Enhancing Portuguese Public Services: Prototype of a Mobile Application with a Digital Assistant

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TRABALHO DE PROJETO SUBMETIDO COMO REQUISITO PARCIAL PARA OBTENÇÃO DO GRAU DE MESTRE EM AUDIOVISUAL E MULTIMÉDIA

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DECLARAÇÃO ANTI PLÁGIO

Declaro ser a autora do presente trabalho de projeto, elaborado de acordo com os requisitos estipulados para o término do curso de Audiovisual e Multimédia para obtenção do grau de mestre nesta área. Todas as fontes consultadas estão devidamente mencionadas e assinaladas nos espaços para o efeito.

Ana Beatriz Duarte

RESUMO

A inteligência artificial (IA) está a transformar a forma como interagimos com a tecnologia, incluindo a forma como os cidadãos acedem e interagem com os serviços públicos. Portugal desenvolveu uma estratégia nacional para a adoção da IA, a fim de melhorar a experiência e o envolvimento dos cidadãos, com destaque para a inclusão digital e a digitalização da administração pública. Apesar dos progressos, o país está atrasado em relação a outros países da União Europeia no que respeita à transformação digital. Para simplificar e modernizar os serviços públicos, Portugal introduziu o portal ePortugal, que inclui o chatbot "Sigma" e uma assistente virtual, que neste momento ainda se encontra numa versão de teste.

A adoção de sistemas de IA conversacional, como os assistentes de voz e os chatbots, tem o potencial de reduzir os encargos administrativos, melhorar a acessibilidade e aumentar a participação dos cidadãos. Este projeto visa conceber uma aplicação móvel para o ePortugal, que inclui uma assistente digital equipada com funcionalidades de texto e voz.

Palavras-chave: Inteligência artificial, Assistente digital; Assistente de voz; Design de serviços, Confiança; Sistemas de IA fiáveis

ABSTRACT

Artificial intelligence (AI) is transforming the way we interact with technology, including how citizens access and engage with government services. Portugal has developed a national strategy for AI adoption to improve the citizen experience and engagement, with a focus on digital inclusion and the digitalization of public administration. Despite progress, the country lags behind other European Union countries in digital transformation. To simplify and modernize public services, Portugal has introduced the ePortugal portal, featuring a chatbot named "*Sigma*" and a virtual assistant that is currently being tested.

The adoption of conversational AI systems, such as voice assistants and chatbots, has the potential to reduce administrative burdens, improve accessibility, and enhance citizen engagement. This project aims to design the ePortugal mobile application, featuring a digital assistant equipped with both text and voice functionalities.

Keywords: Artificial Intelligence, Digital assistant; Voice assistant; Service Design, Trust; Trustworthy AI systems

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ABBREVIATIONS

AI Artificial Intelligence

GUI Graphical User Interface

HAI Human-Agent Interaction

HCI Human-Computer Interaction

IUI Intelligent User Interface

IxDF Interaction Design Foundation

UCD User-Centered Design

VUI Voice User Interface

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Artificial intelligence (AI) is revolutionizing the way we interact with technology daily. From online services like Netflix and Instagram to chatbots and virtual assistants on our phones like Siri and Google Assistant. With society's increasing digital transformation, the significance of AI is only set to grow. By automating daily tasks and facilitating personalized experiences, AI has the potential to enhance productivity, innovation, and efficiency across various industries.

The field of AI is swiftly advancing in both research and technology applications, with the potential to significantly transform public services. In the foreseeable future, AI technology holds the potential to automate everyday tasks, facilitating public employees to dedicate more time to high-value work, with estimates suggesting that up to 30 percent of their time can be freed up (Viechnicki & Eggers, 2017). Furthermore, AI can assist governments in designing better policies, making more informed decisions, and improving communication and engagement with citizens and residents. By upgrading the speed and quality of public services, AI can enhance productivity and efficiency, leading to significant benefits for society.

As a result of recent advancements in AI, governmental organizations worldwide have begun to implement chatbots in various areas of their operations. The integration of AI chatbots into public sector operations is driving the development of citizen-centric models that can offer personalized services and facilitate efficient communication channels between citizens and government entities. These conversational interfaces possess a significant potential for enhancing public services and can serve to mitigate obstacles to interactions with governmental entities.

Conversational AI systems, such as voice assistants and chatbots, have been gaining traction in various industries and can offer a convenient and efficient means of interacting with public services. Voice assistants, for instance, can help citizens navigate public services by providing voice-guided assistance for accessing information, improving the accessibility for individuals with visual or physical impairments. Meanwhile, chatbots can offer 24/7 support for frequently asked questions, provide information on services, and guide users through online processes. These systems have the potential to reduce administrative burdens and enhance citizen engagement by providing a more seamless and personalized experience.

As per a report conducted by EY on behalf of Microsoft, 65% of European public organizations surveyed acknowledge the significance of AI and consider it a priority, with 67% having already incorporated at least one AI application into their operations (Microsoft & EY, 2020). Nevertheless, the implementation of AI

technology within government services is subject on the availability of resources and the level of trust citizens have in both the technology and the government. The most immediate and beneficial opportunities for AI integration in government services lie in reducing administrative burdens, resolving resource allocation problems, and managing complex tasks. The use of AI in governmental processes can enable employees to allocate their time more efficiently, which in turn can enhance citizen engagement and improve service delivery. As public services often fail to satisfy citizens, AI may serve as a means of bridging the gap and enhancing trust in both the technology and the government entities. Ultimately, the relationship between citizens and government may be strengthened with AI technology in government services.

Considering the current situation of digital transformation, this project aims to design a unified virtual assistant to interact with multiple government platforms in the Portuguese context, leveraging the capabilities of AI technology. The goal is to improve the user experience by providing a more user-friendly and intuitive interface that is equipped with voice capabilities for increased accessibility. The purpose of this project is to design and develop a mobile application prototype for the ePortugal, which will include a digital assistant equipped with both text and voice functionalities. The goal is to enhance the user experience of Portuguese State services and provide a centralized platform for easy access to information on these services, ultimately improving electronic access to government services.

The project is divided into six chapters. The first two chapters focus on the state of the art in human-agent interaction and human trust in artificial intelligence. The first chapter discusses the evolution of human-computer interaction and the emergence of human-agent interaction in the age of AI. It explores the challenges and opportunities of designing and developing agent-based mechanisms that enable rich and natural interaction between humans and agents, while also considering the potential downsides of such interactions. Covering topics such as software agents, the role of user interfaces, intelligent user interfaces, and voice user interfaces. The second chapter covers various aspects of developing trustworthy AI systems, including the role of trust in AI, the European Union framework for building such systems, the significance of service design for developing reliable and trustworthy AI systems, and the relevance of e-government in this context. The chapter also presents a case study on Bürokratt. The third chapter presents the results of the eight user interviews that were conducted to understand the user needs and the relevance of the project. These findings were fundamental in shaping the project to meet user needs and preferences, forming the foundation for optimizing the mobile application functionality. Chapter four focuses on the project conception. It encompasses the delineation of the target audience, the establishment of user personas, benchmark, the establishment of requirements and functionalities, mapping out the user flow, and the subsequent design process of the prototype. Chapter five, it is dedicated to the visual identity of the user

interface, providing a comprehensive explanation of the foundations used such as the layout grid, colour palette, typography choice, and iconography. Chapter six is dedicated to the presentation of the developed prototype. In chapter seven, the project is concluded by summarizing the key findings and highlighting the implications of the research. Additionally, recommendations for the further development and implementation of the project are discussed.

1 HUMAN-AGENT INTERACTION

Until the late 1970s, only specialists in computer science could interact with computers. This situation, however, changed with the development of personal computers, allowing anyone to become a computer user. As personal computers became more popular, user experience problems became more evident. Consequently, the field of human-computer interaction (HCI) started to be developed, driven mainly by human factors, psychology, and computer science. HCI, as an interdisciplinary field, adopts a human-centered design approach in order to develop digital products that can meet the needs of its users (MacKenzie, 2013; Grudin, 2005 & 2012; Carroll, 2014).

Human-computer interaction is constantly evolving in response to technological advances. Initially, HCI was concerned with how a user would interact with a desktop computer, being mainly concerned with the user interface, since it was important to design and evaluate the interface of a computer system so that ordinary users could perform their work in a computer easily. It was at this time that the concept of usability got a lot of attention, to which usability testing became an important task (Grudin, 2005 & 2012; Kim, 2015). In the late 1990s, mobile innovation began, and HCI was no longer limited to desktop computers. The possibility of performing multiple actions and providing feedback on a small screen with a limited number of buttons became a focus within the HCI research community (Kim, 2015). In 2007, many companies, like Apple, LG, and HTC, launched new models of mobile devices. These new models were no longer equipped with keyboards, instead, they were replaced with touchscreens. This resulted in a significant shift in how users interact with computing systems, with people nowadays expecting to be able to touch, select, and sort on every screen (Lee & Zhai, 2009).

As we enter the age of artificial intelligence, we are witnessing the beginning of a new technological wave, facing a similar challenge compared to when personal computers were first introduced. It is predicted that technology will become more ubiquitous, with homes, workplaces, and public spaces becoming smart, anticipating and adapting to the needs of their inhabitants and visitors, powered by AI and using big data to shape and refine their decision-making. In such environments, interactions will not only be conscious and intentional, but also subconscious and even unintentional. Users' location, attitudes, emotions, habits, intentions, culture and thoughts can be used as input commands to a variety of visible and invisible technological artefacts embedded in the environment, and this information will be communicated "naturally" from one counterpart interaction to another. In such technological environments, robotic and agent-based systems will be incorporated (Stephanidis, et al., 2019).

Thus, there has been a significant interest in the research field that focuses on human interaction with agents. While HCI studies the interaction between humans and computers, the purpose of the field of human-agent interaction (HAI) is to design and develop agent-based mechanisms that enable rich and natural interaction between humans and agents. Hence, the research focus is on systems, models, applications and methodologies that can allow humans and agents to interact, collaborate, and negotiate (Prada & Paiva, 2014).

In contrast to HCI, in HAI, there is "autonomy" on the machine side, resulting in richer, decentralised, and emergent interaction. However, HAI has its downside, because as humans, when we interact with agents, our expectations are high, which makes it more difficult for an agent to keep up with the high expectations that are created. Therefore, the interactions between agents and humans may lead to miscommunication, deadlocks, and hand-holding issues and so on. For this reason, HAI needs to consider both the design of systems in which humans are interacting with agents - whether or not embodied - as well as the study of types and styles of interactions that occur once humans and agents get together. On the other hand, the main goal of HAI is to improve the interaction between users and agent-based systems, which makes these systems feasible and sensitive to users' needs, mindsets and, overall, specific human characteristics (Prada & Paiva, 2014).

