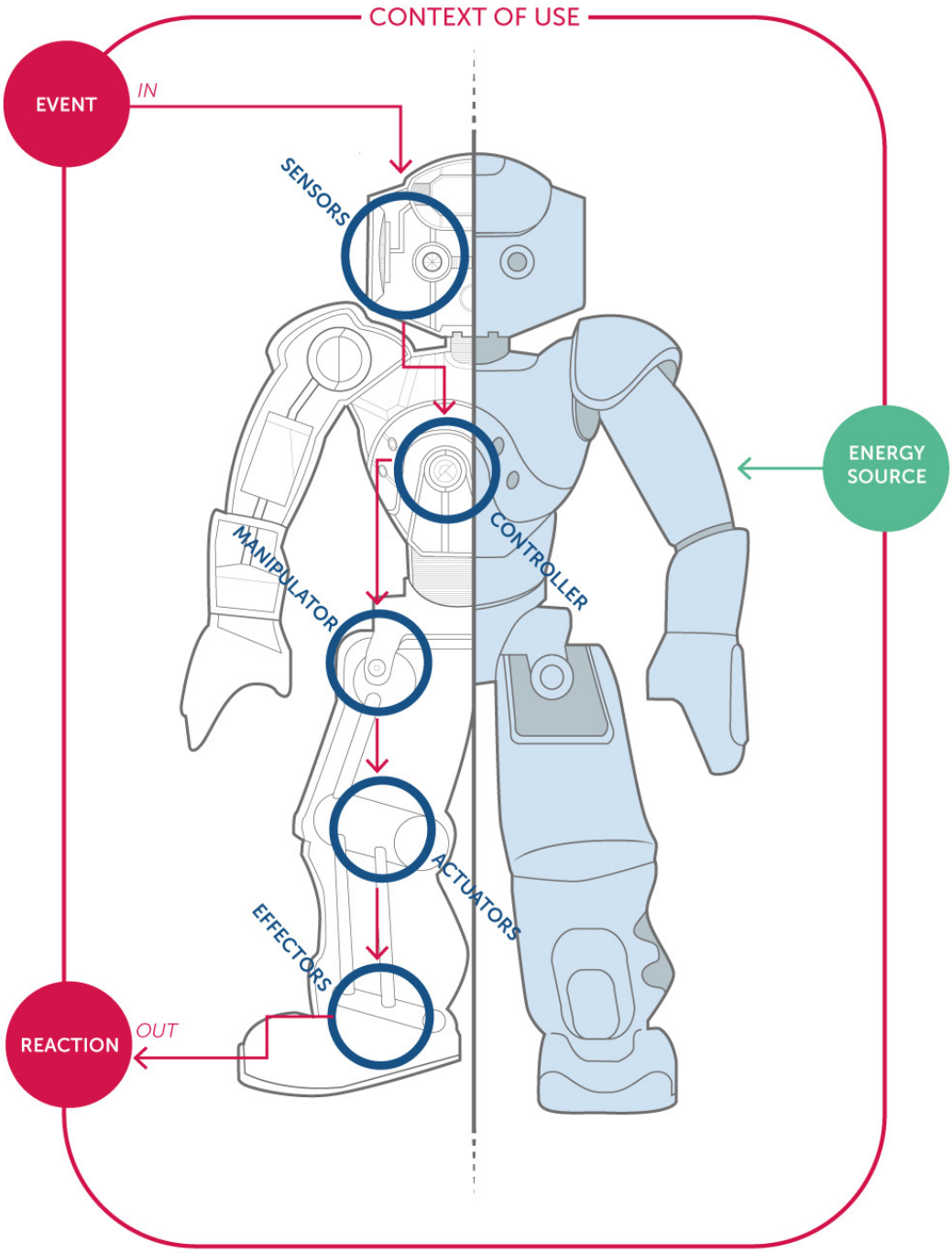


figure 4: What is a robot

Brady's definition is a very broad one, but it defines the general idea of robots. Starting from this definition one of the first step of the research it has been creating a definition of the robot to which refer. One of the elements that define a robot is its physicality; this element is fundamental in the design and the interaction with the user. This aspect should be integrated into the definition, so this element it has been adding in the words of Professor Michael Brady "Any artificial agent able to perform one or more operations (smart); perceiving, analyzing and acting in the context space." (Brady, 1989)

Robots base components

As it has been said before a robot is a system composed of several elements, those elements can resume in the archetypal structure of the robot:

- **Sensors:** Sensors are used to collect information about the internal state of the robot or to communicate with the outside environment. Robots are often equipped with external sensory devices such as a vision system, touch, and tactile sensors. Which help to communicate with the environment
- **Controller:** The controller receives data from the computer, controls the motions of the actuator and coordinates these motions with the sensory feedback information.
- **Manipulator:** This is the main body of the Robot and consists of links, joints and structural elements of the Robot.
- **Actuators:** Actuators are the muscles of the manipulators. Common types of actuators are servomotors, stepper motors, pneumatic cylinders.
- **End Effector:** This is the part that handles objects, makes connections to other machines, or performs the required tasks. It can vary in size and complexity from an end effector on the space shuttle to a small gripper

2.2 Robot and popular culture

As many probably know, the word "robot" derives from the popular culture. This terminology has been used for the first time in the novel "R.U.R. (Rossum Universal Robot)" (Čapek, 1925) a 1925 science fiction romance of Czech writer Karel Čapek. The Czech word "Robota," in fact means both "working hard" and "Slayer." Consequently, the world robot it has been used in large scale for define artificial device able to manifest outstanding feature. Hence, there is no doubt that robots since the beginning have been conceived to perform fatiguing tasks or to help humans.

Like in the Čapek's book, starting from some years ago, the industrial market began to widespread use robots in their production lines. In this scenario, robots are usually used to perform complex, dangerous and stressful tasks displaying a working precision more elevated than the human one. Conceiving this field of application, in the major of these cases engineers have designed robots with no anthropomorphous shape, comparing them with tools.

The idea to start to develop robots similar to the human shape born from the collective social imagination. Since in the past ages, in fact, humans have built statues or artifact trying to simulate the aesthetics of nature. If we look at the examples that our cultural background proposes, this consideration takes its confirmation by robots that are for the most of the cases, represented in an anthropomorphic way. In particular, in the collective imagination robot humanisation is often the cause of their demonization because in literature for the major of the cases robots with human features have a negative meaning. Anthropomorphism earns relevance in function of the emotive and cultural resonance that can have compared to man. In particular, people naturally lead to give features depending from aesthetics. There is an instinctive association between beauty and goodness that is regularly present in literature over the time. As humans, we project our human being and our way to relate to everything even on inanimate objects. This relation is possible thanks to our mirror neurons system, a class of neurons that are activated when someone performs an action and when a person observes it. Domenico Parisi published an article on the Treccani encyclopedia that resumes the relation trough the mirror neurons system (Parisi, 2010). The discovery of the canonical neurons and mirror neurons forms the basis of the theory of object understanding. Understand an object means activate in our brain the plan of action that normally we would make in response to the perception of that object. Plan of actions could also be activated looking at someone act, or perform, a task using an object. Summarizing the mirror neuron theory, it is possible can say that in a spontaneous way we attribute meaning to everything we observe. This meaning is composed of our experience and our behavior.

Robotics cultural categories

Therefore Because of our cultural background, we see machines like a fear catalyst, and the more the robot is built with humans features, the more it has been easy to project on him our fears and expectations. Movies and literature have well described this fears and contrasting hopes. For this reasons the references that we have from our collective imagination are so important to give value to this class of artifact. Roberto Cingolani and Giorgio Metta in their book "Umani e Umanoidi" (Cingolani et. al., 2015) define the types of robots present in our cultural background:

- **Robot buddies**: probably the most famous couple of robot buddies are R2D2 and C3P8 from the Star Wars franchise. In this category are inserted all the robot that have peaceful mood with humans, the robots present of this kind are helpers and generally with good behaviors.

- **Robotics society:** many films have theorized the coexistence of different species; people, and robots living together in a fragile social equilibrium. In Blade Runner and the Terminator saga, robots and replicants mesh with the human population, and there is a continuous battle for ensuring the survival of the humanity
- **Cruel and rebels robots:** it exists an extensive list of movie where machines act in a mean way. In the film Metropolis, for example, the servant robot Maria rebels against her creator, the robots present in this class are bad examples of coexistence between humans and technology
- **Robots with feelings:** there are films in which are told stories about little kind robots, which they have feelings and which they are conscious about themselves. Wall-E is one example of them, in this case, the story of the robot it is narrated as a reminder
- **Robot interconnected with humans:** a last typology of film talk about humans symbiotic with robots, belong to this class of robots Robocop or the robot present in ghost in the shell, in this case, the technology and human are merged indivisibly

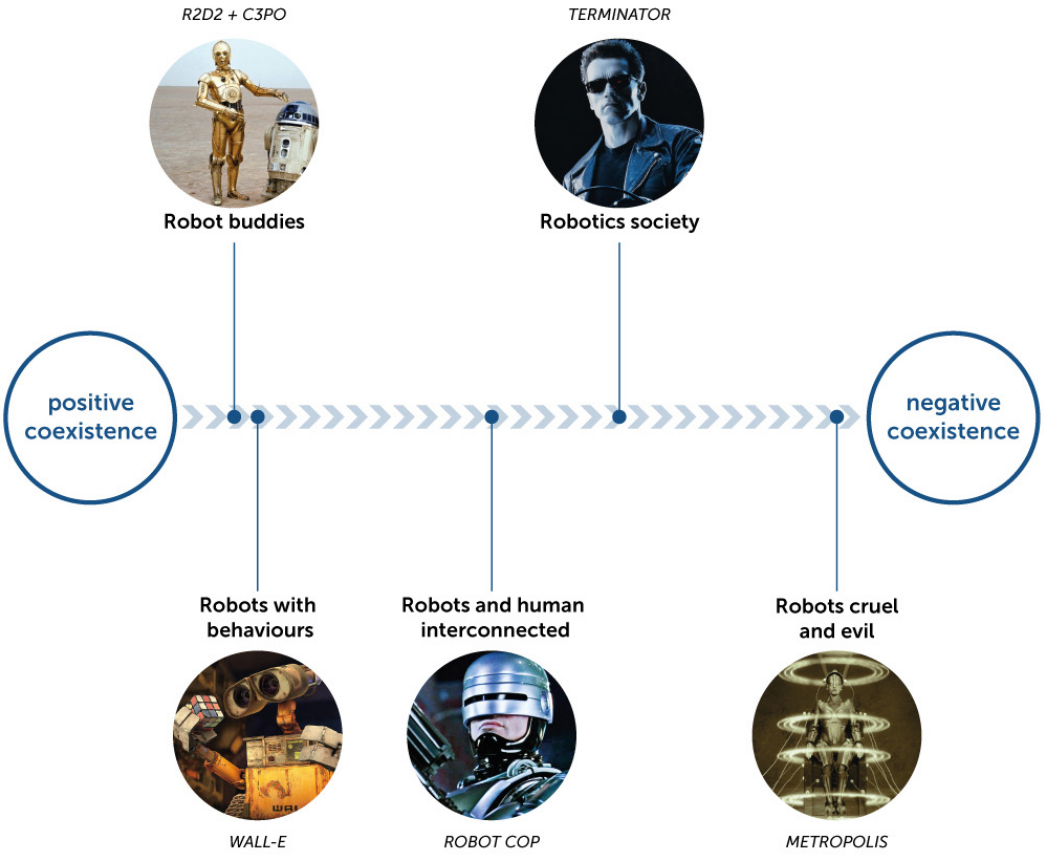


figure 5: Robots and popular culture

2.3 Service Robotics

Cultural background gave us some example of robotics applications, but for the most of the cases, today, we are far away from what popular literature has predicted. Define which are the most common applications of use today in robotics it is not easy. A robot is a complex system made by a several numbers of components that shall operate simultaneously and in a synchronized way.

Market growing importance

Therefore the market is in a growing phase, in a 2013 study conducted by the Institute of Management of Technology of the National Chiao Tung University (Chen, et. al., 2013), it has been made a screening of the future size of the robotics market. The study present the prediction made by the Japan Robotics Association (JRA) about the Personal/Professional Robotics market that in 2025 is going to reach 51.7 billions of US dollars, actually the value market amount to 17.1 billion (figure 6), so an increase of the 300% is forecasted.

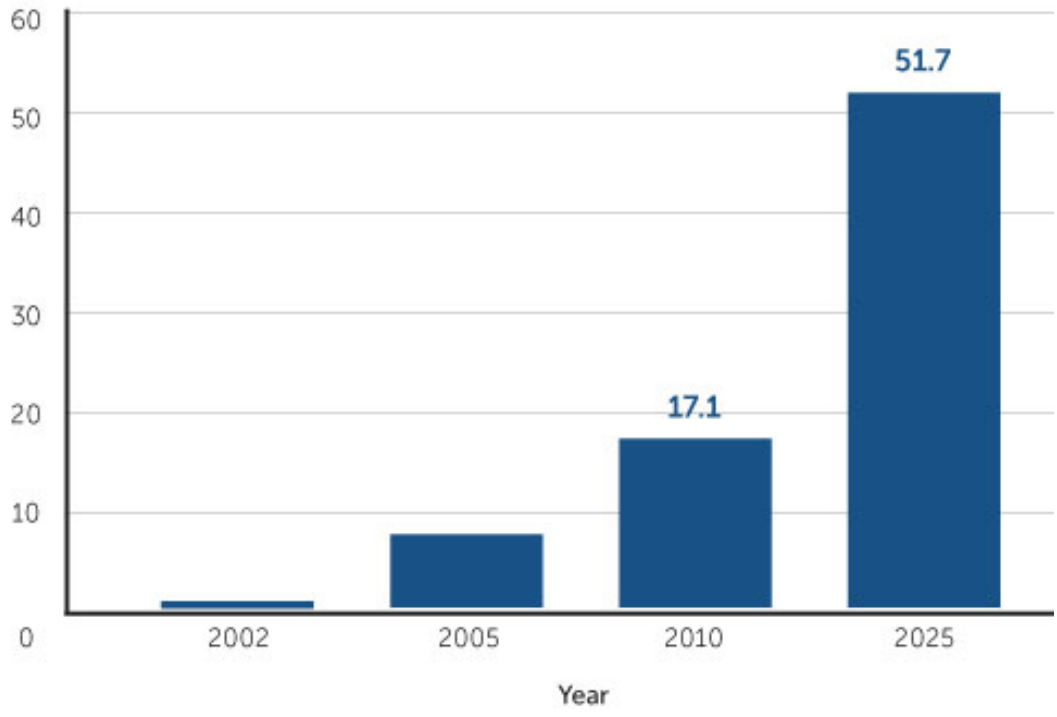


figure 6: Growth in personal/ professional robotics

These future achievements are forecastable because of the success gained in the technological innovation. The study present also a diagram about which are the most influence technological issue fixed divided in a time scale (figure 7):

- Computer Vision for the Recognition of Overlapping Parts
- Market for Tactile Sensors with Recognition Capability
- Task Level Programming Languages
- Development of Service Sector Market for Robots
- Introduction to Automated Robot Programming for Industrial Tasks
- Introduction of Lightweight, Compliant Manipulator Links
- Autonomous/Intelligent Mobile Robots

All those features have to be considered as the market driver in the robotics field, and thanks to those achievements, the robotic market is growing increasingly. One of the growing areas in the robotics market is household and entertainment robots.

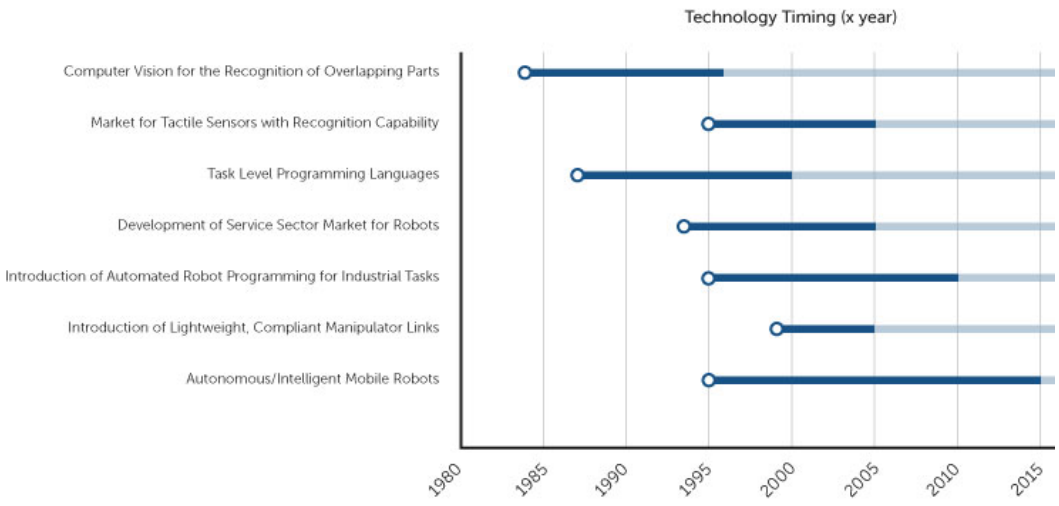


figure 7: Technology Timing x year

Robots typologies

Elprocus website, suggest a possible classification of robots based on their complexity. In this case, robots are categorized based on the final field of application (Agarwal, 2014) (figure 8):

- **Advanced production system:** *These robots bring into play in an industrialized manufacturing atmosphere. Typically these are articulated arms particularly created for applications like- material handling, painting, welding, and others. If we evaluate merely by application then this sort of robots can also consist of some automatically guided automobiles and other robots.*

- **Adaptive servant and intelligent homes:** *Robots which are used at home. This sort of robots consists of numerous different gears for example- robotic pool cleaners, robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners and other robots that can perform different household tasks. Also, a number of scrutiny and telepresence robots can also be considered as domestic robots if brought into play in that sort of environment.*
- **Healthcare and life quality:** *Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots. Also, some robotic directed automobiles and perhaps lifting supporters.*
- **Service robots:** *Robots that cannot be classed into any other types by practice. These could be various data collecting robots; robots prepared to exhibit technologies, robots employed for research, etc.*
- **Edutainment robots:** *These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as Robosapien or the running photo frames and concludes with real heavyweights like articulated robot arms employed as movement simulators.*
- **Outdoor Robotics:** *This type of robots would consist of the robots employed on Canadarm that was brought into play in Space Shuttles, the International Space Station, together with Mars explorers and other robots employed into space exploration & other activities.*

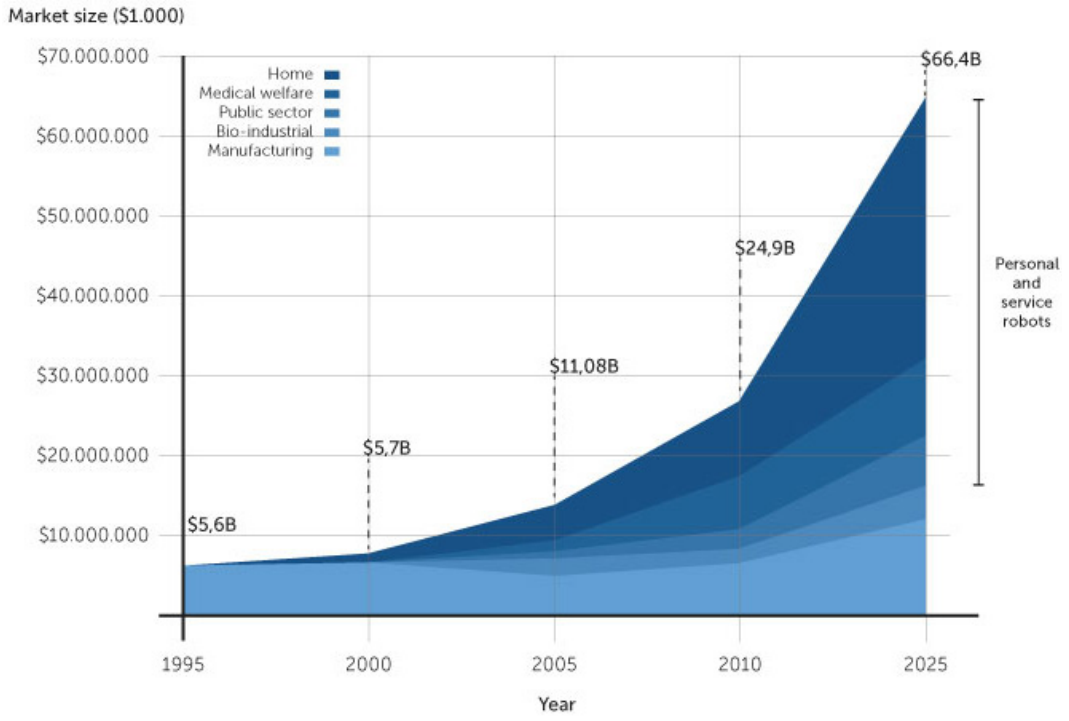


figure 8: Service robotics market size

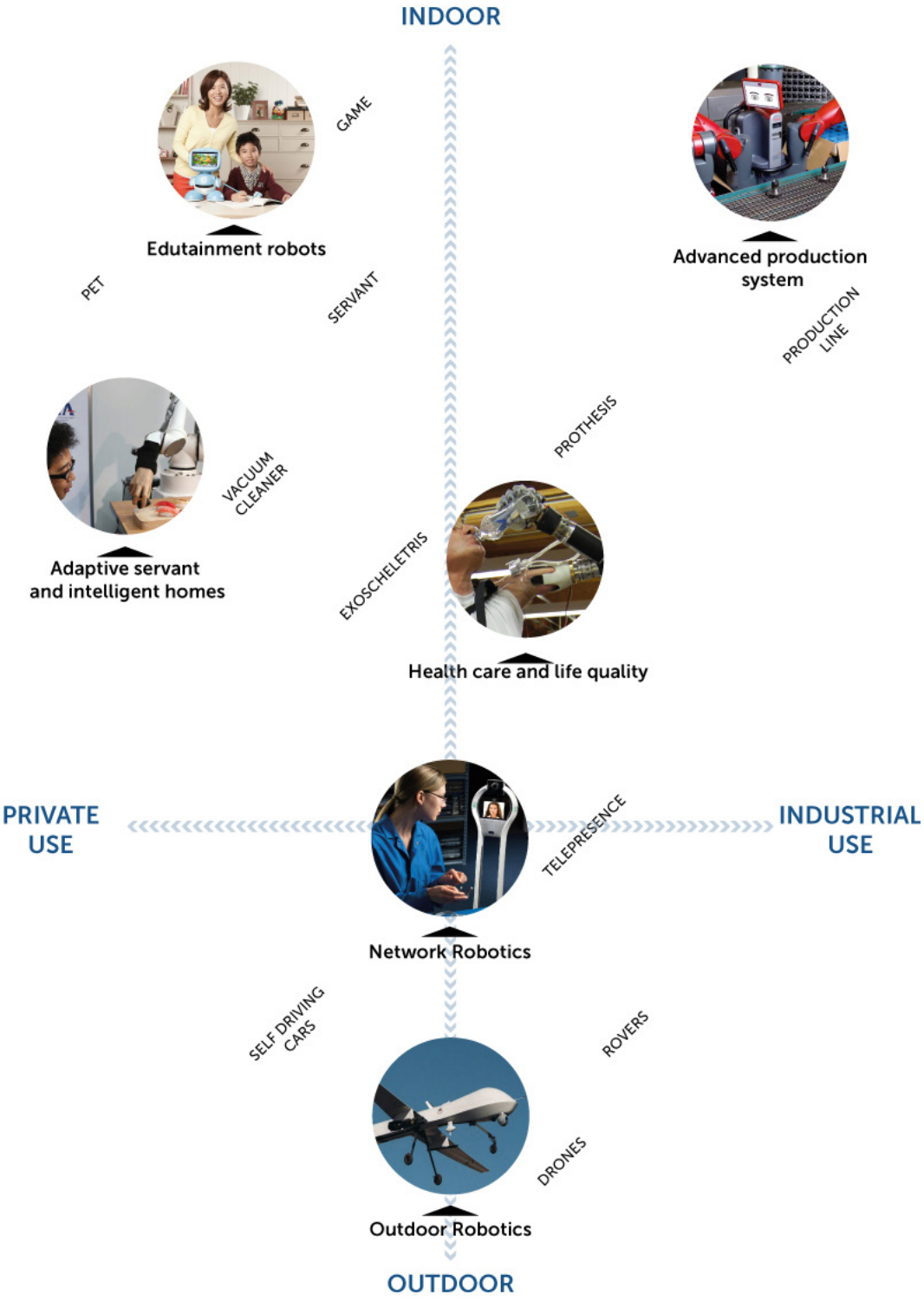


figure 9: Service Robotics applications

What the market suggest is not entirely explanatory of all the future robotics applications. The market highlighted some trend but it is necessary to go further in the analysis and try to define which are the emerging categories in robotics. In the paper published in the conference on aesthetics of interaction: dynamic, multisensory, wise. Deform, are highlighted the new emerging trend of the service robotics, it has been highlighted the new classes of robotics applications (Germak, et. al., 2014):

Robotics new frontiers

- **Makers and Manufacturers:** The world of makers includes all those composite robots, generated by the associations of printed circuit board, 3D printed components and other available materials, such as Arduino robots, characterized by an entirely open approach, both hardware and software. This method promotes the free dissemination of the design concept, each application, indeed, is shared on web platforms in a perspective of sharing knowledge. An example of the manufacturer approach is, instead, Jibo (figure 10), a robot companion designed by Cynthia Breazeal. Jibo is a small family robot, able to observe, recognize faces, take photos, interact via speech, learn from user behavior and communicate emotions (Guizzo, 2014). Its functions are not very different from those of a smartphone, in fact to it are entrusted mainly communication activities, but to these, it adds the execution autonomy and the ability to orient itself according to the user.

figure 10: Jibo

- **Parasitic:** The ability to connect a digital device to a robotic artifact is a phenomenon in a large rise and can be ascribed within the concept of parasite robot. The phenomenon of parasitism, in fact, concerns solutions, robotic or not, that works by exploiting the capabilities of others, called guest. In this parasitic relationship, the two identities are distinguished primarily by cognitive and motor abilities. It is possible to identify, in fact, two main types of robot parasite: robotic devices with movement ability whose cognitive part is assigned to a device, such as a smartphone, and smart devices that are attached to mobile robots, to expand their cognitive abilities. The robot Romo (figure 11), for example, consists of tiny crawler that only works if hooked to an iPhone, on which it is installed an app that manages the movement, allows to make video calls and acts as the face of the robot, which acquires, thus, expressive skills.

figure 11: Romo

- **New humanization:** In some cases, a robot reaches a high level of acceptance (Beer, 2011) at the moment in which manifests its function and is in line with the context in which it is located, but there are cases in which the high level of engagement can be reached through charm. This is the case of the telepresence robot Double (figure 12), that consists of a base similar to a Segway in which is inserted a pole with support for iPad. Its function, in fact, is to allow a person to participate in the event of various kinds (business meetings, medical, school lessons) via streaming video and differs from a traditional video conferencing for

the ability to move in the environment. The Double arises from the digital world, integrating the capacity to move into an existing service. However, the charm of this robot is achieved through the expressivity. Its morphology reminded the human one but dematerialized: the slender structure supports a sort of head (tablet), and the wheels represent the feet, which give it an apparent fragility and generate a gentle oscillatory motion. It is precisely the sense of precarious balance, combined with the archetypal morphology of human skeleton, which makes this robot fascinating and highly accepted. Also, this robot, thanks to its function, represents also the overcome of the human-robot interaction on behalf of the human-robot-human interaction (Kristoffersson, et. al. 2013). The head, represented by the tablet, allows a physical dematerialization in the name of the virtual, in which the empathy is entrusted to the multimedia communication.

figure 12: Double

2.3.1 Telepresence

Telepresence robots are pieces of a quickly evolving area of technology that pushes the boundaries of how technology can augment or stand in for humans (Michaud, et. al. 2007). In practical use, these devices constitute a more profound innovation in distance collaboration and relation that mixes increased engagement with an element of fun. Market forecasts for this industry, certify that in the future,

telepresence robots would be more and more present in our daily life. The research conducted by Market Research Store evaluated the market potentiality of telepresence robotics; the actual market is 812 million dollars but, it is estimated that in 2022 is foreseen that market is going to reach 7 billion dollars (Market Research Store, 2016). The reasons for this expansion may be given by the changing of lifestyle that people are facing, today always more globally connected. A telepresence robot, in most of the cases, is presented as a tablet connected to a movement system (i.e. wheels) and supported by a rod or a structure acting as a body. Although this structure may seem very simple, telepresence robots technology is much more complex than a "screen with the wheels." First of all, cloud technology gives the ability to connect with these robots from any part of the world, also having the capacity to be controlled through the Internet. Therefore they can be used to act as an intermediary in the completion of a remote task.In some cases also, telepresence robots present some level of autonomy that allows to these machines to move in different environments autonomously: at home, in the office area, at the hospital. From the aesthetic point of view, sometimes those robots may also have a humanoid form according to the task they have to perform, and the type of user with which they have to interact.

Telepresence features

The archetypal concept of a telepresence presents some essential features (Desai, et al., 2011):

- **Video:** *"Video information is critical in telepresence robots for conversation and navigation. Due to the mobility afforded by these robots, the information must be transferred wirelessly. Video streams constitute a significant portion of the data being transferred and can be adversely affected by the network connection. The quality of a wireless connection is influenced by several factors including bandwidth, latency, and packet loss."*
- **Audio:** *"The most important component of communicating through a telepresence robot is the conversation itself. The audio quality must be comparable to that of a landline phone conversation."*
- **User Interface:** *"The user interface (UI) is a critical component of the telepresence system. It is the driver's portal to the remote world. The UI must be simple, easy to use, not distracting, and provide the necessary functionality without overwhelming the driver."*

Telepresence robot has also to be designed following precise physical feature guidelines (Desai, et al., 2011):

- **Robot height:** *"Ideally, the driver should be able to change the robot's height to any desired length remotely. If such a mechanism is too complicated and expensive, the robot should at least be able to switch between two preset heights so that the driver can be eye-level for sitting and standing conversations."*
- **Robot speed:** *"The robots should be able to move at average human walking speeds of about 3 miles per hour. This speed is especially important for situations in which the driver is walking with a person or a group of people while talking*

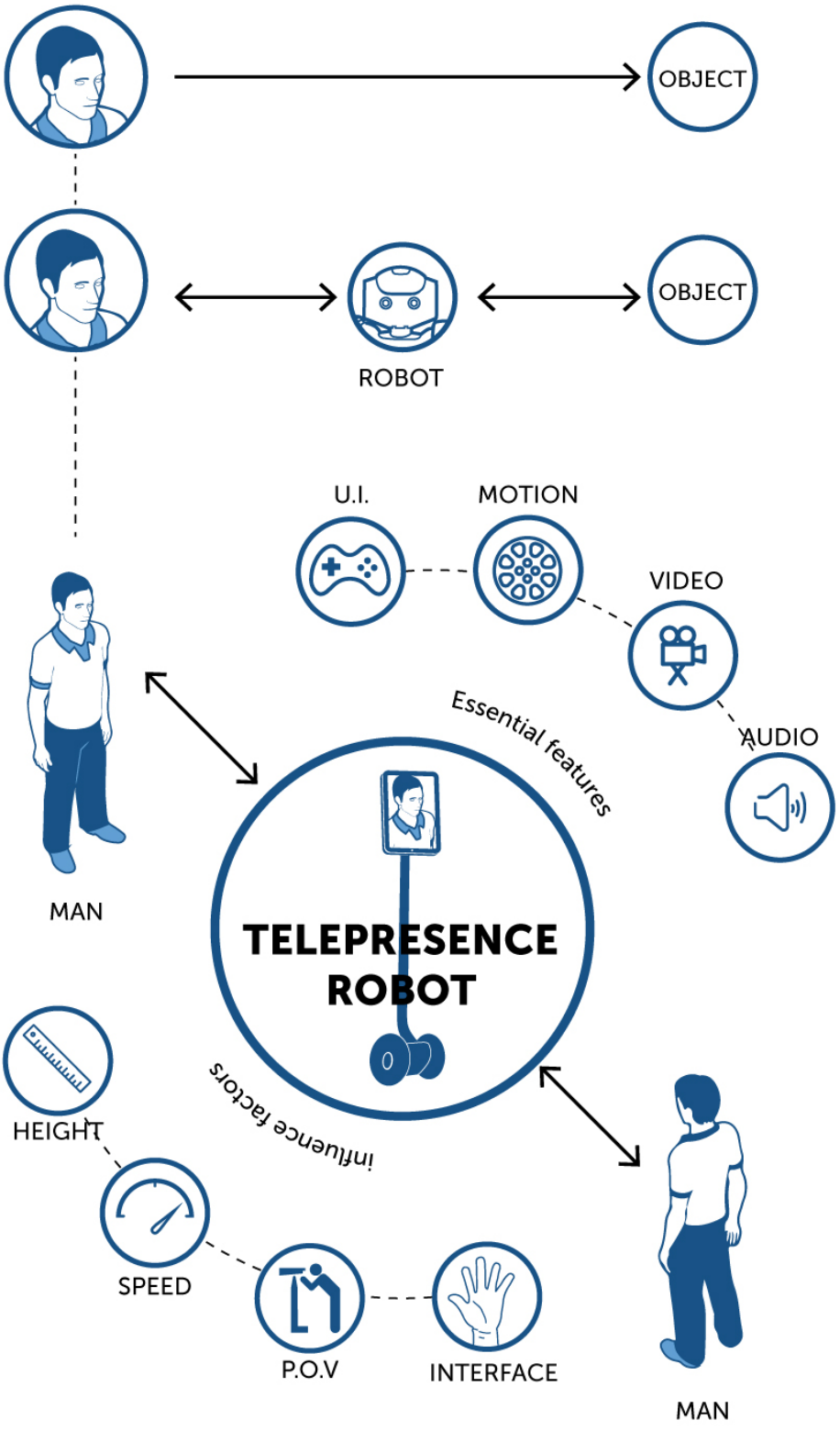


figure 13: Telepresence robotics scheme

to them."

- **Multiple cameras:** *"The robots must have at least two cameras. One of them must be a forward facing camera that can be used during conversations and while driving to view the path ahead. The conversation camera must be high enough off the floor to show the face of the person physically with the robot. Unless the field of view for the conversation camera is vertically wide enough, it is not possible to see both the person's face and see the area immediately surrounding the robot. A second camera showing the base of the robot can be used as a reference point by the driver for navigation."*
- **Wide field of view:** *"The front facing camera must have a wide field of view (FOV). A wide FOV is essential during navigation because it provides the driver with better situation awareness"*
- **Access point switching:** *"As robots move around, they have to switch access points. Depending on the environment, there can be multiple access points that the robot might have to connect to while moving. While switching access points, the flow of information to and from the robot might get interrupted, which can be a potential problem, especially when the robot is being teleoperated."*

As it has been said before, telepresence robot can move autonomously or in a semi-autonomous way. Autonomous navigation behaviors are desirable because of safety reasons and for ease of use. For example, a remote driver may see in their video feed a person exiting a conference room and stop so the person can pass in front of the robot. Under teleoperation, the robot may or may not stop in time, depending on the delay given the robot's video feed to the driver and then the navigation command back to the robot. Processing the sensor data locally allows the robot to take immediate action, thereby providing a tighter closed loop control of the robot. Hence, autonomous behaviors allow for better control of the robot under varying network conditions. Driving a remote robot is also cognitively demanding. So it is necessary to furnish to the robot an assisted navigation, and a human-like speed to enforce the control task and avoid the obstacle present in the environment. For which concern the field of application of telepresence, in the market are prents mainly four categories of use: health care, householding, security, and business. Figure 14 to 21 present a series of the most significant device found on the market.

DOUBLE ROBOT

MAIN FEATURES

Field of use:
Indoor environment
Movement system:
2 Wheels gyroscope
Autonomous driving:
No
Aesthetics features:
Minimal design
Year:
2013
Producer:
Double robotics

figure 14: Double Robot

E VIGILANTE

MAIN FEATURES

Field of use:
Outdoor/ Indoor environment, Security
Movement system:
3 Wheels
Autonomous driving:
Semi autonomous
Aesthetics features:
Tiny dimensions
Year:
2013
Producer:
Eos

figure 15: E Vigilante

RP VITA

MAIN FEATURES

Field of use:
Indoor environment
Movement system:
4 Wheels
Autonomous driving:
No
Aesthetics features:
Big screen
Year:
2010
Producer:
IRobots

figure 16: RP Vita

QB ROBOT

MAIN FEATURES

Field of use:
Indoor environment
Movement system:
2 Wheels
Autonomous driving:
No
Aesthetics features:
Human like
Year:
2010
Producer:
Anybots

figure 17: QB Robot

K5 ROBOT

MAIN FEATURES

Field of use:
Outdoor environment, Security, Vigilance
Movement system:
4 Wheels
Autonomous driving:
Yes
Aesthetics features:
Protective Shield
Year:
2014
Producer:
KnightScope

figure 18: K5 Robot

PEPPER

MAIN FEATURES

Field of use:
Indoor environment
Movement system:
2 Wheels
Autonomous driving:
No
Aesthetics features:
Antropomorphic Design
Year:
2014
Producer:
Aldebaran

figure 19: Pepper

SAVIOKE

MAIN FEATURES

Field of use:
Indoor environment, Delivery
Movement system:
4 Wheels
Autonomous driving:
Yes
Aesthetics features:
Compartments
Year:
2014
Producer:
Savioke

figure 20: RP Vita

OSHBOT

MAIN FEATURES

Field of use:
Indoor environment, Fellowing
Movement system:
3 Wheels
Autonomous driving:
Yes + Semi-autonomous
Aesthetics features:
Big interactive screen
Year:
2014
Producer:
Orchard

figure 21: Osh Robot

figure 22: Man-Man relation with the support of Telepresence Robot. Credits: Double Roobotics

In conclusion, as they evolve, telepresence robots will acquire greater autonomy and better remote manipulation. Hardware improvements that enable maneuvering in rough terrain could make them standard equipment for archaeological digs and other field work, allowing visitors to examine faraway sites and experts to render opinions. In classrooms, robots may function as proctors or interact with students as tutors. Inside the classroom and out, these robots might soon recognize gesture-based commands, resulting in a motion-driven robotic telepresence that can raise its hand, point, or perform other movements to reflect those of a remote visitor.

Man - Man relations (figure 28) in this sense would bring back importance, in fact, with telepresence, it would be easier put in connection two distant people not only vocally or trought a video, but using also all others movement features transforming technology to a not inclusive tool of support for the human's relations

2.3.2 The Cloud Robotics

Cloud robotics consists in the integration of the cloud computing technology in the robot, and it is significant because of the increasing in importance that is reaching at the global level. Basically, with this new concept of robotics, the internet is used for augmenting the performances of the robot, principally delegating the computational part and providing on-demand services. In the analysis performed by Frost & Sullivan "Innovation in Cloud Robotics.", Authors argue that cloud technology will bring to the development of robots more intelligent and with a higher degree of computational powers. Google's James Kuffner coined the term "Cloud Robotics" in 2010. Cloud Robot and Automation systems can be broadly defined as any robot or automation system that relies on data or code from a network to support its operation, i.e., were not all sensing, computation, and memory is combined into a single standalone system. There are at least four potential advantages to using the Cloud (Kuffer, 2010):

- **Big Data:** access to updated libraries of images, maps, and object/product data,
- **Cloud Computing:** access to parallel grid computing on demand for statistical analysis, learning, and motion planning,
- **Collective Learning:** robots and systems sharing trajectories, control policies, and outcomes,
- **Human Computation:** use of crowdsourcing to tap human skills for analyzing images and video, classification, learning, and error recovery.

The Cloud can also provide access to:

- *datasets, publications, models, benchmarks, and simulation tools,*
- *open competitions for designs and systems,*
- *open-source software.*

Discoveries in the field of cloud robotics have had a considerable enthusiasm, thanks to the initiatives of major enterprises such as Google and IBM and the efforts of several research institutions active in numerous projects around the world. High-performance and affordability characterize the focus in the developing of robots for many research activities. Considering the massive cloud computing technology diffusion, in the tablet and smartphone market sector; robotics market area should attend a powerful growth. Furthermore, cloud robotics will be a catalyst for the birth of a commercial market for service robotics. One of the Key challenges in this research is represented by the high dependency of cloud robotics towards internet connection, which is necessary for activating the computational processes. In all the area with a limited or absent connection, robots that use cloud platforms are unable to work efficiently, and they can not respond promptly in case of critical situations.

Another Key challenge is the development of valuable services toward the user, the cloud technology is very flexible and allows to different robots to collaborate

and exchange data. These characteristics make it a very powerful vector for the innovation of new services, considering, using this technology could give an answer to the demand for more and more connected and customized solutions.

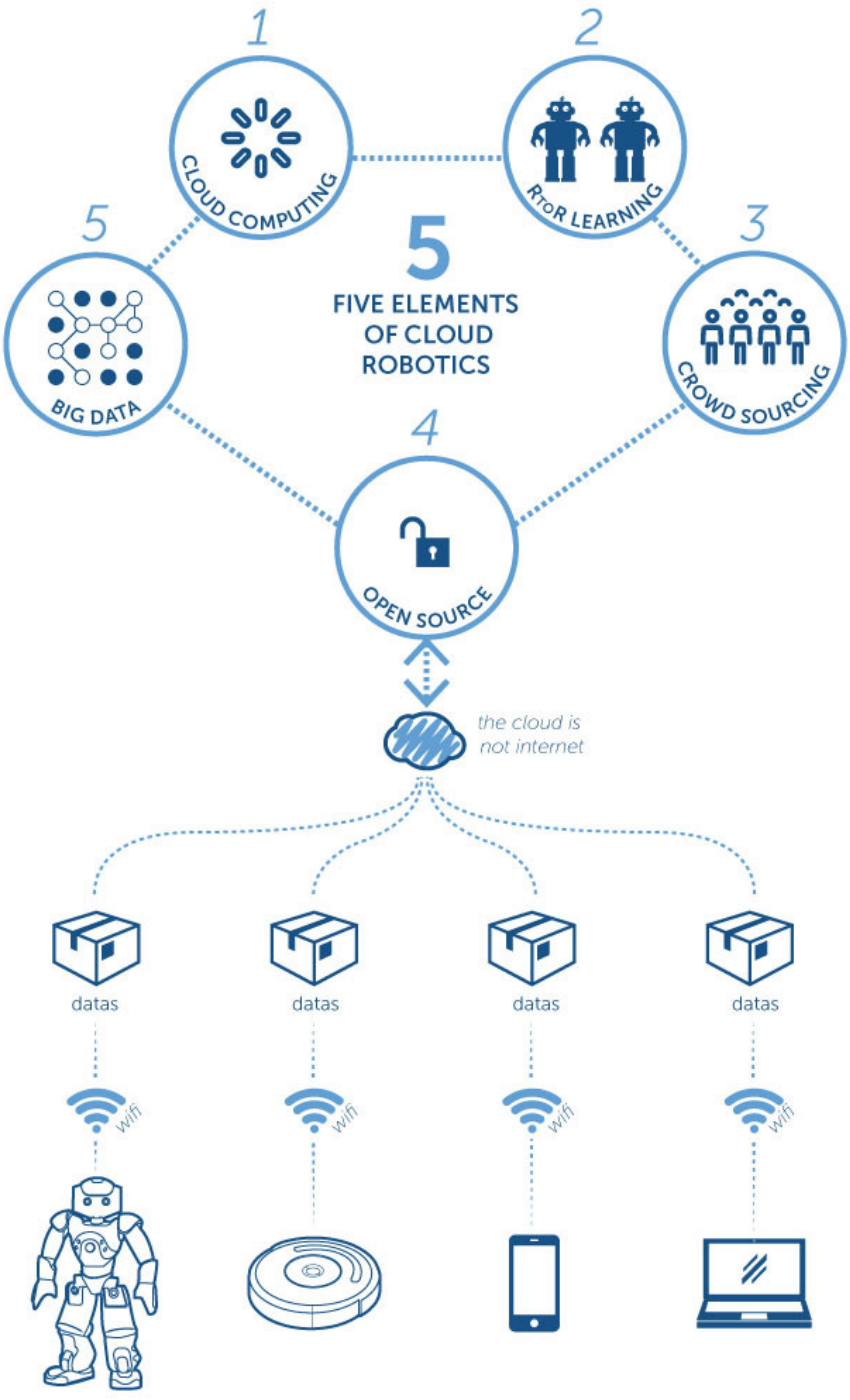


figure 23: Cloud robotics

2.4 Why a Roboethics refection is today necessary?

Robots are spreading in the civilian world. As they become smarter and more widespread, autonomous machines are bound to end up making life-or-death decisions in unpredictable situations, thus assuming, or at least appearing to assume moral agency. Ethical dilemmas are surely going to be addressed soon. Should a drone fire on a house where a target is known to be hiding, which may also be sheltering civilians? Should a driverless car swerve to avoid pedestrians if that means hitting other vehicles or endangering its occupants? Should a robot involved in disaster recovery tell people the truth about what is happening if that risks causing a panic? Such questions have led to the emergence of the field of "machine ethics", which aims to give machines the ability to make such choices appropriately or in other words, to tell right from wrong.

Roboethics: an urgent reflection

Society needs to develop urgently ways of dealing with the ethics of robotics. In the United States have been scrambling to pass laws covering driverless cars, which have been operating in a legal gray area as the technology runs ahead of legislation. It is clear that rules of the road are required in this complex area, and not just for robots with wheels. The best-known set of guidelines for roboethics are the "three laws of robotics" coined by Isaac Asimov, a science-fiction writer, in 1942. The laws require robots to protect humans, obey orders and preserve themselves, in that order. Unfortunately, the laws are of little use in the real world. Battlefield robots would be required to violate the first law. Moreover, Asimov's robot stories are fun precisely because they highlight the unexpected complications that arise when robots try to follow his apparently sensible rules. Regulating the development and use of autonomous robots will require a rather more elaborate framework. Technology has driven humanity's progress, but each new advance has posed troubling new questions. Autonomous machines are no different. The sooner the questions of moral agency they raise are answered, the easier it will be for humankind to enjoy the benefits that they will undoubtedly bring. It is the first time in history that humanity is approaching the challenge to replicate an intelligent and autonomous entity. The scientific community is asked to examine the very concept of intelligence, in humans, animals, and of the mechanical, from a cybernetic standpoint closely. It can become necessary that Robotics will be drawn by several disciplines other than Mechatronics like Logic, Linguistics, Neuroscience, Psychology, Biology, Physiology, Philosophy, Literature, Natural History, Anthropology, Art, Design. Robotics de facto combines the so called two cultures, Science and Humanities. The effort to design Roboethics should take into account this specificity. This means that experts shall consider Robotics as a whole, despite the current early stage which recalls a melting pot so that they can achieve the vision of the Robotics' future.

2.4.1 Roboethics principles

Robots Evolution will have a profound impact on our habits and our daily life, and this it will be possible because of the last three decades technology push that has allowed to technological devices to reach results unimaginable. Therefore a reflection about the future coexistence between humans and robots is necessary.

It is a common belief, in fact, that robotics, especially the ones belonging to the service category, will have a great impact on our welfare. The development of service robotics is a trademark that very shortly human, and robots will need to learn how to share, not only environments but also, activities each other. The result of this coexistence probably will bring a competition between the two subjects. Then, roboticists will be responsible for the establishing the boundaries of this opposition, modeling the future scenarios of this discipline.

Roboethics and multidisciplinarity

The interdisciplinary nature of all the knowledge that will be involved will play a fundamental role on this future coexistence. The theme of human replacement in many activities is already widely addressed, both by the scientific community and from mass media. The scientific debate has always questioned which effect might bring this scientific and technological progress on productive systems and, in particular, on human activities. The central position statements, from the scientific/humanistic perspective, are represented by two conflicting ways of thinking. On the one hand, the technological progress of robotics is considered a real phenomenon, while on the contrary, there is skepticism against the diffusion of robots. The main guideline to follow in the rising of the robotics revolution it is that the future has to be approached with deeply humility and spirit of ascertainment.

Ethics will help in this sense because allow us to move towards the future staying focused on a fixed element represented by the human being, and in this sense robotics researchers, have started to talk of roboethics. Roboethics is that part of ethics that engage issues related to robots and their relations with man, territory, and society. In the world of the robotics research, one of the most authoritative figures is Gianmarco Veruggio who is for all considered the father of roboethics and in 2006 published the roboethics roadmap. The primary goal of Veruggio's road mapping activity is to identify the current driving forces, objectives, bottlenecks and key challenges for robotics research, for the development of a Roadmap which outlines the multiple pathways for research and exploration in the field. The roadmap embodies the contributions of several scientists and technologists, in many areas of investigations from sciences and humanities.

Veruggio highlights that the different components of society working in Robotics, and the stakeholders in Robotics should intervene in the process of building a Roboethics Roadmap, in a common science experimental case (robotics stakeholder) (Veruggio, 2006).

Therefore recently, different competencies were conveyed in the robotic field.