To ensure human-agent interaction, researchers from the HCI, artificial intelligence and social sciences fields have provided design frameworks, guidelines, processes and tools to assist in the success of HAI. Thus, the field of HAI is multidisciplinary, relying on the expertise and work of many fields, such as cognitive science, HCI, psychology, behavioural economics, affective computing and sociology, among others (Prada & Paiva, 2014; Subramonyam, 2021).

Norman (1994) pointed out that to provide a smooth interaction, both designers and developers have to focus on the way people perceive agents and the extent to which people feel comfortable and can accept the agents' automated and autonomous actions. To accomplish this, some factors must be considered, such as ensuring that the user can be in control of their computing systems while taking privacy into account; considering the nature of human-agent interaction; implementing built-in safeguards to prevent uncontrolled computation; providing clear expectations (to reduce possible false expectations as much as possible); and keeping complexity hidden while the underlying operations are simultaneously revealed.

In this chapter, we will cover topics such software agents, the role of user interfaces, intelligent user interfaces and voice user interfaces.

1.1 Software agents

Since the early days of computer science, people have fantasised about creating software programs that can think and act like humans. Popular notions about androids, humanoids, robots, cyborgs, and science fiction creatures have permeated our culture, and have subconsciously shaped our perception of what software agents are (Bradshaw, 1997).

The concept of an agent was first introduced in the mid-1950s when John McCarthy and Oliver Selfridge proposed a "soft robot", a system that, when given a purpose, would perform the proper proceedings, and be capable of seeking and receiving guidance, whenever it got stuck (Kay, 1984). However, agent research only became serious in the 1970s with the emergence of the Distributed Artificial Intelligence field. This field is closely linked to the work of Carl Hewitt (1977), who presented the "Actor Model". In this model, Hewitt introduced the idea of an agent as a self-contained, interactive, and performative entity, which he referred to as an "actor". The object has encapsulated its internal state and can respond to messages from other similar objects (Nwana & Ndumu, 1998).

Since then, the term agent has been widely used in many research fields, ranging from computer science, psychology, and sociology to human-computer interaction (Silva & Delgado, 1997). However, despite the big efforts, researchers have yet to agree on a common definition for agent (Wooldridge & Jennings, 1995; Nwana, 1996; Bradshaw, 1997).

When we look up the term agent in the dictionary, we get at least one of the following definitions: a person who acts on behalf of another person or group; a person or thing that takes an active role or produces a specified effect; the means by which something occurs or is achieved. These definitions don't imply what an agent does. However, they do imply that an agent is expected to act to achieve a specific goal.

Given that there are different perspectives among researchers, there are many definitions for agent. Pattie Maes (1993) proposed that an agent is a computational system that inhabits in a complex and dynamic environment and can perceive it and act autonomously within it, in order to accomplish a set of objectives that were delegated. Smith, Cypher and Spohrer (1994) considered an agent as a persistent software entity that is dedicated to a specific purpose. Russell and Norvig (1995) suggested that an agent can be anything that perceives its environment through sensors and acts in that environment through actuators, functioning continuously and autonomously through internal organisational mechanisms, articulating with external elements from the environment. Hayes-Roth (1995) focused on the problem-solving abilities of an agent, stating that they have to perform such functions as perceiving dynamic conditions in its environment; taking action to change conditions within its environment; and reasoning to interpret perceptions, solve problems,

draw inferences, and determine actions. Wooldridge and Jennings (1995) defined an agent as a piece of hardware, or a software-based computer system that possesses some level of autonomy, interacts with its environment and other agents, and exhibits pro-activity.

Many other researchers have also attempted to define the concept of agent. Overall, those definitions are similar to the ones mentioned above, however, they impose more limitations when considering a system as an agent. Franklin and Gasser (1996) attempted to come up with a more generic definition by comparing a set of different well-established definitions in the artificial intelligence research community, from which the agents described in such definitions constitute sub-classes. They argue that an agent is a system that is situated in an environment of its own and perceives it and acts upon it through time, acting from its own motivations without the need to consult other entities, with the purpose to interfere in its own future perceptions.

Rather than struggling with its definition, Nwana (1996) recognised that it is difficult to provide a clear definition for software agents given to its applicability in different circumstances and contexts, which leads to a lot of discussion. Stating that it is preferred to use it as an umbrella term so that it can cover a range of other and more specific types of agents.

As a result, a variety of terminologies and synonyms have emerged, the most common being software agents, intelligent agents, autonomous agents, softbots (software robots), knowbots (knowledge-based robots), taskbots (task-based robots), personal assistants and personal agents, among others (Nwana H. , 1996). Some designations are used interchangeably to refer to the same type of agents, and their use depends on the preference of the researchers. For instance, the terms “intelligent agents” and “software agents” are commonly used in similar contexts, however, some researchers argue that the agents that currently exist have too little intelligence or none, and that the term “intelligent” is associated with a lot of problems, so they prefer the term “software agents” (Nwana H., 1996; Shneiderman & Maes, 1997; Lucena, 2003).

Although the definition of a software agent varies, there is an agreement among researchers regarding certain attributes, emphasising autonomy, pro-activity, reactivity, social ability, and persistence. Autonomy is based on the principle that the system can act independently from external users and other agents and has control over its own actions and internal state. An important aspect of autonomy is pro-activity, which means that the system does not simply act in response to its environment, it can take the initiative in order to pursue its pre-defined goals. The ability of an agent to perceive its environment and respond to changes in it in a timely manner is referred to as reactivity. The fourth attribute is the social ability, which implies the capacity of an agent to interact with other agents and possibly with its users. Temporal continuity is

another aspect to be considered. It consists in the persistence of identity and state over a long period of time. Given that the activities of the agents usually involve a series of actions that extend over a certain period of time, it is important that they be stable in order to maintain the integrity of the whole process (Wooldridge & Jennings, 1995; Franklin & Graesser, 1996; Bradshaw, 1997; Silva & Delgado, 1997; Nwana & Ndumu, 1998; Reis, 2003).

1.2 The role of user interfaces

There are several definitions of the concept of interface, nevertheless, in the broad sense, an interface can be defined as the intermediary that allows the interaction between the user and the machine. Negroponte (1995) defined interestingly what a user interface is, referring to it as "the place where bits and people meet", suggesting that an interface is "the image" that the user perceives of the system and the communication channel between the user and the computer.

According to Zhang (2010), a user interface is the methods and devices used to facilitate the interaction between computers and human beings that perform two fundamental tasks: it provides the communication of information from the computer to the user and the communication from the user to the computer.

As our lives have become so dependent on computer and electronic systems, the design of interfaces is, without doubt, one of the most important aspects to consider when developing an application. Whilst the application is being developed, it is necessary to consider that users judge designs quickly and are concerned with usability and likeability (Lindgaard, Fernandes, Dudek, & Brown, 2006). When analysing an interface, the most important thing for the user is to determine whether the tasks they intend to perform will be carried out easily and with minimum effort.

The interface is where the user makes the first contact with a system. This first impression can immediately influence the user's opinion. To exemplify, let's consider a system that has great skills and functionalities, yet its interface is not seen as user-friendly, the user may form a negative opinion about the system. In the same way, a system may be weak, but its interface can be engaging to the user, leading to a positive first impression. Designing interfaces that make a positive difference is a challenge, considering that it is difficult, if not impossible, to satisfy all potential users.

1.2.1 Usability

Usability is an important aspect of user interface design, as it directly impacts user experience and can ultimately determine the success or failure of a product. According to the ISO 9241-11 standard, usability

is defined based on the effectiveness, efficiency and satisfaction in a specified context of use (ISO, 2019). Effectiveness is concerned with the analysis of objectives and how they can be achieved. Efficiency is the number of resources used in relation to the results archived. And satisfaction is defined by the users' acceptability of the product (ISO, 2019).

When designing an interactive product like a smartphone, a television or even a calculator, it is important to go beyond its functional capabilities and consider factors such as usability, effectiveness, and user satisfaction. Thus, it is essential to consider the context of the product's use and the target user audience. Different groups of people may have unique needs and requirements, so it is important to take these factors into account during the design process. A key objective in product design is to optimize the user's interaction with the interface, ensuring that it aligns with their expectations and supports their activities effectively.

To achieve this goal, the design process should follow an iterative, parallel, and incremental approach, incorporating continuous user feedback (Nielsen, 2011). By actively seeking and incorporating user input, designers can identify areas for improvement, introduce new features, and enhance existing ones. Involving users throughout the design process allows the product to continuously evolve based on real user experiences and preferences. This user-centered approach aligns with the principles emphasized by usability expert Jakob Nielsen. By considering user feedback, designers can create interfaces that better meet users' requirements and enhance their overall experience. Nielsen highlights five important aspects of usability: learnability, efficiency, memorability, errors, and satisfaction (2012).

Learnability refers to how easy it is for users to learn how to use a product (Nielsen, 2012). To put it differently, it focuses on the ease with which users can understand the system's functionality and how to interact with it. Learnability is essential for new users who are unfamiliar with the product and need to learn how to use it effectively (Nielsen, 2009).

Efficiency concerns the speed with which users can perform tasks once they have learned to use the product (Nielsen, 2012). A product with good efficiency allows users to accomplish their goals in a timely and effortless manner, without unnecessary steps or delays (Nielsen, 2009).

Memorability evaluates how easily users can remember how to use the product after a period of time has passed (Nielsen, 2012). A highly memorable product allows users to remember how to use it easily, reducing the need for relearning and minimising frustration (Nielsen, 2009).

Errors assess the frequency and severity of errors made by users while interacting with the product (Nielsen, 2012). A product with good usability should minimize the occurrence of errors and provide clear feedback to help users recover from any errors that do occur. The severity of errors should also be considered, as some errors can have more serious consequences than others. By minimizing errors, a product can improve user satisfaction and prevent frustration (Nielsen, 2009).

Satisfaction measures users' overall attitude towards using the product, including their level of enjoyment, ease of use, and likelihood of recommending the product to others (Nielsen, 2012).

Designers need to prioritize usability throughout the entire design process to ensure that the final product meets the expectations and needs of the users. User-centered design (UCD) is an effective approach that places users at the forefront of the design process. UCD is an iterative process that uses investigative and generative methods and tools such as surveys, interviews, and brainstorming to understand user needs. The term UCD was coined in the 1970s and was later popularized by usability engineering expert Donald Norman in his work on improving user experience (IxDF, n.d.)

With the insights gained through this process, designers can create interfaces that are intuitive and meet the users' needs. However, it's essential to test these interfaces with users to identify and address any usability issues. Usability testing is a crucial part of the design process, as emphasized by the Interaction Design Foundation (IxDF). IxDF highlights that usability testing helps to ensure that the product is usable and meets the needs of its intended users. The testing involves real users testing the product to identify any usability issues and provide feedback on how to improve it. Usability testing can be conducted in various ways, such as remote testing, in-person testing, and moderated or unmoderated testing (IxDF, n.d.).

Conducting usability testing enables designers to identify and address usability issues before the product is released to the public, which can save time, money, and potential frustration for the end-users (IxDF, n.d.). In order to ensure a positive user experience, usability is a critically important aspect to consider. Neglecting usability may lead to users abandoning the product and seeking better options if they encounter problems with it. Therefore, to address usability issues, user-centered design and usability testing are required.

During the design and testing phase, it is important to consider the context in which the software is going to be used. As Simões-Marques and Nunes (2012) point out, the context shouldn't be ignored as it plays an essential role in the usability of the product. Considering the context of use during design and testing helps to ensure that the product meets the needs of its users in the real world. Therefore, understanding the context of use is crucial to designing and testing a product that meets the needs of its intended users.

When designing user interfaces, there are several interaction design principles that can be considered to ensure the usability and effectiveness of the interface. Among the many principles proposed by various researchers and practitioners, the principles proposed by Shneiderman, Norman, and Nielsen are widely recognized and commonly used. The eight golden rules of interface design proposed by Shneiderman, Norman's seven principles of interaction design, and Nielsen's ten heuristics provide designers with a comprehensive set of practical guidelines for creating user interfaces that are simple to use, intuitive, efficient, and meet users' needs and expectations.

1.2.2 Ben Shneiderman's eight golden rules

Ben Shneiderman, a distinguished computer scientist and human-computer interaction researcher, has made notable contributions to the field of HCI. In his book *Design the User Interface*, Shneiderman (1987) presented eight rules for designing user interfaces that have become widely accepted and continue to be influential nowadays.

The first rule is to *strive for consistency*, which concerns designing interfaces in a way that they have similar operations and employ similar elements to accomplish similar tasks. Warnings, menus, and help screens, for example, must all use the same terminology.

As for the second rule is to *enable frequent users to use shortcuts*. The reason for using the shortcut is to save time or to boost the performance of an advanced user, as hidden commands are frequently used by experienced users to speed up their performance. As an example, both Windows and Mac systems allow their users to use keyboard shortcuts to copy and paste, so that as users become more experienced, they can navigate and operate the interface faster and more effortlessly.

It is crucial that users understand where they stand and what is happening, so the third rule is to *offer informative feedback*. There are some aspects to consider, in particular the response time and visibility of the feedback.

Design dialogues to yield closure is the fourth rule. Sequences of actions should be organised into groups with a beginning, middle, and end. At each stage of the process, the user is informed of what is already finished and what are the next steps. For instance, in online stores like Amazon, the user is guided through the purchasing process using detailed dialogues, allowing the user to see the current stage of the process and the step in which the current operation is. This makes it easier for the user to navigate and also gives them a sense of security.

A good user interface should avoid as many errors as possible. Nevertheless, in case something goes wrong, the system has to make it easy for users to understand and to fix the problem. Therefore, the fifth rule is to offer *error handling*. This rule is to prevent errors from happening and to provide simple error handling or recovery when an error happens.

The sixth rule is to *permit easy reversal of actions*. Users can quickly recover from the error by undoing all previous actions. If users know there is an easy way to solve a problem, they will be less anxious and more willing to explore the system.

When the system provides the user with a sense of total control over the actions taking place in it, it allows a sense of freedom, which helps to bring the user some reassurance. For that reason, the seventh rule is to *keep users in control*, which empowers users to be the initiators of the action.

The eighth rule, and last, is to *reduce short-term memory load*. As human information processing in short-term memory is limited, interfaces must be as simple as possible with a proper hierarchy of information, focusing on recognition rather than recall. Recognising something is easier than remembering it, since recognising it involves the perception of signs that assist us in accessing our memory.

1.2.3 Donald Norman's seven principles

Donald Norman is a cognitive scientist and usability engineer who has made significant contributions to the fields of HCI, user experience design, and cognitive psychology. He is a former Vice President of Apple and a co-founder of the Nielsen Norman Group, a user experience consulting firm. Norman's work emphasizes the importance of designing products that are not only functional but also user-friendly and intuitive to use. In his book *The Design of Everyday Things* (1988), he presented seven design principles which are known as: *discoverability*, *feedback*, *conceptual model*, *affordances*, *signifiers*, *mappings* and *constraints*.

Discoverability is the ability to recognise what actions can be taken on a system. It is considered an important characteristic of a product from the perspective of user experience. Feedback, conceptual model, affordances, signifiers, mappings and constraints are the six principles that lead to discoverability.

The visible response that the user receives when performing any interaction is known as *feedback*. It informs the user that their input has been received and is being acted upon, and whether that action was successful or not must also be communicated. This will improve the user experience by preventing them from being left wondering what happened and ending any negative feelings of uncertainty they might feel.

A *conceptual model* explains, usually with simplified visualisations, how a product with which we interact works. For instance, the bin icon displayed on a computer desktop assists the users in creating a conceptual model of where to put unwanted files.

Affordances refers to the correlation between an item's appearance and its use. It is Norman's most difficult and misunderstood concept, and it is defined as the relationship between the properties of an object and a person's ability to understand how the object works. A mug, for example, has high affordance because we can tell how to hold it just by looking at it. Once designed, an affordance must be visible, and that is why we have signifiers. These are the descriptors that express how an object should be used. Looking at the mug as an example, it has a handle that signifies where to pick up the mug.

Mapping is the relationship between the layout of controls and the devices being controlled. What users consider intuitive mapping is usually related to their conceptual model of a product. Natural mapping is the easiest way to ensure a good mapping, which means a mapping that can lead to an intuitive understanding because the representation of the functionality of the controls is done according to both physical analogies and cultural standards. For instance, when we intend to close a window that is open on our computer, the close button is displayed as a cross icon.

As for *constraints*, these are referred to as design elements that restrict a set of actions, thus providing guidance to the users' actions and simplifying interpretation. A grey out button is a good example of a constraint. A greyed-out button indicates to the user that it is disabled.

Norman (1988) also debated how people tend to blame themselves when something goes wrong when interacting with a digital product. This situation can lead to a sense of inability to learn, with users believing they are "technically inept". However, poor design is frequently the problem. The author advised on how to avoid such situations and suggested designing techniques to suppress error messages and replace them with help and guidance in a way that makes it possible to fix problems directly from the help and guidance messages, rather than interrupting and making users start again. Furthermore, thorough implementation of feedback, conceptual model, affordances, signifiers, mappings and constraints are expected to reduce the possibility of errors and enhance their fast resolution. The mentioned techniques can be implemented in digital environments to avoid the induction of a negative emotional state, as well as the waste of time and mental effort of users.

1.2.4 Jakob Nielsen's ten heuristics

Jakob Nielsen is a well-known name in the fields of HCI and user experience design. As a co-founder of Nielsen Norman Group, he has been an integral part in advocating for the best practices and providing consulting services in these areas. Nielsen's contributions include the development of a set of heuristics for evaluating the usability of interfaces, which have become widely recognized and used by designers and researchers. The original set of nine heuristics was developed in collaboration with Rolf Molich in 1990 and was later expanded to ten heuristics in 1994 (Nielsen, 1994). These heuristics provide a framework for evaluating and improving the usability of digital products and have been influential in shaping the field of the user experience design.

Thus, there are ten heuristics, which are as follows:

1) *Visibility of system status* advises that the system should always keep users informed about what is happening, through appropriate feedback within a reasonable amount of time.
2) *Match between system and the real world* suggests that the system should speak the users' language, with words, phrases, and concepts familiar to them.
3) *User control and freedom* emphasizes that users should be able to undo and redo their actions, as well as exit and enter the system, easily and without any barriers.
4) *Consistency and standards* promote the use of consistent and recognizable interface elements throughout the system, as well as following platform conventions.
5) *Error prevention* suggests that the system should be designed to prevent errors from occurring in the first place.
6) *Recognition rather than recall*, which encourages the use of visible and easily accessible options and objects, rather than relying on users' memory and recall.
7) *Flexibility and efficiency of use* advocates for the system to accommodate users' different needs, skills, and preferences, allowing for shortcuts, customization, and other means of facilitating efficient interaction.
8) *Aesthetic and minimalist design*, which stresses the importance of visual clarity and simplicity, avoiding unnecessary elements that can distract or confuse users.
9) *Help users recognize, diagnose, and recover from errors* advocates that the system should provide clear and informative error messages, and help users recover from errors when they occur.

10) Help and documentation promotes the provision of user support and documentation, as needed, to help users understand and use the system effectively.

These heuristics are broad guidelines for interaction design and were developed to assist expert evaluators in identifying usability issues (Nielsen, 1994). They are widely recognized and commonly used in usability research, as they provide a comprehensive set of practical guidelines for creating user interfaces that are easy to use, intuitive, efficient, and meet users' needs and expectations.

1.3 Intelligent user interfaces (IUI)

Interface technology has evolved from the early command-line interfaces to the well-established use of graphical user interfaces (GUI) for most software applications (Shaikh, Sawand, Khan, & Solangi, 2017).

For a long time now, GUIs have been the main form of interaction between humans and computers. The GUI based interaction style has made computers easier to use. However, as the way we use computers evolves and computers become more omnipresent, the need for a new type of interactive user interface begins (Turk, 2001).

Currently, technology is so advanced that tasks such as face detection, recognition of emotion, speech and body behaviour have become possible. It is undeniable that GUIs are a powerful way of interaction, nonetheless, it has drawbacks that become evident as the complexity of the computing environment escalates. The two major drawbacks of GUIs are the limitations of direct manipulation, as well as the limited space for indirect management. Advanced technologies, as mentioned above, are dynamic, performing in real-time situations, so they require flexible interfaces that can be used in such situations (Bradshaw, 1997; Shaikh, Sawand, Khan, & Solangi, 2017).

Such interfaces are being developed with the help of the ongoing research conducted in the artificial intelligence and HCI domains, which are known colloquially as intelligent user interfaces (IUIs). It is expected that such interfaces will provide to its users' numerous benefits, such as adaptability, context-sensitivity, and task assistance while maintaining the traditional interface principles such as learnability, usability, and transparency (Maybury & Wahlster, 1998).

As it's known, the HCI domain is mainly focused on seeking solutions that can build efficient and delightful interfaces. In contrast, the research in the AI field handles automation techniques and the construction of

software agents to support users in accomplishing their tasks. Consequently, the term IUI suggests the interface is perceived as "intelligent" by the user to some extent. Therefore, understanding the user is essential so it is possible to meet their goals and needs (Helldin, Bae, & Taylor, 2019).