If robotics was firstly a primary field of mechanical and electronic engineering, nowadays many discipline and knowledge would contribute to it. The evolution of robotics artifact led researchers to question themselves about different themes,

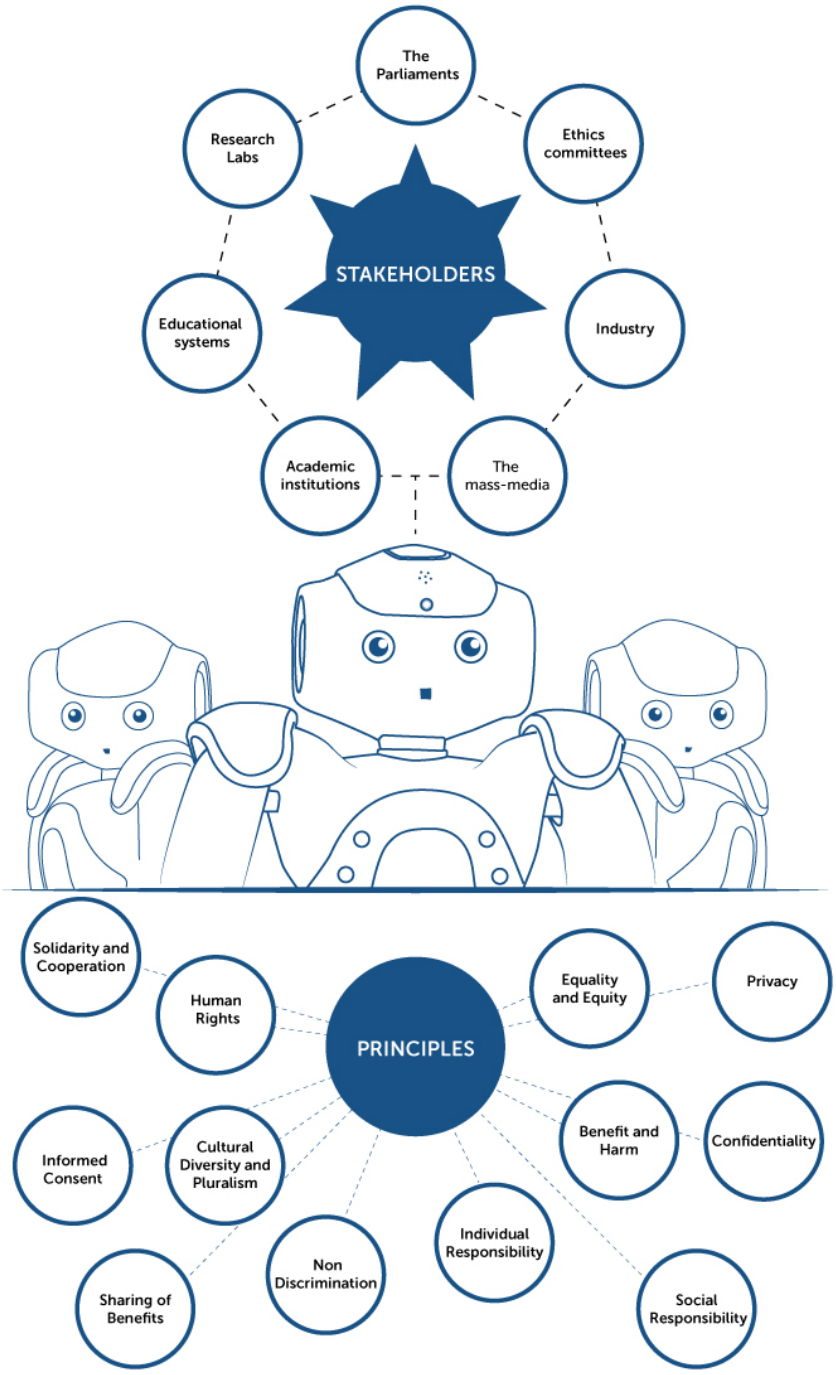


figure 24: Roboethics

such as acceptability and aesthetics. For this reason, it was necessary to enlarge the debate to different disciplines, among which design. Through the contemporary design discipline, in fact, roboticists extend their ability to generate value and meaning, creating relationships between human needs, technology, and contexts. The design contribution, hence, is mainly consisting of two principles: analysis of the stakeholders, and the analysis of the effects that the introduction of robotics can generate.

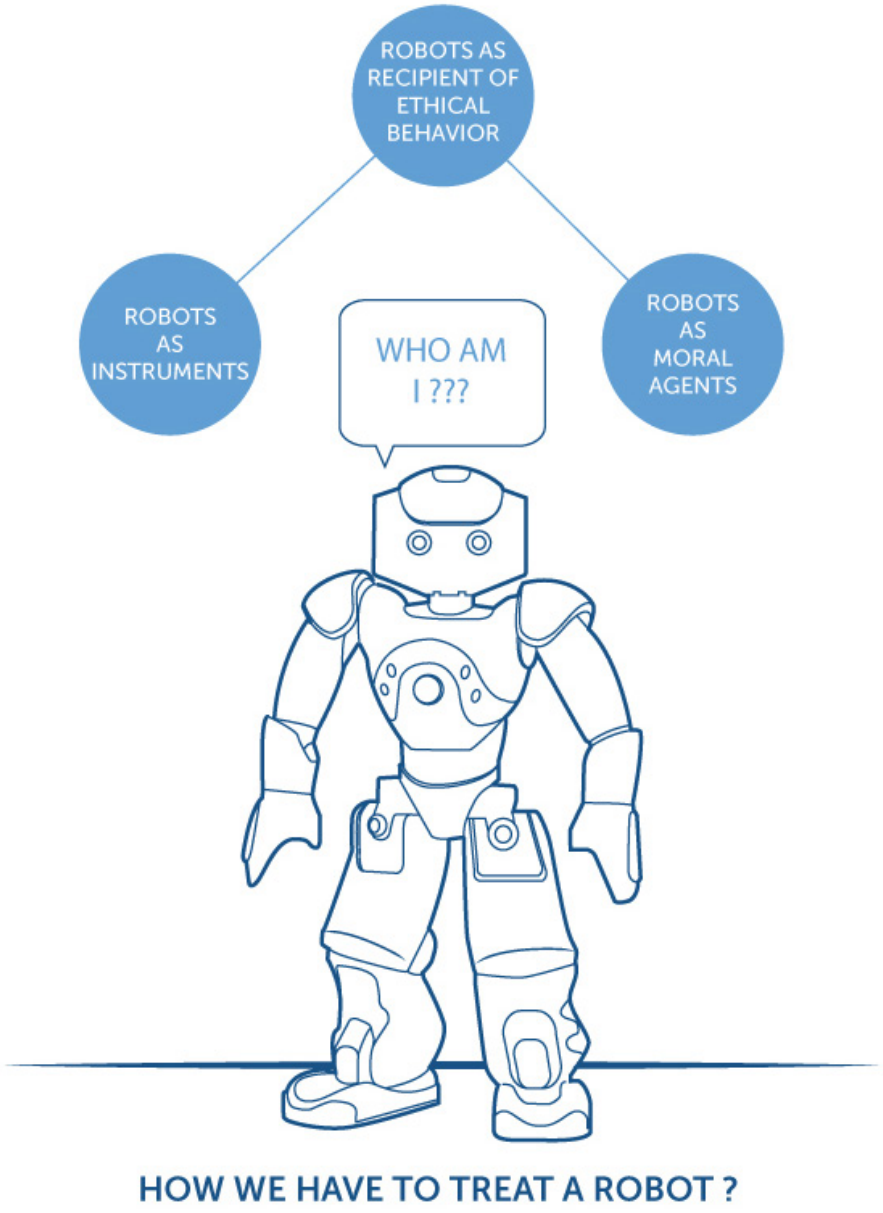


figure 25: Gravitational centers of roboethics

The emergence of new technologies has always required the formation of new ethical concepts and the modification of old ones. This process is not only accompanied by changes in semantics, but also by the creation of entirely new terms. On the recent literature of the field, ethicists draw a birds-eye perspective of Roboethics discipline; they define a series of "gravitational centers" around which the discussions revolve. Gravitational centers help to structure three categories of taxonomies useful to describe how we have to treat a robot in an ethical way (Steinert, 2014).

how we have to treat the robots

- **Robots as instrument:**No doubt, a robot can correctly be classified as "artifact" because human beings have deliberately created it. According to the instrumental view, robots are like any other tool. Robots can be used to alter a situation according to human desires and will. For this reason, robots give rise to the same ethical questions and problems like other, simpler, devices and tools. When we perceive robots as simple tools waiting to be used by us, ethical considerations regarding robots are highly limited in scope. Robots are at best conceived as what Asaro has called "amoral robot agents." They are simply an extension of the human using them, similar to cars, guns and other tools and machines.
- **Robots as recipient of ethical behavior:** Another 'gravitational center' of the ethical discourse is the robot as a recipient of ethical behavior. For many researchers (philosophers included), ethical behavior towards machines is still a long way off. Because robots are merely accumulations of metal, wires, and silicon and not organic material. Scientists argue ethical behavior towards them is conceived as a science fiction fairy tale. There is a correlation between the perceived intelligence of a robot and the degree of vitality attributed to it. In turn, attributed liveliness to robots may lead people to treat them like they would treat other living beings, like animals for example. Given the intimate contact between robots and humans that can be expected in the future, we are well advised to establish some criteria that help us assess the human-robot interaction. A good starting point is to seek out categories of interaction to get a hold on how people conceive of a robot and what they attribute to it. The idea to use the appearance of a robot to deceive the users about its capabilities deliberately is ethically questionable. This fact is especially crucial when it comes to 'socially assistive robots.' These are robots that are supposed to assist humans via social interaction and are therefore in close contact with humans. Designers should be aware of the possibility that the appearance of the machine might deceive users into believing that it has capabilities that it, in fact, does not have. For this reason, Capabilities and lacks of the robots should always be clearly communicated to all people involved in the interaction. Researchers and designers of robots should be sensitive to the impact that their creation might have on the emotions, and hence moral compass, of the humans that interact with robots

- **Robots as moral agents:** In contrast to discussions that revolve around robots as tools or possible recipients of ethical conduct, it exists a third 'gravitational center' that has attracted the attention of ethicists and philosophers. Robots might not only be conceived as passive recipients but also as active moral agents. The focus here is the behavior of the robot itself and its ability to standing as a moral agent. Some tasks and problems have reached a level of complexity that justifies the use of semi or fully autonomous technological systems that have the ability to make crucial decisions on their own. The situation might call for a quick reaction and bring the human into the loop would slow down decision making and cause harm. The question is not only what humans do with their computers and machines but also what these machines can or ought to do on their own. According to Wallach and Allen, the design of artificial moral agents should incorporate two dimensions: Autonomy and sensibility for values. Increasing sophistication in robots has led some people to the conclusion that robots clearly qualify as agents and therefore need to be addressed as such. Apart from technical and practical limitations that accompany the use of robots in different fields, the degrees of independence reflect the moral significance of the context in which robots are used: the possible damage done by a household robot is far less severe than the potential harm that can be inflicted by a combat robot. For example, the vacuums bot might endanger furniture and little animals, whereas the combat robot puts human lives at risk. The interesting ethical question then becomes: Do we want and need combat robots with more autonomy? A satisfying answer needs to balance practical considerations with ethical concerns. For facing those aspects, it is necessary to set up the borders of close collaboration between people with different background experiences

Gravitational centers highlight the issues we as designers have to work on concerning roboethics. Mainly the aspects that influence the most the human-robot interaction in roboethics terms are aesthetics, and autonomy and impact on society.

2.4.2 Robots aesthetics

As it has been introduced before, physical appearance should not induce inferences and inconsistent misleading of the aesthetic features of the robot. Surely an anthropomorphic robot could be an instinctive answer to our need for relation, acceptance, and recognition by others people that are probably the prelude of the new relational way of life. However, Robotics designers, have to consider several aspects during the design of a robot, in particular, they have to take care of the context in which the robot would operate. Contextualize in term of aesthetic a robot with the environment will increase the acceptability of this object setting the human well predisposed towards it. Concerning the aesthetics of the robots, many studies have

been progressed especially in recent years. Among the most reliable researchers, there is certainly that one conducted by Hanson Robotics, headed by David Hanson, called “Sofia project.” (Hanson Robotics, 2016).Sofia (figure 26) is the concept of a humanoid robot that has very similar features to humans ones; its body is covered by flubber, a polymeric material very similar to human skin. Through this prototype robot, Hanson Robotic’s researchers are studying all the different types of relationships that can be established between a man and a machine when the machine is very similar to the latter. A research of this kind is based on uncanny valley theory. This theory holds That the level of realism will directly determinates how eerie (uncanny) to humanlike depiction will be. (Mori, 1970).

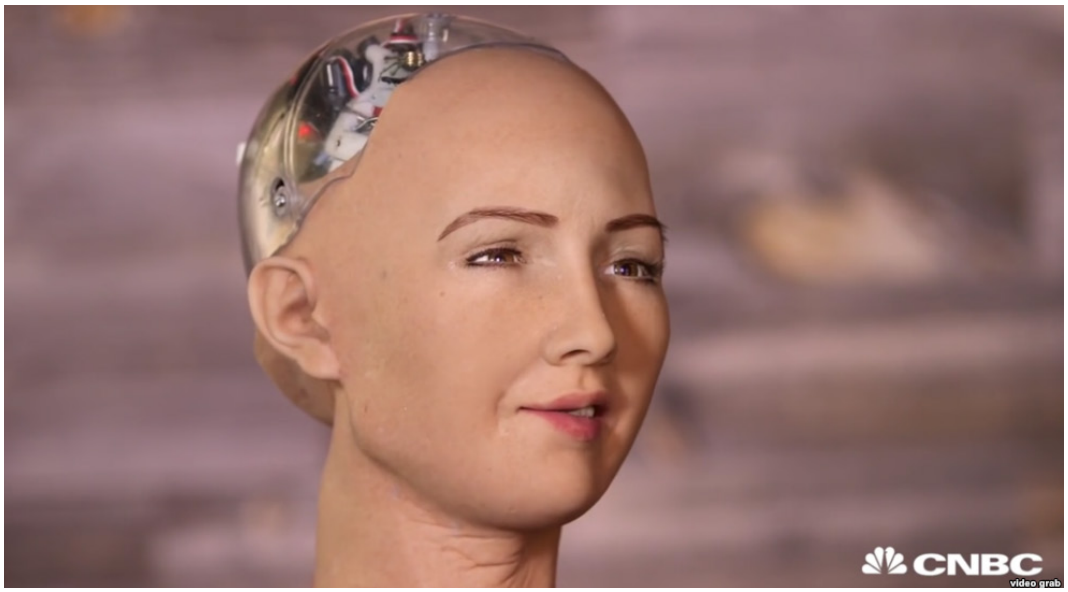


figure 26: Sofia robot, credits CNBC

However, aesthetics could not be set about only the human feature, aesthetic it has to be developed in relationship to the context of use.

They exist some environment were the technological nature of the robot goes in conflict with the artistic aura of the environment. In places like museum, for example, the use of a device with a high degree of technological inspired aesthetic feature can lead to a misleading reading of the message. Another consideration to make is the correlation between aesthetic and functionality. Functionality in the design disciplines is one of the principles useful in the developing of an object. Functional design is the process of responding to the needs or desires of the people who will use an item in a way that allows their needs or desires to be satisfied.

2.4.3 Robots autonomy and impact on society

For which concern autonomy, the main issues are related to the responsibility of the robot actions. Even if some editors of the Roboethics Roadmap believe that these matters are not to be dealt urgently because we are far away from the singular technology concept, really soon we would be prepared for cohabiting with the robot's right and duties. Singular technology is that moment, in the development of the civilization in which technological progress accelerates beyond the ability to understand and be predicted by human beings. Kopacek and Marion (Kopacek et. al, 2015) predicted, in fact, the there will be a moment in which robots will present conscious or semiconscious behaviors until reaching the hypothesis of evolving into new forms of life. The main impact that robotic technologies might have on humanity can be associated at three main levels: activities, environment, and relations. Roboethics should take into account all these levels not only by addressing all the possible negative consequences but also all the opportunities to enhance humanity and create value. Regarding human activities, for instance, robotics could be used to support existing tasks by providing new tools, or by replacing existing tasks for people while providing them new tasks. From the environmental point of view, robotics may be used to replace people in unsafe environments, to prevent environmental damage from human, or to provide more efficient tools for environmental care, such as restoration, or energy management. Finally, concerning relations, robotics might be an opportunity for connecting people through remote embodied interaction, or it could be used to promote social behaviors in people with disabilities, such as autistic children, hospitalized patients or elderly (Casiddu, 2011).

2.4.4 Did the robot will steal the human work?

In the book "The second machine age" Erik Brynjolfsson and Andrew McAfee try to predict the future relations between human jobs and robotics (Brynjolfsson, 2014). Brynjolfsson and McAfee compare the robotics revolution with the industrial revolution took place in the second half of the '700 after the first appearance of the steam engine. Many tasks that human find easy and natural to execute in the physical world are tough to be managed by a robot. For Brynjolfsson and McAfee the working classes that are going to be for the most weakened for the technology evolution are analysts and market expert because their repetitive working methodology of analysis are going to be substituted by an algorithm managed by an artificial intelligence. Concerning physical activities, humans have more flexibility in respect to machines. Automate a single work task activity, like solder a wire or put a screw, it is relatively easy except if the machine operates in a controlled environment and all the passages that the robot has to progress are clear and that is why in the production chain

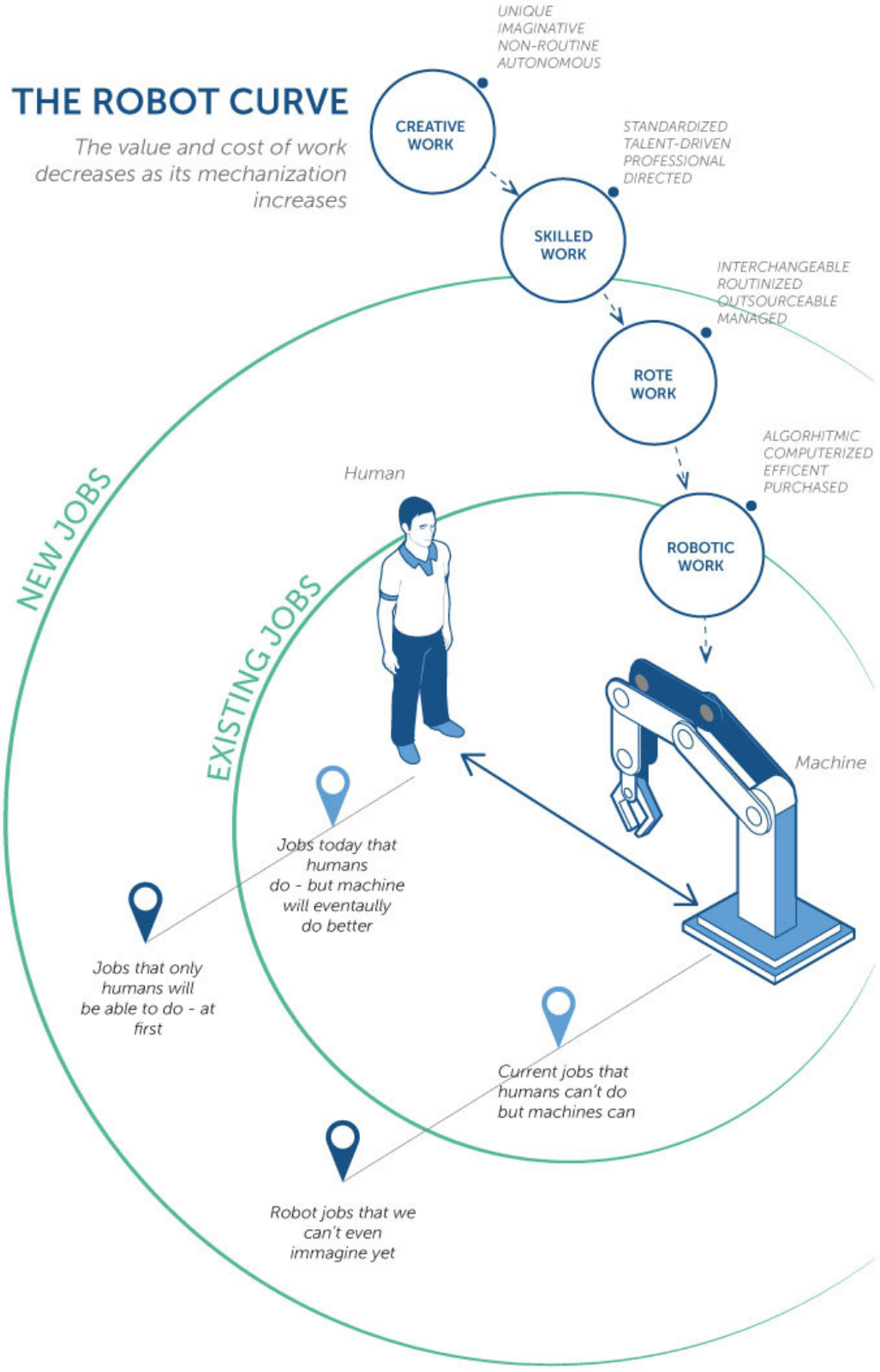


figure 27: The robot curve of work

machines are always overseen by humans. Marty Neumeier defines in this regard a robot curve of a job (figure 27). "The Robot Curve shows that pushing capabilities down the curve produce profits. Every time a new idea become a professional practice or a professional practice becomes a rote procedure, or a rote procedure becomes a robotic operation, there's a chance for someone to profit" (Neumeier, 2012). Neumeier did not see the robotic revolution as a closure, for him, the Robot Curve is a waterfall of opportunity that flows from the creativity to the automated. For the researcher, the humanity is in a recession because we are confusing cause and effect and we are trying to apply Industrial Age Ideas to Robotic Age realities, and the result has been a creative and economic vortex. As designers, we have to start to rethink the future work and give to the future worker new skills, not in competition with the machines ones. In this sense, the Institute for the Future IFTF, an independent, non-profit research organization, in 2011 published the report Future Work (Davies, 2012). In the report are described both which are going to be characteristics of the future work and the main technology driver to achieve those results. In conclusion, the demographic grown run faster than the grown of the workplace and the productivity is no more related to the occupation. Martin Ford author of the book "rise of the robot" underline how the automation may lead to a global unemployment: millions of workers will be out from the labor force without the possibility of getting back into it. The question is: What will these people do? There is no an absolute answer to this issue, but today humanity can count on an incredible set of knowledge. We have a huge baggage of data and information, crossing them, we could have the possibility to solve problems that we drag from centuries (Ford, 2015). In the book "professione robot: 31 lavori che le macchine faranno al posto tuo" author Claudio Simbula present two perspectives (hope and fear). Regarding the hopes, the author thinks that people have to rethink about their behaviors on the base of the new condition of life. If some machines exist and are capable of working in an alternative of us, it is unuseful to stop them. Therefore we have to take the opportunity to do other things; we should use our mind to create something that we will make us happy while the machines work for us. On the opposite side, the author presents some fears. The main one is the fact that we are not conscious about the real border of the technological innovation. If we give to machines a cognitive capability able to model our future without our control what will happen to us? (Simbulla, 2015)

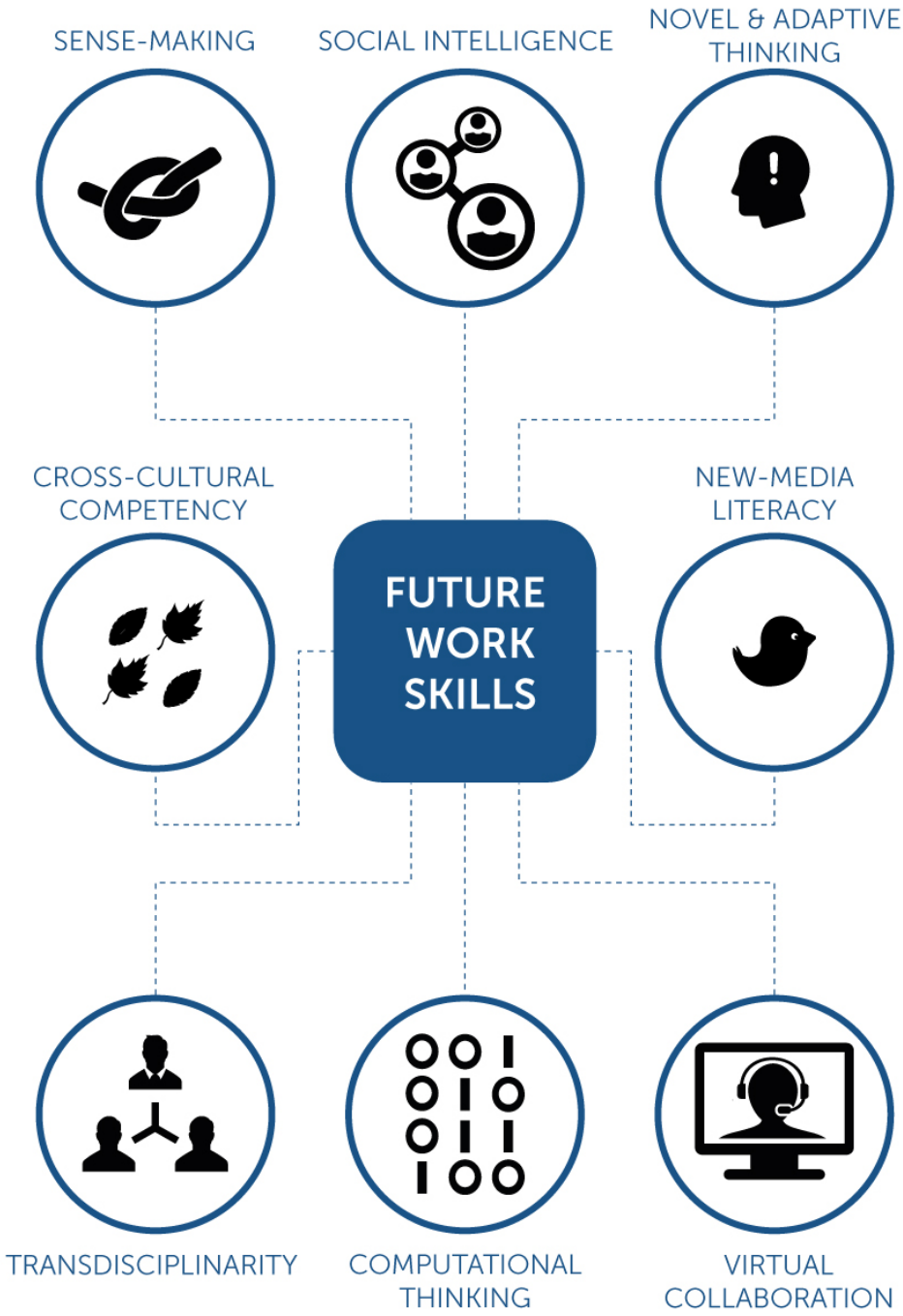


figure 28: Future work skills

2.5 Robot and Design

In the future perspective of the evolution of robotics, is forecasted that designers are going to play a fundamental role. As it has been settled in the previous chapter one of the main skill of contemporary design is the relational capability, and through that methodology, designers can enhance the human experience towards robotics devices. To the Designers, it will be asked in the future to rethinks products and services and organize them setting the man in the center of the project. The designer has the responsibility to be focused on the users' needs to create a compelling solution. That typically means:

- *understanding what users truly value,*
- *understanding users desiderata*
- *focusing on usability*
- *helping people see the benefit on their terms.*
- *forecast the impact on society*
- *preserve the environment*

Thankfully, designers are suited for the role of technology and user interpreter because are trained to be empathetic, have exploration skills, and they can craft solutions with end-users at the center of the process. Fundamentally, a robot designer has to answer to this series of questions:

Movement: How will the robot move within its environment? If it were put in a different environment, would it still be able to move within this new space?

Manipulation: How will the robot move or manipulate other objects within its environment? Can a single robot move or manipulate more than one kind of object?

Energy: How is the robot powered? Can it have more than one energy source?

Intelligence: How does the robot "think?" What does it mean to say that a robot "thinks?"

Sensing: How will my robot "know" or figure out what's in its environment? If it were put in a different environment, would it be able to figure out this new environment

Ethics: How the actions of the robot impact on the context of use physically and socially?

Chapter 3

Contemporary museum experience

3.1 The visit experience

Nowadays the sense and the way of being museum are radically changing, mostly because many institutions are assuming the dynamic role of driving forces for the cultural knowledge. Today the meanings that the museum systems are gathering are several: the historical memory of the society, the high place of the civil society, economical and productive center, educational pole and center of entertainment and leisure.

Museum Roles

Contemporary Museum has as a purpose the historical telling of one or more educational field through the use of artifacts and messages exposed in a real or virtual way (Vitale, 2010). To enhance its capacity of attraction or re-attraction, nowadays the museum yearns to build up a delightful narrative by the integrated use of all the elements decision-making creating the museum identity: location, environment, communication, and, recently, inclusive services for supporting the visit (Vitale, 2013).

All those elements together allow the fruition of the museum exposition emotionally and with participation, perceiving the value of the whole as the prevailing summary of the single element, living the museum as an experience. For sure we know that today, the visit as an experience is one of the purposes that museums look for to grown in competitivity in respect of the decrease of economic resources intended for this industrial field. As we know to overcome this issue, it occurs to help the museum area of research with others expertise such as cognitive science, communications skills, technology integration and design strategies.

Those competencies must support the museum curators in the planning of the Exposition activities establishing relations between purposes, strategies, and tools to enhance the museum aura as added value (Mottola, 1991). With aims, we mean the directions in which the museum intends to stimulate the interest of visitors:

- **Collecting:** exposing vast collections rich in term of meaning.
- **Give value:** presenting original interpretations of the exhibits.
- **Interact:** creating opportunities for the public to interact, directly or indirectly, with the museum exposition.
- **Diversify:** creating itineraries visitors tailored, according to the time available or topics of interest.

Those aims have to be supported with strategies to be effective for the visitors:

- **Storytelling:** Creating an immersive exhibition and stimulating cognitive learning processes
- **Building histories:** disassembling and recombining the exposure dowels
- **Exploring:** driving the visitor to the joy of discovery
- **Playing:** introducing the ludic dimension of the gaming as access key for cultural information

The tools today available for operating with those strategies are of differents nature, and they could be used in an integrated way:

- **Sensorial:** based on the senses
- **Analogs:** a whole of solutions not only with a functional purpose but also used for communicating the environment, such as lights, sounds, movies, graphics
- **Digitals:** a very broad category which includes virtual reality, augmented reality, interactive media, and phygital applications.

Among the tools, in the last decade, they have made their appearance the robotic service systems. Those kinds of instruments are going to deal with in more detail because of are the object of the research.

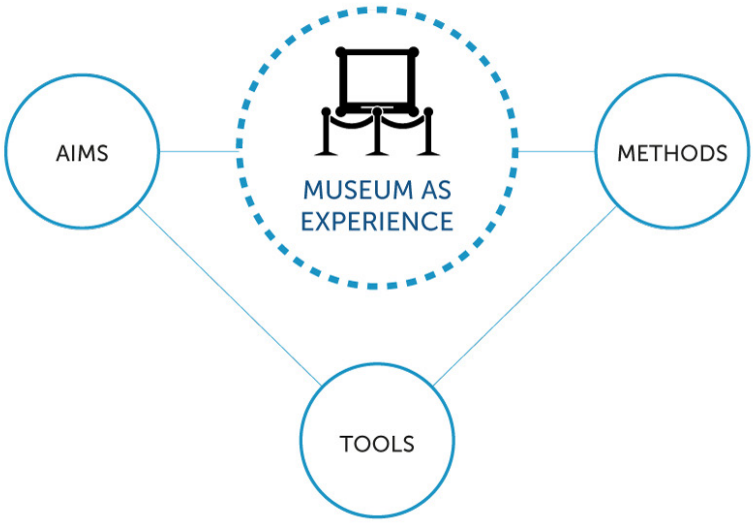


figure 29: Museum as experience

3.2 The empathic link with the Museum environment

Giovanna Vitale in her book "Design di sistema per le istituzioni culturali. Il museo empatico", hint that the empathic feeling is the fundamental emotion that museum has to build up since the beginning of the visit experience for improving the whole museum experience. Empathy can be considered an essential aspect in human relation. With Empathy, we define the cognitive process that allows connecting individuals deeply through shared feelings based on emotions and experience.

It is important to have a knowledge of the empathic link with the environment that surrounds us. Emphatic awareness is essential because it can be assumed the idea that shares experiences that commonly could be considered "beautiful," "good to know" and "necessary to conserve," facilitate and intensify the positive perception of a situation and the quality of our private living. Three main factors could influence the empathy with the museum are (Rosenthal, 2014):

- **Inner and personal factors:** regarding cognitive elements, relational and biological
- **Behaviors:** attitudes implemented in a shared context
- **Environmental events:** circumscribing the person and his behavioral conduct.

3.2.1 Museum-Visitor emphatic framework

From the analysis of the human experience, it is possible to say that everyone sees, hears and perceives things in a personal way. External stimulus pass through a complex system of mental filters builds up by memories, feelings, and perceptions of the past. Since those filters are subjective, we get in contact only with the interpretation of what we assume as reality. The way a person come in connection with the world depend on the perception organs that could be seen as our "doors upon the world" and are represented by the sensorial channels: visual, auditive, kinesthetic, gustatory, and olfactory.

When in a museum we bump into an artifact or artwork (human artifact relation), the first system activated by the cognitive system is the conscious one. Usually, a museum tour is fulfilling if satisfy sensorial experience (visual, auditory and kinesthetic); the design of the exposition could influence this process slowing the perception process with a wrong order of the tour exposition. Disorder and communicational misleading can bring visitors to an imprecise interpretation of the exhibition. Visual perception is the result of complex interactions between external visual stimulus and prior knowledge, goals, and expectations (Palmer, 1975). Understanding how we all perceive things visually will help museums to communicate better. Gestalt principles, or gestalt laws, are rules to follow for the organization of perceptual scenes. Gestalt principles aim to formulate the

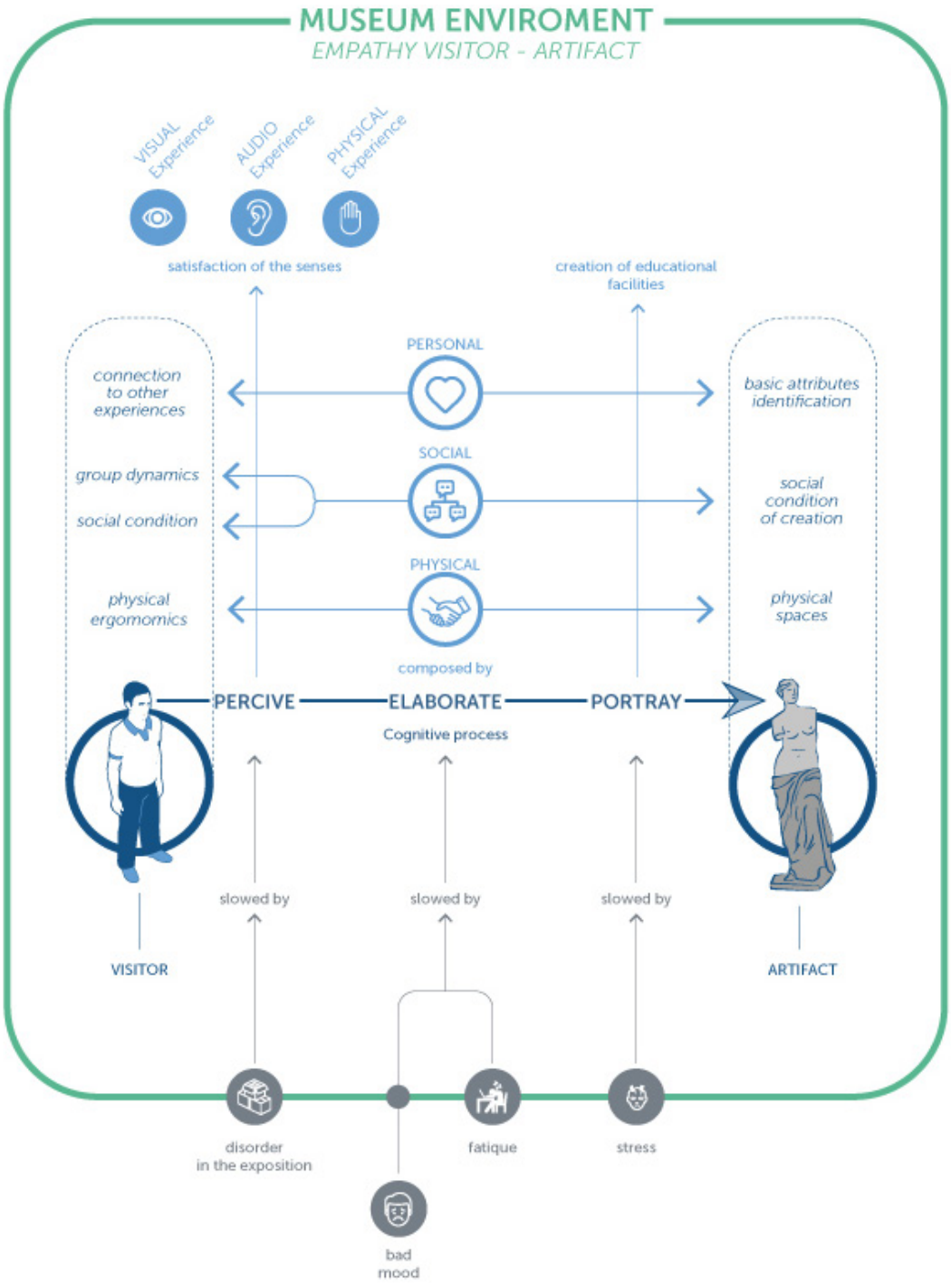


figure 30: Museum-visitor emphatic framework

regularities according to which the perceptual input is organized into unitary forms. Gestalt laws mainly apply to vision, but there are also similar aspects in auditory and somatosensory perception. In visual perception, such forms are the regions of the visual field whose portions are perceived as grouped or joined and are thus segregated from the rest of the visual field. Many of the principles below the patterns described in figure 31 (Kanizsa, 1979).

Influence factor of the visit

A museum exposition that didn't follow visual disposition restrict the visitor perceptive capability and mislead the informative museum message, furthermore, Gestalt laws testify that the perception elaboration occurs in the human mind. In fact, the brain is the place where we record most of ours experiences and behaviors, but, the mind-body system (Dilts, 2003) has nothing to do with sensorial stimulus only, we as human built up our personal perception supported by memories and imagination. Starting from an external stimulus, we could be able to modify it to create new experiences, for example, we can recall back a memory and modify it both intentionally or unintentionally. The simple action of recall a memory from the past could determine a further deformation of the filtered experience. At the end of this process what remains is "a memory of memory." This capability to manipulate the experience allow the people to live experience always in different ways. What change is not the content of an experience, rather the way to represent it personally, resuming external activity is build upon the interior activity, and we are what we think we are. Roberto Spigardi and Giuseppe Zaccuri in the book "L'arte dell'interazione" define that every people have an inner "subjective map," that is a personal way of interpretation in respect of what happen around us. The subjective map it is composed of our thoughts about existence and reality. The map starts to form itself while we are young and is modified and enriched by our life experience (Spigardi, Zaccuri, 2011). Also in the museum experience, this kind of relations take place. In fact, in the human artifact relation, the second stage of interaction after the perception is the elaboration. The elaboration phase corresponds to the main core of the creative process, and three assets express it: physical, social and personal. In the physical asset are involved all the physical aspect related to the visit. Regarding the visitor side, all the physical elements useful to the support of the elaboration are related to the physical ergonomy, the more ergonomics issues are satisfied, the more elaboration processes would be facilitated. Also, museum spaces could affect the elaboration phase, generally comfortable places affect the elaboration process positively. Social factors affect the elaboration process too. Recalling what is written in the book Il museo empatico, Giovanna Vitale, define the museum as a social place where people have to share experiences and spaces, the concept of sharing is fundamental to set the empathy between two individuals. In the human-human relations some facilitators factors enhance the empathic link such as culture, task, timing and attitude and during the design of the museum experience, those social factors are to take into consideration. Regarding the environmental factors, the museum context is full of stimulus. The major risk that can occur to a museum

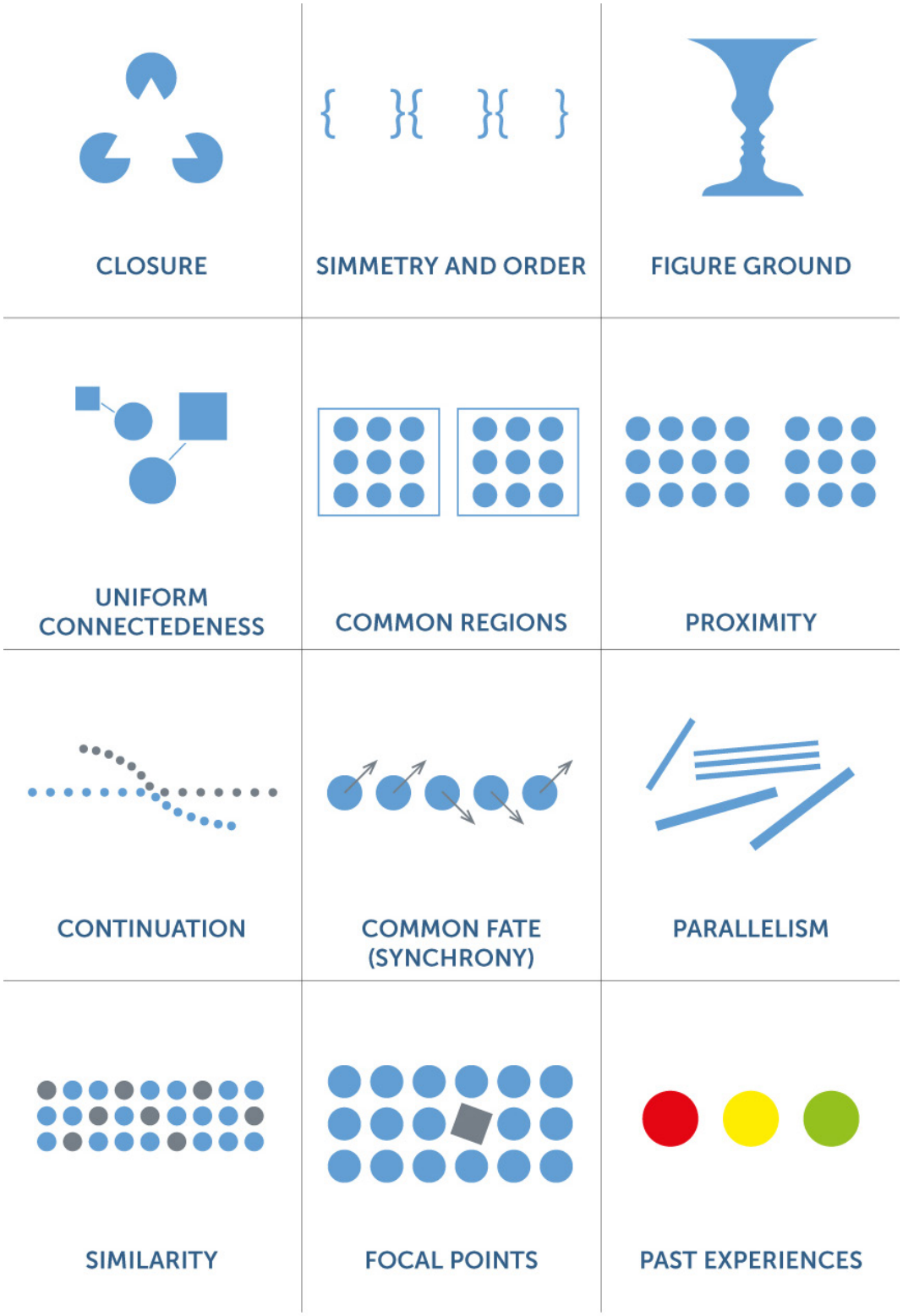


figure 31: Gestalt laws

is to become too much linked to the economic aspects and the scientific one.

Develop the experience without taking into account the user need could allow the design of experiences fatiguing and boring. Fatigue and boredom, in fact, have a severe impact on the workload of the Fatigue and boredom, in fact, have a severe impact on the workload of the visitors and consequently on the appreciation of the visit. Paths extremely long or with an incorrect balance between information provided and information assimilable can occur to a not pleasant experience of visit, but rather stressful. The environment, the tools and the people involved in the relationship between visitors and the museum play a crucial role in this equilibrium. More and more museums, to answer this requirement, they are setting up routes of visit diversified and personalized according to the time available to the user and the journey length.

In conclusion, concerning the museum experience, empathy could be reached starting from an increasing consciousness of the following elements:

- **Communicative dimension of the museum**
- **Individual and collective relationship built up inside the museum**

figure 32: Fatique effect on the museum visit

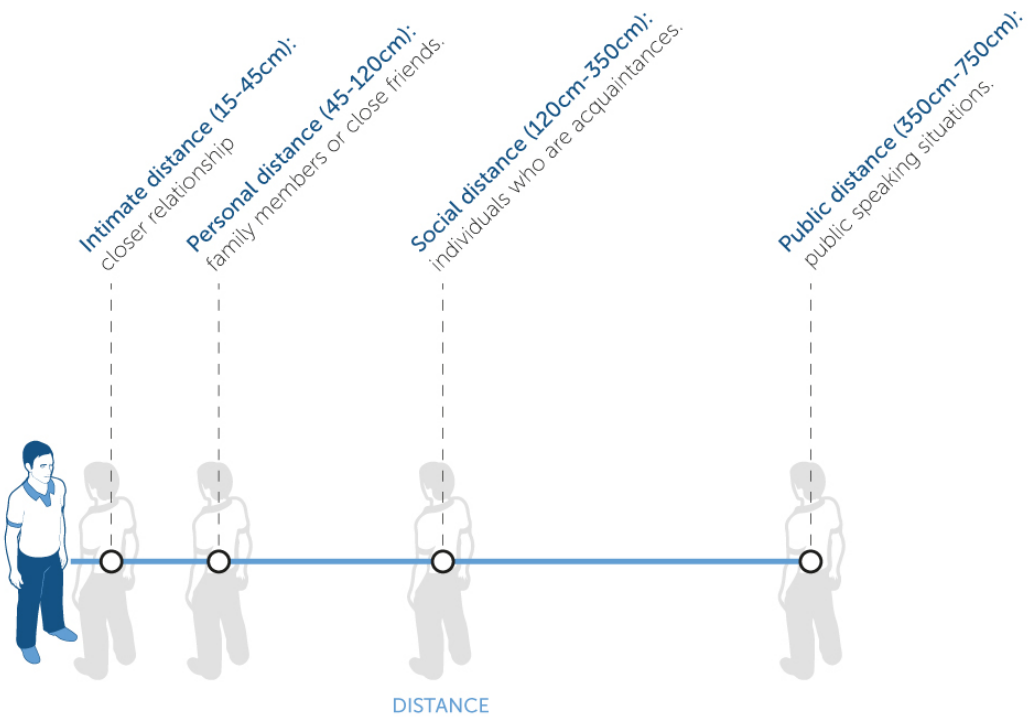


figure 33: Proxemics principles

3.2.2 Museum as social space

In the research literature in the museum field, there are arises some evidence that can be useful for the designer and the curators and that support the importance of the museum as social space. Studies have confirmed that the learning process is facilitated by the observation of actions or movements made by who surround us, and the mirror neurons present in our brain are activated imitating the movement by the others (Bolognini, et. al, 2002). We can not consider the brain only as a simple elaborator of information. Also, the emotions and the gestures affect the communication process. The characteristics of the mirror neural system define that throughout the people it exists a space of action that can be shared with the others giving origin to a new form of interaction concerned to the inner structure of the human being. The proxemic studies this relation, it can be defined as the study of means in which individuals make use of the physical space in the interaction between the individuals. Each and every organism in the universe tries to occupy, cultivate, preserve and utilize space. This process of owning the space by above said means differ from culture to culture. People often feel uncomfortable when operating in the spaces different from those in which they are familiar. There are three fundamental areas with which the experts in the field categorize Proxemics: distance, spaces, and behaviors. Based on observation in social situations, Hall classifies the distance as figure 33 (Hall, 1968).

3.3 Museum aims

Today the meanings that the museum systems are gathering are several: the historical memory of the society, the high place of the civil society, economical and productive center, educational pole and center of entertainment and leisure. In a certain sense, it is possible to determine that the museum is reestablishing its classical meaning. The word museum, in fact, derives from the Greek substantive museion which indicated a temple where poetry, dance, and chant were taught and dedicated to muses. Only in the second-century a.C. museum became a storage place for significant artifacts. In fact, in the ancient Rome, museums became not only storage places but also exposition places of the artifacts collected during the conquest campaigns (Alexander, 2007). The museum became a collection of artifact considered deserved to be preserved.

With the Renaissance, the meaning related to the museum changed again. The Renaissance brought a new vision of the world and a higher interest for the human art and nature. In the XV-XVI century, for example, Italy became headquarters of significant private collections made up by the efforts made by Lords and that for the most of the time included famous sculptures and paintings. Even in the rest of the Europe started to be appreciated the private collections that showed different cultures, those places were called cabinets of curiosities or Wunderkammern (Olmi, 2001), and they will be the corpus of more wider collection for the national museums like the British in London, the Louvre in Paris and the Pardo in Madrid. To reach the modern concept of the museum as a collection of different nature and open to a large number of visitors addressed to the sharing of knowledge, it is necessary to wait until the end of the 600 a.c. starting from that moment Museum has been defined as cognitive and rational itinerary.

The modern museum is no longer interested in the storage dimension of the collection but wants to create a cultural pole (Bennet, 2013). Americans and Europeans modern museum were considered as knowledge preserver and broadcaster of the memory and culture. In the last years of the 900 visitors changed from a definite one (curators, educators, researchers) to an undifferentiated one (i.e. families). This changing is still transforming the motivations and the sense of the museum institutions. An unsorted public has led to a vision concept of the museum as a global document: the museum logic could start, as tradition, from the exposition of a collection or, as often is happening, could start from an original approach based on an unforeseen experiential proposal for the visitor. Therefore to be read correctly, a modern museum has to show always the history of its cultural formation, the territorial character of the city where is set, the building in which it is the host and the original identity of the artifact exposed. Those features made up the personality of the museum and its identity. If the cultural institutions are unable to engine those values, they will face huge difficulty to survive.

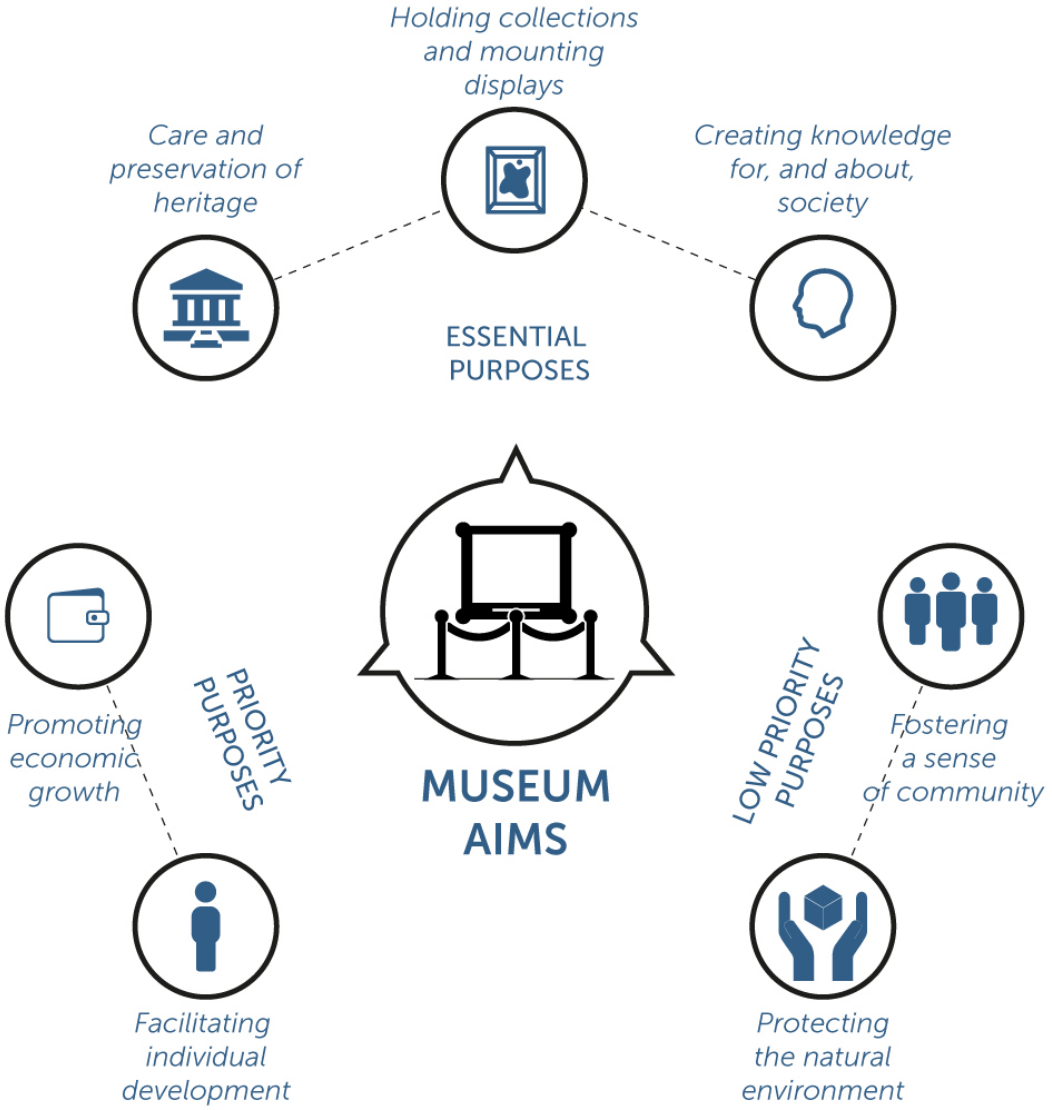


figure 34: Museum aims

The new concept brought by the modern museum has, as a result, evolved the changing of aim related to this institution. In the report published by BritainThinks for Museums Association ”Thinks for Museums Association, Public perceptions of the purposes of museums in society” authors resumed which are the main aims that a museum has to follow. Objectives that a museum has to achieve could be divided into different layers: there are some essential purposes, those that are mentioned spontaneously and are held as central to the definition of a museum (Museum association, 2013):

Museum Aims

- *Care and preservation of Heritage: Preservation of national heritage is firmly connected to national historical identity, and this is seen as fundamental to the very nature of museums. This purpose is important to understand where we have got to as a community and to recognize how we live now in comparison to past generations.*
- *Holding collections: While storage for its purpose is a crucial part of preserving heritage, museum experts emphasized the importance of rotating collections to attract more visitors (while keeping high profile artifacts on display permanently) and that shows were as interactive and user-friendly as possible.*
- *Creating knowledge for, and about, society: Participants interpreted this purpose as being about public education, rather than academic or elite research. The fact that the terminology 'creating knowledge' was consistently turned to 'sharing knowledge' indicates the perception of this as a key part of what museums are for.*

Then there are some priority purposes, which are less important than essential purposes. Even if an institution can still be counted a museum if it does not accomplish these purposes, having these goals should be a priority:

- *Promoting economic growth through tourism, investment, and regeneration: Achieving a return on investment applies to all publicly funded institutions is essential for museums to survive economically.*
- *Facilitating individual development through education, stimulation and building skills: Education is covered in the essential purposes and is especially important for all children in society. A large-scale 'individual development' purpose received major support. For adults, the purpose of museums is less about 'education' than 'inspiration' and 'information.'*

Below the priority purpose, there are the low priority purposes. Museums can seek to achieve those but resources should not be redirected away from essential or priority purposes. Futhermore, if the museum is publicly financed, it should not perform specific roles already carried out by other state organizations.

- *Fostering a sense of community and helping the vulnerable: The public regards social services or charities as supplementing more value here. Some hints to this included the role of museums in protecting and fostering a sense of identity and pride, and participants recognized that in more rural or remote areas, museums could play a greater part in the community. Concerning helping the vulnerable, participants were very much in support of museums being accessible and inclusive to all, including the most vulnerable in society.*
- *Protecting the natural environment: This was not suggested spontaneously as a purpose and considered to be a topic that could be spoken about by museums, if relevant to the type of museum in question. Importantly, the role of museums here is to educate, rather than lecture to people or judge behavior.*

3.4 Digital tools

As we live increasingly mobile, digital and virtual lives, museums will have to develop new ways to tell stories and engage their audiences (Grinter et al., 2002). New technologies like augmented reality are changing how and where we can have museum-like experiences. Social and cultural shifts are changing the type of experiences people will expect, while restrictions to funding will continue to put pressure on some museums to be both pro table and more inclusive at the same time (Parry, 2013). As it has been said before, the main objective of a museum is to promote the cultural heritage and to achieve this goal the communicational aspect with the audience assume a vital role to complete this task. Museums are cultural industries that optimize their work by the use communicative goods that take part of our typical and relational, social life. The modern museum, as a services undertaking, makes use of a vast number of digital and analogical devices that result in a communicational system broadly and complex. Some of these devices enter priorly in contact with the audience (i.e. audio guide, smartphone apps, holograms), others are used for managing the whole structure or for the safeguard of the exposition. In the debate about the use of technology facilities inside the museum, one of the critical issues regard the loss of museum cultural identity (Dahlstrom, 2014). For the most of the museums the definition of the museum image, that is strictly related to the museum identity, it is still lived as a problem, a need that arises because of the increasing competition in the museum market. As a consequence museum market could occur to the situation in which technological improvement will be seen only as a marketing exigency, a sort of commercial makeup, without taking in count the cultural significance of the cultural heritage propose. There are many cases of use of museum and technology, and it is possible to set up a list of the most used design solutions (Walker, 2010).

Digital tools categories

- **Audio guides:** The audio guide (or audio tour) is a tool that allows the listening to a recorded audio narration, usually through a portable electronic device, with the use of audio information about monument, museum or cultural site. Through the spoken commentary, audio guides offer information and insights on various issues, for example, history, art history, architecture, company history, related to the place or the object visitor looking at. The audio content, often in multilingual, can also be enhanced with sound effects, music, artist interviews of directors of museums, archaeological sites, exhibitions, etc. According to Tallon (Tallon, 2009) the visitors who use audio guides spend more time in front of the artworks, develop a stronger interest in the artist, and are more likely to report a positive emotional response.
- **Touch desks:** commonly this tool is represented with interactive totems. Those devices are at the disposal of the visitors for having further information about the museum or the cultural heritage in visiting. This kind of tools are usually set next to the most famous works of art of the exhibition, and they allow to the

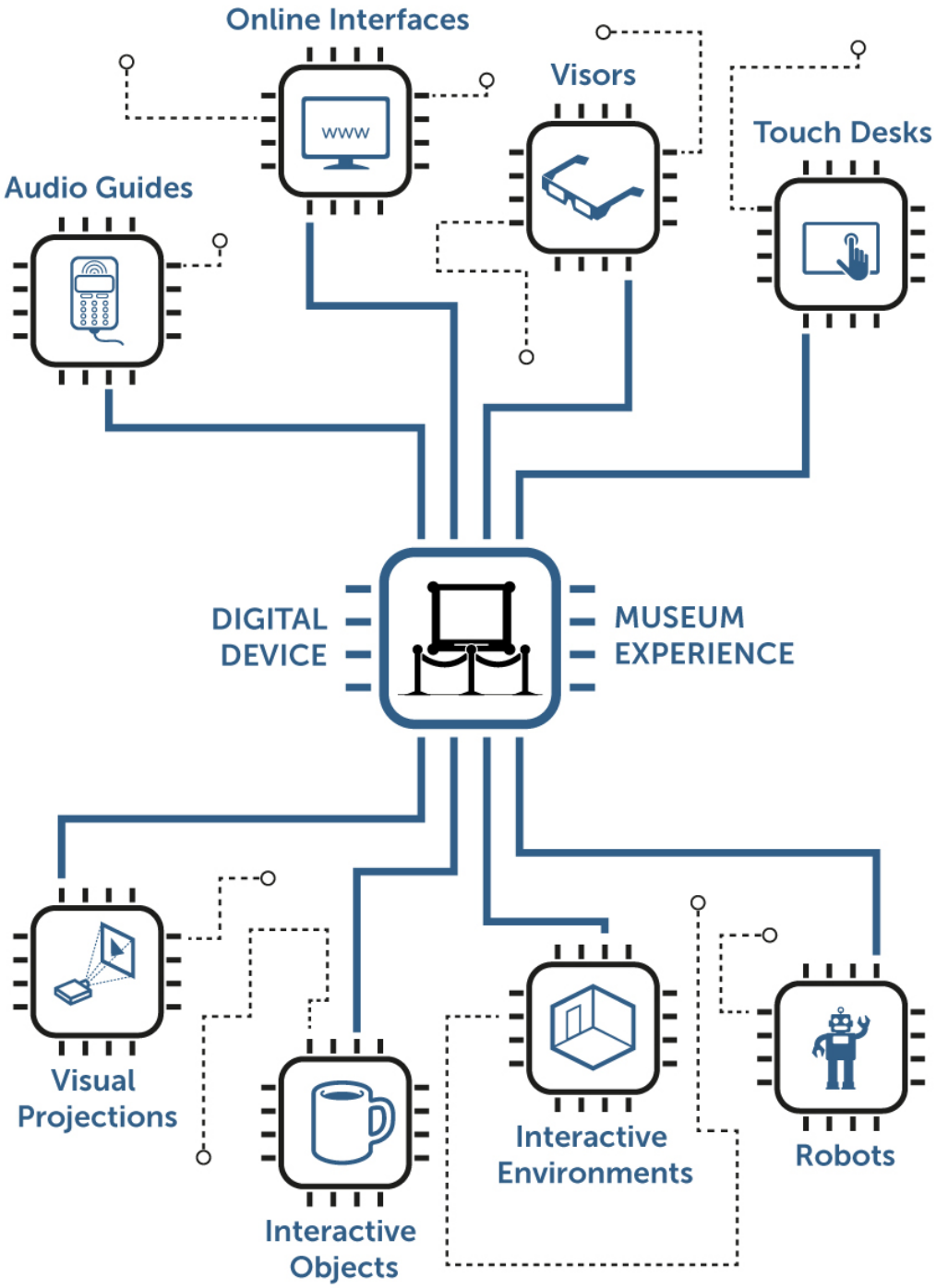


figure 35: Museum digital tools

visitor to receive more in the deep info about the operas.

- **Web sites and online interfaces:** website is a common used tools in the museum communication system. Inside the website, visitors can find information about museum opening hours, pricing and events. ‘
- **Glasses or visors:** this typology of devices are recently used to shown extra information in the museum. This tool it has been used for disabled people also.
- **Holograms or visual projections:** A hologram is a three-dimensional image, created with accurate projection. Unlike 3-D or virtual reality on a two-dimensional computer display, a hologram is a truly three-dimensional and free-standing image that does not simulate spatial depth or require a special viewing device. Even this kind of technology is not used worldwide, in museums are present some samples of its application. Usually, holograms are used for giving to the audience additional information about the exposition or offer a more emotional experience of the visit.
- **Interactive objects:** in some exposition, it is possible to find some interactive object that could enhance the visiting experience. Commonly with the support of this device, it is feasible to manage the information related to the exposition and personalize individual experience
- **Interactive environments:** in some exposition, it is possible to be immersed in interactive environments. In this cases, the visiting experience is totally immersive, and the visitor could experience the museum in a complete attractive way.
- **Robotics device:** since the last decade robotics device have been used in support of the museum experience. The categories of use of this technology are several, and, in respect to the others typologies of the digital device mentioned before, robots can be useful for enhancing the phygital aspect of the visit. Phygital approach allows the linking of the physical interaction experience with the digital ones. This new field of museum application is the last born in the

3.4.1 Digital tools benchmarking

Benchmarking (Camp, 1979) is a very useful tool used for interpreting the state of the art of the market field. Xerox Corporation pioneered it in the 1979s. Benchmarking is an iterative analysis process of improving performance by continuously recognizing, interpreting, and adapting outstanding practices and processes related to an assortment of organizations. Mainly used in the manufacturing field, benchmarking could also be utilized in the design research to set up the base of the design scenario of a target area of research.

Similar to the one used in the market analysis, academic benchmarking set the progress achieved by the comparison of several cases studies of research applications. The systematic discipline of benchmarking is focused not only on identifying, studying, analyzing, and adapting best practices and implementing the results. Through this process, it is possible to discover the steps for a significant culture change.

Criteria Analysis definition

For what concern this research it has been dedicated particular effort towards the analysis of digital service and application set in museums or used to promote the cultural heritage. The realized benchmarking regards the comparison of the most 20 interesting example of the use of technology in museums, since now. To facilitate the analysis process every application it has fitted in a template. The layout sheet is designed for simplifying the reading process of the museum experiences selected. In the layout model, it is possible to find several pieces of information about the mapped experience such as general data, interaction degree with the visitors and use of a robotics device. In the first part of the layout sheet, are described the general information about the installation: geographical position, designer, committee and year. Then, in the second part, the layout present a Kano Model-based analysis (Walder, 1993). Kano Model is a useful performance analysis. It is relevant for finding out how each attribute performance of a product impacts on user satisfaction. Prof. Kano, which is the inventor of this methodological approach, in his researches, pointed out that not all product/service attributes have the same role in satisfying customer needs and this technique is used for determining which influence the attributes of products and services have on customer satisfaction. Mainly Prof. Kano defines three categories of attributes/ performances (Jacob, 1997):

- *Basic attributes/dissatisfiers/Must-have*
- *Performance/one-dimensional attributes*
- *Exciting attributes/satisfiers/Attractive*

Since they are sensible to the user satisfaction, one of the tasks required to a designer is to define with the use of contextual analysis methodology, which are the attributes categories specific for define an artifact. Those categories are determined by all the information related to that artifact, from the context of use to the aesthetic attributes. In respect of the museum experience, it has been decided to fit this three parameter in those aspects:

- **Digital acceptance** - Digital acceptance is very useful in term of experience acceptation. The most the experience is empathic with the user, the most it is appreciated. Looking back on what it has told before, in the analysis of the human-robot interaction thesis paragraph. It has decided to focus the attribution analysis in those important features: *aesthetic coherence, clarity of the message, emotionality, personalization of the visit.*
- **Role of the Museum** - There are some duties that museum has respect the society; these purposes define the role of the museum. A digital application

developed without taking in the count those aspects misleads the identity of the museum. The parameters chosen to determine the role of the museum are: *creation of educational facilities, preservation of works art and spaces, over structuration of the environment, correct reinterpretation of the contents*

- **Design of the experience** - The museum experience design is based on some rules to follow to enhance the customer satisfaction. The digital devices commonly are developed taking in count those aspects. The parameters detected in this part of the benchmarking are: *social aggregation, scalability, interactivity, accessibility for physically challenged people.*

Every installation of the 20 selected it has been mapped following this three parameters giving them a value from 1 to 3 defined by the complexity of the performances (low, medium, high) and comparing it with the others one previously selected. The voting session it has been made accordingly between the stakeholders. The designer role it has been to find out which were the most significant case studies than museum expert and technology expert give an evaluation in common agreement.

The analysis performed is a qualitative one, useful to determine the general behaviors of the digital museum applications. The three categories have been chosen for describe the selected application under some relevant aspects. Comparing the result of the votes achieved by all the attributes; it is possible to have a screening about the state of the art of museum applications. The third part of the sheet describe the attributes of the museum experience. Firstly is defined if the experience is online or it is lived in a remote way outside of the museum. The introduction of these on-site and off-site museum experiences is still a rather controversial matter due to its novelty and its relatively early stage of development. While it encourages accessibility to objects, sites or buildings, it is also true that it presents a series of drawbacks that raise eyebrows about the feasibility of a widespread use of museums. As McTavish states, museums are expected to be on the technological avant-garde, but this does not reason enough for justifying the use of technology without a clear purpose. Accessibility to collections has been mentioned as one of the best assets of use of gitial device, for example for providing a complete experience to people with disabilities. Second part of the bechnmark sheet layout, resume the core set device technology used for the experience, thirdly which is the nature of the installation if it is functional, meaning only as a support of the museum visit, or attractive, meaning that involve entertainment factors.

MUSEO AUDIOVISIVO DELLA RESISTENZA

DESIGNER
STUDIO AZZURRO
CLIENTS
MUSEO DELLA RESISTENZA
LOCATION
FOSDINOVO, ITALY
YEAR
2000

This museum exhibit is developed to show a new vision of the Resistance. The exhibit shows faces, in large scale, emphasizing and highlighting they expressivity, to involve visitors in those stories which represent the memory of a population. The exhibit consists of a big room with many tables, where are projected information and pictures activable with hand gestures interaction

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE — *On Site*

CLASSIFICATION — *Attractive*

SET DEVICE — *Projections*

LA MERICA! DA GENOVA AD ELLIS ISLAND

DESIGNER
PIERANGELO CAMPODONICO
CLIENTS
GALATA MUSEO DEL MARE
LOCATION
GENOVA, ITALY
YEAR
2008

Compared to others traditional exhibitions dealing with the theme of emmigration, for the most documentary and based on photographs. This installation allows visitors to relive the emigration experience.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE — *On Site*

CLASSIFICATION — *Attractive*

SET DEVICE — *Projections*

THE VIRTUAL MUSEUM OF IRAQ

DESIGNER
CNR
CLIENTS
MINISTERO AFFARI ESTERI
LOCATION
WEB SITE
YEAR
2009

This virtual museum is an interdisciplinary project realized by CNR with the contribution of archaeologists, historians and information and communication technology experts.
The museum is built using 3d modeling, laser scanning, computer graphics, photography, interactive videos, and other digital tools. The exhibit is structured as a succession of virtual rooms, in which different artwork are located accompanied by a brief description.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
Remote

CLASSIFICATION
Functional

SET DEVICE
Online interface

MUSEO DELLA CERAMICA

DESIGNER
STUDIO AZZURRO
CLIENTS
MUSEO DELLA CERAMICA
LOCATION
MONDOVI, ITALY
YEAR
2010

The museum shows a significant collection of ceramics realized with the manufacturing typical of Mondovì. The information about materials, realization techniques, and uses are proposed through videos projected on tables, panels, and walls. The most interesting elements in the exhibit are the tables where the visitor can put an object in correspondence of a spotlight, activating a projection on the table with related video to it.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Projections

DENTRO L'ULTIMA CENA: IL XIII TESTIMONE

DESIGNER
STUDIO AZZURRO
CLIENTS
CASTELLO SFORZESCO
LOCATION
VIGEVANO, ITALY
YEAR
2010

The exhibit design is dedicated to The Last Dinner, by Leonardo Da Vinci and is based on the concept of visitor participation. It is divided n three different level of involvement and deepening. The first one is the most traditional level and shows information and contents with a cinematographic approach. The second level offers the possibility to use interactive stations to personalize the experience The third level is based on the involvement of visitors who can collect and share pictures

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

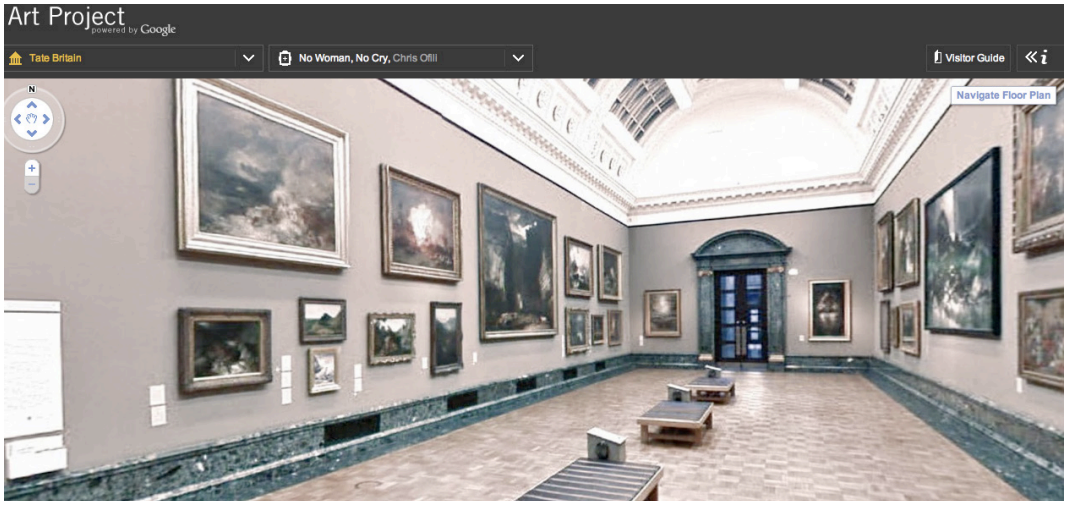
Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Interactive objects

GOOGLE ART PROJECT



DESIGNER
GOOGLE CULTURAL INSTITUTE
CLIENTS
GOOGLE
LOCATION
WEB SITE
YEAR
2011

This project is an app designed to guide visitors into a museum exhibit. Through this app, the user can follow the map, select his interest points, define his path, go deeper into information and adapt the interface to his needs. In this tool the traditional contents of audio guides is offered in a more manageable way, in fact, the explanations of the artworks is provided as a recorded speech but, in addition, there are pictures, notes and is possible to save preferences

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
Remote

CLASSIFICATION
Functional

SET DEVICE
Online interface

IMPOSSIBLE ANIMALS INSTALLATION

DESIGNER
PO-MO INC.
CLIENTS
CHILDREN'S MUSEUM
LOCATION
WINNIPEG, CANADA
YEAR
2012

This temporary exhibition for Children's Museum consists of two projection screens where is projected a sort of fantastic landscape. Children, first, have to color an egg, printed on a sheet. After that, the drawings are scanned, and through a touchscreen, children can choose to put them on the grass, or water or air. A small robot enters into the projection-carrying the egg. In the last step, the child touches his egg projected, which opens and release a wonderful animal.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Interactive env.

LITTLE SUN

DESIGNER
OLAFUR ELIASSON
CLIENTS
TATE MODERN MUSEUM
LOCATION
LONDON, UK
YEAR
2012

People explore works of art using the light of Eliasson's Little Sun solar-powered lamp. the museum experience can be visit in a total different way and even during the night

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Functional

SET DEVICE
Interactive objects

ALTER BAHNHOF VIDEO WALK

DESIGNER
CARDIFF & MILLER
CLIENTS
DOCUMENTA 13
LOCATION
KASSEL, GERMANY
YEAR
2012

The Alter Bahnhof Video Walk was designed for the old train station in Kassel. Using the camera of the smartphone, it is possible to see an alternate world where fiction and reality are mixed with the use of augmented reality.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Audioguide

TOUCH TOURS

DESIGNER
LOSS & PENN VISION CENTER
CLIENTS
PENN MUSEUM
LOCATION
LEHIGH VALLEY, USA
YEAR
2012

Touch tour is a project that allows blind people to interact with artifacts collected by museums. The visitors are driven in the exhibit by a guide who explain the exhibition and help them. They use physical interaction to perceive objects, shapes, and materials.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE — *On Site*

CLASSIFICATION — *Functional*

SET DEVICE — *Interactive env.*

WALL COLLECTION

DESIGNER
D. FRANKLIN, A. CUTLER
CLIENTS
CLEVELAND MUSEUM OF ART
LOCATION
CLEVELAND, USA
YEAR
2013

The Collection Wall is the largest multi-touch screen in the United States. The display changes every 40 seconds, grouping works by theme and type, such as the historical period. It has been developed fo facilitate the discovery desire and the dialogue with others visitors.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Touch screens

GOOGLE GLASS 4 LIS

DESIGNER
EGIPTIAN MUSEUM TORINO
CLIENTS
EGIPTIAN MUSEUM TORINO
LOCATION
TORINO, ITALY
YEAR
2013

The aim of this project is to give an alternative kind of guide in the museum, accessible for the deaf. In fact, the traditional audio guide reproduces a recorded speech which is entirely useless for the deaf.The Google glass shows the explanations in LIS, Italian deaf language. Those explanations are translated in LIS by the Atlas platform, developed by Polytechnic and University of Turin.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

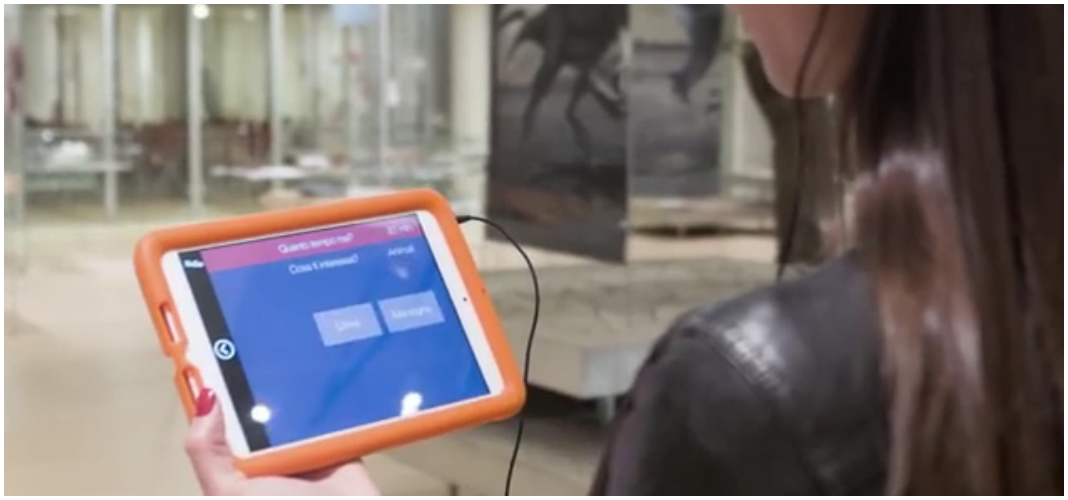
Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE — *On Site*

CLASSIFICATION — *Functional*

SET DEVICE — *Glasses*

EXPLORA MUSEUM



DESIGNER
GNV&PARTNERS
CLIENTS
MUSE (Trento Science Museum)
LOCATION
TRENTO, ITALY
YEAR
2013

This project is an app for iPad which designed to guide visitors into the museum exhibit. Through this app, the user can follow the map, select his interest points, define his path, go deeper into information and adapt the interface to his needs. In this tool the traditional contents of audio guides is offered in a more manageable way, the explanations of the art works is provided as a recorded speech but, in addiction, there are pictures, notes and is possible to save preferences

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

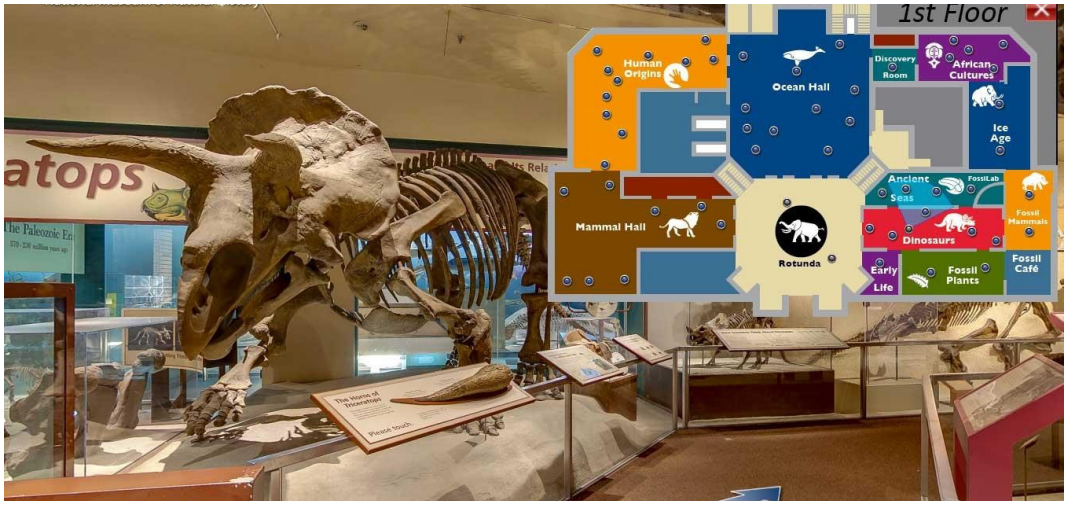
Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Functional

SET DEVICE
Audioguide

NATIONAL MUSEUM OF NATURAL HISTORY



DESIGNER
SMITHSONIAN INSTITUTION
CLIENTS
SMITHSONIAN INSTITUTION
LOCATION
WASHINGTON, USA
YEAR
2011

This comprehensive virtual tour allows visitors using a desktop computer or a mobile device to take a virtual, self-guided, room-by-room walking tour of the whole museum. The visitor can even browse a list of past exhibit, which is included on the ground floor map. The visitor can navigate from room to room by clicking map locations or by following blue arrow links on the floor that connect the rooms.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
Remote

CLASSIFICATION
Functional

SET DEVICE
Online interface

MUSEUM ROBOTS

DESIGNER
FRAUNHOFER IPA
CLIENTS
KOMMUNIKATION MUSEUM
LOCATION
BERLIN, GERMANY
YEAR
2000

The Kommunikation Museum in Berlin is provided of three robots, located at the entrance of the museum. These robots welcome visitors, guide them and play ball with them.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Robots

TPR ROBINA

DESIGNER
TOYOTA
CLIENTS
KAIKAN EXHIBITION ALL
LOCATION
KAIKAN, JAPAN
YEAR
2007

Toyota decided to use a robot as a museum guide for the museum exhibit. This robot can move autonomously to many destinations avoiding obstacles. The interface of the robot makes it able to move the fingers to point and, eventually, to sign autographs. The robot has facial recognition ability and can memorize information. Those skills make it usefull to interact directly with visitors.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

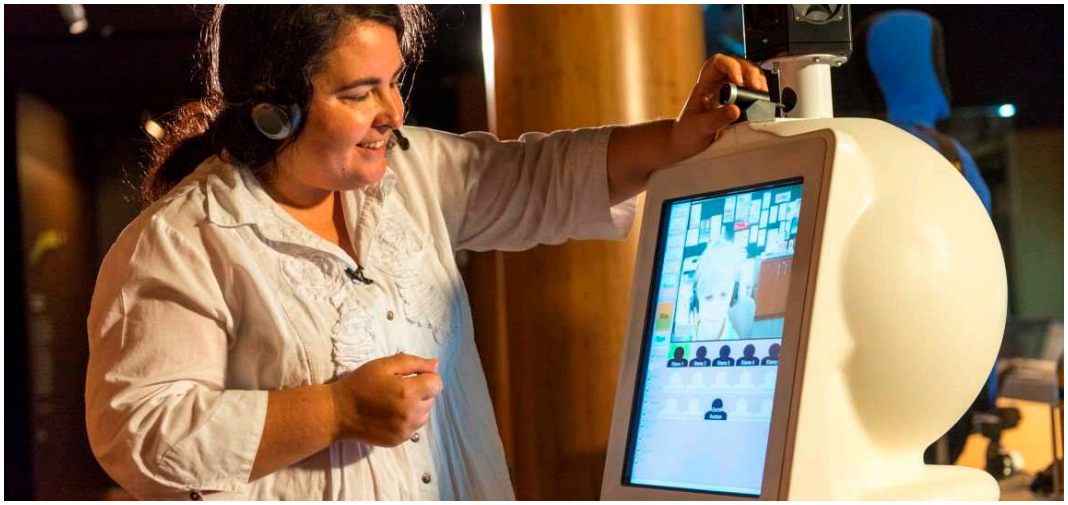
Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Robots

CSIRO ROBOT



DESIGNER
CSIRO
CLIENTS
NATIONAL MUSEUM AUSTRALIA
LOCATION
ACTON, AUSTRALIA
YEAR
2013

This telepresence robot allows students or other visitors to take a tour of the museum through a device, PC or smartphone.
The students interact with a human educator who is in the museum and walk around the exhibit followed by the robot, that is provided with a panoramic camera which allows the students connected to watch around, in any direction they want and they also have the possibility to focus on detail.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

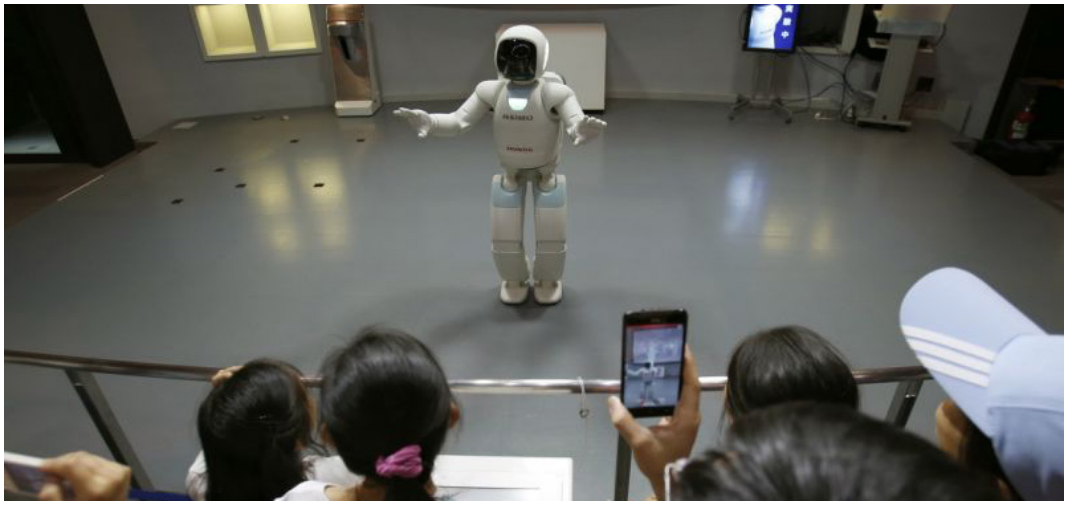
Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
Remote

CLASSIFICATION
Functional

SET DEVICE
Robots

ASIMO



DESIGNER
HONDA
CLIENTS
MIRAIKAN MUSEUM
LOCATION
TOKYO, JAPAN
YEAR
2013

The robot is part of the exhibit of this museum dedicated to science and innovation. Asimo communicates interactively with visitors by asking questions that they can respond to by raising their hands, predicting their intentions based on their responses, and providing explanations in an easy-to-understand manner that includes gestures.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
On Site

CLASSIFICATION
Attractive

SET DEVICE
Robots

ROBOT NORIO

DESIGNER
DROIDS COMPANY
CLIENTS
ORION CASTLE
LOCATION
MONT-SAINT MICHEL, FRANCE
YEAR
2013

In this project, the robot gives to disable people, especially the ones using a wheelchair, the possibility to visit the top floor of the museum. The visitor through a computer at the ground floor, connected by wi-fi, can interact and drives the robot, which gives back the real-time images of the area, thanks to its camera. The robot is also provided with a screen where is visible the face of the user who, in this way, can also interact with others visitors in the room.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE
Remote

CLASSIFICATION
Functional

SET DEVICE
Robots

AFTER DARK

DESIGNER
THE WORKERS
CLIENTS
TATE BRITAIN
LOCATION
LONDON, UK
YEAR
2014

In this project, visitors will be able to drive robots around the museum during the night remotely, and each virtual visit will be timed and is possible for other users to have access to the same real-time remote exploration.
The robot moves around the museum and shows the art works with a spot light.

Digital acceptance
aesthetic coherence
clarity of the message
emotionality
personalization of the visit

Role of the Museum
educational facilities
preservation
over structuration
correct reinterpretation

Design of the experience
social aggregation
scalability
interactivity
accessibility for disabled

PRESENCE — *Remote*

CLASSIFICATION — *Functional*

SET DEVICE — *Robots*

3.4.2 Digital tools benchmarking results

Benchmark highlights how the interactivity and the service aspect of the museum experience have emerged in the last decade. As can be noticed, figure 36 resume the distribution of the votes for each category. The figure shows that it exists a gap between the categories related to the design of the service and experience and the one related to the role of the museum. This lapse could be the results of the continuous use of technology inside the museum exhibit. Museums are always more exploring digital and mobile technologies to enhance the visitor experience. Therefore there are a lot of beneficial things that new technologies have brought to museums; it is necessary to make a reflection about how to hold back on audience engagement. Museums should not try to compete with the multimedia attractions of contemporary culture by imitating them. On the contrary, museums should allow those who want to enjoy the pleasure of seeing the pleasant exposition that curator has created and discovered in the past get on with it, without the distractions of modern gadgets. Technology in this sense has to be very careful. This situation it has been to relate to the fact that commonly the digital museum application is developed for the museum and not with the museum. Commonly those applications, in fact, are designed by professional studio experts in the treatment of digital application but with limited knowledge of the cultural heritage.

Benchmark also emerged the question about the presence or not of visitors inside the museum during the visit. In literature, there is no a convincing argument for replacing a physical museum visit with a virtual one, despite solely virtual museums are more and more prevalent and offer intriguing possibilities for curating

figure 36: Benchmarking voting results

exhibits which could not properly be constructed. The virtual visit is considered to be a solitary activity, one that might allow for enhanced concentration. By contrast, the physical visit is seen as a collective activity. Nevertheless, being part of a group viewing an exhibit (even a group of strangers) can alter the experience. While this might be a negative factor, in the museum space a dialogue is at least possible

Surely, a curated exhibition offline can have all the impact of a curated exhibition in a physical space except for those elements which are specifically related to physicality: scale, texture, surface, three-dimensionality, and physical context. However, those elements can make all the difference in memorability and the creation of educational facilities.

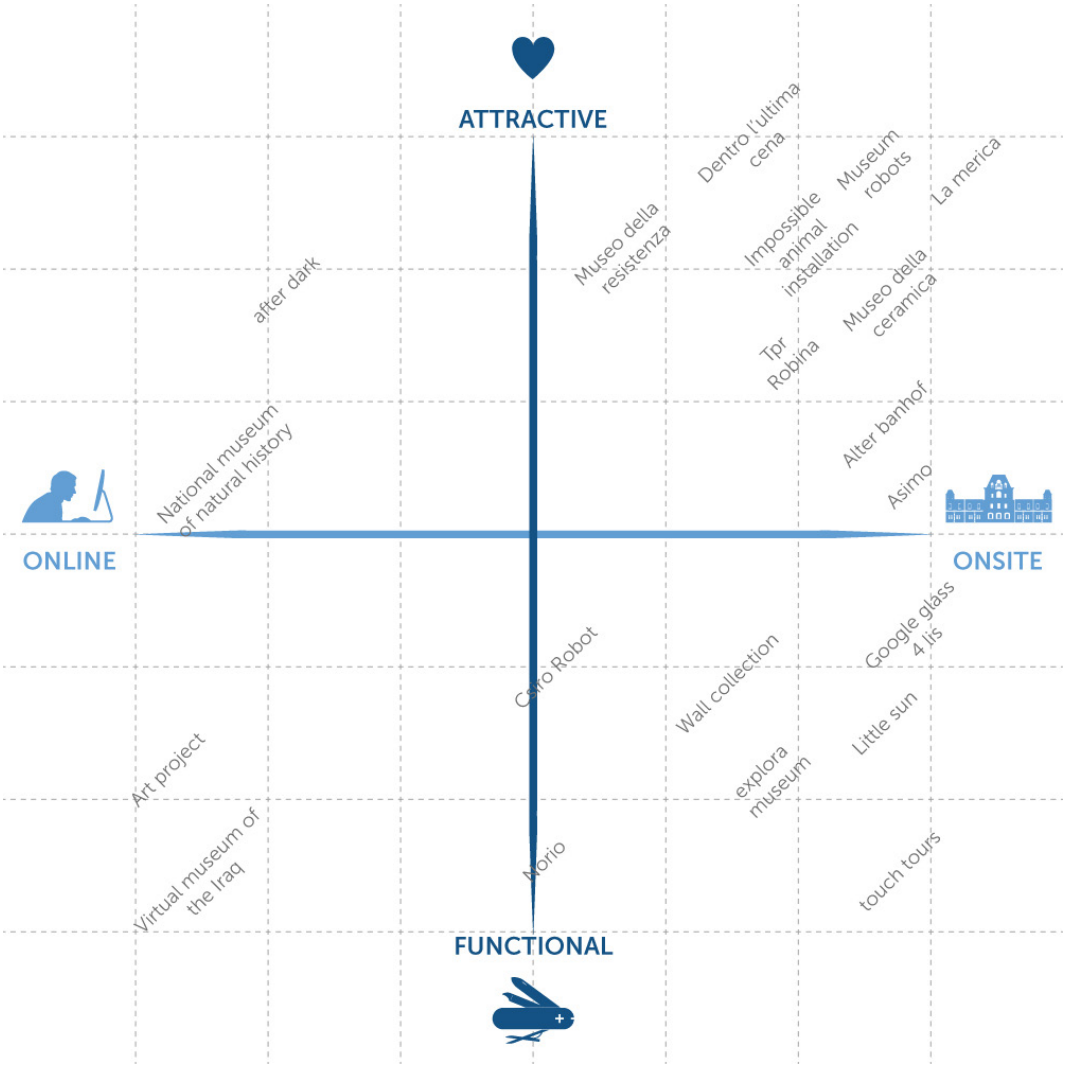


figure 37: Case study dislocation

3.4.3 Robots and museum

In the benchmark, several uses of robotics in the museum were selected. Whose applications in museums have recently increased, introduce new challenges especially from the service point of view. Mainly the taxonomies of use of robots in the museum are robots as the museum guide, explorer robots (telepresence), and robot installations. In particular for which concern this research the effort of the study were conveyed in the first two categories.

Already in the nineties took place experimentations with guide robots that were initially addressing problems of navigations and obstacle avoidance. Over time these application faced increasing challenges, such as the dialogue with visitors, the ability to express emotions, until becoming capable of adapting the guide on the base of people's behaviors and moods. In the benchmark, there are some examples of usage of the technology in this sense. A group of three different robots was introduced at the Museum fur Kommunikation, Berlin (Graff, 2000). These three robots were entrusted with various duties: instruction, invitation, and entertainment. The instructive robot was, indeed, a museum guide that accompanied visitors on tour giving explanations about the exhibit. It was able to move the head up and down to indicate which object it was referring to and also it was provided of a screen on which it could show additional contents. Recently, a famous humanoid robot, Asimo, was tested as a museum guide at the Japan's National Museum of Emerging Science and Innovation (Macaluso, 2005). The basic purpose was the same of previous projects, but in this case, there was a particular attention to the interaction with a group of people. For example, to understand who from the public was asking a question, it used to suggest people raise a hand before. Unfortunately, this feature, such as others, was not working as it was supposed to and the overall experience resulted ineffectively.

figure 38: Museum fur Kommunikation

figure 39: Asimo at the Japan Museum

Regarding exploring robots, these are used to improve cultural heritage's accessibility for those who are unable to reach the museum site for geographical limitations or mobility impairments. The robot Csiro, for example, was introduced at the National Museum of Australia, to increase accessibility for people unable to reach the museum, e.g. students from rural areas of Australia or aged in nursing homes. The robot Norio, instead, was designed to allow people with limited mobility, e.g. wheelchair users, to visit a museum, which, otherwise, would result impervious for them. This robot was placed and is still working, at the National Centre for Monuments, Chateau d'Orion, France (Khlat, 2014). At the ground zero of the museum is positioned a cockpit from which, through a computer, the visitor can remotely drive the robot located on the first floor.Moreover, the telepresence allows also to experiencing a visit out of the ordinary, such as exploring a museum during the night, when it is closed to the public. Another case of use of the robot for exploring the museum area is the After Dark project (After Dark, 2014), which involved the Tate Britain, in London. The aim of the project was to allow people to explore the museum areas during the night, playing with the sense of prohibition and exploiting the charm that this place assumes during the evening. During this experience, available for five nights, in August 2014, some people, chosen randomly, connected and drove via the internet the four robots placed in the museum.

figure 40,41,42: Csiro, Afterdark, and Norio

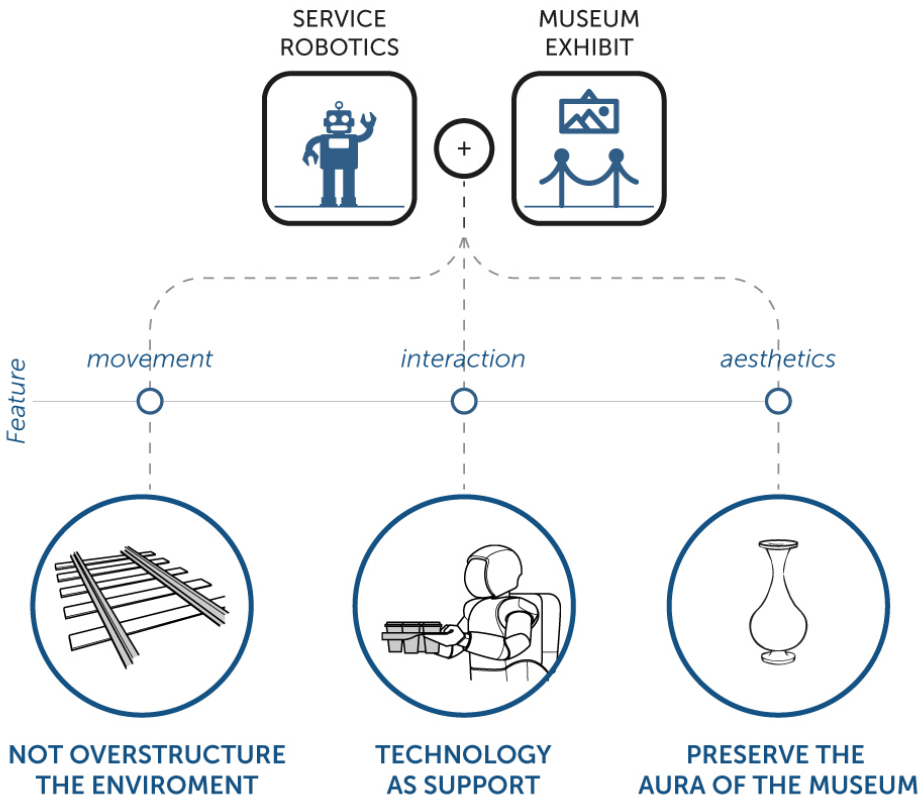


figure 43: Service robotics for museum issues

Robotic technologies are increasingly being applied in museum contexts for installations and performances, aiming at the engagement and participation of the visitors. Analyze the robotic museum applications is useful because it provides the design concepts that has to be followed during the design phase. Mainly the weaknesses categories presented by these types of equipment, for which concern the museum's applications are: the movement, interaction, and aesthetics. Handling should be structured through autonomous driving and not provide to over structure the museum environment. Include the Museum of walkways or superstructures; it would cause the loss of artistic aura of these environments.Interaction with other visitors and with the museum guide, however, is critical in the relationship between museum and visitor, replace it with a robot with a communicative apparatus not evolved it may cause a lack of clarity of the messages communicated by the institution. From an aesthetic point of view, all the robots analyzed did not meet the requirements on contextualization, seemingly unrelated objects to these environments, the robots have to be designed taking into account the artistic and cultural context in which have to be inserted. Moreover, tries to go beyond the formal synthesis by introducing the concept of customization based on the context.