Chignell and Hancock (1989) consider IUIs as interfaces that facilitate mechanisms that help reduce the cognitive distance between the user's mental model and how the task is presented by the computer to the user when performing the task. Maybury and Wahlster (1998) state that IUIs purpose is to improve the efficiency, effectiveness, and naturalness of human-computer interaction. In doing so, these interfaces can use the user's knowledge, tasks, tools and content, as well as devices to assist in interaction across different contexts of use (Maybury, 2001).

To achieve its purpose, IUIs must be capable of representing the knowledge they have about their users, the tasks they are allowed to perform through the user interface, the context of use, in which the user will interact with the system, and the ability to interpret inputs and generate appropriate outputs based on all the data that has been collected and the knowledge that has been acquired (Maybury, 2001).

IUIs are seeking to solve problems that current interfaces cannot, such as determining the needs of an individual user while attempting to maximise the effectiveness of the communications with the user to create personalised systems, by assisting in the manipulation of new and complex systems, assuming tasks from the user, thus reducing the information overload resulting from searching for information in large databases or complex systems. By filtering out irrelevant information, the interface can reduce the cognitive load on the user, as well as can propose new and useful sources of information not known to the user. In addition, IUIs can also facilitate alternative ways for human-computer interaction, such as speech and gestures. Making computers easier to use and more accessible to all people, including those with disabilities (Ehlert, 2003).

In this sense, if the IUIs overcome the current interface problems, the next generation of interfaces will be able to adapt to their user and environment. Thus, the efficiency of communication would be maximised considering the user's needs (Ehlert, 2003).

1.4 Voice user interface (VUI)

Speech is the natural way for people to communicate and, as technology evolves and becomes smarter, the use of speech as an input seems to be the most adequate (Padgett, 2017).

A voice user interface (VUI) allows people to use their voice as input rather than their hands when interacting with computers and devices (Padgett, 2017). Prompts, grammar, and dialogue logic (also known as call flow) are the components of a VUI. All recordings or synthesised speech played to the user during a conversation are referred to as prompts. Grammars specify the possible information that speakers may say in response to each prompt. The system can only understand words, sentences, or expressions that are part of the grammar. The system's actions are dictated by the logic of the dialogue. For instance, answering to what the caller has said or reading information gathered from a database (Olofsson, 2018).

The purpose of designing a voice interface is to improve the efficiency and simplicity of the interaction between humans and computers when compared to a GUI (Padgett, 2017). Using speech as an interaction tool comes more naturally than pressing, dragging, or tapping on a screen and keyboard. It is considered to be beneficial if a computer communicates in a "more natural way", taking advantage of the human's communication capacity and thus creating an efficient and effective way of exchanging and interpreting information (Kamm, 1995).

Compared to GUIs, voice interfaces have unique characteristics that can be valuable to users. The primary advantage is that it gives the possibility to the user to interact with an interface, without having his hands occupied or demanding a visual focus on it, allowing the execution of simultaneous tasks (Pearl, 2017). Furthermore, VUI can improve accessibility for users who are blind or have motor impairments (Shneiderman, 2000). Since voice interfaces do not require manual handling, people with physical or motor limitations can interact with these interfaces easily (Nielsen, 2003).

VUIs are increasing in popularity, with voice assistants such as Siri, Google Assistant, and Alexa becoming widely available to users (Padgett, 2017). Nonetheless, despite some significant technological advances (like deep learning approaches applied in speech recognition), the design of interactions with VUIs has been slowly progressing as their popularity grows. At the moment, voice systems lack the "natural" and "conversational" features that have been advertised and that users expect from such systems. The lack of feedback from the system and error correction difficulties seems to remain in the current VUI systems. This leads to the current VUIs failing to meet users' expectations (Murad, Munteanu, Cowan, & Clark, 2021).

As VUIs are still relatively new, voice interface design presents some flaws. Most interface designers may not yet have acquired expertise in designing such interfaces. Designers are most likely currently developing VUIs that are based on standard GUI design principles. However, because audio and speech are the primary means of interaction, designing for voice interaction introduces new usability challenges that do not exist in GUIs (Murad, Munteanu, Cowan, & Clark, 2021).

Given the differences in interfaces, it is impractical to apply the same design guidelines to voice interfaces as to GUIs (IxDF, Voice User Interfaces, 2022). There are no visual affordances in a voice interface, thus when looking at a VUI, the users do not have clear indications about what the interface can do or what their options are. Therefore, it is important that when designing the interface actions, the system should state clearly which options are possible for interaction, informing the user of the features they are using and limiting the amount of information it provides to an amount that users can remember (IxDF, Voice User Interfaces, 2022).

Companies like Google (2018) have been developing guidelines for conversation design and the universities are revising their design curriculums to include the challenges that VUI designers face. However, as this research domain is considered to be new, there are still no standard guidelines to follow (Murad & Munteanu, 2020).

In her book, *Designing for Voice User Interfaces*, Pearl (2017) interviewed Chris Maury, a voice technology expert, about the best practises for VUI design to improve system accessibility. It was suggested that VUI should prioritise personalisation over personality. For instance, allowing the user to choose which text-to-speech voice they wish to hear. It is also important to keep the information short. In a voice interface, there should be no skips like what happens with GUIs, where a user can quickly shift its attention between different sections. Thus, it is only important to give the most relevant information.

A VUI should also allow the user to interrupt anytime, so whenever the system detects speech of any kind, it immediately stops playing the current prompt and starts to listen. Furthermore, the interactions should be time efficient, meaning that VUI has to try to keep the interactions as few as possible (Pearl, 2017).

On top of that, a VUI must provide context, which means guiding users in what they can do. In GUIs, this does not represent as much of an issue, but for voice interfaces, the discovery of features is almost inexistent. As a result, a VUI should be able to help to inform the user on how to respond or what they can do, however, in some cases this is not enough. In such instances, it is recommended an explicit orientation action, meaning the user should be able to ask for help at any time and that the system can guide them towards their current context (Pearl, 2017).

In conclusion, as VUIs continue to grow in popularity, it is imperative for designers to acquire the necessary knowledge to effectively design for these emerging interfaces. While VUIs have unique benefits such as enabling multitasking and improving accessibility, designing for them poses challenges due to their lack of visual affordances and the need for clear and concise communication. Therefore, designers must prioritize

personalization, provide context, and offer explicit orientation actions to create effective and efficient VUIs that meet users' expectations and needs. As VUIs are still relatively new, designers are continuing to develop best practices and guidelines for their design, and improving the usability of voice-based interactions is a crucial first step in making these interfaces successful. By defining design principles that align with the characteristics of VUIs, designers can create intuitive and user-friendly interfaces that enhance the user experience.

2 HUMAN TRUST IN ARTIFICIAL INTELLIGENCE

Artificial intelligence has been studied for decades and remains one of the fascinating topics in computer science due to its complexity and ambiguity. The term "artificial intelligence" was coined in 1956 by John McCarthy, who described it as "the science and engineering of making intelligent machines" (McCarthy, 2007).

Nowadays, AI is considered one of the most promising new technologies in the world, encompassing algorithms, systems and machines that can simulate intelligent human behaviour. Machine learning, natural language processing, and neural networks, to name a few, are examples of such technologies that enable machines to autonomously recognise, understand, act, and learn through the interaction between human and machine (Kopalle, et al., 2022).

Artificial intelligence can be found in almost every aspect of our lives. From making our everyday lives easier with online search recommendations, voice assistants and facial recognition logins, to facilitating advances in healthcare, AI is indeed a disruptive technology with far-reaching impacts. So far, the impact of artificial intelligence in society has been mostly positive, providing valuable contributions that have made our lives easier; one good example of this is the virtual and home assistants that have improved our daily routines (Defined.ai, 2020).

Due to its fast speed of processing and storage capacity, AI can help to reduce errors and risk in the execution of tasks, automate repetitive processes, adapt to user's preferences, or even improve the accuracy of training systems for highly qualified professionals. Despite its potential to bring benefits to society, AI technology is still encountering challenges in its development. Often, AI professionals focus too much on algorithms and fail to consider users' needs, which can lead to the failure of many AI systems. Moreover, when AI is trained with biased or incorrect data, it can produce biased and even harmful results, which can be particularly troublesome when AI is used for decision-making in businesses and government services (Scott & Yampolskiy, 2019; Xu, Dainoff, Ge, & Gao, 2021).

Notwithstanding the potential benefits of AI technology, its adoption and deployment may have been hindered by concerns around safety, accountability, and transparency. Reports in the media of accidents and failures linked to AI might result in a lack of trust among users and stakeholders, who can be hesitant to rely on AI systems in their decision-making processes. To promote wider acceptance and use of AI, it is essential to address these concerns and enhance the overall trustworthiness of AI systems.

Trust is an essential factor that underpins the acceptance and adoption of AI technology. The presence of trust among users and stakeholders promotes progress in the development and deployment of AI systems, contributing to their continued growth and evolution (Rodrigues, 2021). Trust is the belief that an entity, such as a system or technology can perform as expected and achieve its intended objectives without leading to any harmful or undesirable outcomes. In the context of AI, trust is vital as AI systems are being employed more frequently in applications that have significant consequences for people's lives, such as healthcare, finance, and transportation, where errors or inaccuracies can have severe repercussions.

To mitigate concerns surrounding trust in AI systems, researchers and practitioners are exploring different solutions, incorporating strategies to improve transparency and accountability in decision-making processes and the development of more effective regulation frameworks. This chapter will delve into three central topics: the concept of trust and its role in AI adoption and deployment, the European Union framework for building trustworthy AI, and the importance of service design in developing AI systems that are reliable and trustworthy. Additionally, we will explore the concept of e-government and its relevance in the context of developing trustworthy AI systems. Furthermore, we will explore a case study on Bürokratt, an innovative project currently under development in Estonia, which seeks to revolutionize the manner in which citizens interact with public services by leveraging the capabilities of AI technology.

2.1 Trust in technology

Trust is a complex and multifaceted concept that has been studied extensively in various fields, including philosophy, psychology, sociology, and computing (Rodrigues, 2021). It plays a crucial role in human interactions, especially in the context of technology, where trust is often a decisive factor in the adoption and use of technological innovations, as it helps to reduce social and technical complexity (Mayer et al., 1995; Gefen et al., 2003; Söllner et al., 2016; Balaskas et al., 2022; Choung, et al., 2022).

Trust is a term that is often defined as an individual's willingness to place reliance on another party due to their perceived characteristics (Mcknight et al., 2011). Mayer et al., (1995) claimed that trust is the willingness to be vulnerable to the actions of another party, based on the expectation that the other party will act in a manner that is trustworthy. This willingness to be vulnerable stems from the fact that the trustor is dependent on the trustee to act in their best interests, and that the trustee has the opportunity to exploit this dependence for their own gain (Johnson-George & Swap, 1982; Baier, 1986; Kee & Knox, 1970; Choung et al., 2022).