3.5 Methods

The benchmark also gives suggestions about the methods used in the designing of a museum exhibit. From the analysis of the previously selected case studies emerged four taxonomies of approach. Those categories could be ulteriorly mixed for giving the user a more enhancing experience.

Exploring is for sure one of the most common use of the technology inside a museum. A project like Google Art or the Virtual Museum of Iraq gave to visitors, even not physically present in the institution, the possibility to visually explore several areas of the institution. This category of use is also dedicated to people with disability. Google Glass 4 Lif give an example of correct use of technology in this sense, giving a chance to deaf people to live the museum experience.

figure 43: Virtual Museum of Iraq

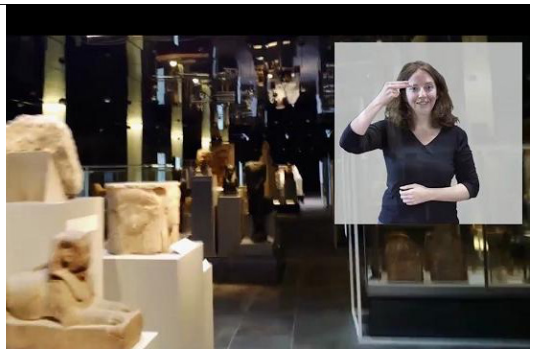


figure 44: Google Glass 4 Lif

Storytelling is an important part of the visit. With the storytelling, the museum can empathize exhibit giving the visitor an enhancing reading of the exposition and facilitating the portray process. An excellent example of storytelling is The Alter Bahnhof Video Walk designed for the old train station in Kassel. In this installation, visitors using the camera of their smartphone can see an alternate world where fiction and reality are mixed with the use of augmented reality.

figure 45: The Alter Bahnhof Video Walk

Recently gamification methodologies have been used by curators to enhance exhibition visit. Trought the playing it is possible to create educational facilities useful to the comprehension of the exhibit. In the benchmark, there are some examples of game used in the museum. Impossible animal installation, for instance, consists of play were children have to color an egg, printed on a piece of paper. And subsequently, through a touchscreen, children can choose to put them on the grass, or water or air. In the last step, the child touches his egg projected, which opens and release an incredible animal with the characteristic of the landscape selected.

figure 46: Impossible animal installation

Surely the use of digital tools in the museum introduced interacting factor. Wall collection, a large multi-touch screen utilized in the Cleveland Museum of Art, for example, display every 40 seconds, a grouping of artworks divided by theme and type. Visitors can interact solely or in a group with it and create their experience of the visit. Interact does not intend to interact with information only, but some applications can allow the interaction with the whole museum enviroment. Is this the case of “Museo della ceramica”. The museum shows a significant collection of ceramics realized with the manufacturing typical of Mondovì. Interacting with tables visitor can put an object in correspondence of a spotlight, activating a projection with related video to it.

figure 47: Cleveland Museum of Art

figure 48: Museo della ceramica

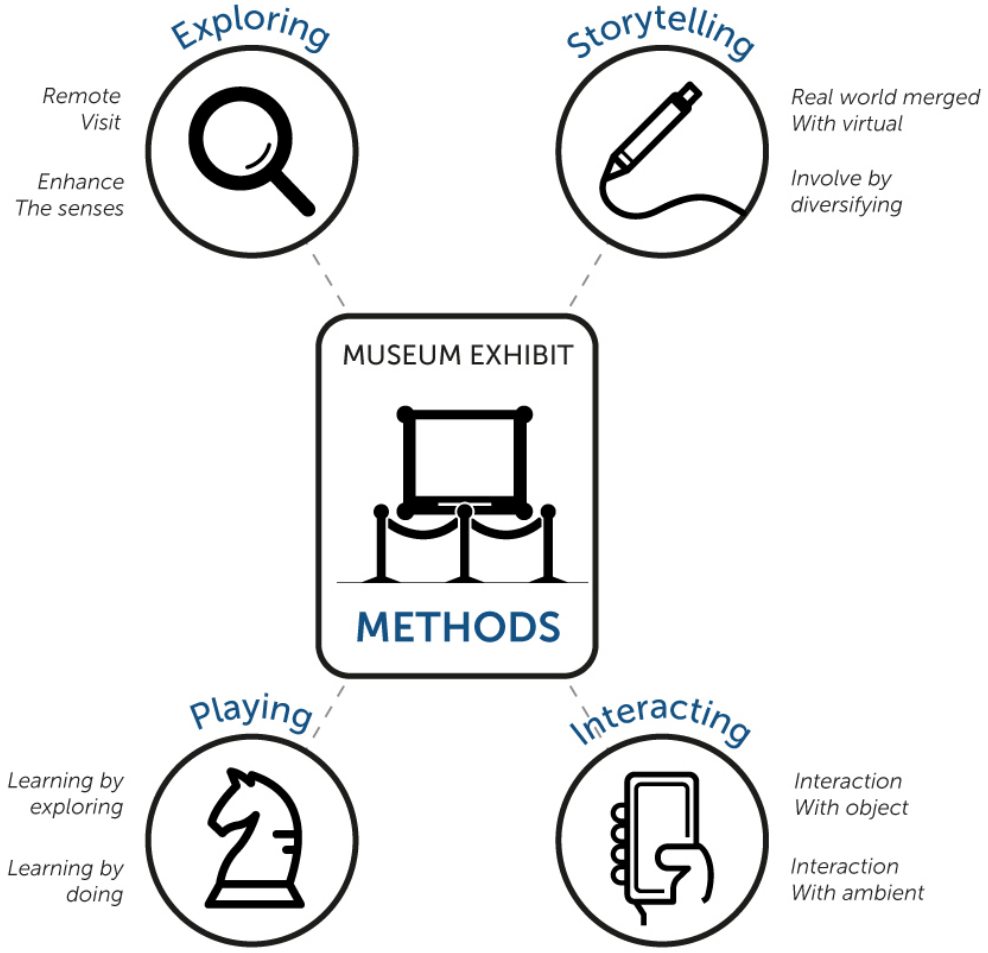


figure 49: Museum Methods

Chapter 4

The Racconigi Castle Workshop

figure 50: Corona delle delizie

4.1 Project scenario, Piedmont Cultural Heritage

Since 1997 some Royal Residences in Torino and Piemonte have been enrolled on the World Heritage List. Each one of these residences is marked by distinctive features that offer an extraordinary fresco of the history of Piedmont and Italy. With a particular reference to the events that led to the formation of the Italian state, Royal Residences is a cultural, historical, architectural and environmental circuit which has an exceptional value for the Italian heritage.Royal Residence is a complex system composed of buildings, "vineyard," villas, and castles belonging to the "Delitie crown" commissioned by the dynasty Savoy around Turin (Pavoni, 2016). Subsequently, this first group of buildings has been expanded to include new residences, dwellings and territorial extensions involving the most skilled workers and the most famous architects of the period: Juvarra, Guarini, Pelagie, the Castellamonte. The buildings that compose the royal residences are: (all the descriptions, are obtained from the Royal Residences official website):

Heritage scenario

Palazzo Reale: The hub of the Court and political power, the Royal Palace, and the surrounding buildings formed the center of command and the main place for representing all the majesty of the House of Savoy.

Palazzo Chiablese: The Chiablese Palace is set on Piazza del Duomo in Turin. Currently, it contains the offices of the Ministry for Cultural Heritage and Activities.

Palazzo Madama: The Palazzo has its origins in a Roman castrum (military defense complex), in the years above has been modernized by Filippo Juvarra who designed the grand staircase and the elegant facade

Palazzo Carignano: Palazzo Carignano, is one of the most original baroque constructions in Turin

Castello del Valentino: In the green heart of the 19th-century park of Torino, the Castle of Valentino had various uses over the centuries before being taken over by the Faculty of Architecture of Torino Polytechnic.

Villa Della Regina: After careful restoration, the Villa of the Queen has been reopened to the public. Acting as a dramatic backdrop to the city, it is in the center of Italianate gardens with pavilions, fountains and agricultural areas once again in production.

Reggia di Venaria: Built in the mid-1600s as a hunting lodge for Charles Emmanuel II, it was designed by Amedeo di Castellamonte. After a long restoration, the Palace with its tour is now the headquarters to major exhibitions and concerts.

Castello de La Mandria: Built during the creation of the Palace of Venaria for breeding thoroughbred horses, it was subsequently converted by Victor Emmanuel II for habitation, soon becoming his favorite place of residence.

Castello di Rivoli: Starting out in the 11th century as a military stronghold, the Castle of Rivoli is now home to the Museum of Contemporary Art which has

a prestigious permanent collection and occasional major exhibitions in an original historical and architectural context.

Palazzina di Caccia di Stupinigi: A place of leisure and hunting, this was the favorite spot of the Savoy family for spectacular parties and solemn marriages, as well as being the residence of Napoleon in the early 19th century.

Castello di Moncalieri: One of the oldest of the Savoy residences, the Castle of Moncalieri, located just a short way from Torino, rises in all its restrained monumentality to guard the River Po. Built in the medieval period for defense purposes, it was transformed by the Savoy into a "place of delight" by extensive enlarging and embellishing.

Tenuta Reale di Pollenzo: It was Charles Albert who first realized the agricultural potential of Pollenzo, creating a proper farm with vineyards and wine cellars. The complex has continued to retain its original link with agriculture: promoted by Slow Food, it now accommodates the University of Gastronomic Sciences and the Bank of Wine.

Castello Ducale di Agliè: Surrounded by a park with ancient trees and vast glasshouses, the castle has over 300 rooms, including a legacy of furniture and precious, eclectic collections ranging from paintings to archaeological finds and through to extraordinary ornithological and oriental collections.

Castello di Govone: A fortress dating back to medieval times, it was reconstructed in its current baroque form by the counts Solaro. Acquired by the Savoy family at the end of the 18th century, Charles Felix selected it as his summer residence.

Castello di Casotto: Originally a Carthusian monastery, it was acquired by the Savoy and transformed into a castle and hunting lodge by Charles Albert. Even today, fragments of Court life can be seen in the bedrooms that retain their original furniture, as well as in the king's kitchens.

Castello e Parco di Racconigi: From the times of Charles Albert through to the fall of the monarchy, the Royal family would spend its holidays in this imposing castle built by Guarini for the princes of Carignano. It is surrounded by a majestic park, which is one of the most famous examples in Europe of the sensitivity to nature and scenery that prevailed during Romanticism. Visiting the Castle of Racconigi now means not only re-experiencing the luxuries of the House of Savoy by seeing the original furnishings and the splendid collection of portraits but also provides the opportunity of strolling through glasshouses and farmhouses and sighting the storks that nest in the park, a haven of exceptional natural interest.

The buildings described above emphasize the systemic structure of the Piedmont cultural heritage. One of the most significant aspects of the heritage is to be strictly related not only to the territory but also, historically, cause of the Savoy monarchy who reigned in this area in the last centuries

Palazzo Reale

Palazzo Chiablese

Palazzo Madama

Palazzo Carignano

Castello del Valentino

Villa Della Regina

Reggia di Venaria

La Mandria

Castello di Rivoli

Palazzina di Stupinigi

Castello di Moncalieri

Tenuta di Pollenzo

Castello di Agliè

Castello di Govone

Castello di Casotto

Castello di Racconigi

4.2 Workshop scenario - The castle of Racconigi

This project has been developed for a particular museum context: the royal residence of Racconigi Castle, in Piedmont, Italy. This castle, called over time as "villa of delights," (Agosto et al., 2006) was a holiday residence of the Savoy royal family. This residence is a surprisingly rich context (artworks, furniture, everyday objects, clothing, working machinery, etc.) but, simultaneously, extremely delicate.

The Castle, which is located in the town center, is impressive and it is a point of reference for the habitants of Racconigi and the surrounding. Castle tours are guided, visitors can not enter the residence without being accompanied by the museum guide, who manage the tour. The visit takes place within the castle, on the first floor, second floor and residential kitchens in the basement. Often in the castle, temporary exhibitions of great importance are also held. Behind the castle, there is a park of 170 hectares who won the "most beautiful park in Italy" prize. Furthermore, Zelkova, One of the oldest trees in the park, become a symbol of merchandising. At the bottom of the park, about 2 km from the Castle, there are Margarite and Serre. The King Carlo Alberto created the first to increase the agricultural activity and the second, known all over Europe, to produce and cultivate imported plants.In this area, which can be visited separately and which can be reached via an entrance located at the bottom of the wall of the castle, are often established performances of great importance.The "festival of the readers" is an annual event, as well as the summer concerts of classical music.

Museum Characteristics

Due to its characteristics the castle, it has been selected as a model, meaning a real case laboratory where perform to the experimentations. The castle, in fact, presents different features that with the project the team wants to explore such as:

- **Museum guide tour**
- **Historical connection with the cultural heritage territorial system**
- **The presence of delicate areas (inaccessible)**

figure 51: Castle of Racconigi


LVDOVICVS·A·SABAVDIA·MDCCLVII

4.2.1 Historical Event of the Castle

Racconigi Castle could be categorized a "Territorial Museum," meaning a museum build up in a historical building and with an unyielding relation with the territory. The main characteristic of this kind of museum is given by the fact that initially these buildings were not intended as exhibition spaces. Therefore the areas accessible to visitors are the result of renovations and changes that took place over the time. Analyze the historical events of the place is useful to understand the shape and artistic value. Below a brief history of the Castle obtained from the Terre dei Savoia official website

THE OLD MEDIEVAL FORTRESS: *"The first information regarding the Castello di Racconigi can be traced back to medieval times and bears witness to the presence of an old fortress with towers. In the 13th century, Manfredo II, Marquis of Saluzzo, had a new, square-based, castle erected, with an internal courtyard, corner towers and moat raised that became one of the fortifications for the defense of the Marquisate of Saluzzo. During the second half of the 14th century, the feudal holding passed first to the Savoy-Acaia, then to the Savoy-Racconigi, lateral branches of the Savoy dynasty that kept the castle for military use almost unaltered from its old plans until halfway through the 17th century. Through the course of time maintenance has been performed, but no transformations or enlargements".*

FROM FORTRESS TO "VILLA OF DELIGHTS": *"With the extinction of the Savoy-Racconigi dynasty, in 1620 the Duke Carlo Emanuele I of Savoy wanted to give Racconigi to the younger son, Tommaso. After many unfinished projects, it was his son, Emanuele Filiberto, "the mute", who was the first real advocate of the first transformation of the castle. He entrusted the architect from Modena, Guarino Guarini, with the responsibility for designing the restructuring of the building. Only the splendid western façade toward the park and the central salon, with imposing raised tower at the centre of the palace on the pre-existing internal courtyard, were completed from the project made by Guarini, started in 1676. This is the only portion of the castle today from the seventeen-century. At the end of the Guarini works, the residence remained unfinished on the southern side facing the town".*

T**HE EIGHTEENTH-CENTURY TRANSFORMATION:** *"The fourth Prince of Carignano, Ludovico Luigi Vittorio, was the actual creator of the second phase of transformation and modernization. Starting from 1755, he entrusted Giovan Battista Borra with the reconstruction of the façade facing the populated area in the neoclassical style. The façade was decorated with a staircase that was included in a splendid proanos with ionic columns and a triangular tympanum.*

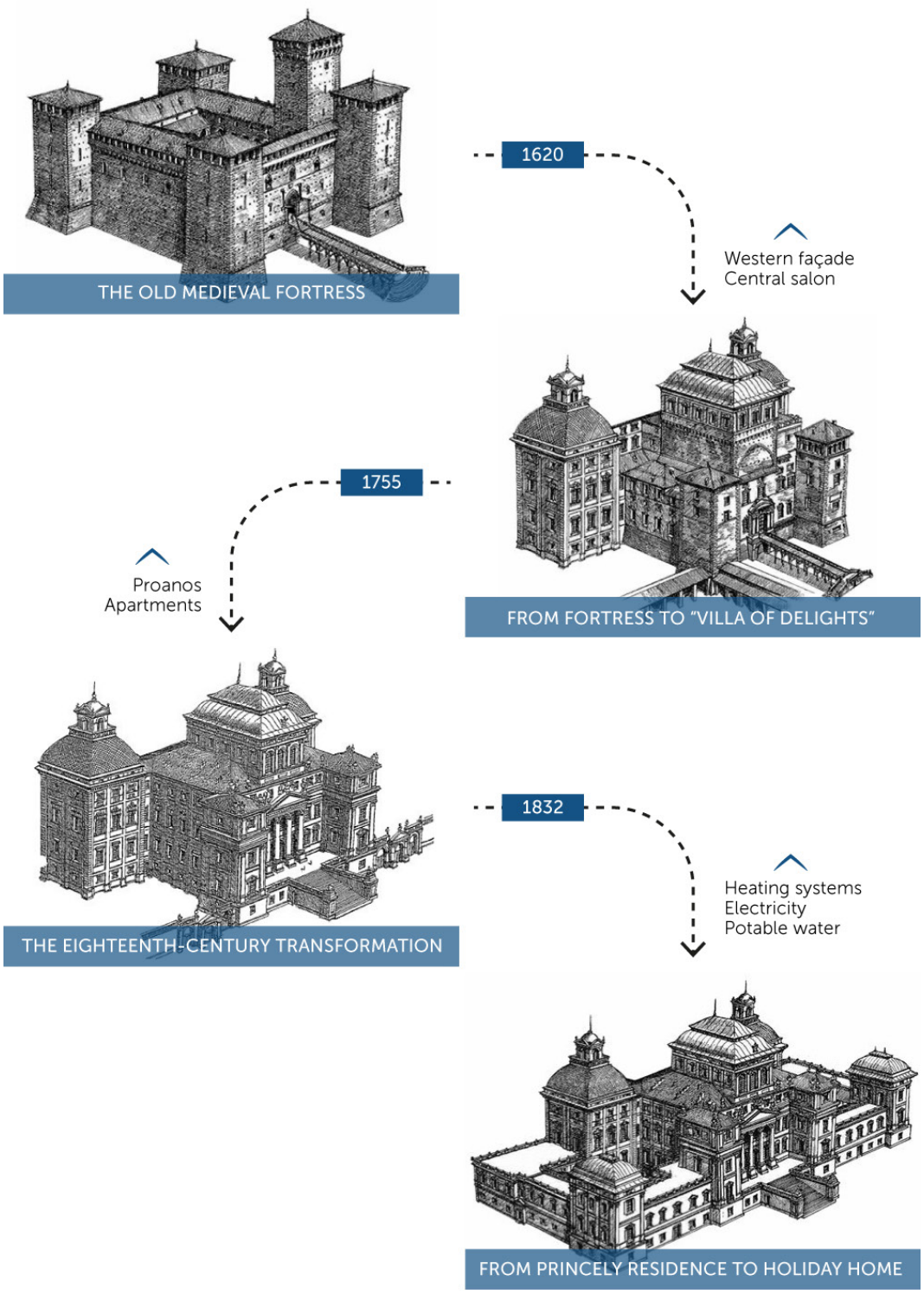


figure 51: Castle of Racconigi historical evolution

In this period, most of the apartments and halls were changed and refurbished in neoclassical style, according to the taste of the period. A few of the interiors still maintain the eighteenth-century interiors and décor, like the Salone d'Ercole and the Sala di Diana works by the architect Borra and the stucco artist Bolina, and the Chinese apartments that highlight the exoticism of the late seventeen-hundreds".

FROM PRINCELY RESIDENCE TO ROYAL HOLIDAY HOME: *"The great artisan in the 1800s transformation of Racconigi Castle was Carlo Alberto, seventh Prince of Carignano. The young prince, even before he became king prized the residence of his ancestors as a summer residence, and in 1832, the year following his ascent to the throne, had this residence added to the protocol of royal holiday residences. Carlo Alberto entrusted the court architect, Ernest Melano, with the expansion of the vault to make new apartments on the first floor for guests, thus adapting the residence to the court's needs. The architect Pelagio Palagi was charged, on the other hand, with furnishing and decorating the internal spaces of the royal floors. Construction was finished in 1842, but even during the works, the castle continued to be regularly lived by the royal family who visited it for at least two months every summer, accompanied by the courtiers, illustrious guests, and locals. After the death of Carlo Alberto, the summer residence was visited less frequently. The long summer holidays were shortened and gave way to quick visits. Racconigi was the scene for some celebrations, including the end of the 19th century, but it was only after the death of Umberto I, in 1900, that the residence regained its vitality due to the initiatives of the new royal couple. The castle returned to be a regularly visited holiday residence, almost every year by Vittorio Emanuele II and Elena of Montenegro. It was transformed according to the modern needs of the time. Heating systems were installed, as were bathrooms, electricity, and new pumps for potable water on each floor. Radios and record players were common. A photographic laboratory for the exclusive use of the king and queen was built. Some rooms on the royal floors were restored. The palace was thus equipped to receive prestigious guests properly when visiting the sovereigns: in 1909 the Czar of Russia, Nicolas II was a guest, and in 1918 the parents of Queen Elena. In 1904, the last King of Italy was born in this residence, Umberto II. During the years of the First World War, with Vittorio Emanuele II at the front, and the queen's commitments in Rome, the opportunities for staying in Racconigi were rare. The last grand event was the celebration, in 1925, of the wedding of Filippo of Assia and Mafalda of Savoy, the princess who tragically died in the Buschenwald massacre. The castle and park in Racconigi were the holiday residence of the Savoy until the end of the Second World War. Purchased by the State in 1980, they underwent long and careful renovations and were opened to the public in 1987".*

4.3 The tour of visit

The tour visit is performed inside the castle and visitors accompanied by the museum guide could visit the main area of the castle. The guided tour last approximately 1 hour and a half, and during this amount of time 25 persons each group has the opportunity the rooms and the spaces composing the museum exhibit. The concept behind the exhibition is based on the recalling of ancient lifestyle, and all the environment of the castle is arranged with pieces of furniture, paintings, and artifacts dating back to early last century. Below a brief description of the area inserted in the guided tour.

IL SALONE D'ERCOLE: the tour starts from this environment, which is the result of the 1757's intervention made by the architect Giovanni Battista Borra. The salon, set up in the neoclassical style, corresponds to the old courtyard of the previous medieval structure which served as a lobby to welcome the guests. Given the excellent acoustics, the salon was also used as a dance hall, placing the orchestra on the "Loggia dei Musici," a structure that is above the entrance to the adjoining Hall of Diana. In the lower portion, the walls contain six niches that include sculptures representing Hercules's fatigues

Topic of the exposition in this area:

- *Architectural evolution of the castle*

ROYAL SUITES: The west side of the second floor of the castle contains the royal suites, this area was completely renovated from the early years of the twentieth century. This environment is divided into apartments belonged to the King from those belonged to the Queen. The door at the end of this area, which is communicating with the gallery, allowed the entrance of the service staff. Maria Teresa's room maintains the decorations and the furnishings of the thirties. The present bed is a reconstruction of the original one made during the last restoration. The tapestry was revised identical to the original model in silk and texturized by the architect Pelagio Palagi with rosettes. Carlo Alberto's room was a place

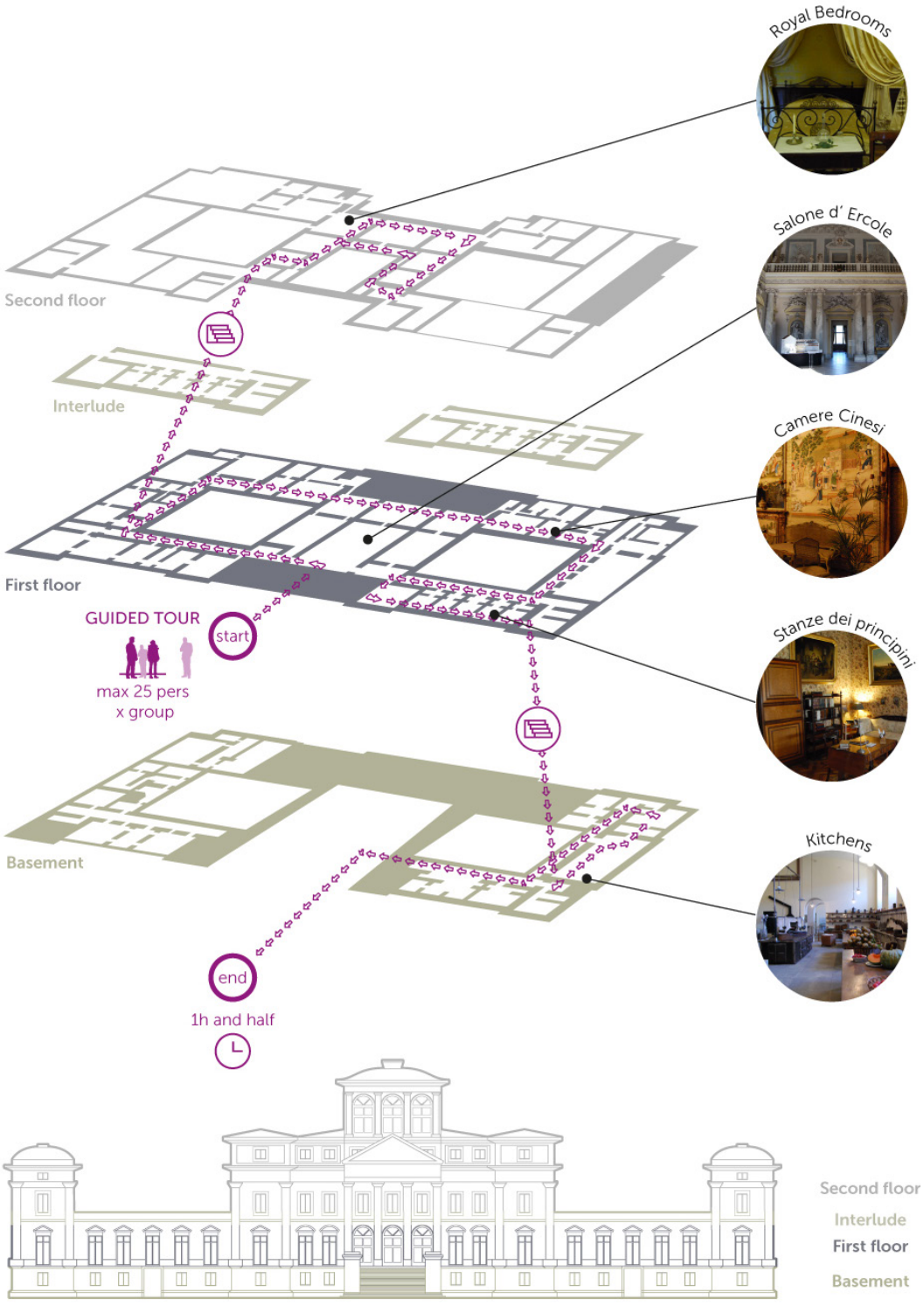


figure 51: Castle of Racconigi tour of visit

of reflection and study. The room is fully retained with its original furnishings. Twenty-six lithographs representing the most famous events of the Savoy rulers and their descendants characterizes the furnishings of the room.

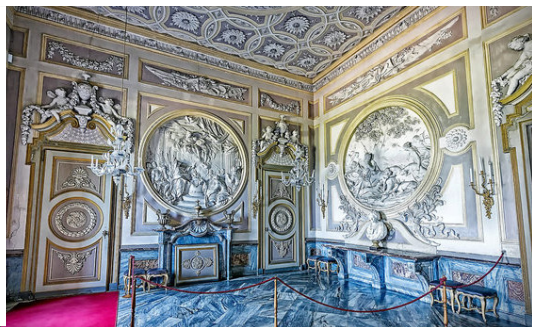
Topic of the exposition in this area:

- *Maria Teresa's life*
- *Carlo Alberto's life*


THE DIANA'S HALL: The Diana Hall was the representation entrance of the castle. The room takes its name from the decorations on the walls representing the myth of Diana, goddess of the hunt. From the ceiling, a beautiful Murano glass chandelier hangs down

Topic of the exposition in this area:

- *House Savoy politics relations*

RECEPTION HALL: This is the most luxurious room of the castle, where the significant presence of golden decoration evoked the prestige and power of the sovereign. In this chamber, Charles Albert and his successors hosted prominent figures such as ambassadors and counselors. The ceiling is decorated with neoclassical motifs in golden leaf. Decorations show the monogram of Charles Albert, also repeated in the furnishings. The sofas and armchairs are covered with

the original Savoy royal blue. Portraits of King Carlo Alberto and his wife Maria Teresa di Toscana are hung on the walls. A massive chandelier of Bohemian crystal in neo-Gothic style gives great value to the chambers.

Topic of the exposition in this area:


CHINESE CHAMBERS: Realized around the middle of the eighteenth century for the directions of Ludovico Luigi Vittorio of Carignano, the Chinese apartments were part of the royal guesthouse. The rooms are characterized by the use of high-quality hand-painted wallpaper rice paper made and perfectly preserved. Furniture, vases, and porcelains represent Chinese decorations. These rooms were restricted to special guests, such as Vittorio Emanuele II during his Holiday, and also for Tsar Nicholas II during his visit to Racconigi in 1909

Topic of the exposition in this area:

- *House Savoy international politics relations*


PRINCELINGS APARTMENTS: The apartments of the young princes were built in the early twentieth century to host Prince Umberto II with his sisters Yolanda, Mafalda, Giovanna, and Maria. Excluding the apartment of the prince, the bigger ones, the other areas consisted of a bedroom preceded by an anteroom, with bathroom, and a staircase connecting with accommodations of nurses located on the interlude floor above.

Topic of the exposition in this area:

- *Everyday life of the Princelings*
- *Education of the Princelings*
- *Court life style*

ROYAL KITCHEN: The kitchen occupied a large area of the castle since it was created for a large number of guests. In these environments, it took place the whole direction of the banquet preparation for the royal table, and the meals for the servant. Each course was controlled by the Chief Inspector that directs and coordinated all the kitchen. Inside the kitchen, several activities were held: management of the meal services, the supply of food, conservation, cleaning, and preparation of various dishes and services.

Topic of the exposition in this area:

- *Court life style*
- *Territorial uses and costumes*
- *Food and territory*
- *Piedmont cultural heritage*

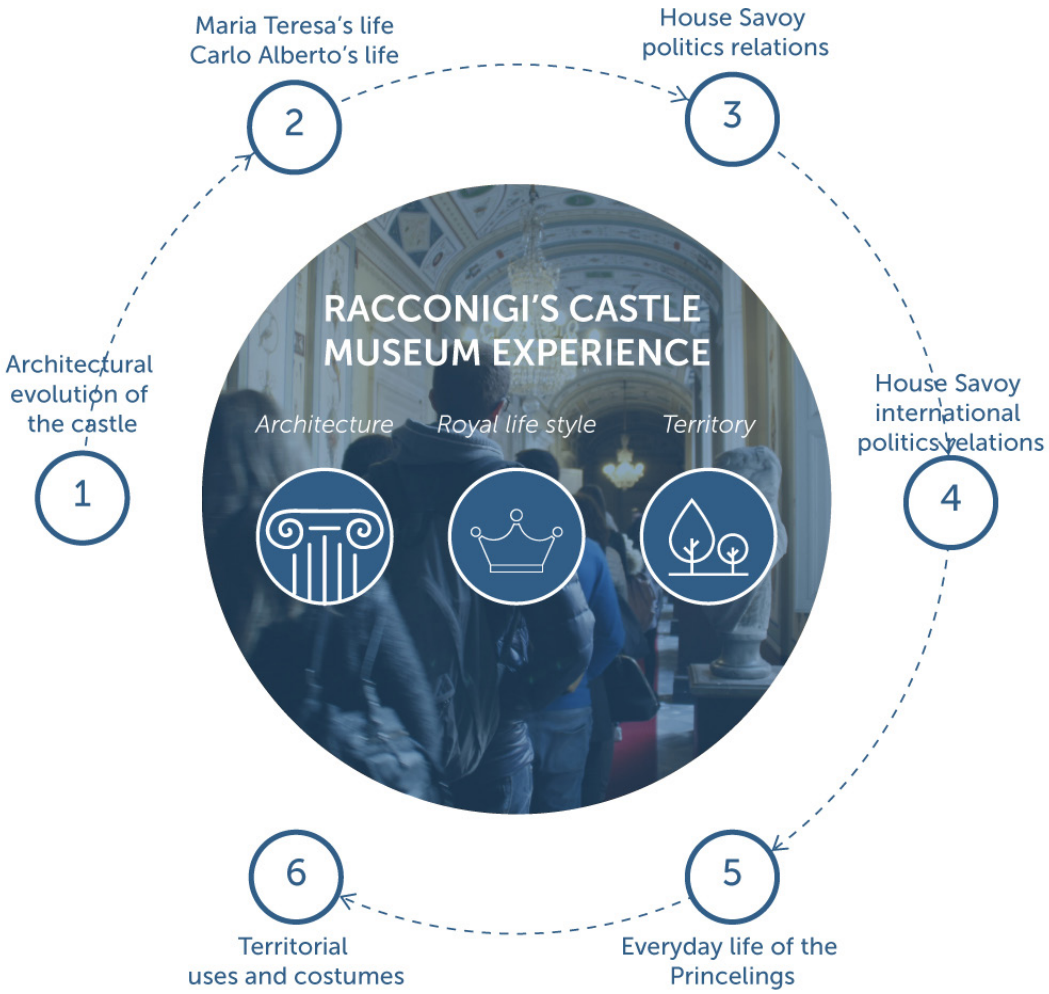


figure 52: Castle of Racconigi topics of visit

4.3.1 Not explorable areas of the museum

Historical Event of the Castle has shaped the actual usage of the castle which is now used as a museum. The architectural changing, have caused the closing of some areas of the castle and the restoration has been forecasted for only some primary environments (which now compose the exposition tour). The signs of the passing of times are clearly visible during the exhibit which it has been made trying to recall the country yard life of the castle during the first years of the '900. In the book "Intervista sulla fabbrica dell'arte," Argan describes the museum as a generator of cultures, no more longer a place for the conservation of historical relics but rather a relational and agreeable space with the scope of creating a pleasant experience and participation (Argan, 1980). Those aspects enhance the social importance of the museum and highlight the exigence to preserve and defend those areas. The commitment of the cultural heritage preservation assumes a fundamental part of the scientific debate. Implications of potential damages to the cultural heritage could be remarkable, and they could have an impact not only in the damaging of artworks of immeasurable value, but also on: visitors safety, reputational damage, and a loss of tourism attractivity of the country. Marco Vaudetti, in the manual "Mostrare l'archeologia" resume the accessibility to a museum area in two factors: geomorphological situation, and openness to the urban context (Vaudetti, 2013). Those two factors are used as vectors by the administrations for structuring the management of the museum spaces. Thus, for compliance with legal aspects spaces are in this way defined as accessible to the public or not. This reflection puts in evidence how in many cases museum spaces are not accessible for the visitor not for a lack of attractiveness but instead for commissioning a set of legal rules, hiding in most cases areas that contain artefacts with an high degree of artistic and historical value unfortunately included in fragile contexts. In this sense Racconigi Castle, which is included in territorial museum category, meaning museums born in historical buildings that have not been originally built for museum purpose, It is an example of a museum space in which due to legislation, not all areas are accessible. Analyzing the museum area, it is possible to relief three categories of inaccessible spaces:

1. **Accessible spaces but not in the tour of visit:** are inserted in this category all those spaces which are legally accessible but that are out of the narrative exposition
2. **Not accessible spaces for restoration:** are inserted in this category all those spaces which would be opening soon but that are currently closed for legislative reasons.
3. **Not accessible spaces for restoration:** are inserted in this category all those spaces which are not open for physical safety of the visitors. Those spaces have an high degree of deterioration and visiting them could put in risk the human safety.

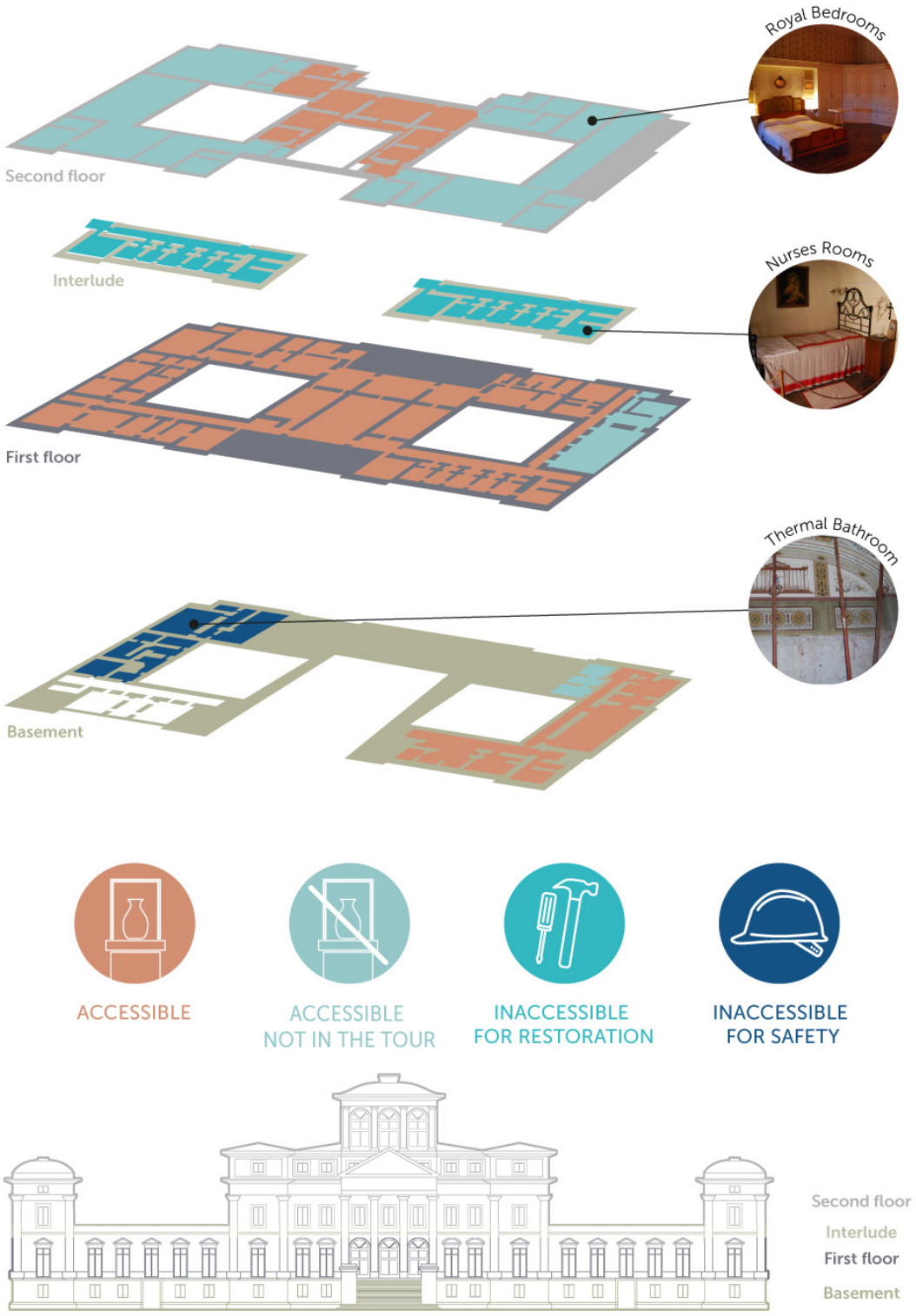
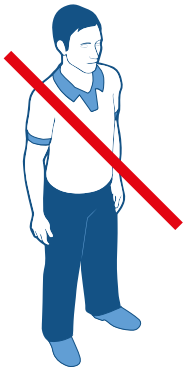


figure 53: Castle of Racconigi tour of visit, fragile areas

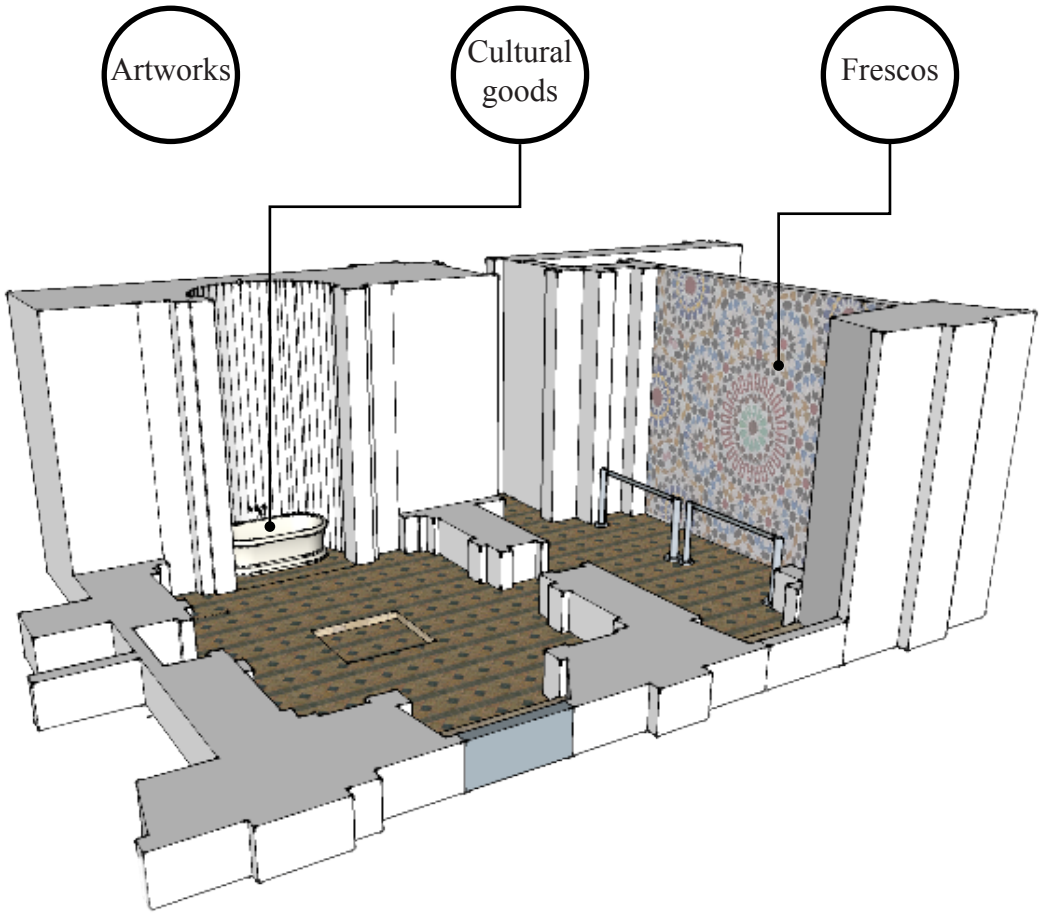
FOCUS ON: THERMAL BATHROOM



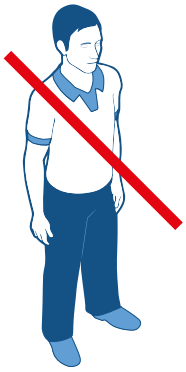
NOT ACCESSIBLE FOR:
SAFETY

Pelagio Palagi designed Carlo Alberto's thermal apartments with a neoclassical style. In the realization of this area of the castle, the author was inspired by the ancient Rome thermae and by the Pompeian villas "Balnea."
In the king's thermal room it is present a large tub of white marble, the tube presents a shaped swan neck faucet, and it is decorated with reliefs with the form of seashells and dolphins. On the ceiling is painted the Birth of Venus; moreover, the bath was hot water provided with a thermal plant different from that of the kitchen

CONTENTS:



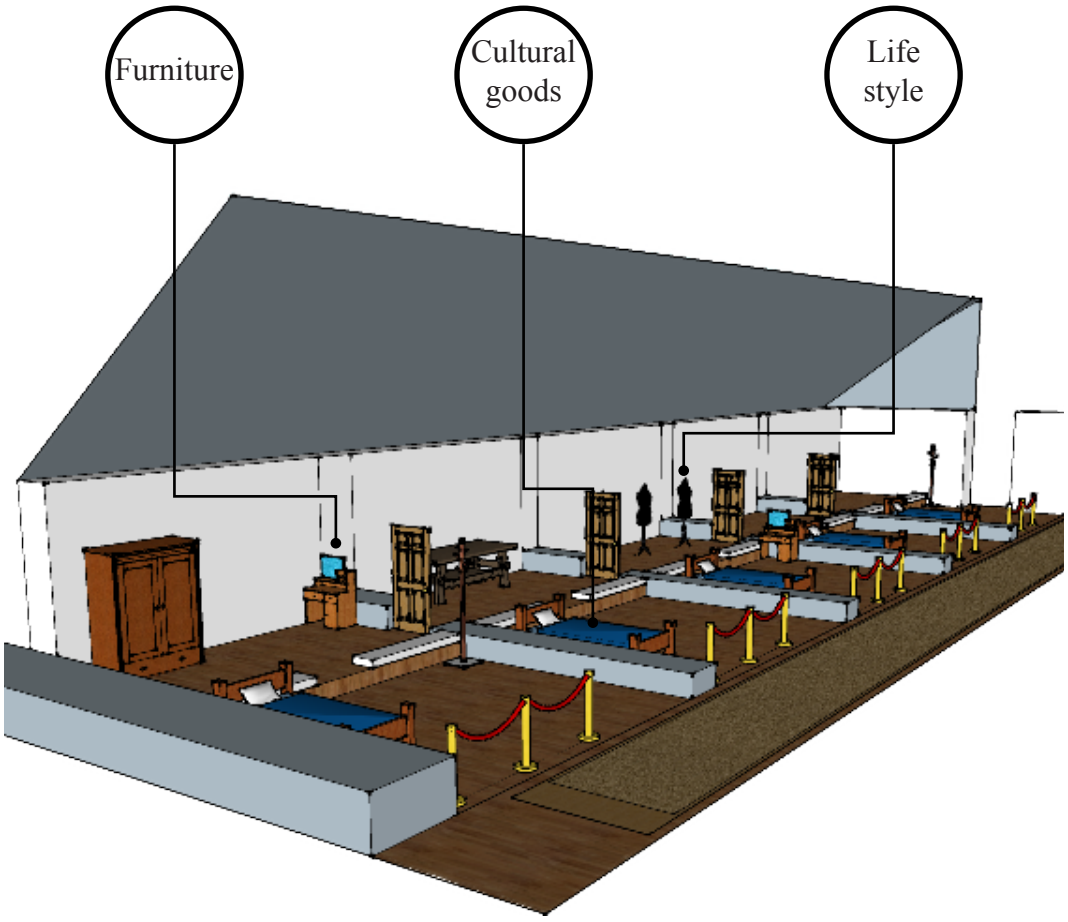
FOCUS ON: NURSES ROOMS



NOT ACCESSIBLE FOR:
RESTORATION

The rooms of the nannies are placed in the interlude between the first and second floors. This environment is divided into four apartments; each one was assigned to one of the nurses of the Savoy little prince. Until not long time ago, this environment was included in the exhibition of the museum, but a cause of restoration work it is currently not accessible to the public. Inside the apartments of the nurses, it is possible to found everyday objects, clothes and furniture belonging to the trustees

CONTENTS:



4.4 Visiting categories

Since 2009 the castle activated a series of activities intended in particular for high schools and elementary schools students. The principles on which those actions are based is to offers the opportunity to deepness the experience and the knowledge of the thematics treated during the visit of the museum. Proposing several approaches and forecasting the possibility of developing four layers of research.

- Gaming: intended as tool able to open in a funny and involving way educational moments
- Story: proposed as tool for creating relations about differents cultural ad artistic facts which have characterized an era or a territory
- Scientific knowledge: meant as tool able to understand the environment
- Language: a tool for amplifying the communication skills.

Museum, also, proposes three different categories of visit:

- Classical: Visiting category addressed to a wide range of users. During the tour, visitors, accompanied by a museum guide, visit some areas of the castle
- Thematic: Visiting category addressed to different degrees of investigations. The tour is designed for classes of students who intend to address the issues exposed following one of the proposed reading keys (gaming, history, scientific knowledge, and language).
- Laboratory: in-depth activities of thematic visits. They are held in dedicated spaces and allow students to develop creativity and dexterity

figure 54: Castle of Racconigi, children in visit

GIALLO AL CASTELLO

Students turn into detectives, and the visit becomes a clue-hunting.
Through the play, the ability to observe and to listen to useful information with the scope to find a solution to a problem is highlighted; the activity upgrades the work team ability to achieve a common goal.