There has been considerable discussion about trust in technology, with the belief that putting more focus on trust could facilitate the determination of the qualities that make technology trustworthy. This can be

achieved independently of the people and human structures surrounding the technology (Mcknight et al., 2011).

Trust is usually measured by three human-like trusting beliefs: integrity, competence, and benevolence (Mayer et al.,1995; Lankton et al., 2015). Ability concerns to the trustee's skills, competencies, and attributes that allow them to exert influence in a given domain. Integrity is concerned with the degree to which the trustee follows to a set of principles that are deemed acceptable by the trustor. Lastly, benevolence denotes the degree to which the trustee's motivations and intentions align with those of the trustor. Since people tend to anthropomorphize technology and attribute human characteristics to it, researchers have used these humanlike trusting beliefs to study trust in technology (Lankton, McKnight, & Tripp, 2015). Thus, these factors are widely recognized as fundamental components of trustworthiness, and their perceived presence or absence can play a significant role in establishing and maintaining trust in various contexts, whether they relate to individuals or organizations (Srinivasan, 2019).

In contrast, it is important to note that, when considering trust in technology, these attributes may not be applicable, as they may lack the ability to make choices or act ethically without being pre-programmed to do so. Hence, some researchers have developed alternative trust belief constructs that do not assume technologies possess volition or ethical decision-making capabilities (Lankton, McKnight, & Tripp, 2015). For instance, Lippert and Swiercz (2005) proposed a technology trust model that is based on the individual's specific expectations of the technology's predictability, reliability, and utility. In comparison, Söellner et al., (2012) identify performance, process, and purpose as the three key beliefs that signify trust in technology. Meanwhile, McKnight et al., (2011), proposed that trust in technology can be measured through its reliability, functionality, and helpfulness, which are derived from human-like trust attributes of integrity, competence, and benevolence. These system-like beliefs are aligned with human trust but are less likely to violate humans' understanding of technology capabilities. Reliability refers to the belief that the technology will consistently function properly, functionality means that the technology has the necessary features to meet users' needs, and helpfulness entails the belief that the technology will provide adequate and responsive assistance.

The literature is unclear on whether using human-like or system-like trust constructs is more appropriate in different contexts, and the choice of construct may impact the results. Lankton et al., (2015) propose operationalizing a technology's humanness on a continuum between system-like and human-like, based on individuals' perceptions of its person-like or technology-like characteristics.

According to Andras, et al., (2018) there is three levels of trust: inductive trust, social trust, and moral trust. Inductive trust is based on personal past experience, while social and moral trust are necessary to establish trust in a human-machine relationship where inductive trust is not possible. The authors suggest that to support initial trust formation, an AI system needs to be transparent, which is why the concept of "trustworthy AI" has emerged in recent research. This concept aims to address the perceived lack of transparency in artificial intelligence decisions and foster the rise of trust.

2.2 Building Trustworthy AI: The European Union Framework

The use of AI in various applications has raised concerns about trust in the development and deployment of these systems. To ensure reliable and ethical use of AI and engender trust in its users, it is necessary to have technical solutions, regulatory frameworks, and ethical guidelines. Achieving trustworthy AI requires not only technical solutions but also regulatory frameworks and ethical guidelines that ensure that AI is developed and used in a responsible and transparent manner (Jobin, Ienca, & Vayena, 2019).

The European Union (EU) framework for trustworthy AI aims to promote the development, deployment, and use of AI systems in a way that aligns with human rights and democratic values, while remaining globally competitive. It emphasizes the importance of accountability processes to ensure that AI systems act accordingly and do not compromise ethical values. The framework is based on three components: lawful, ethical, and robust AI, which support the development and deployment of AI solutions. The ultimate goal is to enable a future where everyone can thrive in an AI-based world (AI HLEG, 2019).

To achieve this goal, the first component of the framework requires that the AI system is lawful. It must comply with all applicable laws, regulations, and ethical standards, designed with a clear understanding of legal requirements and with respect for fundamental rights and values, such as privacy, data protection, and non-discrimination. The second component of the framework is ethical AI, which means that the system must respect ethical principles and values. The AI system should promote human well-being, human rights, and democratic values and prevent harm to individuals, groups, and society as a whole. Finally, the third component is robust AI, which means that the system must be technically and socially robust. The AI system should be designed to function reliably and securely, even in uncertain or changing environments, and be resilient to cyber-attacks, misuse, or abuse.

The EU's trustworthy AI framework is based on fundamental human rights protected by EU treaties, the EU Charter, and international human rights law. These rights, which stem from respect for human dignity, include individual freedom, equality, solidarity, citizen's rights, and respect for democracy, justice, and the rule of law. The framework aims to ensure that AI systems uphold these rights rather than undermine them.

Vulnerable groups, such as children, persons with disabilities, and those in situations where power is imbalanced, require particular attention. While AI systems offer significant benefits, the framework recognizes that they also pose risks and potential negative impacts. Therefore, adequate measures should be taken to address these risks throughout the AI solutions' lifecycle in proportion to their severity.

Aside from the aforementioned three components, there are also four important ethical principles that must be followed when creating, using, and deploying AI systems. These principles are respect for human autonomy, prevention of harm, fairness, and explicability. The principle of respect for human autonomy means that people who use AI systems should have the ability to make their own decisions and not be manipulated or coerced by the AI. Human oversight is also important to ensure that AI systems are used ethically. As for the principle of prevention of harm means that AI systems should never cause harm or negatively impact humans, the environment, or other living beings. AI systems must be safe and secure and not vulnerable to malicious use. The principle of fairness is about ensuring that AI systems distribute benefits and costs equitably and without bias, discrimination and stigmatisation. AI practitioners should strive for social fairness and balance competing interests and objectives. People must also be able to contest decisions made by AI systems, and those responsible for the decisions must be identifiable and explain the decision-making process. Lastly, the principle of explicability refers to the need for AI systems to be transparent and openly communicate their capabilities and decision-making processes. This is necessary to build trust in the AI system and to effectively contest decisions. When explanation is not possible, other measures such as traceability, auditability, and transparent communication may be necessary. The importance of explicability and the other ethical imperatives depend on the severity of consequences if the AI system produces inaccurate results.

These four principles are achieved through seven key requirements for trustworthy AI, which should be transparently communicated to stakeholders. Any tensions or trade-offs between the requirements should be documented and communicated, and these requirements apply throughout the entire life cycle of the AI system, depending on the specific use case. The first requirement is human agency and oversight, which involves users being able to make informed decisions and challenge the system. The second requirement is technical robustness and safety, which requires preventative measures to avoid risks and reliable performance. The third requirement is privacy and data protection, which should be ensured throughout the AI system's life cycle. The fourth requirement is transparency, which involves traceability, explainability, and communication. The fifth requirement is diversity, non-discrimination, and fairness, which means identifying and removing discriminatory biases. The sixth requirement is societal and environmental well-being, which involves assessing and monitoring the system's impact. The seventh requirement is

accountability, which involves auditing the AI system and addressing any trade-offs made. An overview diagram of the framework can be found in Appendix 1.

2.3 Service Design and conversational AI systems in e-Government

The convergence of service design and trustworthy AI is particularly relevant in the context of e-Government, where the adoption of digital technologies has transformed the way public services are delivered. The term "e-Government" is an abbreviated form of "electronic government" that refers to the use of digital technologies to provide government services and information to citizens, businesses, and other government entities. E-Government services can range from simple information provision, such as public service announcements, to complex services like tax filing, healthcare, and public safety. Its widespread use dates back to the mid-1990s, when the internet experienced a surge in expansion (Grönlund & Horan, 2005). Nonetheless, the adoption of information and communication technologies in public administration can be traced back to the early days of computer adoption (Yildiz, 2007). E-Government is viewed as both a tool and a goal, with the potential to promote administrative reform (Harfouche & Robbin, 2015).

E-Government has been influential in improving public service delivery by enhancing efficiency, accessibility, and transparency (Al-Besher & Kumar, 2022; Reis, Santo, & Melão, 2019). In recent years, there has been a growing interest in e-Government, which can be attributed to advancements in technology and the changing priorities of government strategies. While the early definitions of e-government were centered on technology and service delivery by public administration, current definitions are more focused on citizen involvement and the democratic process (Harfouche & Robbin, 2015). The emergence of new digital media and artificial intelligence technology has further expanded the range of service delivery channels available to citizens. These channels are classified into three groups: traditional channels, e-government channels, and new digital media. Traditional channels include in-person meetings, voice calls, and postal mail. E-government channels refer to government websites and email. New digital media encompasses text messaging, social media, and mobile apps. Moreover, the development of AI technology has introduced a new type of channel known as "intelligent channels". These channels include chatbots, intelligent assistants, and humanoids (Jakovic & Chandrasegaram, 2021). Through these channels, citizens can communicate their requests and needs to the government, which, in turn, provides them with the necessary services and information.

The adoption of digital technologies has transformed the way public services are delivered through e-Government. However, as the range of services offered through e-Government grows, it becomes imperative to ensure that they prioritize the needs and expectations of citizens while adhering to ethical

principles. This is where the convergence of service design and trustworthy AI can have a significant impact. Service design emphasizes meeting customer needs and enhancing user experience, while trustworthy AI aims to ensure the development and use of AI that is safe, transparent, and ethical. Together, these concepts can support the creation of AI-powered services that not only meet customer expectations but also align with ethical principles.

Service design is an interdisciplinary field that draws on a range of disciplines, including design, management and process engineering (Stickdorn & Schneider, 2011). It is committed to creating and improving services that are user-centered, efficient, effective, and enjoyable. The process of service design typically involves understanding user needs, identifying pain points in existing services, and developing solutions to address those pain points.

In the handbook, This Is Service Design Doing: Applying Service Design Thinking in the Real World (2018), service design is defined as an approach that considers both the customer's and the business's needs when creating services. It uses design thinking to improve and create services that are creative and focused on the customer. By working collaboratively with customers and service teams, organizations can gain a complete understanding of their services and make meaningful improvements.

Modern principles of service design, as described by Stickdorn et al., (2018), emphasize the importance of being human-centered, collaborative, iterative, sequential, real, and holistic in creating and improving offerings for organizations. The human-centered principle requires that service designers consider the experience of all those affected by the service. The collaborative principle emphasizes the importance of actively engaging stakeholders from various backgrounds and functions in the service design process. The iterative principle suggests that service design is an exploratory, adaptive, and experimental approach, iterating toward implementation. The sequential principle recommends that the service should be visualized and orchestrated as a sequence of interrelated actions. The real principle highlights the need for service designers to research needs in reality, prototype ideas in reality, and demonstrate intangible values as physical or digital reality. Finally, the holistic principle advocates that services should sustainably address the needs of all stakeholders through the entire service and across the business.