THEMATHIC	AGE	DURATION	KNOWLEDGE
Gaming	8+	1hour and half	*Hystory* *Art* *Litteratture*

IL GIRO DEL MONDO IN 80 ANIMALI

Countries and the animals of the world are represented in the castle decorations. Starting from these decorations, students face a journey through different cultures, beliefs, and stories related to animals..

THEMATHIC	AGE	DURATION	KNOWLEDGE
Science	8+	1hour and half	*Geography* *Mitology* *Litteratture*

L'EDUCAZIONE DEL PICCOLO PRINCIPE

Life and education of the princes of Savoy house are used as a comparison to find similarities and differences between the court life of young people "offspring" of a powerful dynasty in parallel with education and daily life of nowadays students.

THEMATHIC	AGE	DURATION	KNOWLEDGE
Story	12+	1hour and half	*Hystory* *Art*

I NOMI DEL MONDO

Cross the garden by learning the names of trees, flowers and plants. elements of the garden are explained through several languages: Italian, Chinese, Arabic, English and Romanian.

THEMATHIC	AGE	DURATION	KNOWLEDGE
Language	8+	1hour and half	*Foreign language* *Botanic* *Gardening*

4.5 Museum organization

Racconigi Castle work structuration follows the direction expressed by the MiBACT (Ministero dei beni e delle attività culturali del turismo). MiBACT is the Italian agency for the tutelage of culture, and preservation of the artistic and cultural heritage and landscape. In 2008 the agency published the "Carta nazionale delle professioni museali." (Mibact, 2008) The document presents a roadmap about the duties and the tasks related to each person enrolled in the museum system. The report highlights first of all the important and strategical role of Museum Director. The Director is the keeper and the interpreter of the museum identity while respecting the administration aspects. He is responsible for the management of the whole museum, and he is the responsible for the implementation and development of its cultural and scientific project. In particular, the director mansions are:

- Be responsible for the assigned resources, for the economic planning and the implementation of the institutional project,
- Be the depositary of the museum collections, having the responsibility towards to entity owning
- Participate, in conjunction with the competent authorities, to the safeguarding and enhancement of the cultural heritage of the local areas,
- Represent the institution outside and promote its public image,
- Contribute to the definition of the mission of the museum, elaborating a statute, a list of regulations and the institutional project, defining objectives and orientations.
- Develop the service in according with the needs of the public and with the administration's goals.

Museum directors have a list of people with individuals who work him. Every person that work inside a museum has a particular skill and a first working environment. The professional areas required to manage a museum are:

Research, care, and management of the collections: responsible for the conservation, security, management and exploitation of the collections. As the director, they are responsible for the identity and mission of the museum.

- *Curator*
- *Cataloguer*
- *Registrar*
- *Officer collections assistant*

Services and relationship with the visitors: managers of educational services develops educational projects and coordinates the realization, identifying the modes of communication and mediation, using appropriate and functional tools for different educational activities. Further, they perform educational interventions

adapting the museum to the characteristics and needs of different visitors.

- *Head of education*
- *Museum educator*
- *Coordinator of the reception and custody services*
- *Operator of the reception and custody services*
- *Responsible for documentation services*
- *Library manager*

Administrative, financial, management and public relations: responsible for the governmental administration of the museum, for the financial and human resources and the legal procedures and standard function.

- *Head of administration and finance*
- *Secretary manager*
- *Press office and public relations manager*
- *Responsible for development: fundraising, promotion, and marketing*
- *Website manager*

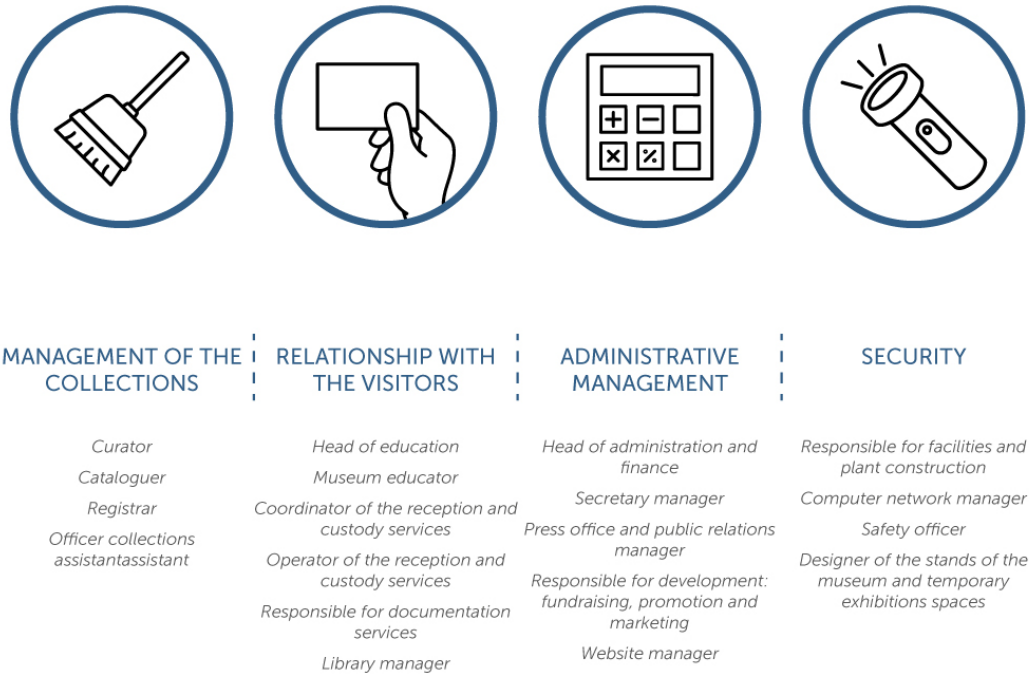


figure 54: Castle of Racconigi, jobs organization

Security and facilities: ensure the management of the structures and facilities of the museum. Manage the network and the computer system. They take care of the permanent and temporary exhibitions of the museum, providing the space and ensuring the optimal mode presentation and conservation of the works.

- *Responsible for facilities and plant construction*
- *computer network manager*
- *Safety Officer*
- *Designer of the stands of the museum and temporary exhibitions spaces.*

Since it is a small medium Museum, Castle of Racconigi did not present all the working categories described before. In particular from the scenario analysis emerged that many of the work related to the service design are managed directly administered by the curator and the museum guide. The museum guide figure is gaining increasing importance in the museum economy. Becasue it is the person in charge to welcome the visitor and also have the task of planning the exhibit experience

4.5.1 The key role of the museum guide

Between the professions enrolled in the museum management, the guide in the museum has one of the most significant role, so necessary for this research that needs to be explained thoroughly. The guide embodies the ambassador of the knowledge, and it is the vassal of the museum identity. Its narrative filters the trustability of what it is exposed in the museum. In the large number of museum services the guided tour is the learning tool par excellence, one of the most traditional ways for educating the visitors and one of the pedagogical instrument more direct and efficient used for developing the interactivity indispensable for understand and comprehend the artifacts exposed. It does not exist a universal pattern of exposition of the guided tours; every museum presents a different scenario of exposition: different collection, different spaces, a different narrative ability of the guide, and different composition of the group of visiting. Therefore the job of the museum guide is very complex and need a very careful planning of the tasks. The guide allows for the museum visit to be lived as a unique and unrepeatable event. Traditionally the museum experience is an active communicational process between the museum (broadcaster) and the visitor (receiver) through an artifact (medium) (Jonassen, et.al, 2012), this agreement has to be facilitated by the work of the museum guide whose role is to activate, accompany and stimulate the communicational process. The complexity of the tasks required to the Guide, and consequently the educational success of

the visit, depends on by the fact that the communication process is not linear but circular. The objective of the museum guide job is not only to furnish a message or a strict and static information; the guide has to draw educational experiences taking care of the context and stimulating the active participations of the visitors during the museum tour.

Visitors did not go to the museum as an "empty container," they bring with them their beliefs, their knowledge, and their culture, so they have not to be handled as a passive receiver of the information but as actors dynamically enrolled in the process. Museum guide should not only have to take care of the exposition of the set of artifacts present in the museum, but it has to bring attention also to the way the visitors are perceiving and living the tour. The pillar on which is based the work of the museum guide is the dialogue within the visitors; an inspiring and interactive exchange composed of a succession of questions and answers could create a very useful tool for the learning and could allow to visitors to give a personal interpretation about what they are watching. The list of tasks that the museum guide have to accomplish during its work can be summarized in three main categories: dialogue, planning and organizational.

Museum guide tasks

Public speaking tasks:

- Describe tour points of interest to group members, and respond to questions.
- Provide directions and other pertinent information to visitors.
- Escort individuals or groups on cruises, sightseeing tours, or through places of interest
- Monitor visitors activities to ensure compliance with establishment or tour regulations and safety practices.
- Speak foreign languages to communicate with foreign visitors.

Planning tasks:

- Conduct educational activities for school children.
- Select travel routes and sites to be visited based on knowledge of specific areas.
- Research various topics, including site history, environmental conditions, and clients' skills and abilities to plan appropriate expeditions, instruction, and commentary.

Organizational tasks:

- Greet and register visitors, and issue any required identification badges or safety devices.
- Assemble and check the required supplies and equipment prior to departure.

figure 55,56: Castle of Racconigi, Museum guide shows the exhibit

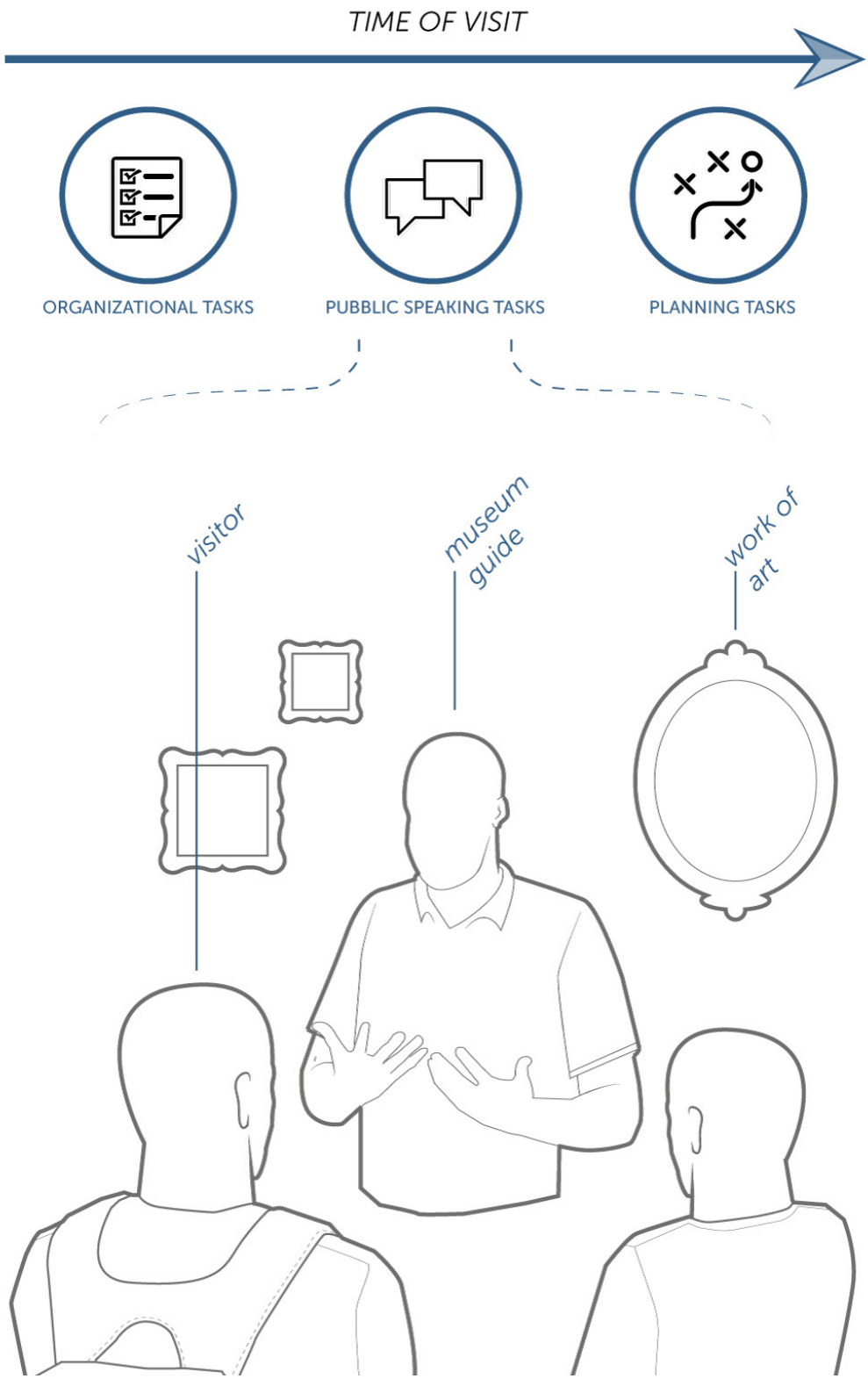


figure 57: Guide-Visitor relation

4.6 Project Requirements

From the analysis of the museum scenario and the identification of the stakeholders involved in it has emerged two primary design goals that the project could satisfy: increase visibility for the inaccessible areas of the castle and enhancement of the storytelling activity of the museum guides. The project had to fulfill these two emerging needs taking into account the limits and the opportunities offered by the robotic technology.

As a matter of fact, the team had the chance to use a mobile robotic platform, provided by a camera, and able to move teleoperated or autonomously by exploiting the Cloud Robotics Platform. During the development of the design process it was crucial to answer questions like: is it effectively useful to introduce the robot for this purpose? Is it preferable to use the robot compared to other technologies? Is the use of a robot fair towards the various stakeholders?

According to this approach, the ethical dimension of the project was achieved by the attempt to ensure respect for both for the cultural environment and the various stakeholders. From the cultural environment point of view, the service proposes a possible solution to the issue of inaccessibility of many cultural heritages. The concept of widening the accessibility meets the statements of the Franceschini administration policy, according to which, the social fruition of cultural heritage has to be guaranteed for the widest possible audience. This is also reaffirmed by the (Italian) Judgment Law no. 112, which states that a Cultural Heritage has to guarantee the full accessibility, physical and intellectual, of its collections, also ensuring the consultation of goods excluded from the exhibition. From the stakeholder's point of view, the project has to bring benefits to all the actors involved. The visitors, indeed, benefit from the expanded visiting experience, enriched by the additional knowledge about the robotic solution. The museum guides, instead, assume a central role in the visiting experience, due to they are entrusted with both the cultural storytelling and the robot control. This generates an enhancement of human work and further professionalization. This aspect is particularly crucial since it relates to a widely diffused concern about the introduction of robots. The diffusion of robots in the industrial field, indeed, generated a substantial replacement of human work and, consequently, an increase in unemployment. The introduction of robotics in other areas raises the concern that the same phenomenon could occur. For this reason, during the design process, it is necessary to consider the human work, avoid its replacement and, moreover, enhance it. Finally, the institutions, to which the Cultural Heritage management is entrusted, benefit from the improvement of visibility and attractiveness.

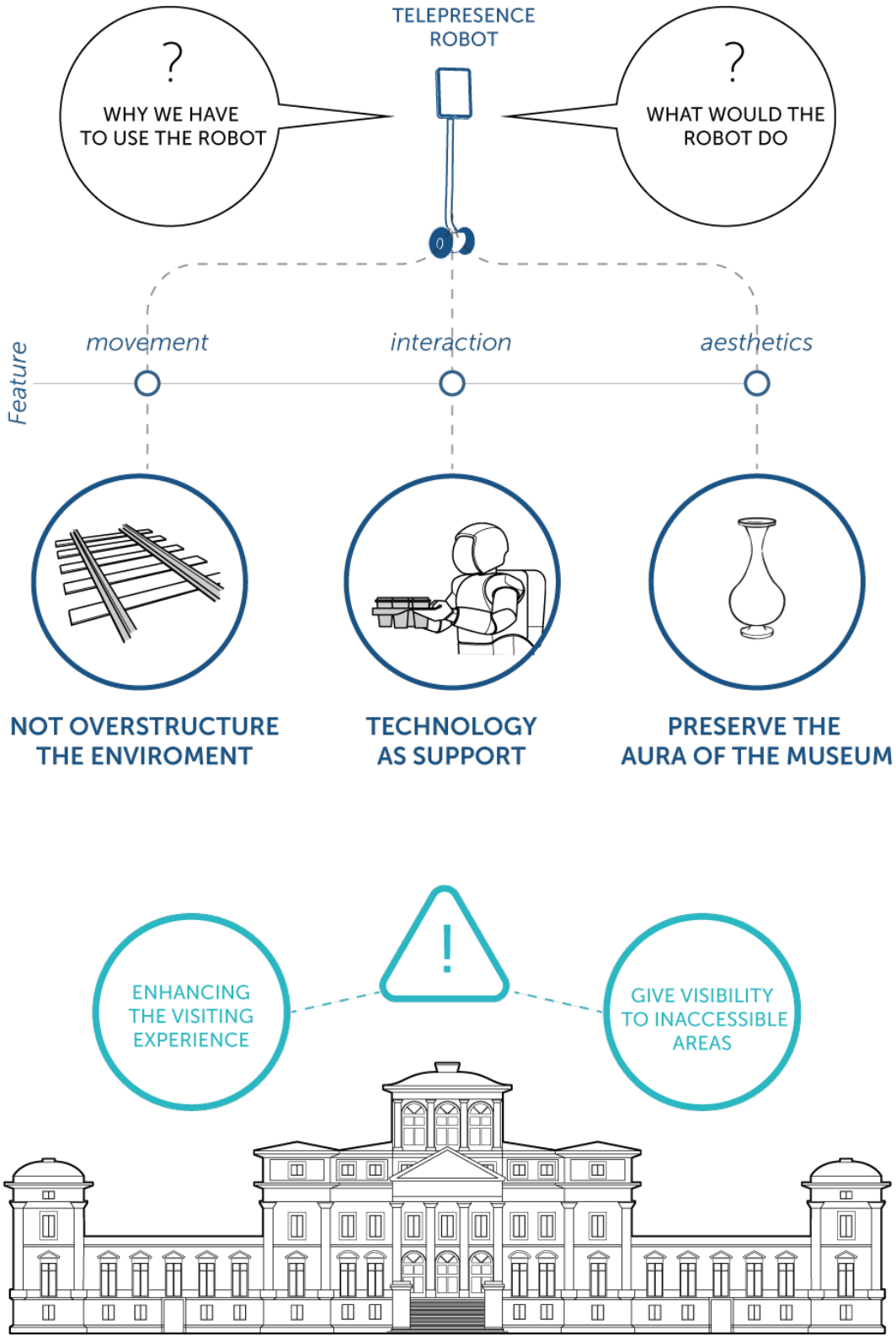


figure 58: Project requirements

Chapter 5

Virgil project: designing the product & the service

5.1 Codesign of the experience

For approaching the project, The design experience is based on the codesign methodologies. Codesign is a generative design process which provides the active and participatory involvement of the user in the design phase (Gajski et al., 1997). The role of the designer, in those process, is to facilitate the participation of the stakeholders, which are the experts of the ambit of the research. The designer facilitator role forecasts the support of the users to imagine and access to their experiences and expectation to actively and efficiently help the design process. To make sure that the co-design process would be useful it must operate trying to satisfy different types of experience (Sanders et al., 2008):

- **Physics And tangible:** doing things helps people to explore, record, remember and imagine
- **Narrative:** Telling stories and giving examples can help the user to project him needs to respect the situation that is analyzing
- **Reflective:** activities that support reflection and introspection help the user to express thoughts which are fixed in him daily lives in an accessible and agreeable way.

The research is conducted in two main phases; the first one is the commissioning of the robot, the second one, structured after the user test session, it consists of the direct involvement of the final user (museum visitors) in the interaction between the robot and visited environment. The project Virgil was developed under the curatorship of the design team, from Politecnico di Torino. Nevertheless, the whole design process involved actively various stakeholders. First of all, the promoters

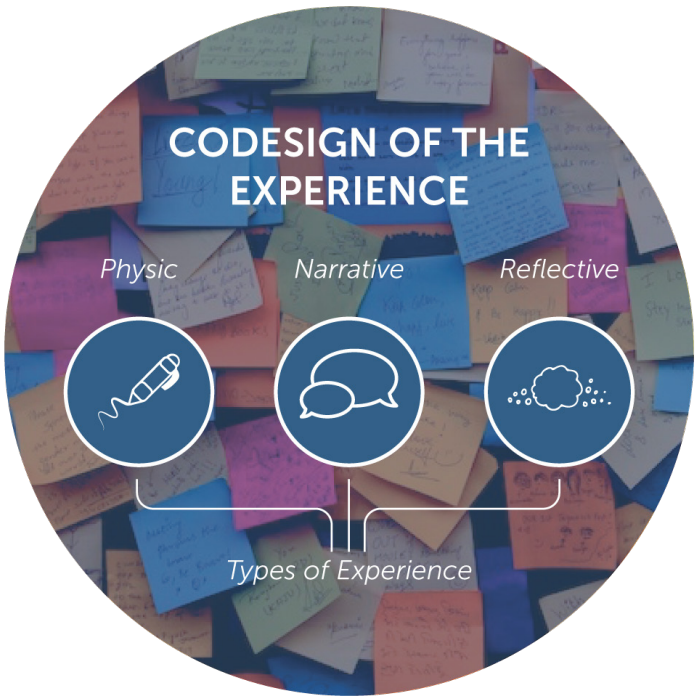


figure 59: Codesign

of the project: Jol CRAB (Connected Robotics Application laB) and the Terre dei Savoia association, promoter of cultural activities on the territory. These represent the stakeholders directly involved in the decision-making process (DMP), and the design team has been involved as an additional partner to investigate the context e lead the design process. The whole project was also developed in collaboration with a representative of the museum guides who attended all the roundtables, the tests and provided in-depth knowledge about the heritage and, above all, the visitors.

As often happens among designers (Zimmerman, 2005), the project has been approached taking care of the social impact of the results, listening all the opinions of the stakeholders. To make this experience shareable, moments of production are alternate with the time of debate and synthesis for all the phases of the design process, summarized in figure xx. The output stage consists of the specific activities of the design team that was produced and then elaborated mostly in slide presentations. The slide presentations were then used during the debate stages as a basis for the discussion and the decision-making process. The production steps, also, concerned the three most critical phases of the project development: analysis, design, and test. The debates were organized in the lab as roundtables involving the various stakeholders and took place about once a month. Additionally, smaller meetings focused on specific topics, held approximately weekly. These meetings did not include all the interested parties but only those involved in the specific subject.

This continuous involvement of the various stakeholders in the decision-making process allows the contamination between the different domains of each (Warr, 2005) which lead to generate more creative ideas, acceptable and valuable for the whole, or at least a large part, of the museum ecology (Sabanovic, 2010). During each brainstorming session, different topics of the project have been presented, in the form of visual representations of some aspects of the projects, combining pictures and texts, to allow an easier communication of the issues. In the synthesis phase, all the feedbacks, suggestions and directions for things to do next, as well as a summary of the debates, were collected in reports and to-do lists by the design team and then shared with all the other stakeholders.

The ideas formalized during the discussion session were then made explicit through the using a prototype of the robotic platform. The prototype, built redesigning a robot currently on the market, has served to qualitatively evaluate the process and check the progress that the research was taking. Within the use of the robotic prototype framework, many feedbacks were received about how to improve and optimize the design process.

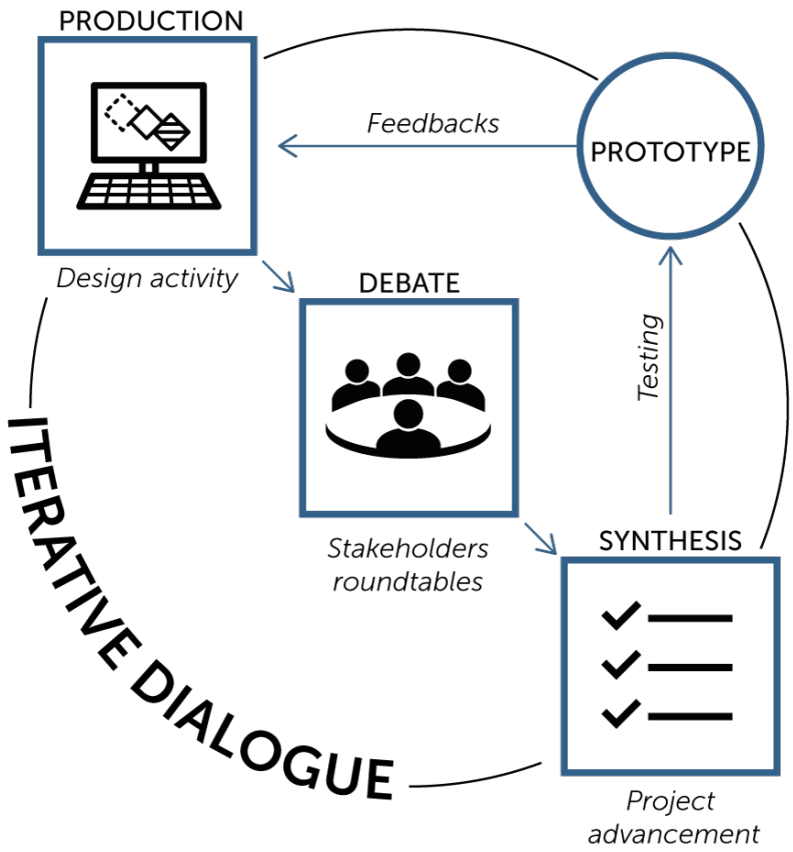


figure 60: Iterative dialogue process

5.2 Ethical Guidelines of Virgil Project

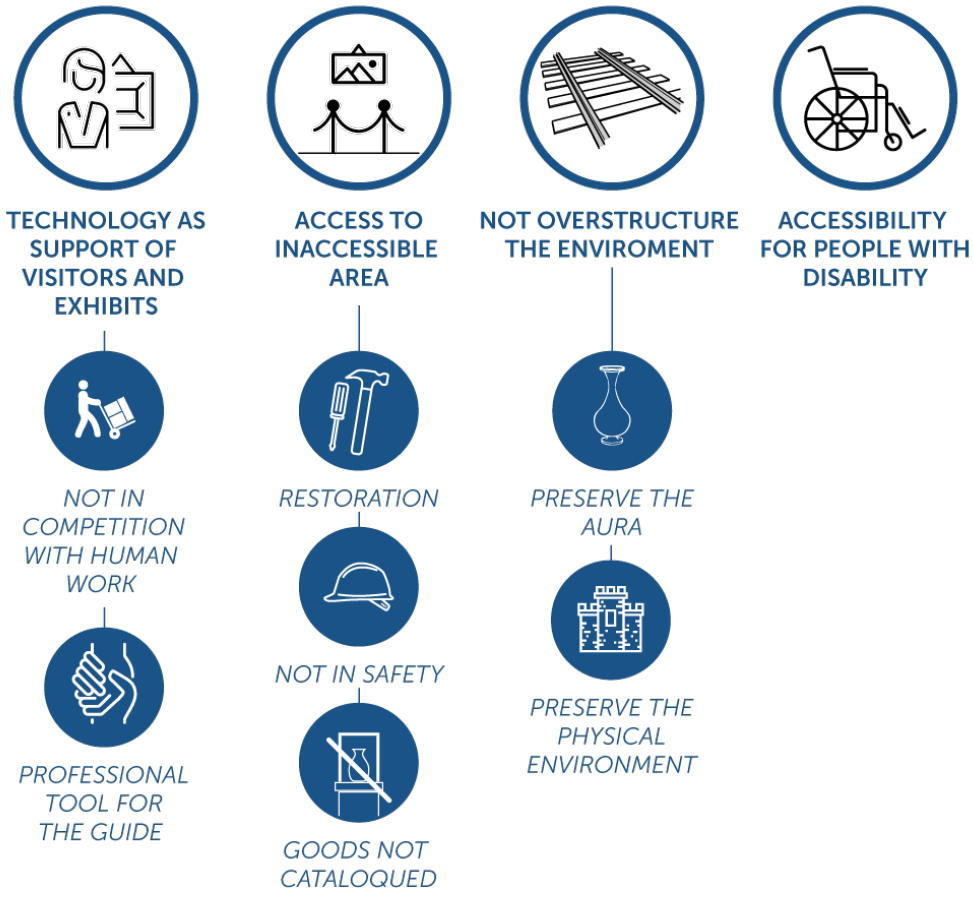


figure 61: Ethical guidelines

At the beginning of the design process, shared ethical reflections were made through the iterative dialogue between the design team and the stakeholders. Four important ethical guidelines have

been highlighted. Firstly, the robot has to enhance the work of the museum guide and does not be competitive with it (technology as support). Second, the telepresence operability of the robot makes it capable of being moved and show in real time the inaccessible area for people of the museum. Third, the robotic solution does not have to over structure the environment and spoil the artistic aura of the cultural heritage. Fourth, the robot can overtake the issues related to the architectural barrier and make the whole area accessible for people with motion disability (Figure 61). According to the roboethics reflections, the main guideline followed during the project was to avoid the human work replacement of the museum guide. Furthermore, instead of replacing the human work, it was enhanced by providing a novel tool, together with new skills and new interaction opportunities.

5.3 Design of the service

The service concept elaborated through this process is the result of a mutual shaping between robotic opportunities, offered by the lab, and the heritage requirements, emerged by the castle analysis. The proposed service, indeed, consists of an extension of the visiting experience through the use of a telepresence robot located in an inaccessible area of the castle.

Differents service concepts have been proposed before to start to pursuit this project decision. In this phase the role of the design it has been providing the archetypal structure of the concept proposals which in according with the others stakeholders have been analyzed and evaluated from the feasibility and coherence with the museum concept. The evaluation criteria of the concepts have been developed taking care of the technology available in the Jol crab laboratory, the museum requirements, and service design issues. Regarding the telepresence robot needs, the aspects evaluated, concerned the function implementation, the upgradability of the system, and the expected use of broadband for manage the cloud platform system. Therefore, the main issues related to the museum aspect are the over structuration of the museum area, the scalability of the service model in differents museum sites, and the enhancing of the exhibit experience. For which concern the service design the criteria of evaluation are: active involvement of the visitor, the service diversification, and the mixing between the physical world and the virtual one. Each of the service concepts has been evaluating following those parameters in a ranking that goes from one to five and in according with all the stakeholder's thoughts

The development and the evaluation of differents concepts provide to the stakeholder to confront themselves upon the possible project development of Virgil. Among the proposals, the one that got more preferences was inaccessible room/ explorer. This solution, in fact, is the one which it is more fitted with the robotics technology issues, often used to replace the human presence in fragile environments. The others proposals were not rejected. Therefore they have ignited the debate on how to implement the best solution selected. As it had emerged from the analysis of the scenario, in fact, the role of the museum guide is very delicate in relations between visitors and the museum.

GUIDE ASSISTANT / VALET

SERVICE CONCEPT: A robot follows the guide during the visit

A robot provided of a big screen (e.g. 22") follow the guide who shows on it his insights and the realtime videos of inaccessible rooms. The robot with him follow a path and a guide, while the remote robot is driven by the guide through a G.U.I. on a tablet.

Museum

over structuration
scalability
enhancing

Technology

function implementation
upgradability
broad band usage

Service

active involvement
service diversification
physical / virtual

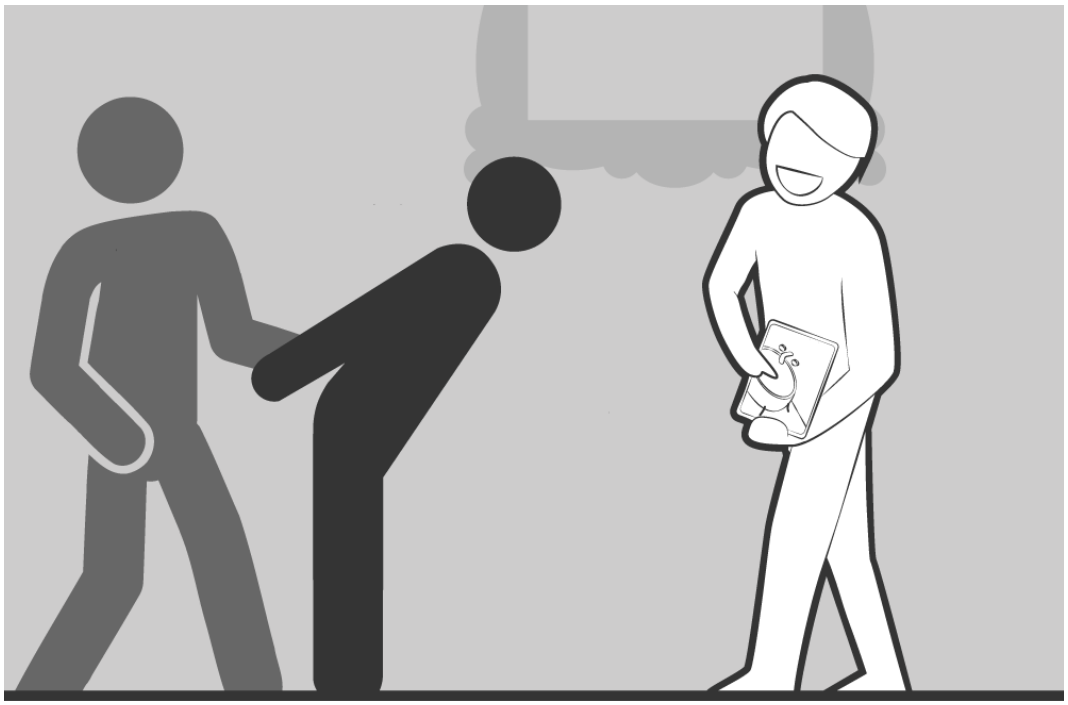
PROS +

ATTRACTIVE / Visitors can see the robot
VISIBILITY / The big screen is more visible
MOBILE / Not overbuild in the context

CONS -

CLUMSY / The robot movement is not satisfying
DANGER / Visitors can bump the robot
BARRIERS / The exhibit includes narrow passages

GUIDE ASSISTANT / DIGITAL FOLDER



SERVICE CONCEPT: A tablet is used as joystick and repository

The guide is provided of a tablet on which he can interact with a remote robot through a G.U.I and also upload many insights to show to the visitors during the exhibit. This object replace the traditional folder used by a guide lled of printed pictures.

Museum

over structuration
scalability
enhancing

Technology

function implementation
upgradability
broad band usage

Service

active involvement
service diversification
physical / virtual

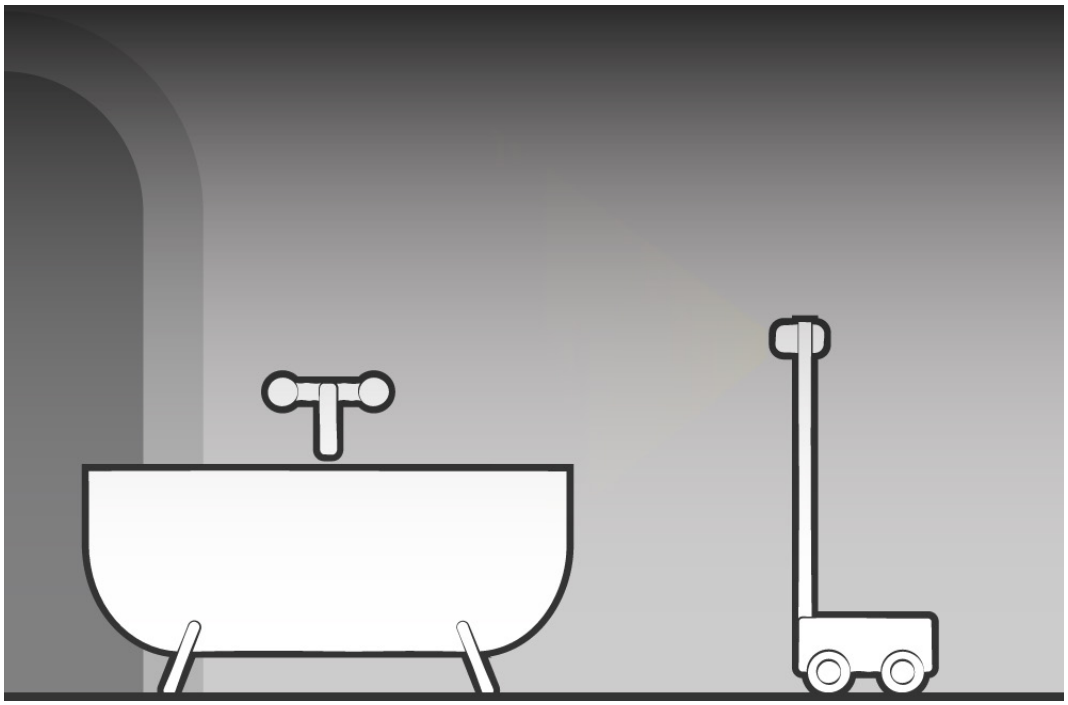
PROS +

FRIENDLY / Use of familiar device
COMFORT / The device is light and adaptable
DISCREET / Preserve the relation between visitors and guide
MOBILE / Not overbuild in the context

CONS -

SMALL / The tablet screen dimension doesn't give great visibility
INVISIBILITY / Visitors can't have direct interaction with the robot

INACCESSIBLE ROOMS / EXPLORER



SERVICE CONCEPT: A robot allows to watch inaccessible rooms

A robot, provided of a high performances camera and spot light, explores the inaccessible rooms driven by the guide through a G.U.I. on a tablet or another kind of access point (e.g. totem). The images that the robot send back are visualized on a device or a projection (see the guide assistance module)

Museum

over structuration
scalability
enhancing

Technology

function implementation
upgradability
broad band usage

Service

active involvement
service diversification
physical / virtual

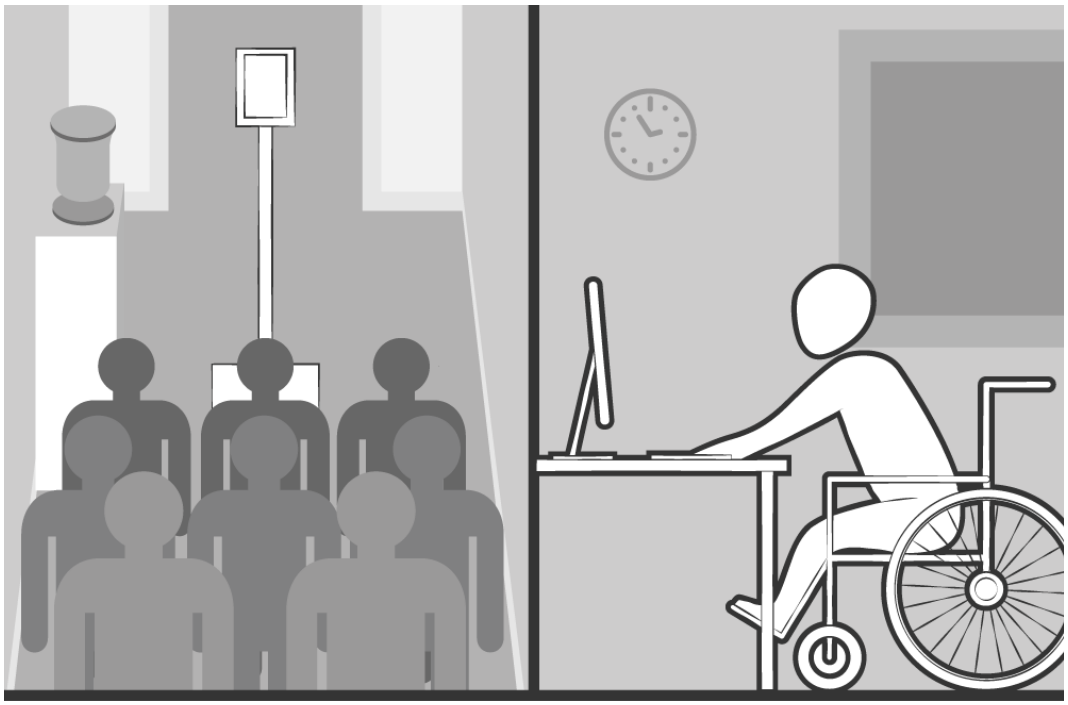
PROS +

ACCESSIBILITY / Visitors can see inaccessible rooms
FLEXIBLE / The robot can be moved from a room to an other.
MOBILE / No need of overbuilding in the context

CONS -

INVISIBILITY / The visitors can't see the robot
UNIDIRECTIONAL / Visitors watch what the robot shows driven by the guide or one visitor
BARRIERS / The exhibit includes narrow passages

ACCESSIBILITY/ TELEPRESENCE



SERVICE CONCEPT: Disable can visit or work at museum through the museum

A robot, provided of a tablet, allows disable people to move around the museum and in case of disable guide it gives the opportunity to keep working or start a job that generally is not possible for disable..

Museum

over structuration
scalability
enhancing

Technology

function implementation
upgradability
broad band usage

Service

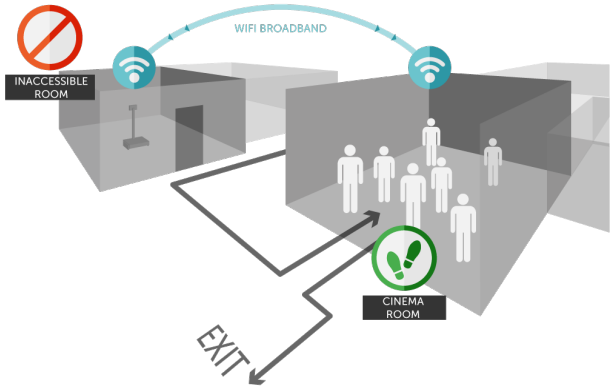
active involvement
service diversification
physical / virtual

PROS +

ACCESSIBILITY / Disable have access to the museum
ATTRACTIVE / The visitors can see the robot

CONS -

DANGER / Visitors can bump the robot
BARRIERS / The exhibit includes narrow passages
POOR APPROACHABILITY / Visitors can't all see the screen at the same time



The final proposal is to use the robot as a tool for enhancing the museum guide tour and give an enriched experience to visitors. In this way, this new robotic service introduces the concept of human-robot collaboration. Conversely to many robotic solutions applied in museums, the storytelling activity continues to be entrusted to the museum guide, and a robot assumes a role of remote collaborator, which explore the areas inaccessible for people.

Keeping the storytelling activity performed by the museum guide is fundamental because only a human can provide the interpretative aspect (Burdeski, et al. 2014). The interpretation, as previously explained, is the process in which the museum guide can create links between the visitor culture and the heritage contents. This process allows visitors to develop an empathic relationship with both the museum guide and the cultural heritage itself. A further consideration has to be addressed in the comparison of this robotic service with other existing technologies, especially virtual tour. As a matter of fact, virtual tours currently seem to be the cheapest and easiest technology available, however, involves considerable limitations regarding imageability and narration. Even if this solution can achieve a high level of image quality, the visual result is never realistic because navigating through these environments the adaptability of the picture, and the fluidity of movement are not like the natural. Also, the historical activity, if entrusted only to multimedia contents, can appear dull, not adaptable and restricted.

Once the service concept was defined, to show how the visitors would experience the proposed solution, it was necessary to illustrate it. The most efficient way to do that is a storyboard. The storyboard shows the main stages of the visiting experience with the introduction of Virgil. The visitors meet the museum guide in front of the castle and then enter the first room: the Sala delle Colonne. Then the visit continues through corridors and halls, which are already part of the tour, and then the museum guide shows that some areas are not accessible for visitors. Then the group is accompanied by the guide to the “cinema” room where is located a big projection screen in which he shows the real time video streaming sent by the robot, which is located in the inaccessible area.

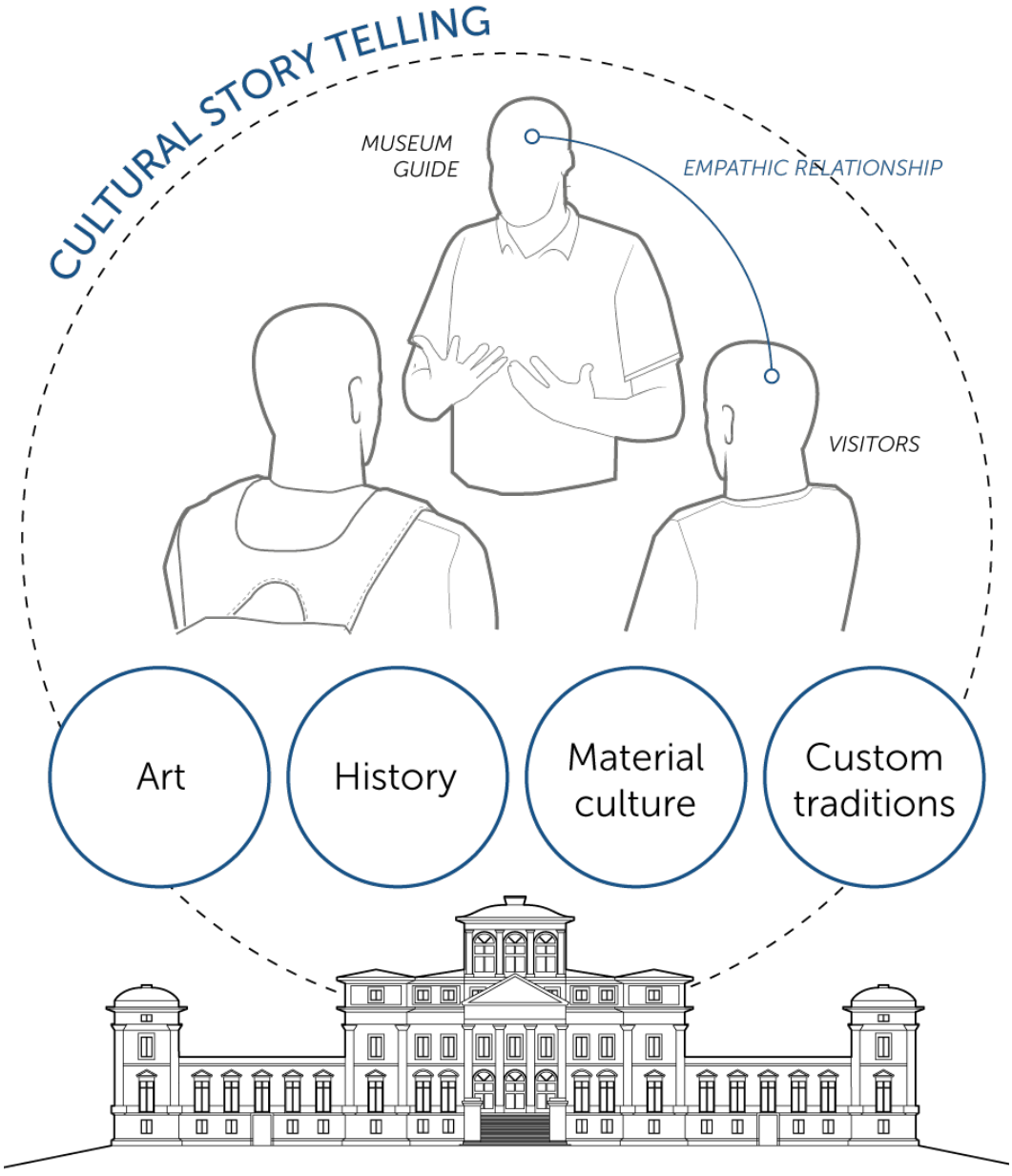
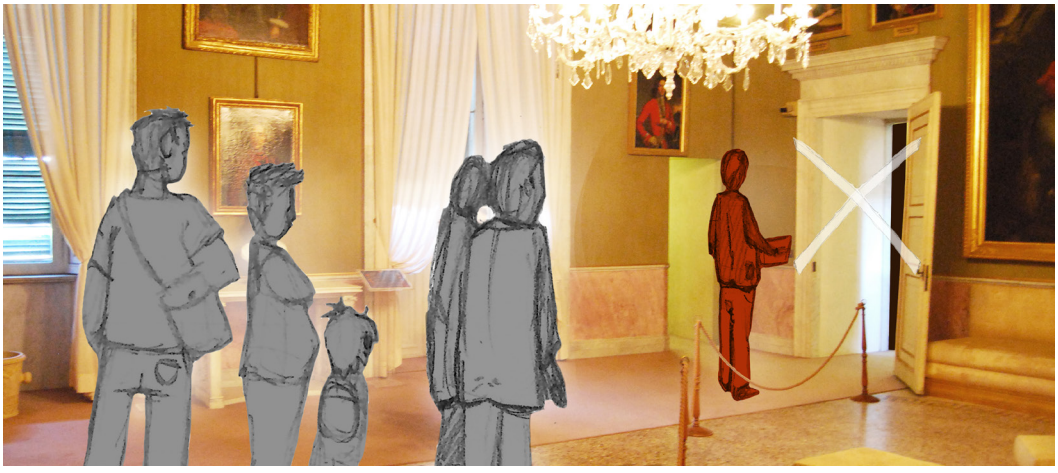


figure 61: Cultural story telling

1- Visitors arrive at the castle

2- Museum guide conducts the visit



3- Visitors reach an inaccesible area

4- The visit continue in the cinema room

5- Museum guide use the robot through a G.U.I

6- Visitors see the inaccessible area of the museum through a shared screen

5.4 Technological feature of the robot

With the intent of combining the need of making accessible the fragile areas of the museum with the technology integration, the research is structured following the development of a first robotics framework prototype. The prototype it has been used for doing feasibility, usability, and perceptive test and for verifying the criticalities of the project. The prototype is developed around the TIM cloud robotics platform. The platform framework is an infrastructure that makes use of a cloud architecture aiming to create a more powerful and centralized brain, where the robot become a cloud agent who relies most of their computational load and data storage on remote servers. Moreover, the cloud robotics platform is also able to guarantee the robustness needed for long-term operativeness in the robotics applications and to expose simple APIs to the final user. A schematic description of the framework used can be seen in figure 62.