Service design is a practical approach that employs research, prototyping, and a set of comprehensible activities and visualization tools to create and manage experiences that fulfil the requirements of the business, user, and all other stakeholders (Stickdorn et al., 2018).

Conversational AI systems can have a significant role in improving citizen engagement and service delivery in the context of e-government. For instance, conversational AI systems like chatbots and voice assistants can provide citizens with constant support and assistance, day or night. However, the success of these systems depends on their design with the principles of service design and trustworthy AI in mind, as conversational AI systems rely on natural language processing and machine learning algorithms to understand user intent and provide personalized responses (Pearl, 2017; Hall, 2018). Therefore, designers should focus on creating conversational AI systems that are not only user-centered and efficient but also transparent, secure, and ethical. Such systems can help e-Government organizations build trust with citizens and enhance the overall quality of their services.

To achieve this goal, service design principles such as collaboration, iteration, and human-centered design can be applied to ensure that the system is optimized for user needs and preferences. For instance, collaboration can be used to involve users in the design process of these systems, ensuring that their needs and preferences are considered. This can involve conducting user research, focus groups, and usability testing to ensure that the conversational AI system is optimized for users. An example of this approach is the development of Eno, a chatbot designed by Capital One. The responsible design team conducted thorough user research and worked closely with customers to gain insights into their financial management needs. As a result of this process, they were able to develop a tailored system that offers users a smooth and effortless experience (Capital One, 2017; Hay, 2017).

When designing conversational AI systems, it is essential to follow the principles of transparency in service design to ensure that users' concerns about data usage are addressed and trust is built. Shneiderman's (1987) golden rules of interface design and Norman's (1988) principles of design can help designers achieve this goal by creating interfaces and systems that are transparent, consistent, and easily understood by users. Shneiderman's (1987) principles, such as consistency, feedback, and error prevention, can be applied to create interfaces that are transparent and consistent, providing users with clear and understandable responses to their queries about data usage. Norman's (1988) principles of design, such as visibility, affordances, and mapping, can be used to create conversational AI systems that are transparent in their behaviour and purpose, reassuring users that their data is being used in a responsible and ethical way.

By incorporating security and privacy features into the design of conversational AI systems, designers can protect users' data from unauthorized access and promote user trust and confidence in these systems. Security features, such as data encryption and access control, can be incorporated into the design to protect user data, while privacy features, such as data minimization and user consent, can ensure that users have control over their personal information (Nielsen, 1999; Google & Ipsos, 2021; Usercentrics, 2023).

Alexa, Google Assistant, and Siri are all examples of conversational AI systems that have been designed with principles of transparency and privacy in mind. For example, Alexa provides users with the ability to review and delete their voice recordings, and Google Assistant has a dedicated privacy centre that allows users to manage their privacy settings (Amazon, 2023; Google, 2023). In addition, both AI assistants utilize encryption to protect user data, and users have the ability to control which data is collected and stored by the system (Amazon, 2023; Google, 2023). Siri also includes privacy features, such as end-to-end encryption for iMessage, Facetime and Mail conversations and the ability for users to control which apps can access their location data (Apple, 2023). These examples highlight the importance of incorporating security and privacy features into conversational AI system design to protect user data and promote trust and confidence in these systems.

Furthermore, iteration can be used to continuously improve and refine conversational AI systems based on user feedback. This can involve monitoring user interactions with the system, gathering feedback through surveys and interviews, and adjusting the system based on that feedback. Iteration can also involve incorporating new features and capabilities into the system based on user feedback. By applying these principles, designers can help to ensure that AI systems are transparent, secure, and trustworthy, providing users with a smooth and effortless experience while mitigating potential risks associated with the misuse of user data.

2.4 Bürokratt: Case study

The digitalization of government services has become a global trend, as countries recognize the potential benefits of using technology to improve public services and reduce bureaucracy. Estonia has been at the forefront of this movement, with its successful e-government system, known as e-Estonia. Now, Estonia is taking its digital transformation efforts to the next level by leveraging AI through Bürokratt, a visionary initiative that aims to transform the way citizens interact with public services.

2.4.1 Background

Estonia’s journey towards digitalization began in the 1990s when the country gained independence from the Soviet Union. The government recognized the potential benefits of digitalization and began investing in the development of an e-government system. The goal was to make the government more efficient and improve public services for citizens (Kozák, 2018).

The Estonian e-government system, known as e-Estonia, has been developed in layers over time, with the first layer being the X-Road system, which was launched in 2001. The X-Road is a secure data exchange

platform that allows different government agencies to share data with each other. It has played a critical role in enabling the integration of different government services in Estonia (Kozák, 2018).

The e-Estonia system has been successful in reducing bureaucracy and improving public services. It allows citizens to access a range of services online, including digital identification, digital signatures, electronic tax filing, online medical prescriptions and, ultimately, electronic voting (Vassil, 2015). The system has been successful in reducing bureaucracy and improving public services, as evidenced by Estonia's ranking as a top country in Europe for digital public services (European Commission, 2022).

Estonia is now focusing on leveraging AI to enhance its e-government services, and the Bürokratt is an example of how Estonia is seeking to achieve this goal. Bürokratt is a concept and a platform that is currently in development in Estonia, with the aim of enhancing the interoperability of AI applications while providing a virtual assistant for e-state services.

2.4.2 Bürokratt

Bürokratt is a visionary initiative by the Estonian government aimed at transforming the way citizens interact with public services through the use of AI. It is designed to be an interoperable network of AI applications that enable citizens to access public services through a virtual assistant using voice-based interaction (European Commission, 2022).

The Estonian government has been investing in AI since 2018, and in July 2019, the government adopted Estonia's national AI strategy, which aims to increase digital skills, fund research and development, and adapt the legal environment to the new challenges brought by AI (Gonçalves, 2022).

Bürokratt is one of the initiatives that emerged from Estonia's national AI strategy. With the help of open-source components that can be reused by the public and private sectors, Bürokratt aims to benefit from the widespread use of mobile devices and the internet to access public services more easily and efficiently (Gonçalves, 2022).

The overarching goal of Bürokratt is to provide a single channel for both public and private sector services to interact and integrate, allowing government AI agents, bots, and assistants, as well as private sector ones, to serve citizens through a unified channel (European Commission, 2022). This will enable citizens to access a broad range of services through a virtual assistant, such as filing consumer complaints, applying for permits, renewing identification cards, reporting car accidents, and borrowing books (European

Commission, 2022). These tasks will become more convenient and efficient for users and more accessible to individuals who may have difficulty navigating traditional interfaces.

It is noteworthy that the Estonian government has a history of successfully implementing digital platforms and services, such as the X-Road, which serves as a long-term mandatory data exchange layer of digital government (MKM, 2021). The government is taking its digital transformation efforts to the next level by leveraging AI through Bürokratt, making public services more easily accessible and usable for citizens.

Creating a secure and reliable network of AI applications that can seamlessly interact with each other presents a significant challenge in developing Bürokratt. The government must work closely with technology companies and experts in the field of AI to ensure the network's robustness and resilience. Moreover, the network must be designed with the needs and preferences of users in mind, necessitating extensive research and user testing.

Despite these challenges, there is a high probability that Bürokratt will be successful. The Estonian government has already begun rolling out the initiative through several agencies, including the Consumer Protection and Technical Regulatory Authority, Police and Border Guard Board, and National Public Library, demonstrating a commitment to the project's success (European Commission, 2022). Additionally, with a considerable investment in digital transformation, the government has shown its determination to make Bürokratt a success (Gonçalves, 2022).

3 RESEARCH SUPPORTING THE DEVELOPMENT OF THE PROJECT

The intention of this project is to design a mobile app for the ePortugal portal, featuring an integrated digital assistant, with a strong emphasis on enhancing user interaction with a wide array of Portuguese public services. The research conducted focused on (1) identifying the specific requirements of Portuguese population when using public services, (2) evaluating the relevance of developing a digital assistant for public services in Portugal, and (3) identifying the most suitable features for the digital assistant based on user needs and preferences.

Considering the objectives presented, a qualitative research approach was chosen. This approach is geared towards obtaining an in-depth understanding of the participants viewpoints, personal experiences, and the knowledge of their daily lives (Rosala & Pernice, 2023)

3.1 Data collection

3.1.1 User interviews

The decision to use interview as the method in this investigation is based on the selection of a qualitative research approach. Qualitative research, distinguished by its focus on exploring the depth and nuance of human experiences, opinions, and insights, necessitates a research method that can accommodate these intricacies. Interviews are particularly well-suited for this purpose due to their capacity to facilitate in-depth dialogues, allowing participants to provide detailed, narrative responses that capture the subtleties and complexities of their perspectives (Nielsen, 1993). In contrast to quantitative methodologies, which primarily deals with numerical data, interviews excel at exploring the “how” and “why” aspects of a research question by employing open-ended inquiries, thereby enabling a comprehensive, context-specific exploration of the subject matter (Nielsen, 1993).

Patton (2002) outlines three methods for conducting interviews: informal conversational interview; standardized open-ended interview; and general interview guide approach. The latter approach, where questions are predefined and presented uniformly to participants, minimizes potential influences. In cases where responses lack depth or clarity, interviewers can pose additional questions to gather more comprehensive and relevant data.

For this project, it was conducted interviews with users to gain insights into their experiences with public services in Portugal. The interviews were designed to identify the most frequently used public services, evaluate overall satisfaction levels, uncover user habits, and collect personal anecdotes. Both offline and

digital interactions with public services were taken into consideration. This approach allowed to discover user experiences, irrespective of the channel (offline or digital) they used to engage with public services. The data collected from these interviews contributed to the development of user personas and the identification of opportunities for enhancing the public service user experience in Portugal.

3.1.1.1 Interview methodology and participants

In the context of this research, between July 25th and August 7th, 2023, eight interviews were conducted with Portuguese citizens residing in Portugal, with participants ages ranging from 24 to 64 years old. The sessions had an average duration of 30 minutes each. Four of them were conducted in person, while the other four were held via Google Meet. In both cases, the audio of the sessions was recorded with the participants consent.

To facilitate the interviews, it was prepared a script with 29 questions (Appendix II). However, these questions were flexible and subject to adaptation based on the interviewee's responses. The approach adopted was intended to give interviewees the freedom to develop their perceptions and opinions.