The robot is deployed and communicates with the Cloud Robotics Platform (CRP) through Long Term Evolution (LTE) technology (Goldberg, 2013). CRP has a central unit called “Robot Clone Manager” which take care of all the jobs necessary to communicate user with the robot (Rosa, et al. 2015). RCM manages the information from the robot and sensors and exposes them to the user. At the same time, receives commands from the user, processes and transmits them to the robot. Finally, the user can interact with the robot through a Graphical User Interface (GUI) (Redmond, 1995), displayed on a smart device via web browser.

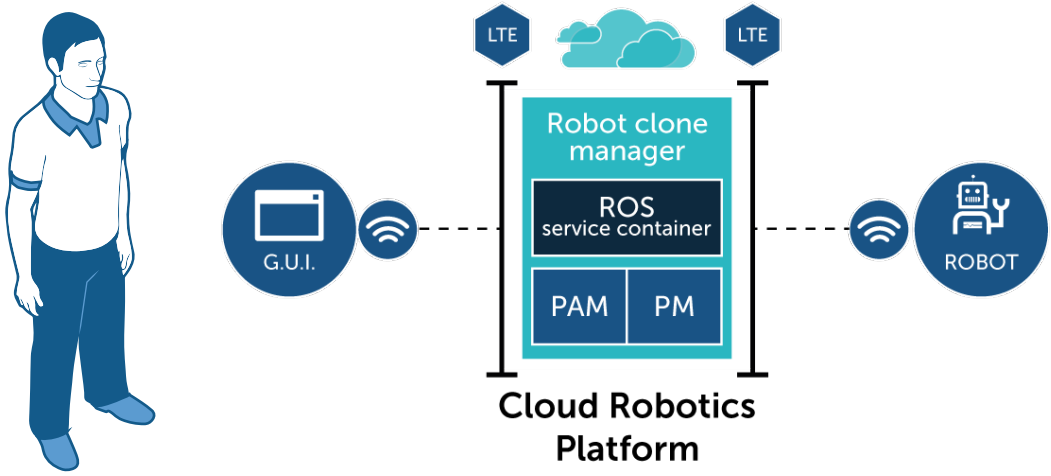


figure 62: Cloud Robotics Platform

figure 63: Swinggo

Robot architecture

Virgil prototype is based on the redesign of four wheels drives mobile robot able to move through indoor structured environments called Swinggo and produced by Milanese manufacturer Nuzoo. Nuzoo robot is a commercial one, and fully ROS compatible platform suitable for a broad range of activities (Quigley, 2009). Its mechanical structure is designed with a rectangular base of 50 x 55 cm, a support rod for a tablet with a height of 120 cm and a weight of 10 kg approx. Wheels are moved by two electric motors, a set of gears and belts. Each engine provides traction to each side in a separate way. Autonomy may be several hours of operational time depending on the usage factors, the maximum speed of the robot is 1 m/s, and it can move In teleoperation mode through the assisted guidance of a user connected remotely via a web server application. The onboard sensors include wheel encoders, Hokuyo UTM-30LX laser range finder, and a DCS- 5222L Pan/Tilt camera.

The overall robot hardware architecture is depicted in figure 64. Hardware components of the robot are located inside the robot's base. Power is provided by a 12V Li-Fe battery, and the robot is equipped with both proprioceptive and exteroceptive sensors that can estimate its motion.

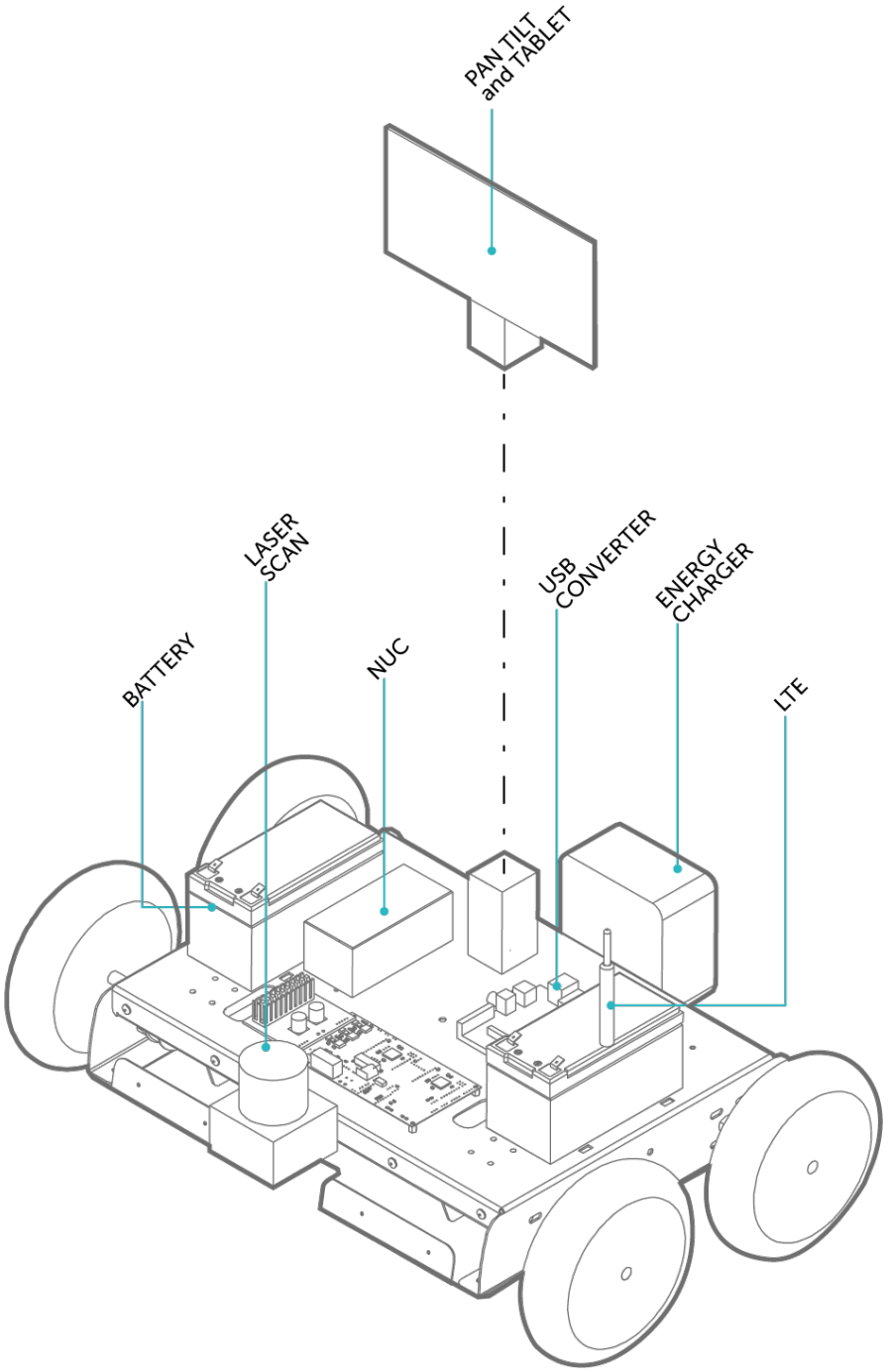


figure 64: Robot hardware architecture

The framework platform is based on the Robotics Operating System framework (ROS), to exploit the vast amount of already available ROS nodes and abstract robot hardware towards ROS service logic applications. figure 65, shows a schematic block diagram of the Cloud Robotics Platform and the relationship of all its parts.

Robot Clone Manager (RCM) is the element able to generate a Service Container (SC) which hosts all ROS nodes necessary to control the robot. These nodes can perform computation, to support abstraction of hardware layer (robot and sensors) towards applications on top of the cloud robotics platform. The system presents different types of ROS nodes which are described below:

• Sensor Drivers (SD): are ROS nodes that abstract the information from the sensors (Laser scan, PT camera, etc.) and convert it into ROS messages.

• Robot Driver (RD): is an ROS node that abstracts the information of the robot and converts it into ROS messages.

• Application nodes (AD): are ROS nodes which process information coming from the sensors and the robot and interact inside of the ROS container, to define the application.

• Bridge node (BN): is an ROS node that provides a Web socket transport layer to connect the ROS service container with the Internet App.

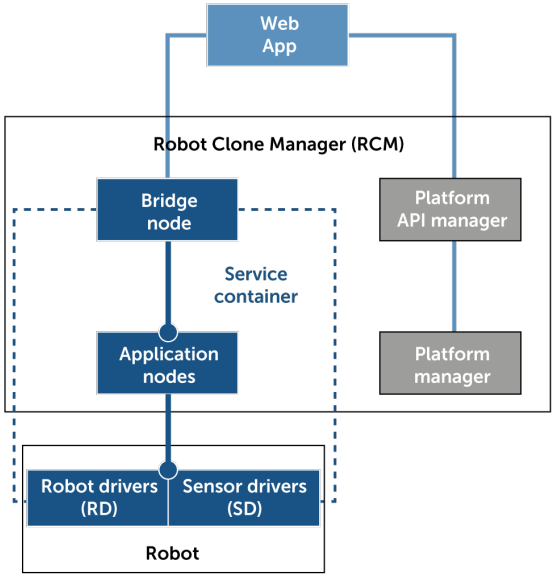


figure 65: Cloud Robotics Platform block diagram

As a result, there is a virtualization of the physical robot, and a Robot clone (cloud-agent) is created. This clone resides on remote servers, where it can load and store significant amounts of data and information. RCM is also supported by a Platform Manager (PM) and the platform API Manager (PAM). PM is the element in charge of managing the objects inside RCM.

5.5 Design of the product

The robot Virgil aesthetics has been developed considering the artistic elements and material culture of the context for which it was developed (Verganti, 2013). The cover body of the robot is made of PMMA (poly-methyl-methacrylate), a transparent material, chosen for its lightness, both from the physical and the visual point of view. Furthermore, the front and rear surfaces are provided with an adhesive décor representing a Palagian Palm, a typical element of the Racconigi Castle, applied to furniture and architectural elements. This customization is a consequence of the awareness about the fact that the creation of meaning cannot disregard from the context for which the artifact is designed.

Moreover, both the formal synthesis ad the choice of the tangible result from a process of participative design, in which, key stakeholders, were involved in two roundtables to discuss these aspects. These discussions aimed to prevent designing solutions unaware of the possible consequences that the introduction of a technological innovation could have on the museum ecology. In the first roundtable, the designer suggested three possible approaches to defining the appearance of the robot:

- **Minimal-tech,**
- **Ethereal,**
- **Dressed up.**

Minimal-tech approach meant synthetic forms combined with some technical elements of are exposed to communicate the function and the nature of the robot. The ethereal approach referred to a totemic element characterized by an extremely synthetic shape that hides the technological and mechanical aspects. Whereas, the dressed up approach consists of covering the robot with a sort of puppet inspired by period costumes of the context. These three typologies were expected to provoke the participants, who have highlighted two important aspects: the minimal-tech approach can communicate the nature of the robot (from the functional point of view). Nevertheless, it is interesting to give it a customization based on the culture of the context.

Subsequently, these two aspects were identified as guidelines for the design of the robot. During the second roundtable, the same participants were asked to discuss a series of design proposals, differentiated by materials and finishes, but all based on the same basic structure. From the observation of these samples the PMMA, a transparent material, was the preferred solution thanks to its ability to confer greater lightness, both from the physical and perceptive point of views. Also, as already happened in the first roundtable, the participants preferred the versions with decoration, which represented a typical Baroque décor. To devote much attention to the appearance of the robot might appear unnecessary since this operates in an

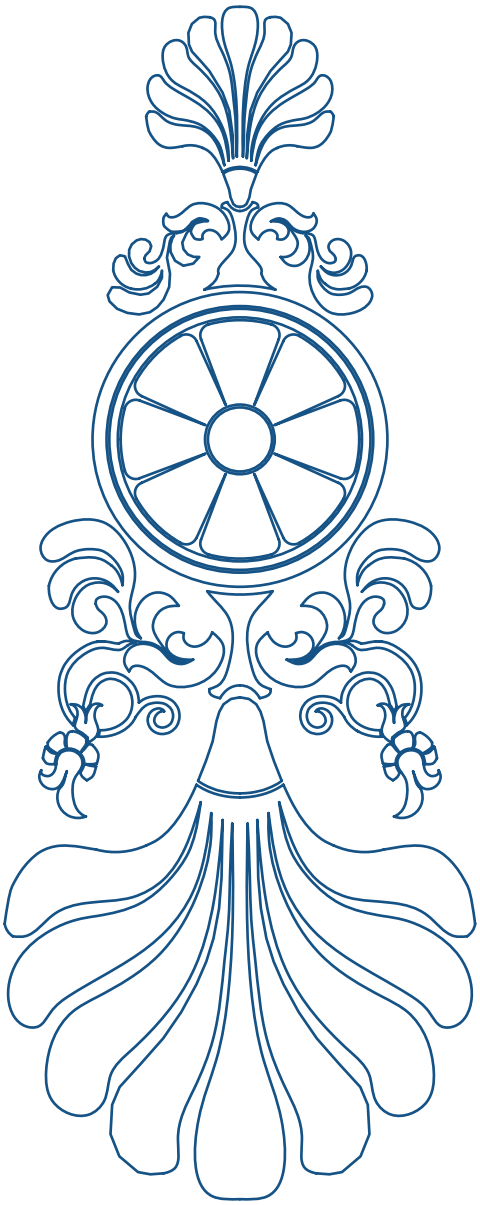
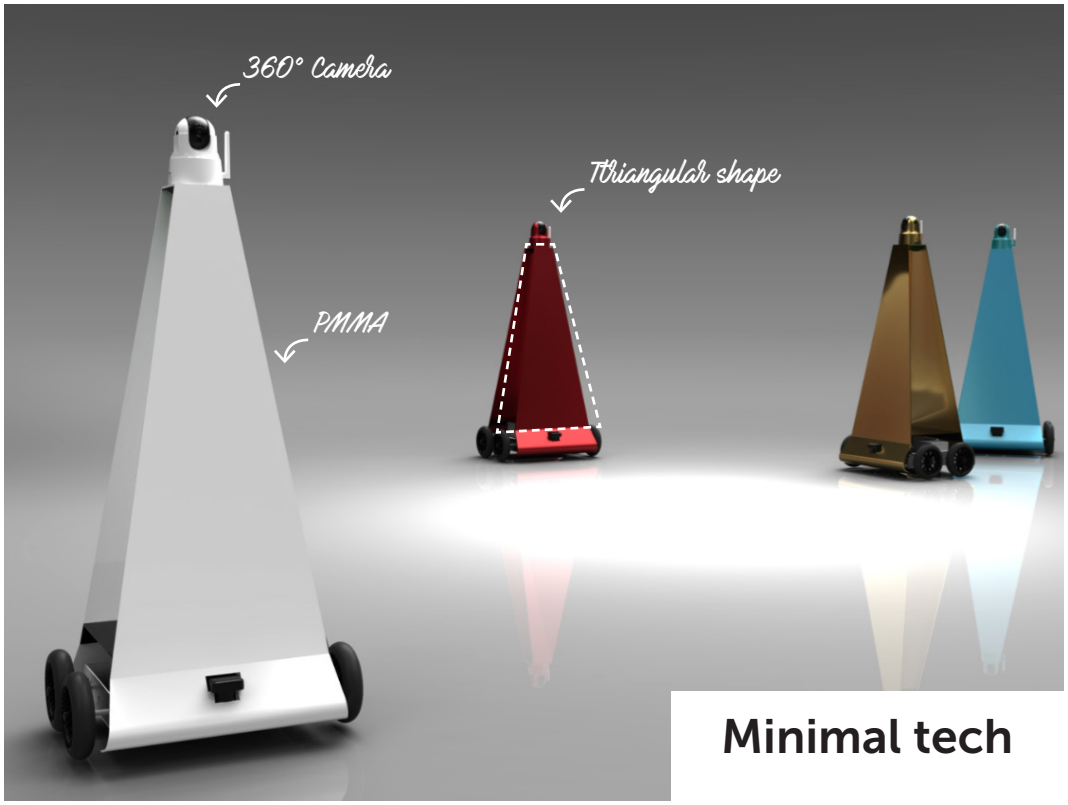
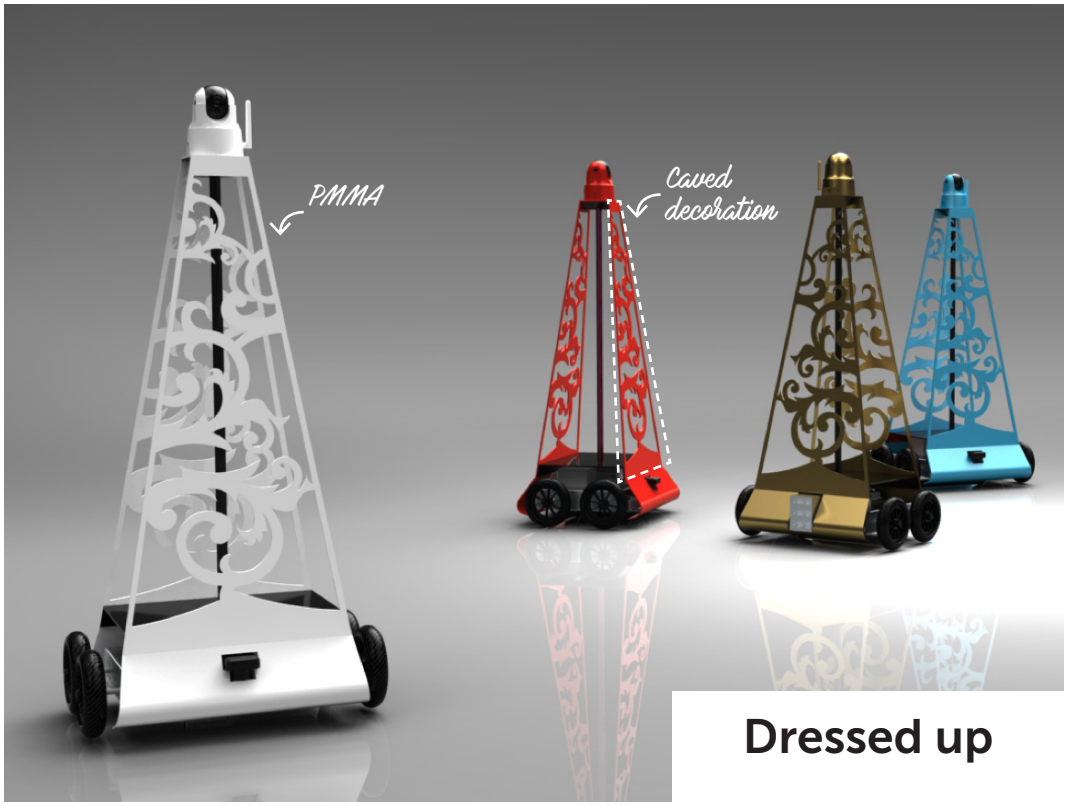


figure 66: Pelagian' palm

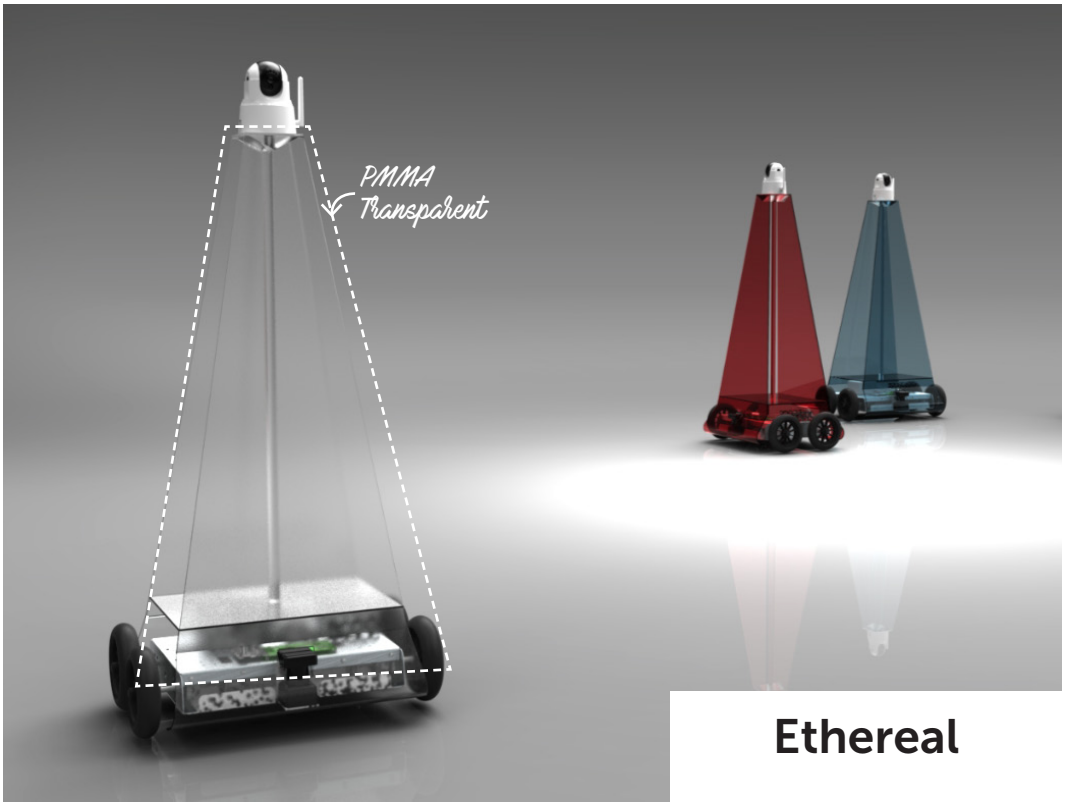
inaccessible area and, therefore, is not visible from the public. Although, it assumes a strategic role because the project was developed in a real context where it has to be accepted by the various stakeholders. The social acceptance of the project, in fact, is also determined by the visual impact on the stakeholders. The appearance of Virgil, which reminds to the context, does not invoke the stereotype of the robot,


360° Camera
Triangular shape
PMMA
Minimal tech

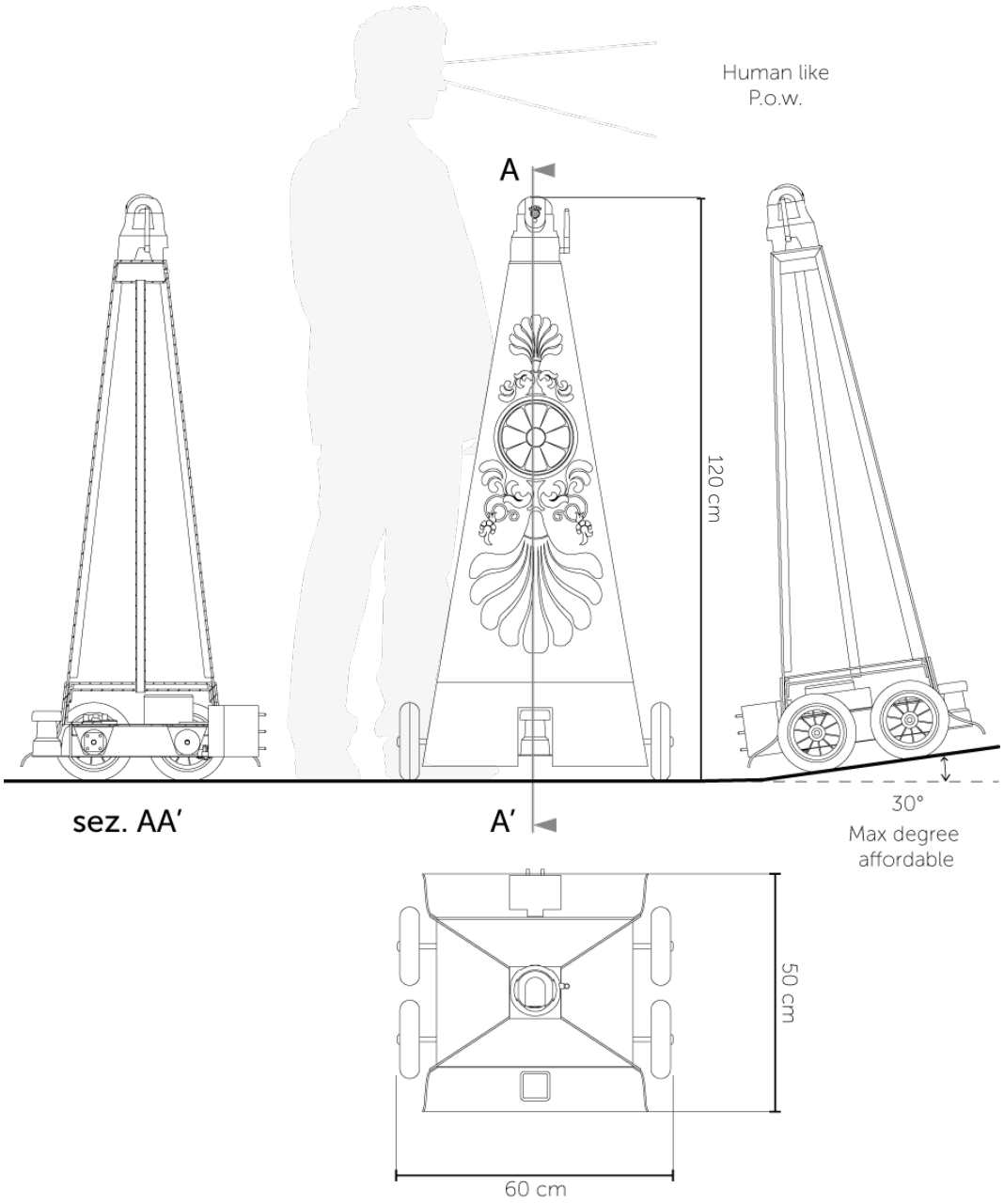

Decorative texture
PMMA + Stickers
Dressed up



Dressed up



Ethereal


Human like
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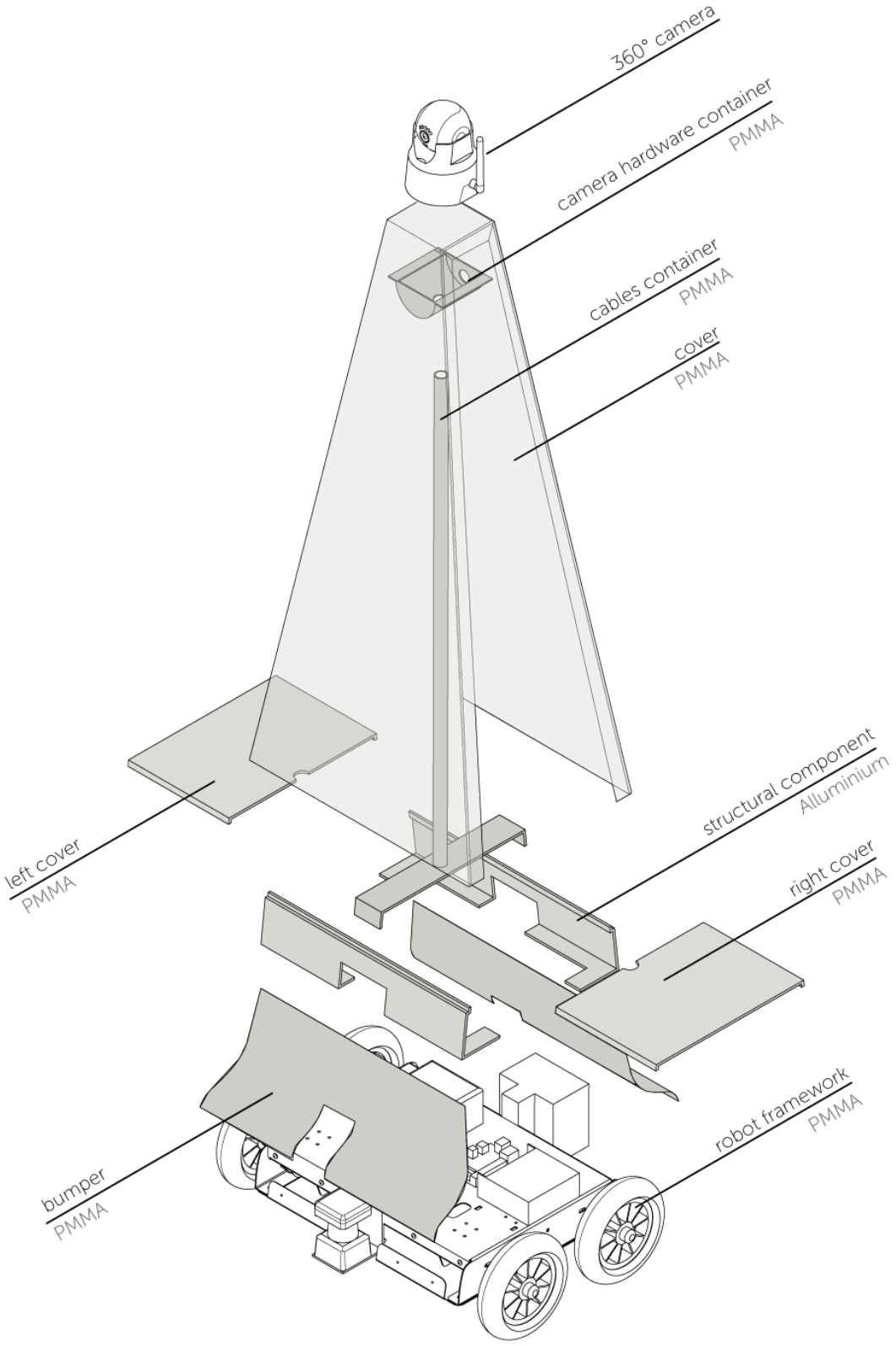


figure 67: Explose

5.5.1 Control G.U.I.

figure 68: GUI components

GUI development

The principal instrument that the museum guide use for interact with the robot is a G.U.I. developed for a samasung s10 tablet.

In parallel with the prototyping of the robot, it has been elaborated a preliminary study for the redesign of the graphical user interface (GUI) (Redmond, 1995). In this phase, the engineers involved in the project provided a prototype of the GUI with all the functional components of the interface. The design team analyzed the GUI from the functional and ergonomic point of view to make it more usable and intuitive for the museum guide, that should be the primary user. For this reason, also this design stage involved the museum guide, who provided continuous feedbacks and suggestions.

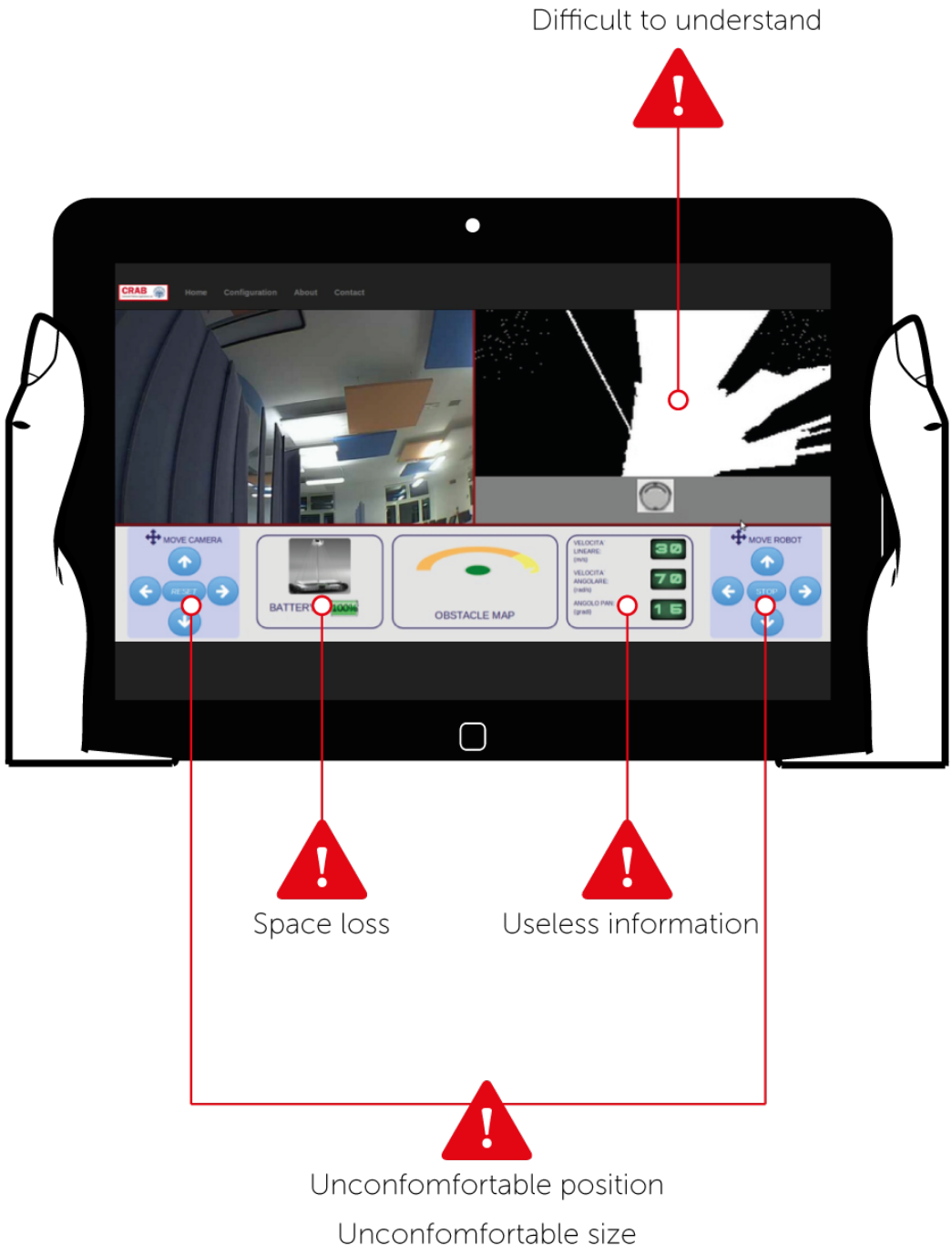


figure 69: GUI criticalities

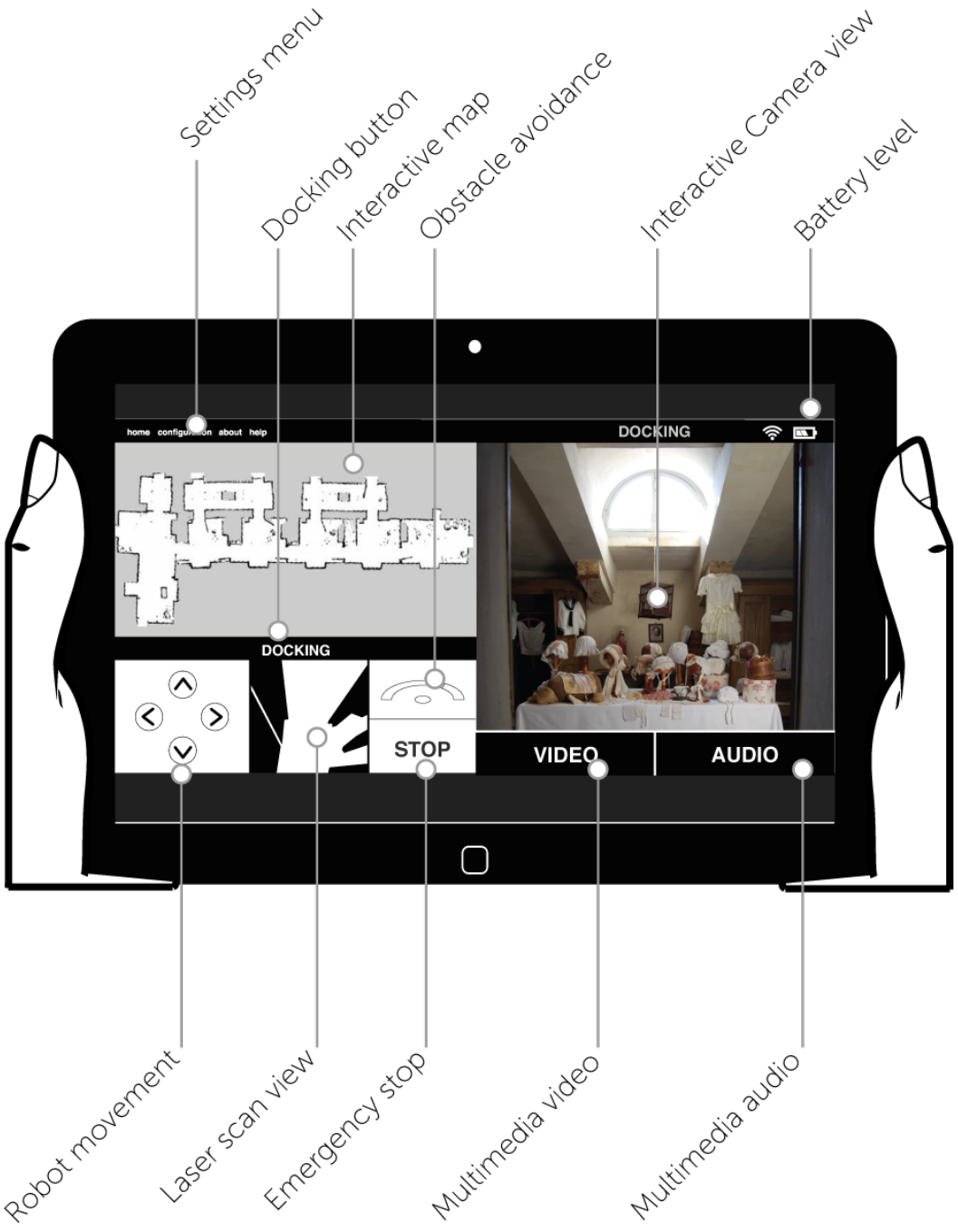


figure 70: GUI redesign

As shown in Figure xx, it will be composed by several elements, namely:

- STREAMING VIDEO This window shows a real-time video stream coming from the camera of the robot.
- LASER IMAGE FLOW: This element shows the data received from the laser-scan sensor. Through this image flow, the user can see the obstacles during the tele-operation stages.
- TELE-OPERATION BUTTONS: These elements, reminding to the ones of a control pad, are used to move the robot in the environment.
- ASSISTANCE PANEL: This panel consists of various elements that provide information and assistance to the user during teleoperation, such as robot speed (linear and angular).
- MAP: This panel provides the user with an overview of the environment in which the robot is moving.
- MULTIMEDIA BUTTONS: These buttons allow the activation of the multimedia contents.

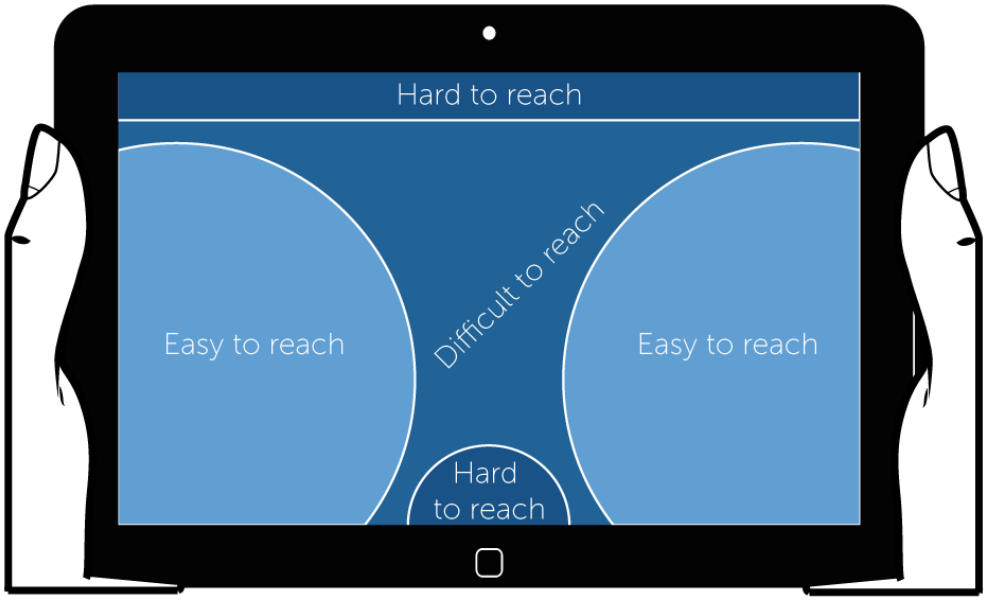


figure 71: GUI ergonomics

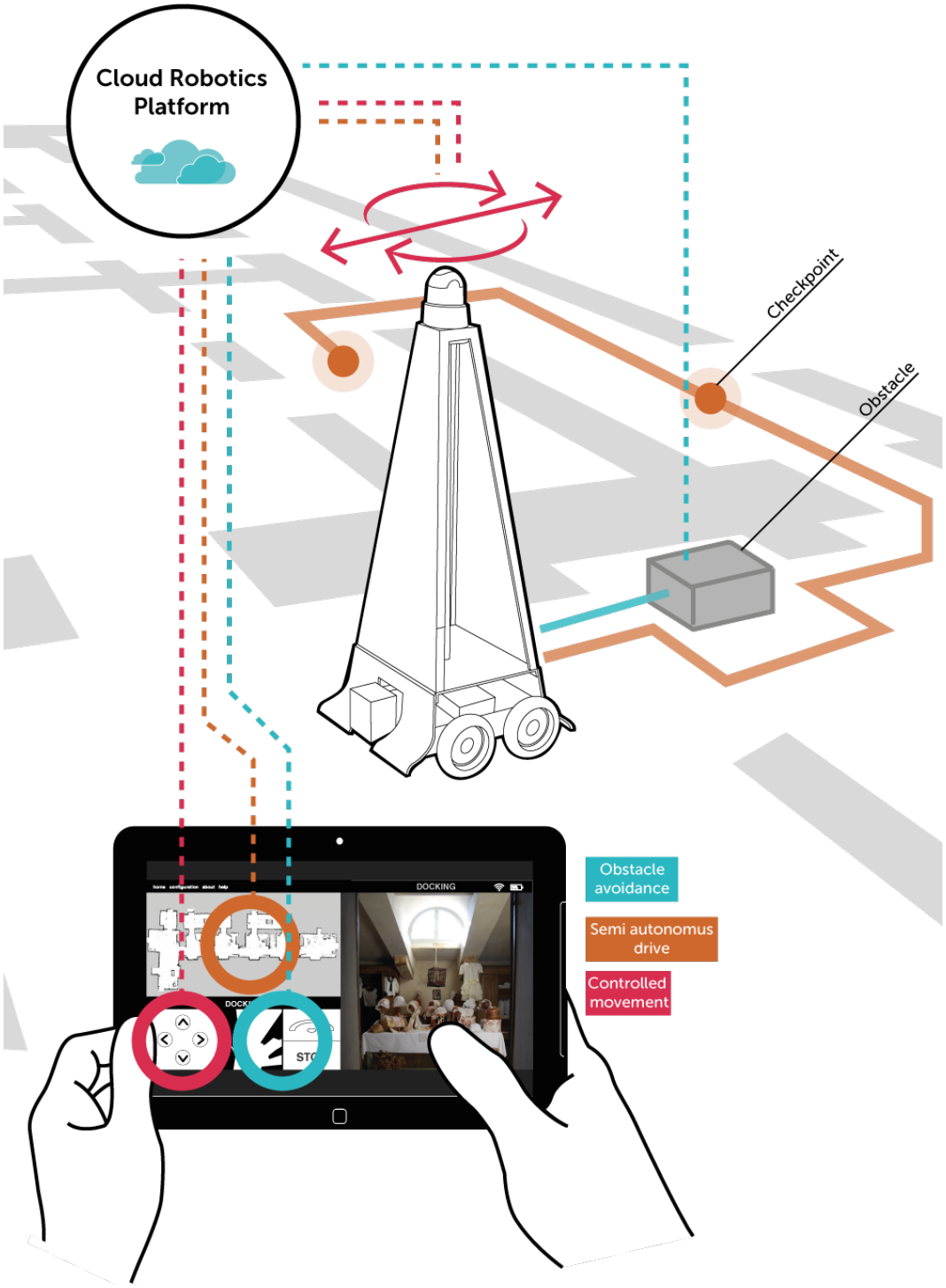


figure 72: GUI commands explenation

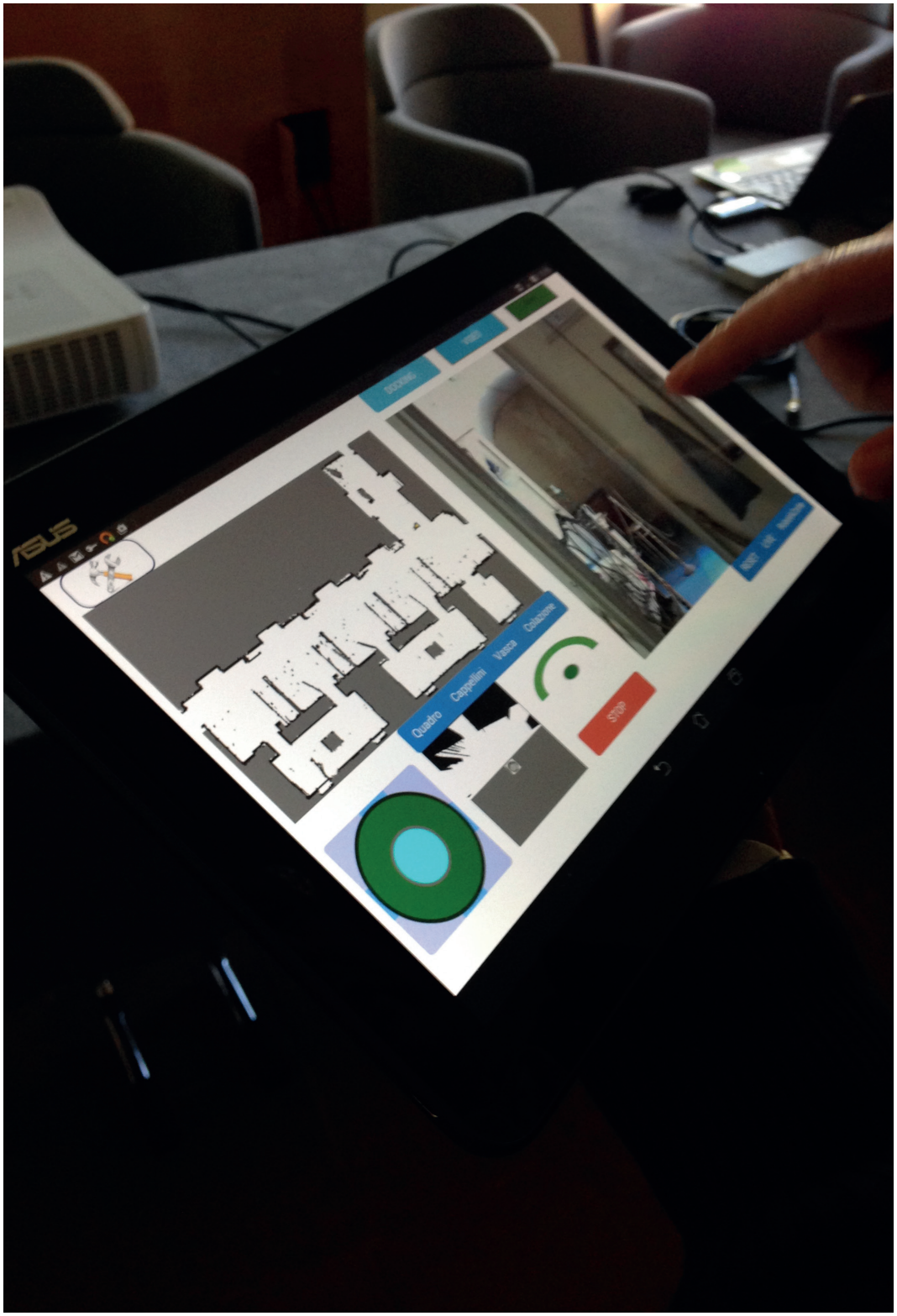


figure 73: GUI actual version

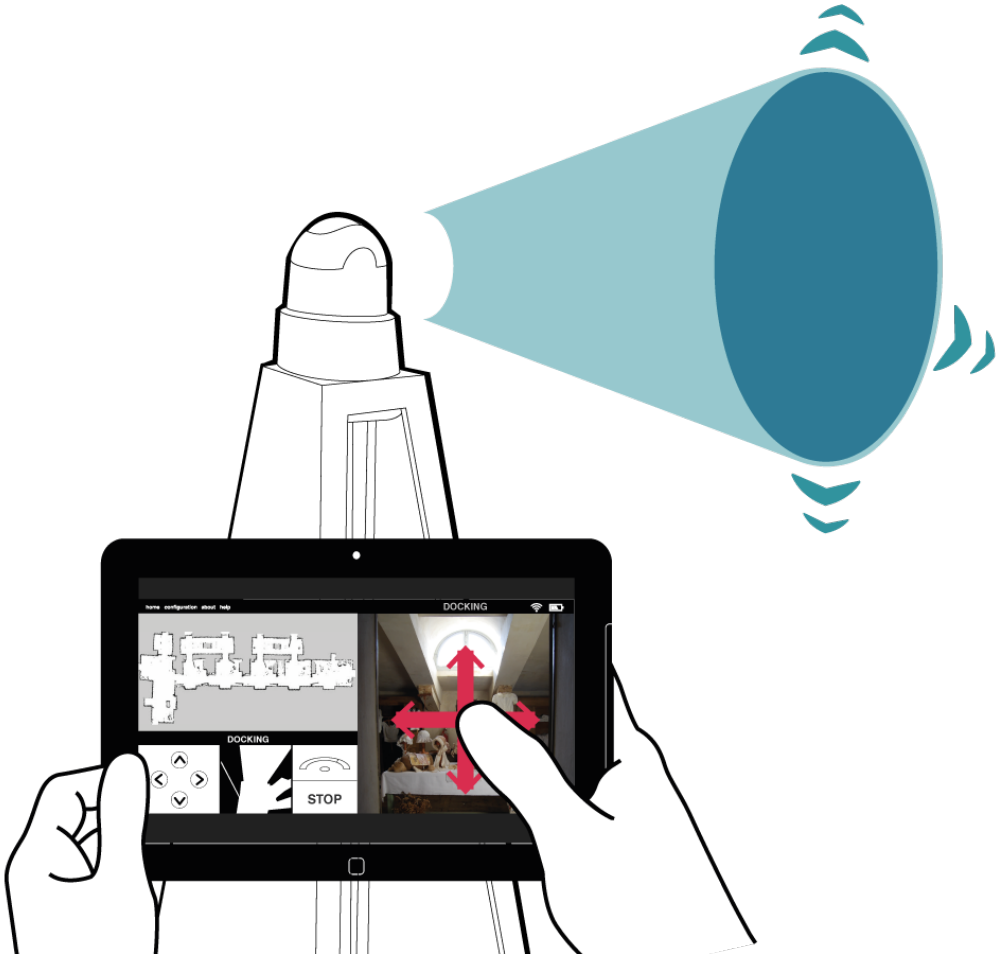
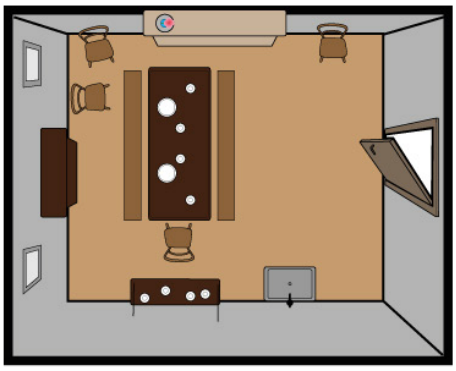


figure 74: GUI camera movement

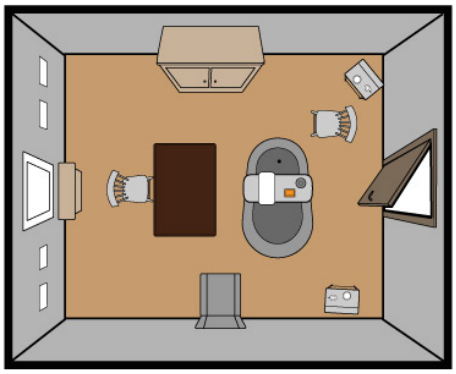
5.5.2 Multimedia set up

The application of digital tools and the connectivity allowed to expand the contents offer and the type of experience. Rather than just showing a streaming video of the inaccessible areas, the system has been enriched with multimedia materials such as old pictures, videos, and soundtracks. The use of multimedia contents allowed the museum guide to deepen its storytelling and to emphasize the atmosphere of the past. Audio and videos were realized on the cultural storytelling linked to experimentation scenario: the nurses' rooms.