The interviews were conducted in Portuguese and the script was structured into seven sections: i) introduction to the project; ii) demographic information; iii) access and experience with Portuguese public services; iv) use of virtual assistants; v) familiarity with ePortugal and the relevance of a mobile application for the platform; vi) perspective on the ePortugal virtual assistant; vii) closing remarks. Following the conclusion of the user interviews, all collected data was transcribed, and its contents were analysed.

Name	***Age***	***Gender***	***Nationality***
P1	64 years old	Male	Portuguese
P2	57 years old	Female	Portuguese
P3	27 years old	Female	Portuguese
P4	24 years old	Female	Portuguese
P5	27 years old	Female	Portuguese
P6	30 years old	Male	Portuguese
P7	39 years old	Male	Portuguese
P8	31 years old	Male	Portuguese

Table 1 - Participants

3.1.1.2 Analysis and discussion of the results

Regarding the data analysis, the content analysis technique was used which, as defined by Bardin and cited in the study by Rocha, Gobbi, & Simão (2005), is a technique that allows an in-depth understanding of the meaning present in textual or communicative data. Bardin defines content analysis as "*a set of techniques for analysing communications, aiming, through systematic and objective procedures for describing the content of messages, to obtain quantitative or non-quantitative indicators that allow the inference of knowledge relating to the conditions of production/reception (inferred variables) of the messages*" (Rocha, Gobbi, & Simão, 2005) .

Bardin's content analysis process consists of three stages. The first stage, known as pre-analysis, entails crafting a precise working framework with well-defined yet adaptable procedures, serving as an initial structure for analysis (Rocha, Gobbi, & Simão, 2005). In the subsequent stage, material exploration, the previously established guidelines are put into practice, with the researcher adhering to them (Rocha, Gobbi, & Simão, 2005). Finally, during the results processing and interpretation stage, the researcher, supported by the initial data, endeavours to extract meaningful and valid insights, uncovering relationships and underlying meanings within the analysed content (Rocha, Gobbi, & Simão, 2005).

Thus, the analysis of the interviews was based on four categories that were previously stipulated for the interview script: i) access and experience with Portuguese public services; ii) use of virtual assistants; iii) familiarity with ePortugal and the relevance of a mobile application for the platform; iv) perspective on the ePortugal virtual assistant., which were then divided into subcategories and then the data was analysed, as you can see in the table 2.

Category	**Subcategory**
A. Access and experience with Portuguese public services	1. Preferred Device 2. Service access preference 3. Familiarity with digital service 4. Frequency of digital service use 5. Most used services 6. Overall experience 7. Suggestions for improvement
B. Use of virtual assistants	1. Familiarity with virtual assistants 2. Personal use of virtual assistants

	3. Ease of use 4. Utility of virtual assistants 5. Preferred Services for virtual assistants 6. Situations for virtual assistants use
C. Familiarity with ePortugal and the relevance of a mobile app for the platform	1. Familiarity with ePortugal 2. Relevance of an app for the platform 3. Desired app features 4. Privacy and security concerns
D. Perspective on the ePortugal virtual assistant	1. Awareness of virtual assistant 2. Testing the virtual assistant 3. Opinions on the virtual assistant 4. Potential benefits of a virtual assistant on the platform 5. Scenarios of use 6. Expectations and improvement 7. Concerns or hesitations 8. Comparative effectiveness 9. Suggestions

Table 2 - Interview categories and subcategories

3.1.1.2.1 Access and experience with Portuguese public services

In the first category, the objective was to understand how citizens access and interact with public services offered by the State, especially those that are available digitally. Concerning the paradigm of public service access, a noteworthy observation was the uniformity in approach among all participants. Initially, there was a discernible preference for the use of digital platforms, websites and mobile applications, for the acquisition of information and services. It is noteworthy that this preference was underscored by the perceived convenience and availability of these digital platforms (P1, P2, P5). It was also observed that all participants only turned to telephone contact with service providers or in-person interactions when they were unable to find the information they sought.

Interviewees responses showed a range of opinions regarding familiarity with online public services. While some demonstrated a significant level of familiarity (P1, P2, P3, P6, P7, P8), others highlighted the lack of effective communication from the government to promote greater dissemination of these services (P2, P4, P6). Thus, a more assertive and comprehensive communication strategy is necessary to ensure that all citizens are fully aware of the existence and relevance of these digital public services (P4). Lack of clarity or knowledge about these options may be an obstacle to their wider use (P2, P6).

The most sought-after public services by the interviewees included taxes services (P1, P2, P3, P4, P6, P7, P8), health services (P4, P6), and social security services (P2, P4). Nevertheless, other services, such as citizenship and documents related services (P1, P3, P4), and the ePortugal platform (P5), were also mentioned.

Frustration and dissatisfaction (P2, P3, P4, P5, P6, P7) dominated the participants experiences with digital platforms for public services. The platforms were described as “difficult to use” and “confusing” (P2, P3, P4, P5, P7). The lack of clarity in the interface and the complexity of navigation were highlighted, making the use of these platforms challenging (P2, P3, P4, P5, P7). A participant expressed the feeling that the problem lay more in their own technological skills than in the platforms themselves (P2).

The interviewees offered recommendations to enhance the quality and efficiency of the services. A common suggestion was to centralize information in one place, possibly through an application that aggregates all services (P1, P3, P5, P6). This would aim to simplify access and use of public services, eliminating the need to navigate through multiple platforms. Other recommendations included simplifying menus, improving search functions and making platforms more accessible to users with different levels of computer literacy (P5, P6, P8).

3.1.1.2.2 Use of virtual assistants

The second category intended to investigate the interaction and perception of the interviewees regarding virtual assistants, with a specific focus on their use in accessing public services in Portugal.

All participants displayed familiarity with virtual assistants. Nonetheless, their frequency of using these assistants in daily activities varies. Six out of the interviewed individuals (P1, P2, P3, P5, P6, P7) affirmed using virtual assistants for everyday tasks such as navigation, message reading, and quick searches. Yet, one of the six participants (P2) was sceptical about further use of the assistant due to concerns about the time needed to learn how to use it.

In terms of the ease of use of virtual assistants, one of the participants (P1) considers these technologies as "incipient" and with "lot of limitations". This perspective is shared by other individual (P8), who has not entirely formed an opinion on virtual assistants yet, viewing them as still being in their developing stages despite significant progress over the last few years.

All participants showed some openness to the usefulness of virtual assistants in interacting with public services in Portugal. Five out of eight respondents were of the opinion that these tools could speed up access to the information needed (P1, P3, P5, P6, P7), while two participants showed a willingness to test, highlighting the possible benefits of instant availability (P2, P8). Although, one individual (P4) expressed reservations stemming from prior experiences with chatbots and virtual assistants.

In terms of the desired public services accessible through virtual assistants, participants expressed interest in accessing a diverse array of services, including tax services (P2, P3, P4, P5, P6, P7), citizenship and documentation (P1, P2, P3, P5, P6, P7, P8), and healthcare (P1, P2, P3, P5, P6, P7, P8). There was an emphasis on the use of virtual assistants as a search engine for all these services (P3, P4, P5, P6, P7). The respondents identified different situations in which virtual assistants would be used to access public services, such as making appointments, searching for information and solving problems (P1, P2, P3, P4, P5, P6, P7, P8).

All participants agreed that using virtual assistants could improve their interactions with the State, making them more efficient. However, it is worth noting that some participants also expressed specific concerns regarding the State's ability to adequately develop and implement virtual assistants (P1, P4, P6, P8). Lastly, several desired functionalities were mentioned, such as appointment scheduling (P1, P2, P3, P4, P5, P6, P7, P8), form filling (P2, P3), step-by-step guidance, and access information about the different bureaucratic processes (P2, P4, P6).

3.1.1.2.3 Familiarity with ePortugal and the relevance of a mobile app for the platform

In this category, the objective was to determine participants familiarity with ePortugal and obtain their viewpoints about the possible benefits, desired features, and issues concerning an ePortugal mobile application. It was evident that only a minority of participants (P1, P2, and P5) had previous experience with ePortugal, while the remaining participants (P3, P4, P6, P7, P8) reported no prior exposure to the platform. One participant (P4) reinforced the need for the State to enhance its communication regarding online public services to raise awareness among the population.

The participants presented a variety of viewpoints on the importance of the ePortugal mobile app. Among those acquainted with ePortugal, a common theme emerged, emphasizing the necessity for improved usability, efficient information aggregation, and a more user-friendly interface (P1, P2). Among those who were familiar with ePortugal, the importance of improving usability, efficiently aggregating information and using a more user-friendly interface was generally emphasised (P1, P2). In contrast, some respondents who had no familiarity with ePortugal showed optimism for an app that enables access to public services, highlighting the significance of effective information aggregation and service provision (P3, P4, P6). The only regular user of ePortugal (P5), viewed the app as an opportunity for scheduling public services and receiving notifications, for example, the ability to notify users when documents such as passports, citizen cards and vaccination records are due to expire. The other two participants (P7 and P8) who were initially unfamiliar with ePortugal also endorsed the idea that the application could enhance access to public services by streamlining information retrieval and search functionality. Anticipating that the application would simplify service access and drew attention to features such as notifications, request submissions, and efficient information aggregation, and easy navigation.

Most interviewees highlighted the significance of efficient information aggregation and search features, stating that these would accelerate their access to desired services. In addition, some participants (P2, P3, P7) expressed a desire for submission and document upload features, while one participant (P8) proposed the integration of a feedback system for reporting issues or suggesting application enhancements.

Overall, the interviewees demonstrated a concern for the security and privacy of their personal data when digital platforms. Nonetheless, they also expressed trust in the State's capability to manage and protect such data, based on the belief that public administration possesses the technical expertise (P1, P2, P3, P4, P6, P7, P8). Interestingly, one participant (P5) displayed a slightly more sceptical view, expressing uncertainty regarding the security of the database, despite acknowledging the security of the login process.

3.1.1.2.4 Perspective on the ePortugal virtual assistant

This category delves into interviewees awareness, impressions, and expectations regarding the recently launched ePortugal virtual assistant. Initially, only one participant (P1) was aware of the launch of the new virtual assistant in ePortugal, stating that they only learned about this release because they read a brief news article on the internet. The remaining participants were unaware of the existence of the virtual assistant.

As for the initial impressions of the participants regarding the virtual assistant, it followed a pattern of shared reactions and perceptions. Four participants (P1, P2, P5, P6) experienced initial difficulties with the virtual assistant, characterizing it as "slow". For this group, the combination of the avatar and voice did not

appear natural, and the overall usability of the assistant did not meet their expectations. In contrast, three other participants (P3, P7, P8) presented more diverse reactions, revealing a mix of initial concerns and positive assessments. Some mentioned a negative first impression, influenced by the characterized "unnatural" appearance of the avatar, but they recognized the potential of the voice function (P3, P7). Difficulty locating the voice function was a frequent issue among interviewees (P7, P8). A point of consensus among all participants was the characterization of the avatar as "creepy", emphasizing the "strange movements". In one instance, one of the interviewees (P4), encountered technical difficulties during five consecutive attempts to use the assistant via both voice and text. Effective interaction was only established in the last attempt, which caused significant frustration for the participant.