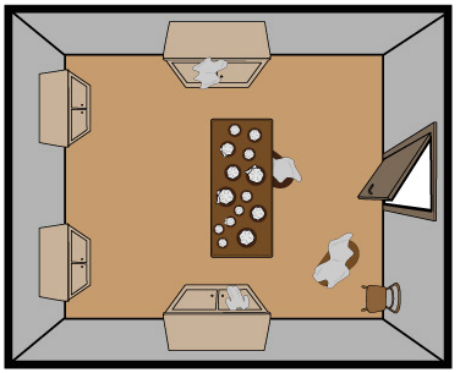
As it has been described before, The nurses' rooms nowadays are closed for restoration. This environment it is composed by four rooms connected by a corridor in which the nurses who were in charge to take care of the Savoy little princess, passed they everyday life. A particular mansion characterizes rooms such as studio, breakfast, bathroom, and ironing.



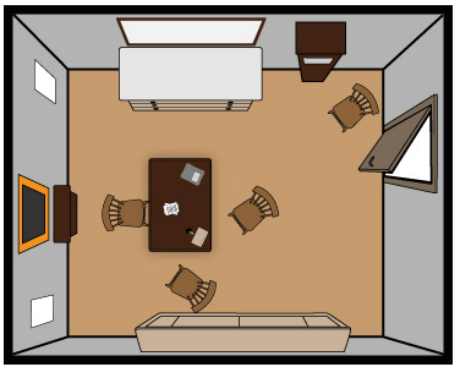
BREAKFAST ROOM

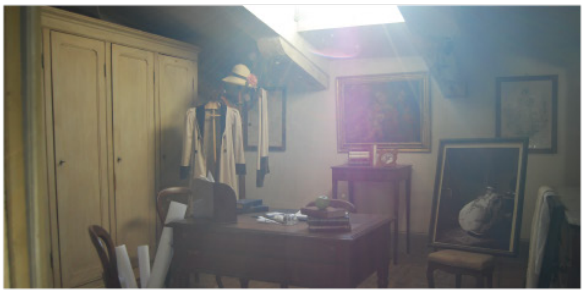


BATH ROOM

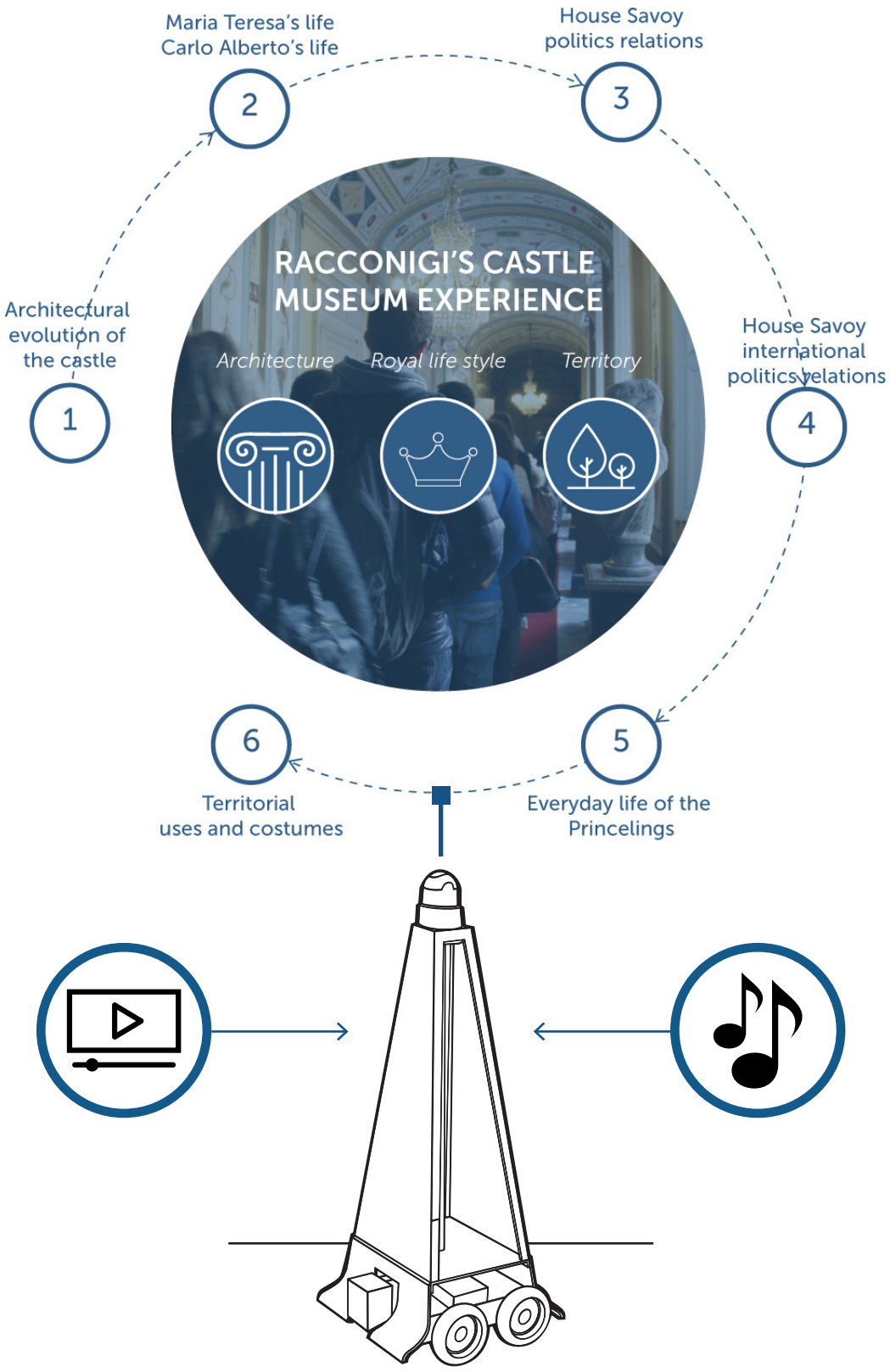


IRONING ROOM

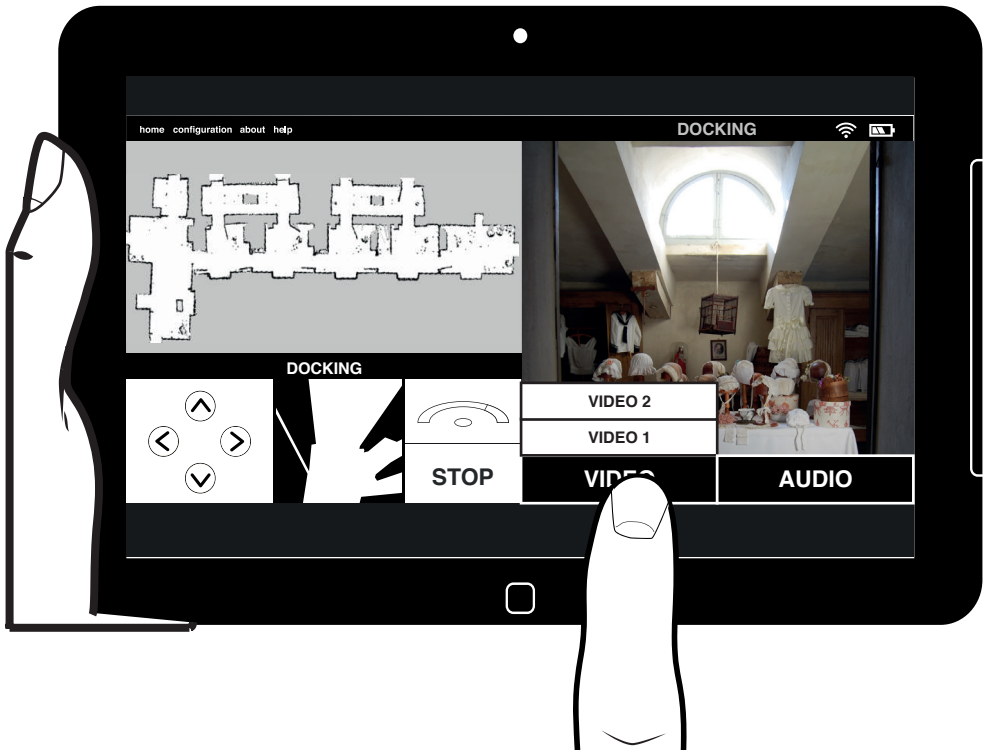




STUDIO ROOM


Maria Teresa's life
Carlo Alberto's life
2
House Savoy
politics relations
3
RACCONIGI'S CASTLE
MUSEUM EXPERIENCE
Architecture
Royal life style
Territory
Architectural
evolution of
the castle
1
House Savoy
international
politics relations
4
6
Territorial
uses and costumes
5
Everyday life of the
Princelings

Historical pictures & Videos A series of historical photos and video were shown to better explain the atmosphere and the customs of the past at the Castle. In particular, a video shows the public celebration of the princess Margherita's birthday, in which the royal family, and the nurses, were in front of the castle receiving presents, wishes, and flower, with the crowd of the local population. In this video the importance of the nurses is evident. While the princess could already walk, the younger prince was just a baby. He was carried outside by the nurse and just after given to the mother. As a matter of fact, the care of the princes and princesses was mostly a nurse's duty.




I Principini
Mafalda, Giovanna, Umberto, Maria, Jolanda
S. A. R. IL PRINCIPE DI PIEMONTE


Principessa Jolanda di Savoia
1901 - 1986


Principessa Mafalda di Savoia
1902 - 1944


Principe Umberto II di Savoia
1904 - 1983


Principessa Maria di Savoia
1914 - 2001


... sul carretto siciliano


LUCE
ARCHIVIO

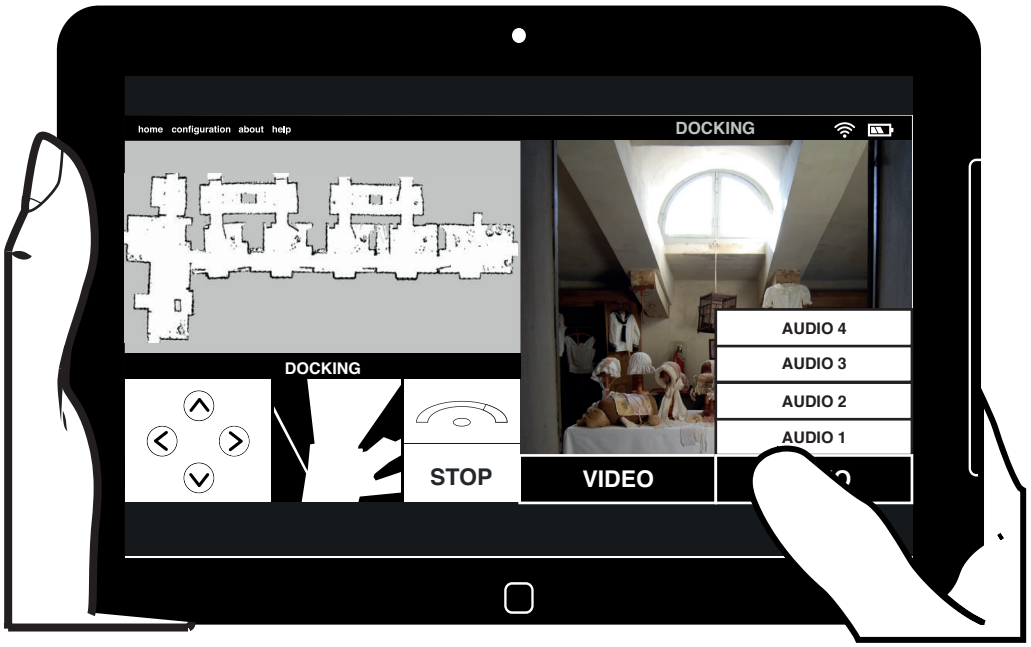

Compleanni Reali a Racconigi
29 settembre 1937, il compleanno di Maria Pia (al centro)

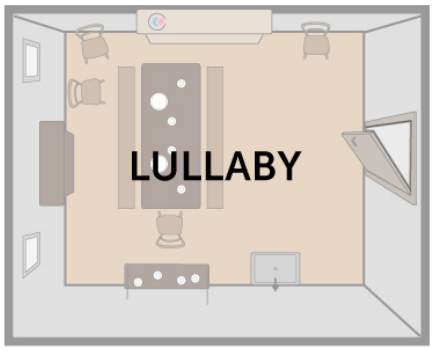

Vittorio Emanuele in braccio alla balia

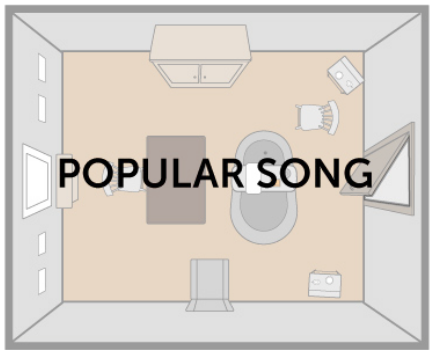

I bambini di Racconigi regalano fiori

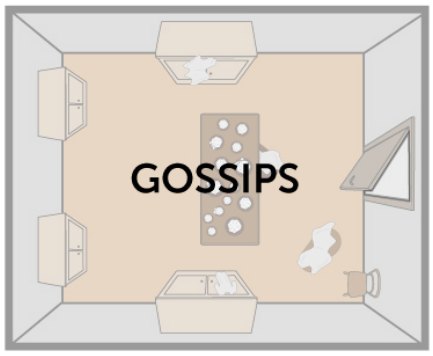

La Regina Maria Josè del Belgio a 31 anni
Dal matrimonio sarebbero ancora nate altre due figlie: Maria Gabriella e Maria Beatrice

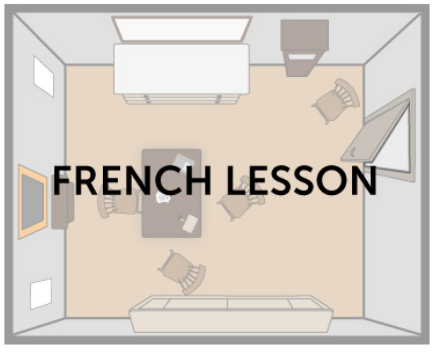
Soundtracks: The soundtrack consisted of five audio contents activated by the museum guide through the GUI. The number of tracks is based on the number of rooms visited through the robot. The tracks were specially recorded for the project. Each one refers to a different aspect of the nurse's life. On the first track, there is a voice of a princess talking to her French nanny/governess. In fact, the Savoy's princes and princess were educated by French and English governesses. In the second room's soundtrack, two nurses are gossiping while ironing. In the third room, the toilet, the soundtrack is characterized by the sound of water and the voice of a nurse singing a traditional song while bathing. In the kitchen, instead, two nurses are talking about politics and the attack of Sarajevo to Francesco Ferdinando Archduke of Austra, which gave way to the First World War. Finally, the last room's soundtrack is characterized by the voice of a nurse singing a lullaby to a crying prince.




LULLABY


POPULAR SONG


GOSSIPS


FRENCH LESSON

5.6 User test

Two experimental sessions have been organized at the Racconigi Castle. During those days, two rounds of guided tours, one in the morning and one in the afternoon, were extended with the introduction of the robotic experience. The visitors involved, invited to attend a guided tour for free, were not informed about the novelty. This choice was based on the willingness to prevent the rise of expectations and preconceptions.

5.6.1 Test set up

The test consisted of a guided tour during which the visitors were accompanied by a Museum Guide through the regular exhibit tour and then in a room specially arranged for the robotic experience (cinema room). The set up of this room consisted of armchairs for visitors, a projection system, a sound system and a tablet on which was installed the GUI to control the robot. During the robotic experience, the streaming video of the remote exploration was alternated with the multimedia insights, such as a slideshow of historical pictures, videos, and soundtracks. At the end of the experience, the museum guide showed a slide in which were summarized the purposes of the project and the future

developments, to give them a brief overview of the project. Finally, after the end of the visiting experience, the participants were asked to complete a questionnaire about their visit, which addressed both general information and a focus on the robotic experience. The choice to use a questionnaire-based study was led by the need to ask visitors the shortest possible time. In fact, since the testers were regular visitors unaware of the robotic novelty, in most of the cases they were already organized to visit other sites after the Racconigi Castle. This fact means that most of them had no time to spend on interviews. This constraint was highlighted by the museum guide who has an in-depth knowledge of the visitor's habits. The evaluation of the experience through a questionnaire was supplemented with the report of the user observation, carried out by two members of the design team. They were instructed to observe and write down the main aspects of the visitor's behavior, like if the visual focus was on the museum guide, on the projected images or rather if they were distracted and appeared bored.

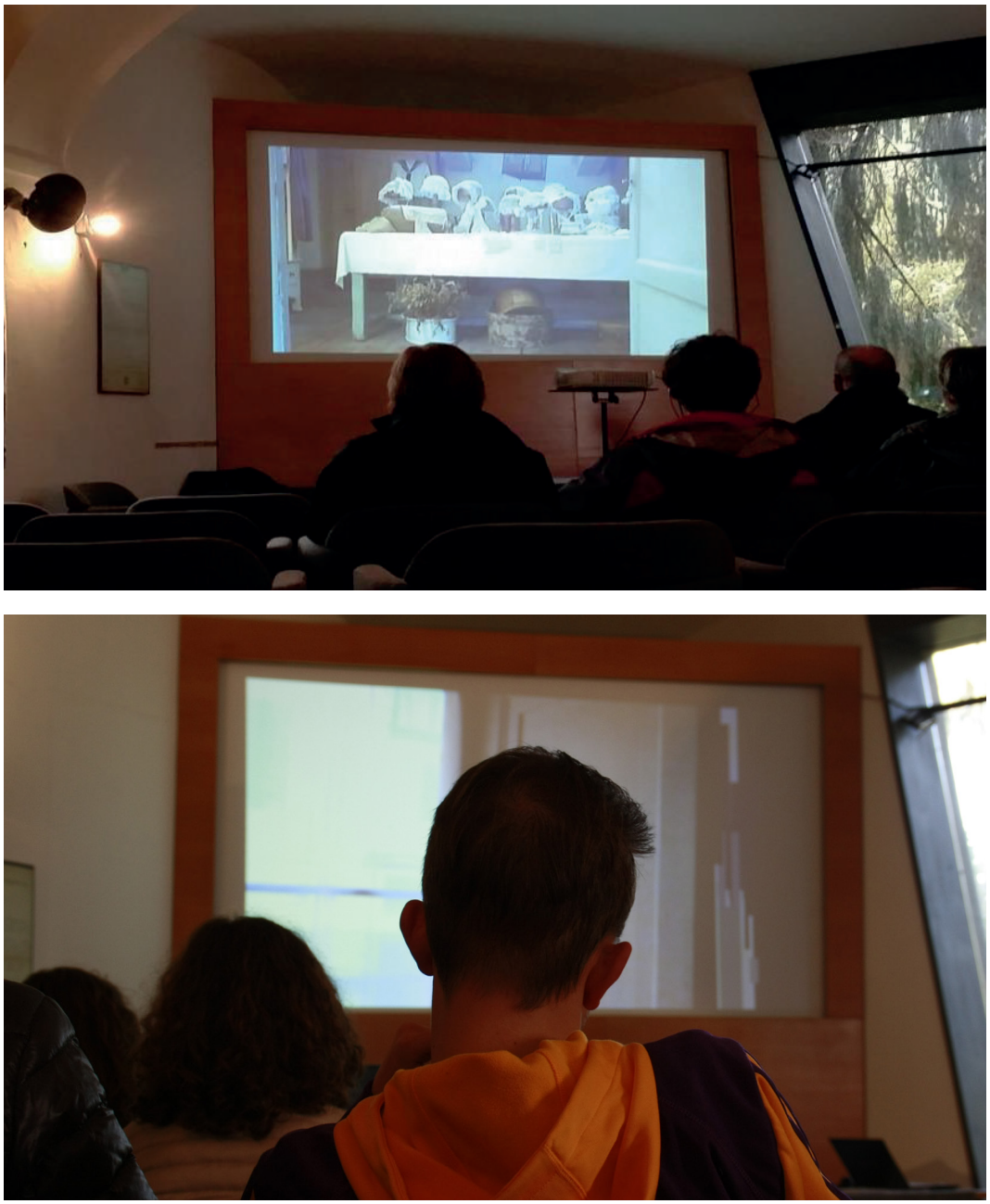


figure 75,76: Test with the user

5.6.2 Questionnaire description

The survey was composed of 26 questions. It included the first part of general information about the visitors and their visit experience, e.g. with whom they have come, if it was the first time at the Castle or not, etc. Other questions regarded their preferences about the themes covered by the museum guide during the visit and their willingness or not to know more about these. The following section was focused on some characteristics of the robotic experience, such as the quality of the video, the attractiveness, and appropriateness of the robot design and the perceived usefulness of this application. In another section, the visit defined by four qualities, namely entertaining, engaging, unexpected and cultural, which had to be evaluated on a five values scale. Finally, the questionnaire included two open questions: active and negative aspects about the experience. Semantic differential framework, A.E.I.O.U.

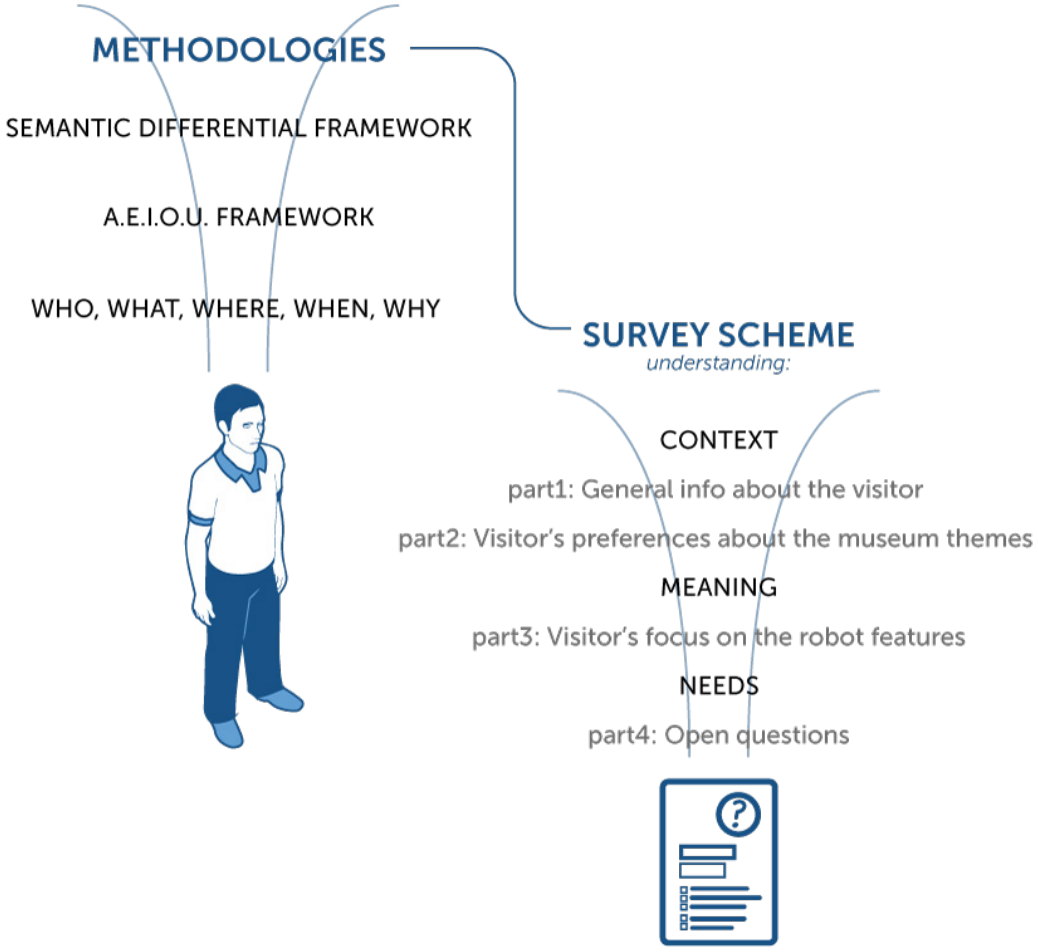


figure 77: Survey methodology

framework and 5W analysis have been used for the developing the survey. Those methodologies, which are typical of the ethnographic interview are useful to analyze different aspects of the user activity and thoughts (Spradley, 2016).

5.6.3 Questionnaire results

The field tests involved a total of 55 people, a group of 28 on the first day and a group of 27 on the second day (divided in morning and afternoon tours). The 62% of the sample was women and the 38% men. They were aged between 8 and 80 years, and around the 40% was more than 60 years old. They were mainly couples, families, and groups of friends. These data show that the sample, even if relatively small, is representative of the people typologies that usually visit the castle. The experience of the tour was evaluated, in general, on the base of four adjectives, namely: entertaining, engaging, unexpected and cultured. The feedbacks gave samples mostly positive. In fact, more than 85% stated that the experience was fun and engaging. Visitors were also asked to specify which of the themes addressed during the visit were most interesting for them. The vast majority, 53%, expressed interest in objects, customs, and traditions, while a 27% preferred architecture and history of the building and a 20% curiosity about historical characters. It was also asked which of these themes they would like to deepen. The interest for objects, customs, and traditions, as well as curiosity about historical characters, were both confirmed, each by more than 33% of the sample. Also, the 18% of the visitors expressed curiosity about the relationship between the Racconigi Castle and other cultural heritage of the territory. The visitors, then, were asked to express their level of satisfaction about four key features of the robotic visiting experience, namely: picture color quality, the stability of the video, movement of the robot and quality of sounds and voices. The participants gave, generally, positive feedbacks, particularly regarding the picture color quality (73,5%) and the quality of sounds and voices (85,3%). However, in some cases, there were negative opinions. Concerning the movement of the robot and the stability of the video the 16% of the sample was not satisfied. Other questions were related to the appearance of the robot. It was asked to the participants if the design of the robot was interesting for them, if it was appropriate for the context and if the use of robotics in this museum context was useful. For all the three questions the answers were similar: more than 70% of the participants gave positive feedbacks. In particular, the use of robotics in the museum context was considered useful or valuable by the 79,2%. They were also able to leave a comment about why they think the robotics is helpful and most of them reaffirmed that it is interesting to have the possibility to explore inaccessible areas of the castle.

Afterward, the participants were asked to say if in the future, they would like to visit other parts of the castle, currently inaccessible and if they would like to drive

the robot. Most of the participants, 89%, stated that would be interested in exploring other areas of the castle, currently inaccessible. As regards to the possibility of driving the robot, the consensus was lower, 64%, while around a 14% stated that is not interested in this possible future development.

Finally, visitors were invited to leave comments about negative or positive aspects of the experience, and none of them gave a negative comment, whereas the positive feedback mostly emphasized the professionalism of the museum guide, the quality of the cultural storytelling and the attention paid to details. Citing the comment of a participant: "the emotion of the past." In the last part of the questionnaire, the comments left by the participants of the field-test demonstrate how the proposed service met its primary objectives: show hidden areas of the castle without impact on the cultural experience and enhance the storytelling activity of the museum guide. In fact, most of them consider that the use of robotics in the museum context is useful, precisely because "the robot can go where people can not" and "allows overcoming logistic and administrative issues." Moreover, above all, people widely appreciated the cultural storytelling made by the museum guide who is the only protagonist of all the final feedbacks.

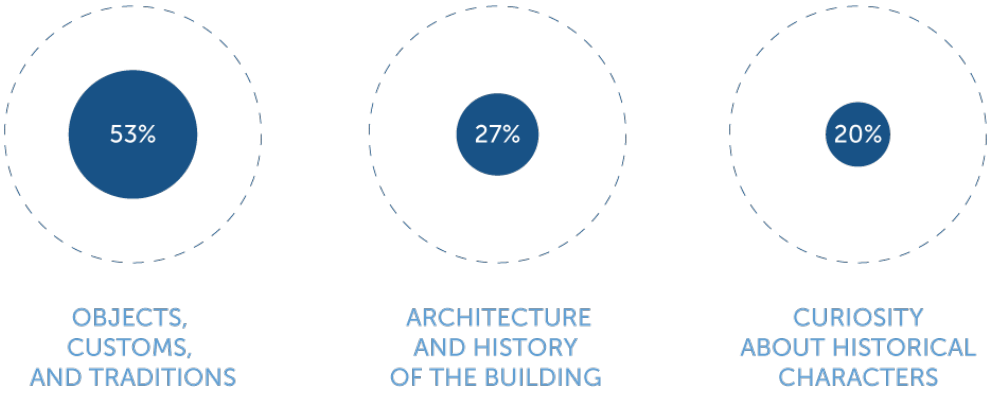


figure 78: Survey results 1

5.6.4 report on the user observation

The report of the observation confirmed some of these data from the questionnaire. In fact, most of the participants have stated that the experience was entertaining and engaging and both the observers reported that the visitors appeared highly involved in the visit. In particular, some people seemed to be amazed by the novelty. For instance, there was a male participant, aged about 60, who was excited by the experience. This was noticeable by the fact that he was always moving on the armchair, leaning forward the torso, as to see better. He was also constantly

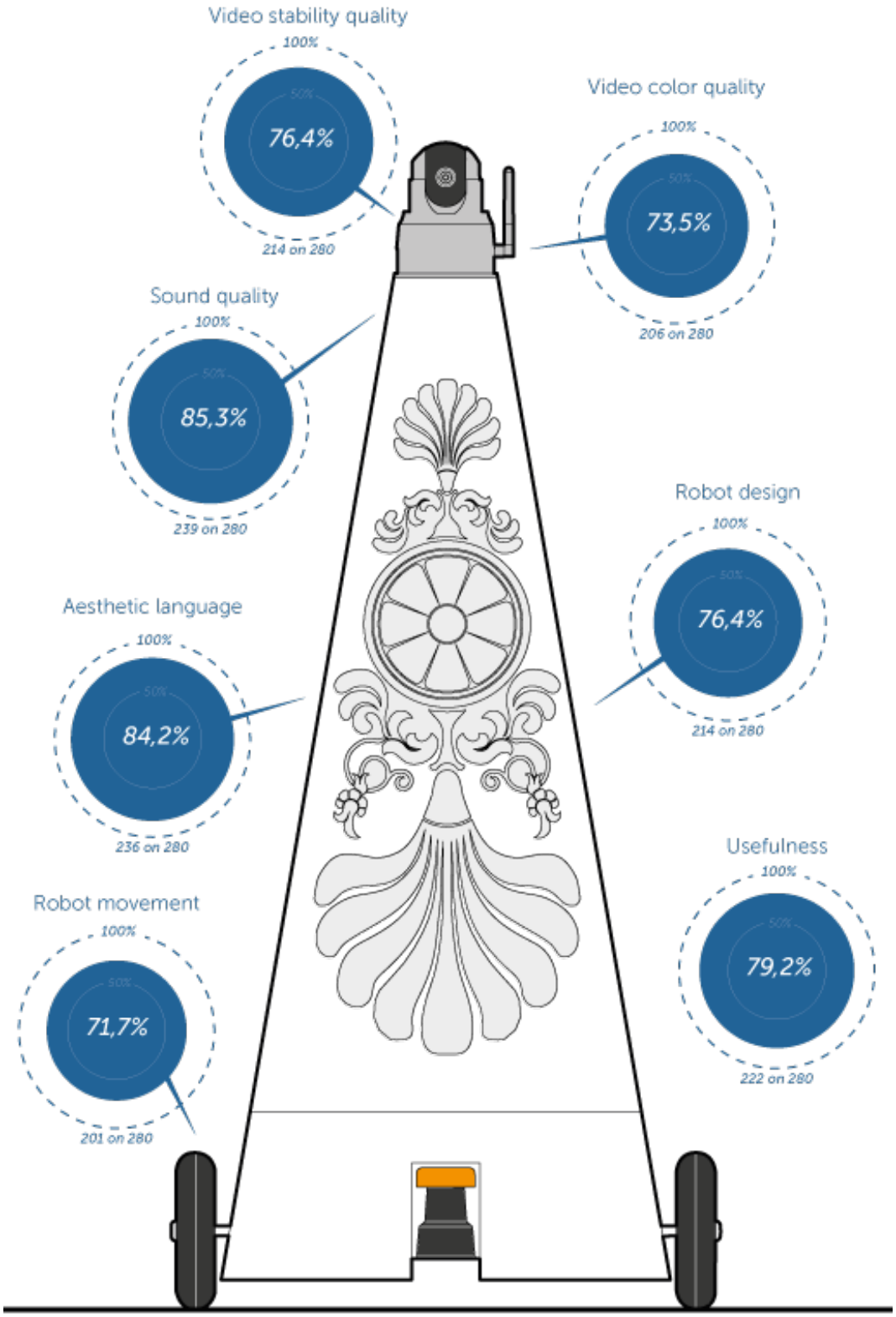


figure 79: Survey results 2

smiling and often seeking eye contact with his partner. The smile and find for eye contact were also noticed on the vast majority of the participants, especially those aged over 50. On the contrary, the younger participants, aged between 8 and 13, appeared to be less involved. They were sitting in a very relaxed way and smiling less than adults.

Overall, when the robot was moving and showing the real time images of the inaccessible area, people were mostly focusing on these while when the projection was showing the multimedia contents the visitors were more looking at the museum guide, who in both cases was talking. At the end of the experience, almost half of the participants expressed their appreciation for the project and thanked us. Contrariwise, a couple of participants aged around 30, were visibly not pleased with the whole experience, they were almost never smiling, but they spontaneously went to the museum guide to talk about the project and to understand more deeply. From the conversation, we found out that one of them was working at the castle and he lost that job there because of the financial issues of the administration. His concern, which also influenced his partner, was related to the adoption of expensive technologies in a context that is currently unable to ensure the necessary care of the heritage and the jobs that depend on this. After the conversation with the museum guide both of them were much more relaxed and friendly, but this example is fundamental to keep in mind the complexity related to the introduction of new technologies, especially in public context.

5.7 Robot improvements

After the analysis of the data obtained by the test, the improvements of the robot concerned four most important aspects of the robotic framework: structure, camera, wheels, and speed. Regarding the structure, the pyramid shape remained unchanged, while the centroid has been moved to make the robot able to climb surfaces with an 8 degree of inclination (the same of ramps for wheelchairs), without slipping or overturning. The camera, instead, has been changed for reducing image distortion and obtaining a higher quality of the chromatic tones. This aspect is crucial for the proper fruition of the heritage since certain kind of contexts are characterized by the atmosphere: soft lighting and sharp contrasts. Finally, the movement of the robot has been improved. On the one hand, by replacing the wheels for obtaining more grip. On the contrary, the engine power has been increased as well as the level of battery autonomy.

5.8 Museal Gaming

To respond to the expressed need of the users to have a more interactive experience a further step towards the direct interaction between visitors and robots thinking about the possibility to gamify the whole experience. Since the test showed that younger users had expressed a more interactive experience, from this point on, the project was supported by a high school class of students that helped the designers through co-design methodologies to give a design response to this directive. The structure of the game is based on the treasure hunt concept. Visitors after have visited the inaccessible areas of the museum with the robot, would have the ability to come back to that places driving themselves the robot and answer to a series of questions regarding several topics treated during the visit. Those issues could be different and for each one player could have a varied experience of the tour. The scope of the game is to answer three multiple-choice questions associated with three different objects present in the fragile areas of the museum. Before to respond to the questions the player, after receiving a clue, have to drive the robot towards the selected object. In this way through the semi-regarding drive of the robot, the visitor will have the capability of interacting directly with the robot driving it, once the robot will be moved inside an area, this area could be visited with the 360-degree camera settled on the top of the robot. The camera furnishes a more immersive perspective of the area because camera movement of the robot corresponds to the action of the player which use the tablet with a haptic interface. The live streaming of the game is also duplicated on a big shared screen so everyone next to the players could give him suggest or interact with the game. The scope of the game is complete the treasure hunt in the faster way possible, and for making the experience more social involving the final score is compared to everyone played the game before.

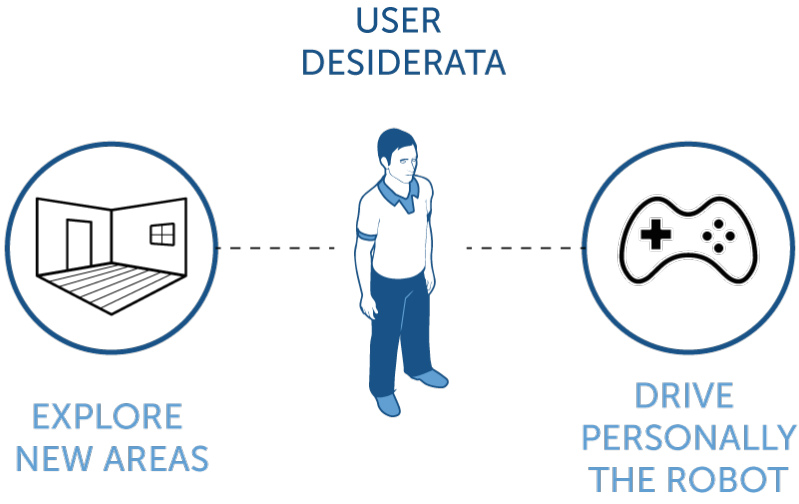
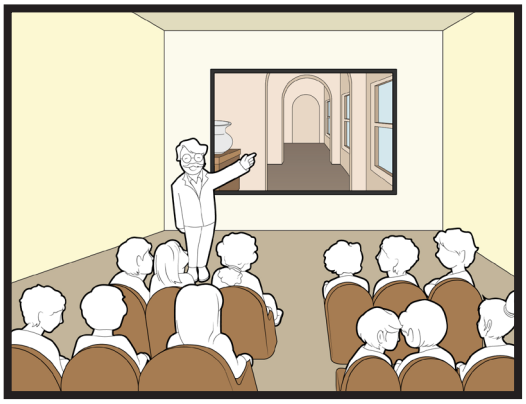
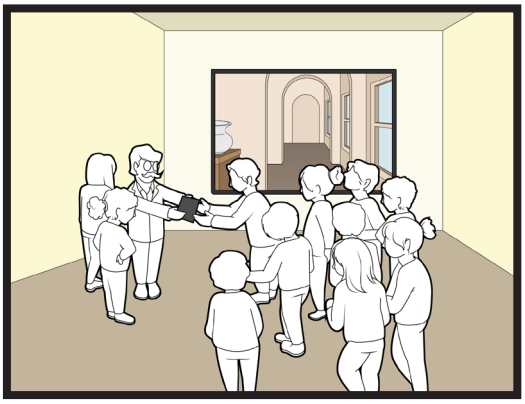


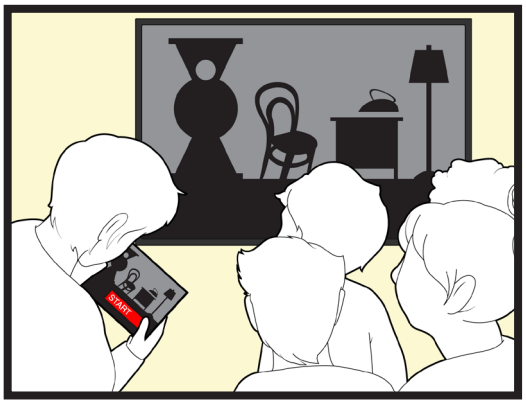
figure 80: User desiderata



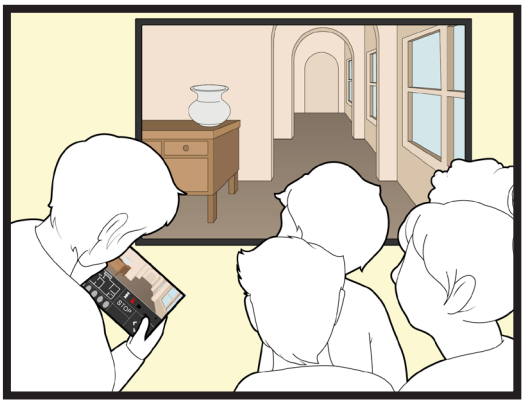
1- Museum Guide finish the visit



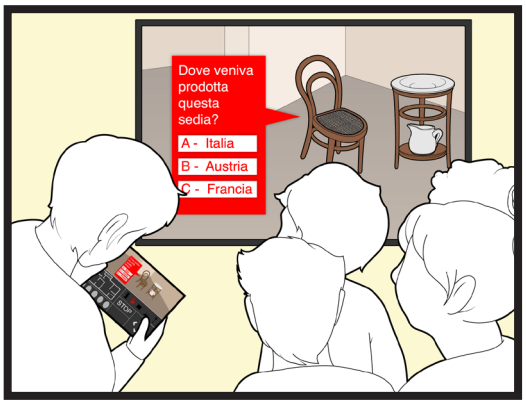
2- Museum Guide pass the control tablet to the group of visit (classroom)



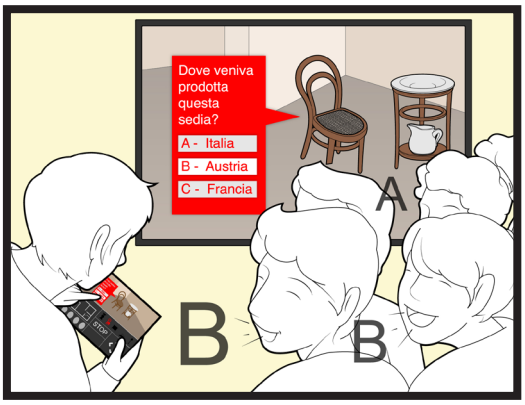
3- Together the visitors decide which adventure play



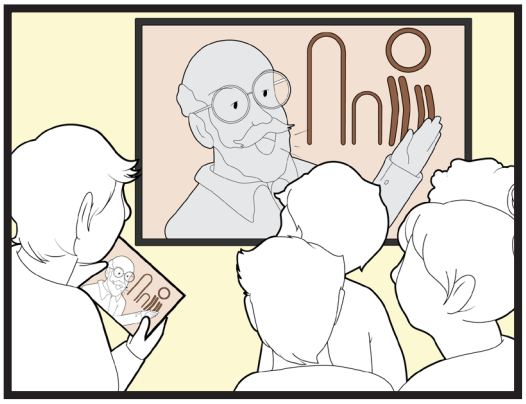
4- In semi autonomous way the visitor which is driving look for an object suggested by the game, in relation with the adventure selected



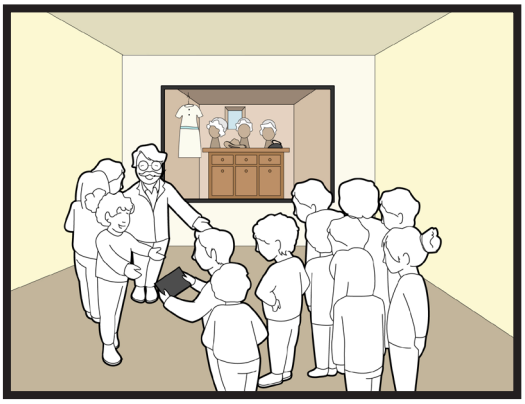
5- Once the group find the object the game asks a contextualized question



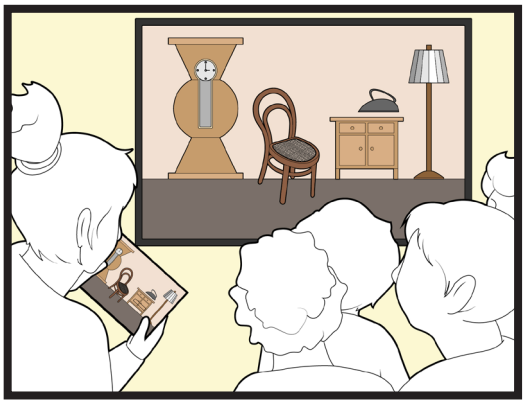
6- The group compares the response



7- The game enable the vision of a multimedia contents on the objected selected



8- The GUI pass to another component of the group



9- The game restart untill all the object of the adventure are been founded

10- At the end, a ranking list collects the time scores of all the schools that played the game

5.8.1 Game set up

Before to start the co-design phase, the museum guide has cataloged all objects in the areas dedicated to the experimentation, providing a report containing general information about them. The cataloging has provided the division of the objects in the following categories: objects of everyday life, the courtyard- style and personal care products, these classes of objects were then used to contextualize the cultural content of the game.

Co-design phase it has been structured in four days of workshops. Those four hours working meetings were made with the aim of implementing the multimedia content of the game and evaluate the confidence of interaction between user and robot. The days of workshops have been conducted both to the museum hosting the project, both in the high school media lab, a dedicated high school area for conduct

figure 81: Object catalogation

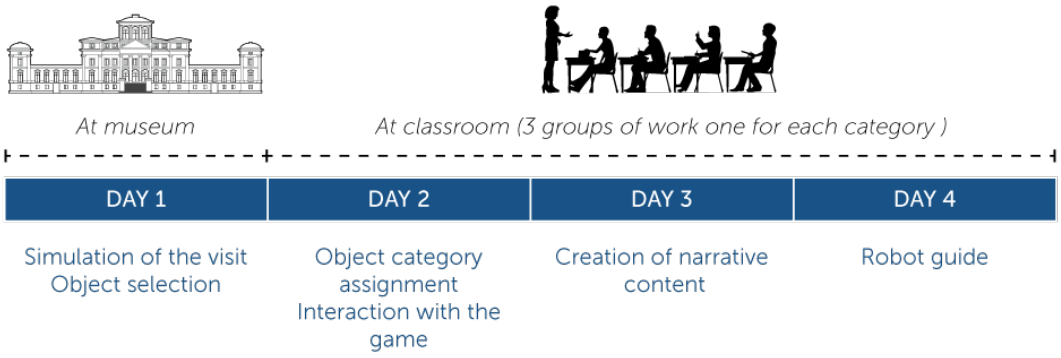


figure 82: Workshop scheduling days and activities

a multimedia research containing several workstations with personal computers, internet connection, and other tools. The first day of the workshop it has been carried out on the museum and provided the simulation of the state of the art of the robotic service. Students have physically visited the castle together with the museum guide and, subsequently, they have performed the remote visit of the fragile areas through the use of the robot. At the end of the day was asked students who were the most interesting things they had seen through a questionnaire, these data were then crossed with the report made by the museum guide for choosing what were the important objects on which working during the next stages. The three subsequent meetings were held instead in the high school media lab. This workshop phase provides the creation of three groups of work. The groups have been maintained until the end of the project, and to each one were assigned a category of objects to analyze (objects of daily life, the courtyard-style and personal care products). The assignment phase was randomized, but students preferences composed the groups, formed of an equal number of people. Dividing the application of the game into steps, each of them was analyzed with methodologies concerning the collaborative design asking to students advice how to improve it. The phases were treated with the students were the following:

Codesign with student

- **Interactions with the game:** in this phase, it has been taking care of the co-design of the interactions, these interactions are present in the game when the user has to find out what items has to look for, and when he receive the clues to find them. This phase was structured through brainstorming, during which students were provided with suggestions and with which they then developed a concept.
- **Creation of narrative content:** after a brief lesson of introduction about research methodology, students investigate the content concerning to their class of objects, for this task groups were supervised by the museum guide who provided its cultural expertise. The cultural materials were subsequently used to structure both the questions in the treasure hunt and the multimedia video screened by the robot
- **Robot guide:** students drove the robot through a process that simulates the one present in the museum.

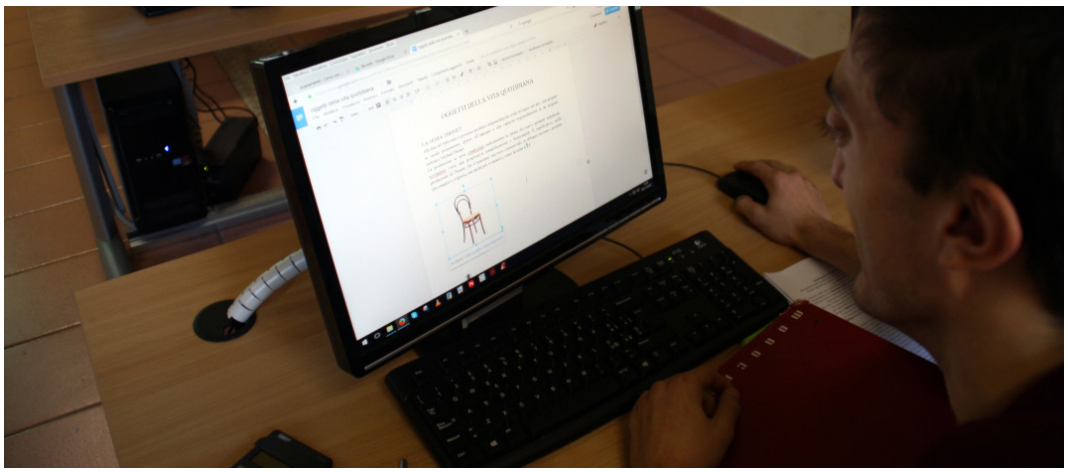


figure 83,84: Workshop day 1, Workshop day 2

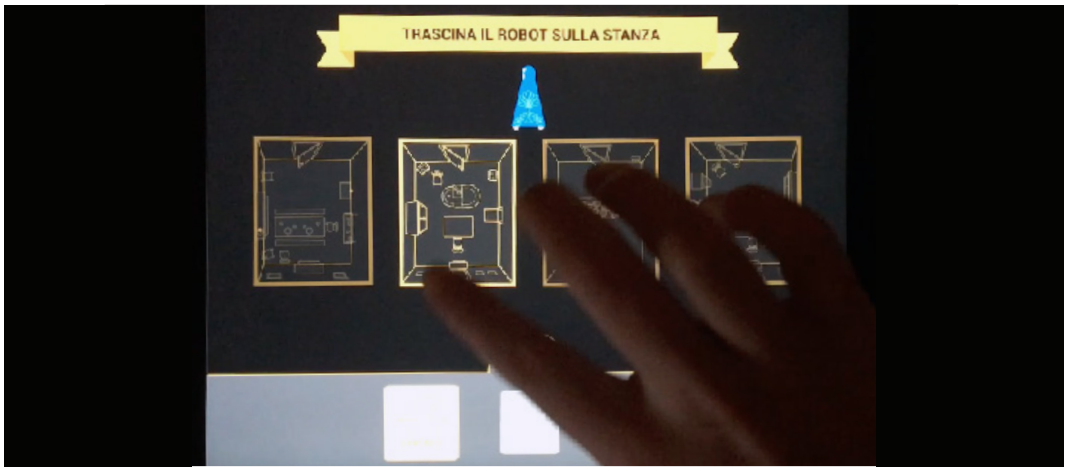


figure 85,86: Workshop day 3, Workshop day 4

Once finished the workshop, multimedia contents and desiderata emerged during the codesign phase have been integrated into the robot G.U.I. app. All the suggestion came out from the workshop were combined on the game. The cultural contents were used to build the question list and have also been assembled in videos on the duration of 1 minute, used as a reward for the correct answer of the question. The rest of the suggestions were used to provide graphics and interactive application.

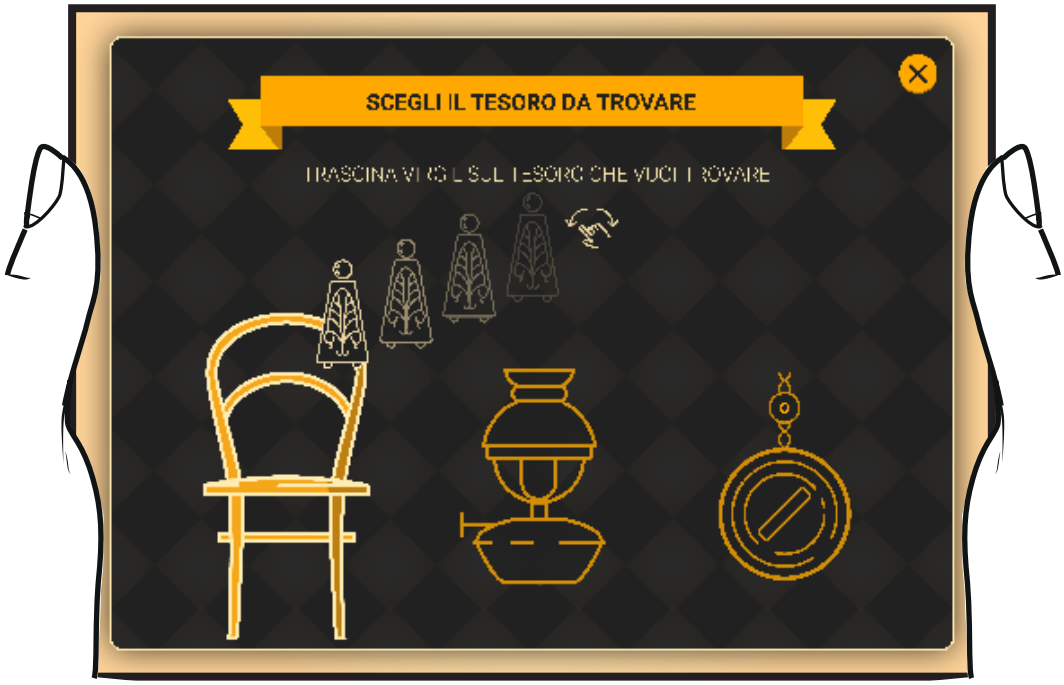
HOME

LANGUAGE SELECTION

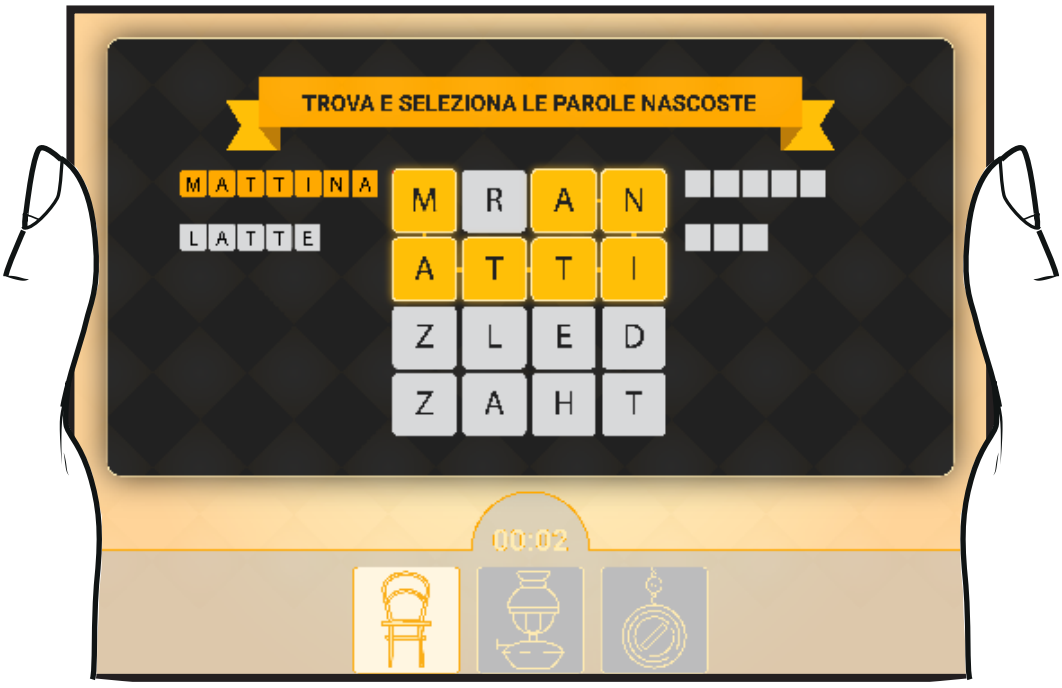
REGISTRATION/ LOGIN

ADVENTURE SELECTION

ACCESS THE ADVENTURE
(The group simultaneously presses the screen)



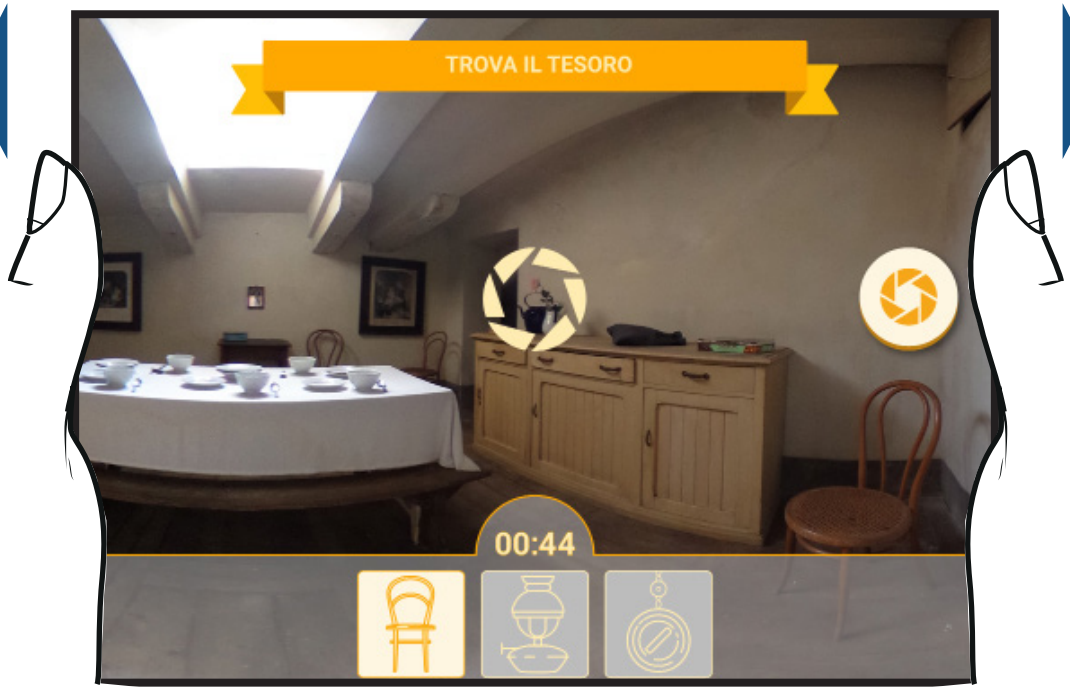
OBJECT SELECTION



FINDING THE HIDDEN WORDS IS POSSIBLE TO KNOW IN WHICH ROOM THE OBJECT IS LOCATED (the group can give suggestions)

IF PLAYER SELECT A WRONG ROOM THE TIME ENCREASE

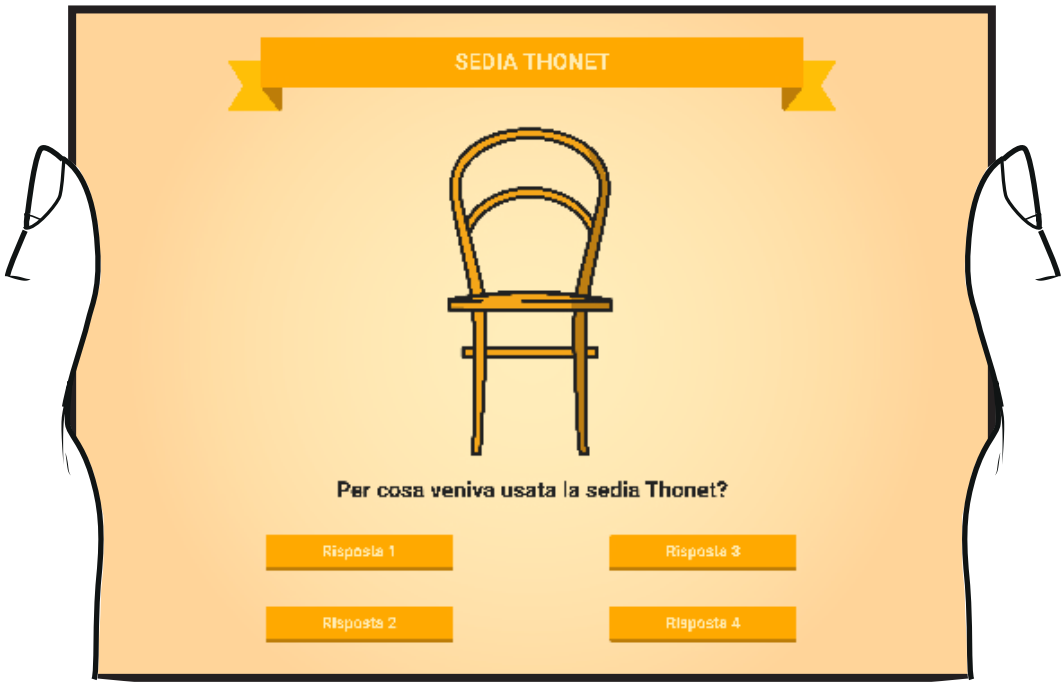
THE VIDEO LIVE STREAMING SHOW THE MOVEMENT OF THE ROBOT



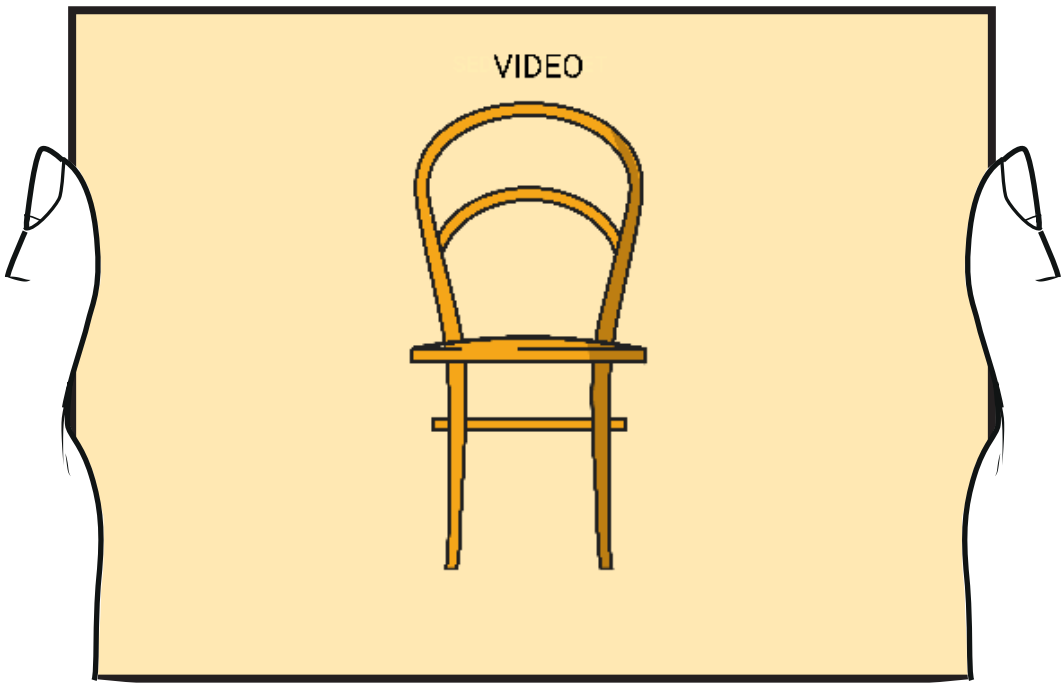
TURNING THE TABLET IT IS POSSIBLE TO MOVE THE CAMERA OF THE ROBOT (right button to select an object once it is in the viewfinder)

IF PLAYER SELECT A WRONG OBJECT THE TIME ENCREASE

IF PLAYER SELECT A RIGHT OBJECT THE GAME CONTINUE



QUESTION LIST RELATED TO THE OBJECT FOUNDED



MULTIMEDIA CONTENT

SCORE VISUALIZATION

RANKING VISUALIZATION


TROVA IL TESORO
09:12

Chapter 6

Conclusion and lessons learned

6.1 Impact of the methodology

The project experience described in the thesis highlights how the use of robotics integrated with a direct involvement of the stakeholders and the final user makes the robotic solution significantly more innovative and socially accepted (Nourbakhsh, 2013). For reach this result the methodological frameworks used helped a lot the dialogue between all the stakeholders. The ability of the design to create a creative environment for the project aimed the discussion and the problem-solving. The stakeholders since the beginning of the project have been clear in mind the role of the robot and, in particular, museum guide did not see him as a competitor for its work. Although a tool for enhancing its abilities.

The use of physical support such as the robotic framework prototype and the real case study environment (Castle of Racconigi) allowed the design team to understand better the criticalities related to the use of a robot inside a museum. Social implications and performance issues create the guidelines for realizing a model replicable for others museum sites with similar characteristics The tests conducted with the final users confirmed the rightness of the project.

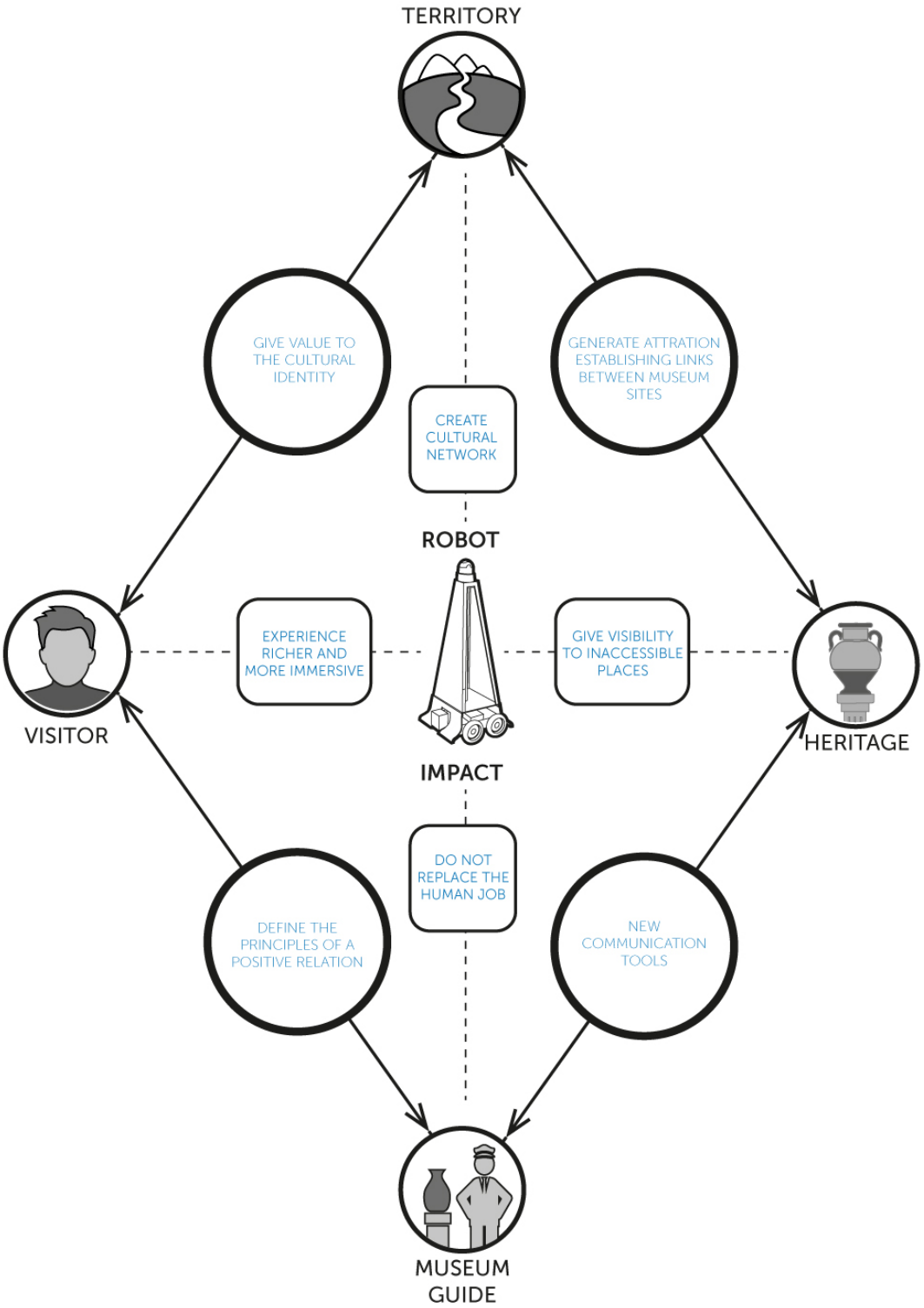


figure 87: Impacts of the project

6.2 Impact of the service

Robotics devices which are slowly entering in the museum market field placing themselves always more in competition with other digital interactive forms (Brynjolfsson et al., 2012) . Especially for which concern the remote visiting museums use real or digital video which allows to the visitor to enter in a distant environment. If compared to this kind of solutions the project did not show advantages regarding visit performances, video quality is comparable to the standard of the market, and the solution rather presents advantages regarding flexibility and interaction. The intelligence of the robot which allows it to move and be driven in a semi-autonomously way by the visitor offers an experience more empathetic and less detached. In fact in interactive aspects robot takes full advantage of its potentiality. With the insertion of this kind of tool in the museum system, it would be possible experiment innovative categories of visiting, the job of the museum guide, which nowadays is living a severe crisis, could be evolved and obtain new skills, such as digital storytelling. Therefore, although the user point of view new experience of the visit could be performed, today with the gaming, tomorrow through new interactivity.

6.3 Impact of the product

The robotic framework developed it has also been used for others research solutions. A fully working prototype of Virgil robot it is used to help the guest to move in the TIM offices located in Via Borgaro in Turin. Thanks to the sensor system that enable the robot to move in a semi-autonomous way, a copy of Virgil it is used for welcoming the people who visit the company. The software structure and the cloud platform it is the same employed in the museum of Racconigi, in this case, the robot presents different aesthetical aspects and another interface of the control. Thanks to experience portrayed in the museum the disrupting use of telepresence robot have created a new service for the company.

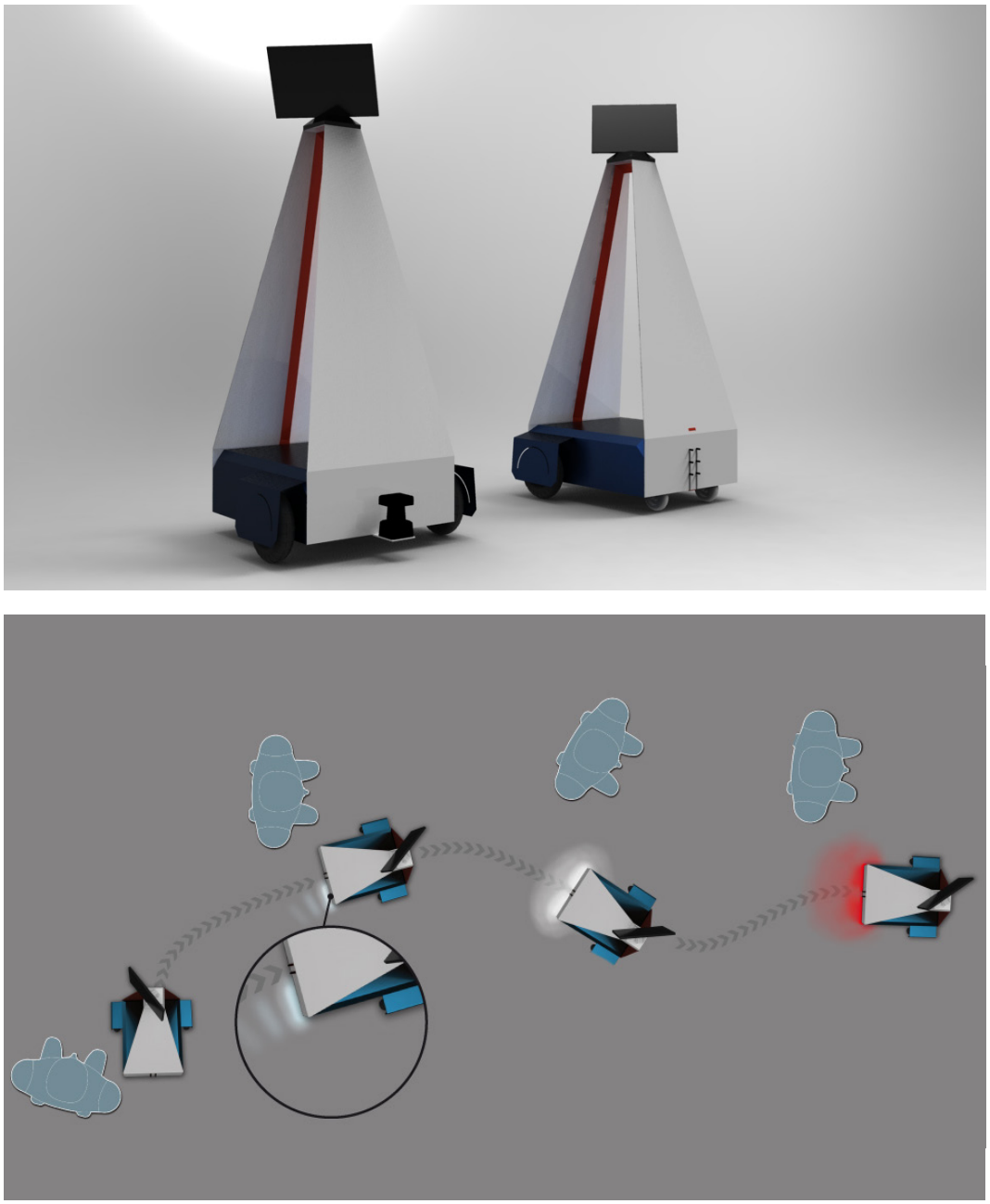


figure 88: Robot courier

6.4 Lesson learned

To investigate the expertise in the cultural heritage field, it is essential to explore how to attract visitors to their local heritage stimulating the economic and socio-cultural development in a sustainable approach (Falk et al., 1985). The development of a territorial, economic growth can be certainly connected to the innovation through the enhancement of new tourism implications, that implies the establishment of new promotional and cultural experiences (Getz et al. 2016).

Nevertheless, it is possible to hypothesize that if the cultural and social activities are not carefully planned under the aim of a neat social innovation, it is possible to incur "into the decline of heritage sites and an increment of environmental, social and cultural costs" (Dragouni, Fouseki 2017). However, speaking specifically about the collection's display inside museums some of the issues emerging from our finding is relate precisely to the alienation of the visitors to the artifacts, that can be translated into a significant loss regarding the display's fruition (Cimoli, 2007).

Within this context a roboethic approach can become extremely relevant concerning sustainability, exploring the economic benefits with impacts on the hosting communities, heritage assets, and the environmental factors. All these elements will contribute to implementing the social well-being, and cultural promotion of the communities through the use of ICT devices, guided with the help of a service design methodology that follows the guidelines of a roboethic approach to enhance the museum experience. The roboethics guidelines assist the museum experience enhancement as a tool to better understand and approach the artifacts (Steinert, Steffen, 2014).

In this Thesis, it is also described the key role of the innovation in the small communities Heritage's tourism and how it can welcome the effective change of destination to host the local activities, such as the Terre dei Savoia association, and the Racconigi's Castle. To and allow a meaningful collaboration with heritage tourism managers and all the stakeholders. Tourism activities and their contribution can be particularly valuable in accomplish long-term commitment to sustainability intents." (Dragouni, Fouseki 2017).

This research wills to contribute to and fill the gap by creating a methodological framework for community participation in heritage tourism planning and management and above all exploring the guidelines for a sustainable and ethical approach toward service robotics applied to cultural Heritage. The research follows a case-study approach, and it is currently focused on the Royal Residence of Racconigi.

Nowadays cultural heritage can be seen as a good testing ground to implement new digital and no digital solution for enhancing the user, but most of all, the visitor experience, and heritage tourism. According to Hampton (Hampton, 2005) enhancement is defined by the will of the visitors to get in touch with their local

heritage, and all the historic landscapes, the archaeological sites, local architectures and uses and customs from the past can be a source to feed this will of experience a specific heritage.

Heritage tourism can also be seen as a tool to promote the economic growth of small museums, particularly since a bond that connects different expertise from different field of studies or labor (Richards, 2007). Although not exclusively, heritage tourism has become particularly relevant to culturally rich and remote regions that wish to stimulate growth and compensate for their depressed primary and secondary industry sectors (Smith, 2006).

According to Drogouni and Fouseki (Drogouni et al. 2017), creating new connections for a rich heritage tourism innovation system should take into account a multi-stakeholder approach, that will define the venue for service design strategies that will address social equity and environmental quality, in a sustainable path.

These new connections can take advantage of new needs of enhancement of local museums, that could be the starting point of a new academic, social and economic discussion between the stakeholders.

Hence, it could conceivably be hypothesized that following the roboethics reflections, and above all the main methodological guidelines that suggest giving importance to the role of people inside the ICT industry, and to not limit the human labor by replacing, on the opposite to enhance the human factors with technology. Before enhancing the human factors, it became essential to give access to people to digital and robotic tools that can improve daily life and labor. In our case study at the Royal residence of Racconigi, was possible to observe the enhancement of the museum guide tools, especially in the inaccessible human contexts. The access to tools and new environment would create a positive cycle of cultural heritage valorization regarding sustainability.

In the Italian Cultural Heritage scenario is possible to investigate and find many local heritages that need the benefit of a well conducted promotional and dissemination project. These project could be a positive example of putting in evidence how inaccessible places.

The challenge in the described case study was to promote the dialogue between the engineering, the design, the museum, and the academic field in order to enhance the cultural heritage dissemination (Peressut, 2005). One of the advisable outcomes of this research was to create an enveloping design structure that connects professional to museum visitors, giving new hints for experience their heritage. New connections and Museum fruition tools will be born from new needs of enhancement of local museums, that could be the starting point of a new academic, social and economic discussion between the stakeholders.

It is important to bear in mind the possible bias in response to these new needs, focalizing on how to facilitate the access of visitors to their heritage. Building up a new technology that fosters public spaces to the audience with a roboethic approach

is essential to make a concrete chance to generate a more accessible culture. Giving tools to understand the heritage can be a turning point for innovation in the cultural process because otherwise, the public would not be able to understand the cultural meaning of the artifacts (Heinich, 1988).

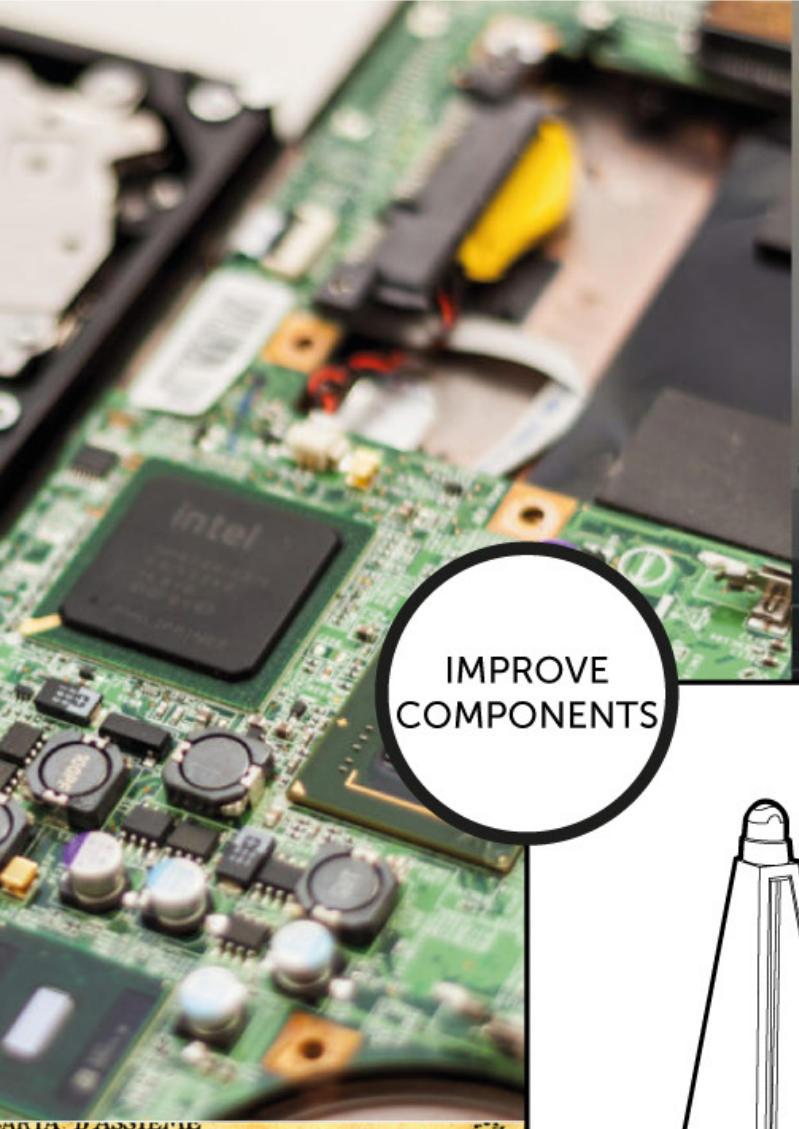
6.5 Future works

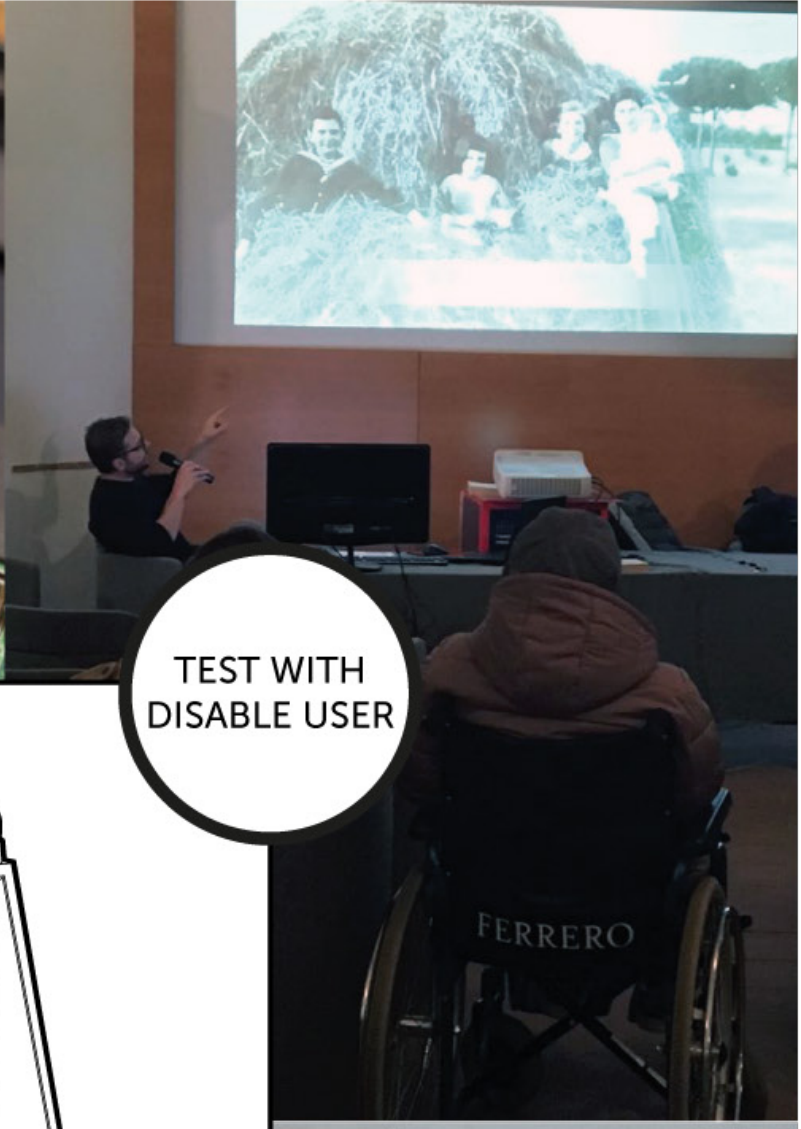
A significant amount of work is still to be done, in particular, some aspects of current solution need to be improved, such as the stability of the images and the movement of the robot. The prototype developed is not ready to be inserted in the market field, it needs an upgrade in term of performance, in particular for which concern the movement system which is not tested yet in a disjointed ground. For face this issue, others inaccessible environments could be tested, in particular, the ones with the safety problem. In fact, soon the robot is going to be proved into the thermal bathroom thanks to a Regional funding. From this experimentation, we expect to check the stability both of the LTE connection and the response of the wheels apparatus on an irregular ground.

The museum game described is still on working. Thus it has to be implemented and tested with visitors. Feedbacks from an UX test are expected for enhancing the interactivity of the experience. Furthermore, new categories of visitors are going to be tested: people with disability. Mobility impairment is one the significant restrictive factors which prevents the museum's visit to the disabled. As others experimentation already do, Virgil can be used to open the visit also to this user category.

A Future perspective of the project is also to create a cultural heritage network based on telepresence robots. Exploiting the capability of the robot to be driven remotely, a series of robots can be installed in several museums. Treat the cultural heritage as a connected system could have a positive impact on the "secondary" museum sites that can obtain visibility from the most visited ones. The idea on the base of a cultural network system is to connect via robots all the museums. Hence, museum guide could create some cultural links connecting the visit experience to the robot and use it remotely to deepen the cultural storytelling.

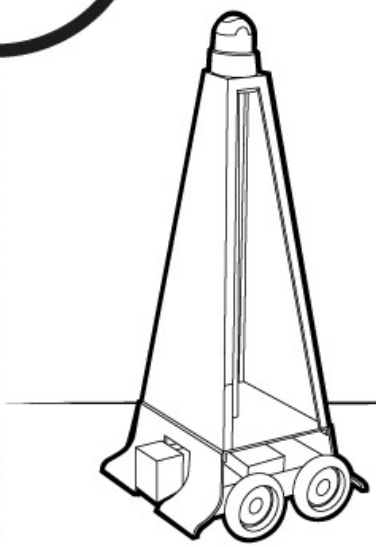
The Virgil project is based on the willingness to apply a human-centered approach to creating a valuable and ethical solution for a real context. The methodology used, then, put in place strategies of participation and co-design, involving multiple stakeholders, to develop a solution born from shared decisions. In fact, the process of continuous debate that we carried out is meant, not only to create an acceptable solution, rather enable the occurrence of the mutual shaping of robotics and society.





IMPROVE COMPONENTS

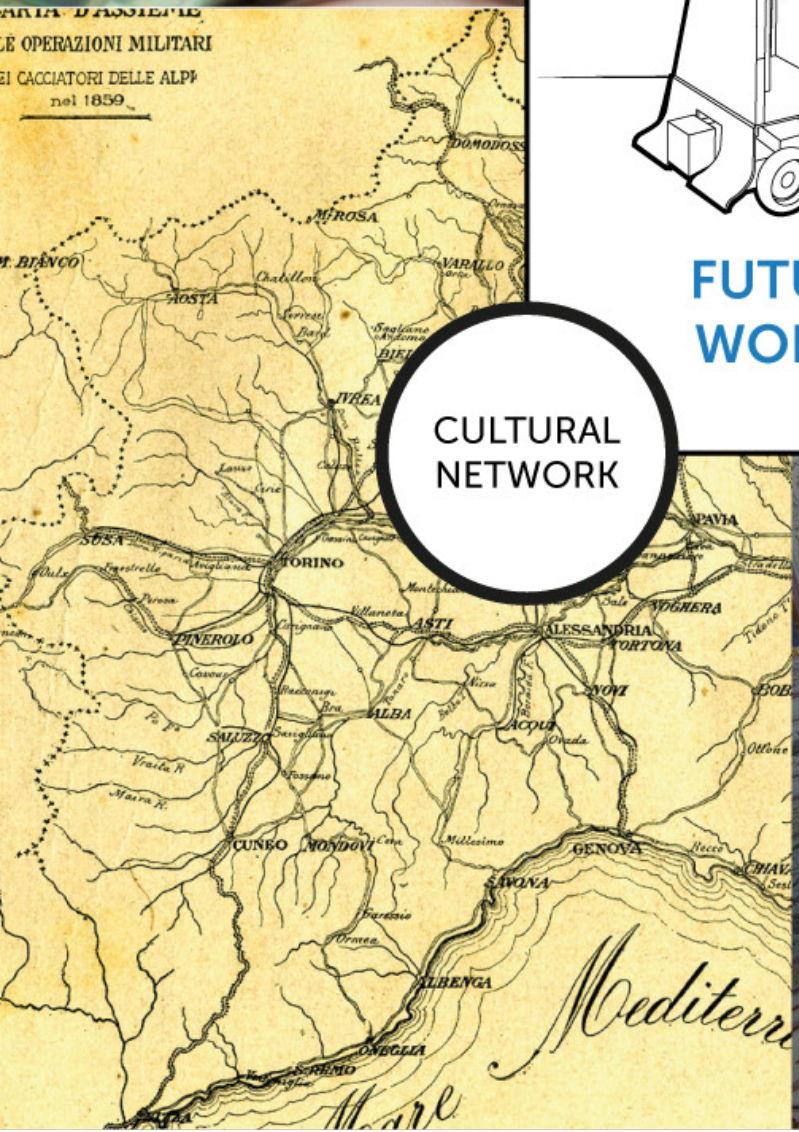
TEST WITH DISABLE USER



FUTURE WORKS

CULTURAL NETWORK

EXPLORE NEW AREAS



6.5 Dissemination and award

the project is described in the following publications:

FULL PAPERS

- Giuliano, L., Roboethics Design: How Cultural Approach Design Could Change The Robotics Human Interaction. The 13th International Conference On Intelligent Autonomous Systems, Ias13, Padova, Italy, 2014, Isbn: 978-88-95872-06-3
- Germak, C., Giuliano, L., Lupetti, M., Robots And Cultural Heritage: New Museum Experiences. Eva London, London, Uk, 2015, Isbn: 978-1-906124-65-6.
- Germak, C., Giuliano, L., Lupetti, M., Ethic Design For Robotics: Place Man And Cultural Context On The Center Of The Project: Case Study On Robotics In Museums, 13th Conference On Practical Applications Of Agents And Multi-Agent Systems Paams'15, At Salamanca, Spain, 2015, Isbn 978-3-319-18943-7
- Germak C., Lupetti. M. L., Giuliano L., 2015. Ethics of Robotics Aesthetics. Proceedings of Desform 2015, aestheCcs of interacCon: dynamic, mulCsensory, wise. 9th InternaConal Conference on Design and SemanCcs of Form and Movement, October 13-17, 2015, Milan, Italy.
- Kaouk Ng, M.; Primatesta, S.; Giuliano, L.; Lupetti, M.L.; Russo, L.O.; Airo Farulla, G.; 2015, A cloud robotics system for telepresence enabling mobility impaired people to enjoy the whole museum experience. DOI:10.1109/DTIS.2015.7127391. pp.1-6. In 2015 10th IEEE International Conference on Design & Technology of Integrated Systems in Nanoscale Era (DTIS) - ISBN:978-1-4799-1999-4
- Maria Luce Lupetti, Luca Giuliano, Claudio Germak, 2016, Virgil Robot at Racconigi's Castle: a Design Challenge, HCITOCH 2016 Seventh International Workshop on Human-Computer Interaction, Tourism and Cultural Heritage; Turin, Italy September 7 – 9, 2016 , ISBN: 978.88.96.471.58.6 :: DOI: 10.978.8896471/586

JOURNALS

- Germak, C.; Lupetti, M.; Giuliano, L.; Kaouk Ng, M. Robots and Cultural Heritage: New Museum Experiences, JOURNAL OF SCIENCE AND TECHNOLOGY OF THE ARTS, Volume 7, N°2 – december 2015, ISSN: 1646-9798 (online)

POSTER

- Germak, C.,Kaouk Ng, M.E., Giuliano, L., Lupetti, M., Virgil A Robot Museum Experience. Study On The Opportunity Given By Robot Capability To Integrate The Actual Museum Visit, Intetain, 7th International Conference On Intelligent Technologies For Interactive Entertainment, Turin, Italy 2015

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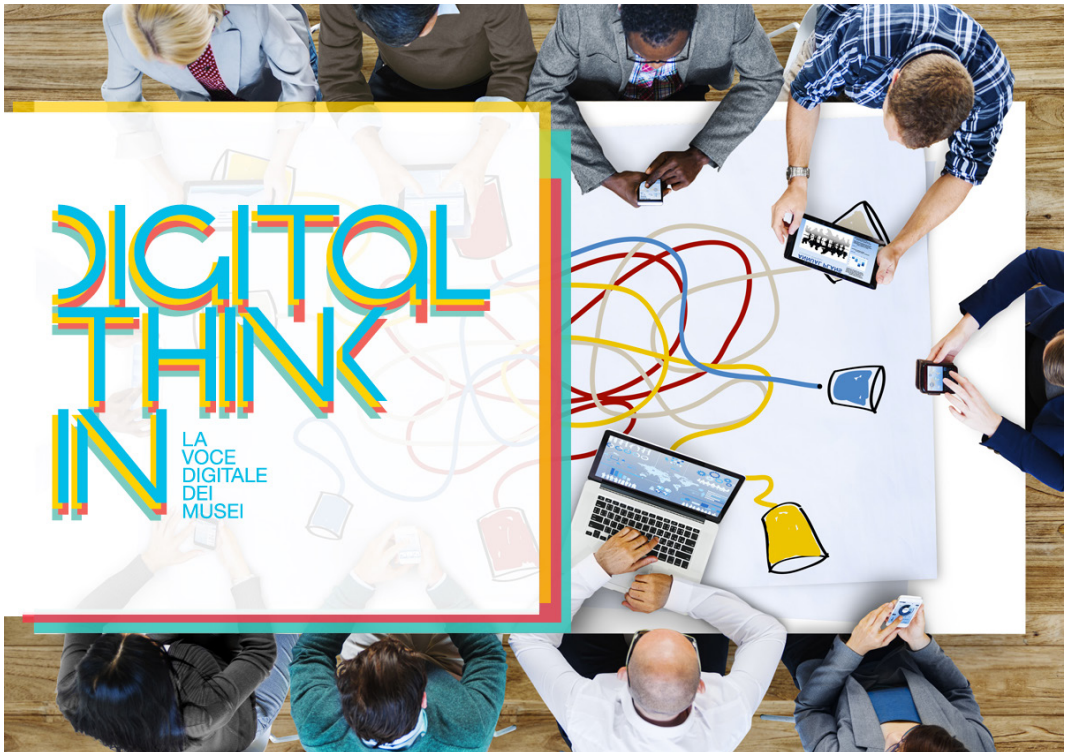
AWARD

- Virgil, un robot a corte La robotica al servizio della fruizione museale – Real Castello di Racconigi; DIGITAL THINK-IN. La voce digitale dei musei



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