The combination of the avatar and voice was notable in the participants feedback, significantly shaping their initial impressions. Various perceptions and reactions were expressed towards this combination. The assistant was described as "unnatural" (P2, P4), "strange" (P5, P6, P8), and also "annoying" (P1), "horrendous" (P3), and "scary" (P4, P7). However, some also recognized the potential of the voice feature, despite the strangeness (P1, P3, P7, P8).

As for the perceived benefits of the virtual assistant, all participants recognized the potential utility of the tool, with an emphasis on voice and text functionalities, especially in terms of accessibility and guidance in public services. Participants highlighted potential for enhanced interaction fluency underscoring the importance of a well-developed voice assistant, especially if equipped with an "extensive vocabulary" (P1). The effectiveness of voice technology, specifically in the areas of public service accessibility and guidance, was emphasized by a number of respondents (P2, P3, P6, P8).

Regarding potential use cases, participants identified the assistant's potential for conducting research on services (P2, P4, P7), providing guidance in situations of immediate need (P1, P2, P3, P6, P7), and aiding in accessibility for individuals with mobility challenges (P5, P8). However, they unanimously highlighted that the virtual assistant cannot fully replace human interaction (P1, P2, P3, P4, P5, P6, P7, P8), particularly in more complex contexts such as those involving tax and financial matters, suggesting a complementary approach (P1, P8).

Participants expressed a common desire for prompt responses (P2, P3, P4, P8), the ability to choose different voices for the assistant (P2, P4, P5, P6), and the importance of natural conversation (P1, P5). Furthermore, participants mentioned desired features, including scheduling capabilities and access to the conversation history with the assistant (P5).

Concerns or hesitations were expressed by two participants. It was raised privacy-related issues in interacting with the virtual assistant (P2), and some hesitation based on past experiences with similar tools (P4).

Regarding the improvements suggested by the participants, they highlighted the necessity to enhance the natural and fluid interaction to reduce slow responses (P1, P3, P6, P7, P8). Lastly, one participant (P1) expressed their belief that artificial intelligence could improve service efficiency. However, they stressed the significance of actively promoting the existence of these platforms, considering that many citizens remain unaware of them. Furthermore, some participants displayed curiosity regarding the State's future course of action regarding the virtual assistant's advancement, while acknowledging its current flawed state owing to its testing phase (P5, P6, P7, P8). They articulated a hopeful outlook for the government to persistently invest in enhancing these technologies (P8).

3.1.1.2.5 Discussion of results

After conducting the interviews and collecting and analysing the results, it was possible to verify that, in the context of the way citizens interact with Portuguese public services, there is a clear preference among the participants for the use of digital platforms, namely websites and mobile applications. to obtain information and access services. Convenience and availability of these digital tools reinforce this preference. Telephone contact with service providers or in-person interactions are only used when the digital platforms do not provide the information that is needed. The level of familiarity with online public services varied among the participants, with some demonstrating a high level of knowledge and others highlighting the need for the government to improve its communication in order to promote these services more effectively. The most popular public services were tax services, health services and social security services. Despite the preference for digital platforms, participants often expressed frustration and dissatisfaction with the usability of these platforms. They cited navigation challenges, lack of clarity and interface difficulties that could hinder wider adoption. Centralising information, simplifying menus, improving search functions and making platforms more accessible to users with different levels of computer literacy were the main recommendations made by participants.

The interviews showed that participants were familiar with virtual assistants and used them regularly for everyday tasks such as navigating, reading messages and quick searching. Although the majority of participants recognised the potential benefits of using virtual assistants to access public services, a small number of interviewees expressed scepticism, mainly in relation to the time needed to learn how to use these tools. Public services, including tax, healthcare, and citizenship and documentation, were among the

most desired areas for integrating virtual assistants. Interviewees highlighted the convenience and efficiency of virtual assistants in terms of access to information and problem solving in relation to these services. However, concerns were raised about the capacity of the State to effectively develop and deploy virtual assistants, and the need for speedy delivery of services. It was also highlighted the need for prompt responses, the ability to customise the voice, and the importance of natural conversation for a successful implementation. The general consensus among participants was that while virtual assistants could improve the way people interact with the state, they could not fully replace human interaction in complex contexts such as taxation and financial issues and suggested a complementary approach.

Concerning the familiarity of the participants with the ePortugal platform, it was clear that only a minority of participants had any prior knowledge of the platform, with the majority stating that they weren't aware of its existence. The expectations and opinions of the respondents differed according to their familiarity with the platform, although they expressed a desire for an ePortugal mobile application. The need for improved usability, efficient information aggregation and a more user-friendly interface was emphasised by those familiar with ePortugal. In contrast, participants who were unfamiliar with ePortugal were optimistic about an application that would facilitate access to public services and streamline information retrieval. Desired features included the ability to submit and upload documents, a feedback system and efficient search functions. Concerns were expressed about privacy and data security, although there was a degree of trust in the ability of the state to handle personal data.

Regarding the recently launched ePortugal virtual assistant, the participants showed varying degrees of awareness, impressions and expectations. Only one participant was aware of the existence of the virtual assistant. The first impressions of the virtual assistant were mixed, with some of the participants describing it as "slow" and "strange". The combination of avatar and voice interface elicited mixed reactions, with many individuals describing it as "unnatural", "strange" and even "creepy". However, most of them recognised the potential of the voice functionality. Participants expected the virtual assistant to help with searches, provide guidance and improve accessibility, particularly for those with reduced mobility. Nevertheless, there was a consensus that a virtual assistant could not fully replace human interaction, especially in complex scenarios, such as tax related services. Concerns about privacy and previous experiences with similar tools were raised by some participants. Suggestions for improvement revolved around increasing response speed and naturalness of interaction, and actively promoting the platform to raise awareness among the Portuguese population. Some participants expressed curiosity about the State's future plans for the development of the virtual assistant and emphasised their hope for continued government investment in improving these technologies.

To conclude, we highlight the following as the main conclusions of the interviews carried out:

i. The interviewees prefer digital channels for accessing public services, stating that telephone and in-person interactions are secondary options. However, they face persistent usability challenges, including confusing interfaces and complex navigation, which can hinder their overall user experience.
ii. Participants exhibit a range of familiarity with online public services. Although, the State's communication strategies must improve to ensure broader awareness and adoption of digital services.
iii. Virtual assistants are seen as having the potential to improve how users interact with public services, offering a streamlined and efficient approach. And have the potential to be seen as complementary to human interactions.
iv. Initial user reactions to the ePortugal virtual assistant were mixed, with concerns about usability and the avatar-voice combination. Highlighting that usability improvements and enhancing natural interaction are critical for success.
v. It was expressed concerns about data privacy but there is trust the State's ability to protect their personal information.

4 PROJECT IDEATION AND IMPLEMENTATION

4.1 Purpose of the project

Artificial intelligence is rapidly transforming various aspects of our daily lives, including how we interact with digital devices and services. In recent years, the use of AI has gained significant attention in the public sector, particularly in the realm of public services. This trend is driven by the potential for AI to improve the efficiency, effectiveness, and accessibility of public services, leading to better citizen satisfaction.

However, the adoption of AI in public services is not without challenges, particularly regarding the design and development of AI systems that are reliable, trustworthy, and accessible to all citizens. This challenge is further compounded by the need to design AI systems that can adapt to the unique needs and contexts of each individual user.

Against this backdrop, the purpose of this project is to design and develop a mobile application prototype for the ePortugal, which will include a digital assistant equipped with both text and voice functionalities. The goal is to enhance the user experience of Portuguese State services and provide a centralized platform for easy access to information on these services, ultimately improving electronic access to government services. In accordance with current product development practices, this project will deliver a Minimum Viable Product (MVP), which is characterised as an initial version of the product, containing only essential features needed for basic functionality.

4.1.1 Project overview

Once the literature review phase of the project was finished, our project moved into the development stage. The project followed the double diamond model, a design thinking framework that consists in four phases: discover, define, develop, and deliver.

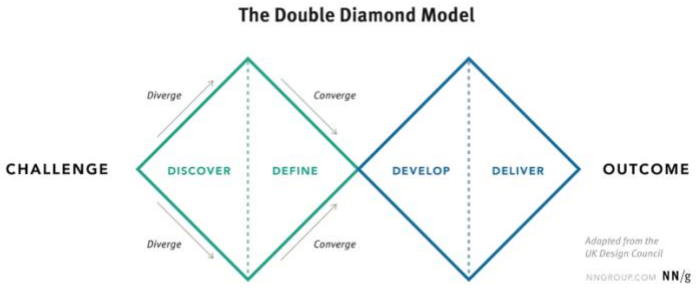

Figure 1 - The double diamond model by (NN Group, 2020)

During the discover stage, user research was conducted to gain insights into user needs and preferences through user interviews. The results of the interviews were analysed and used as the foundation for the next stage of the process, the define phase. This phase involved the conception of two user personas to represent different user types, as well as the establishment of the features that aligned with the users' needs. Additionally, a user flow was created to map out user interactions and ensure a seamless user experience.

Moving into the develop phase, wireframes were designed to visually represent the system layout and content. This stage began with the conception of sketches to gain a better understanding of the necessary screens, which were then transformed into detailed wireframes using Figma. These wireframes served as a foundation for the visual design of the interface of the voice assistant.

In the final stages of the development phase, a functional prototype was developed using Figma, to simulate the product's transitions and interactions, providing a realistic appearance and user experience. With the functional prototype already prepared, the MVP prototype is ready to be delivered for testing.

4.1.2 Project conception

4.1.2.1 Target audience

The ePortugal mobile application is designed to reach a diverse and inclusive audience, including all residents of Portugal, regardless of age or socio-cultural background. Its primary objective is to serve as a comprehensive resource, offering information on Portuguese public services and providing direct links to their respective websites and mobile applications. The overarching goal of the ePortugal mobile application is to enhance the user experience with state services.

4.1.2.2 User personas

A persona constitutes a constructed yet verisimilar representation of a conventional or idealized user for a given product or system. Its principal function lies in fostering empathetic understanding, heightening awareness, and ingraining a lasting impression of the characteristics ascribed to the target user demographic. Moreover, personas serve the pragmatic purpose of facilitating the prioritization of features and informing pivotal design decisions (Harley, 2015).

For this project, three personas were created to represent three user groups, inspired by the data collected in interviews: Leonor, the tech-savvy individual with a cautious approach; António, the senior tech enthusiast.

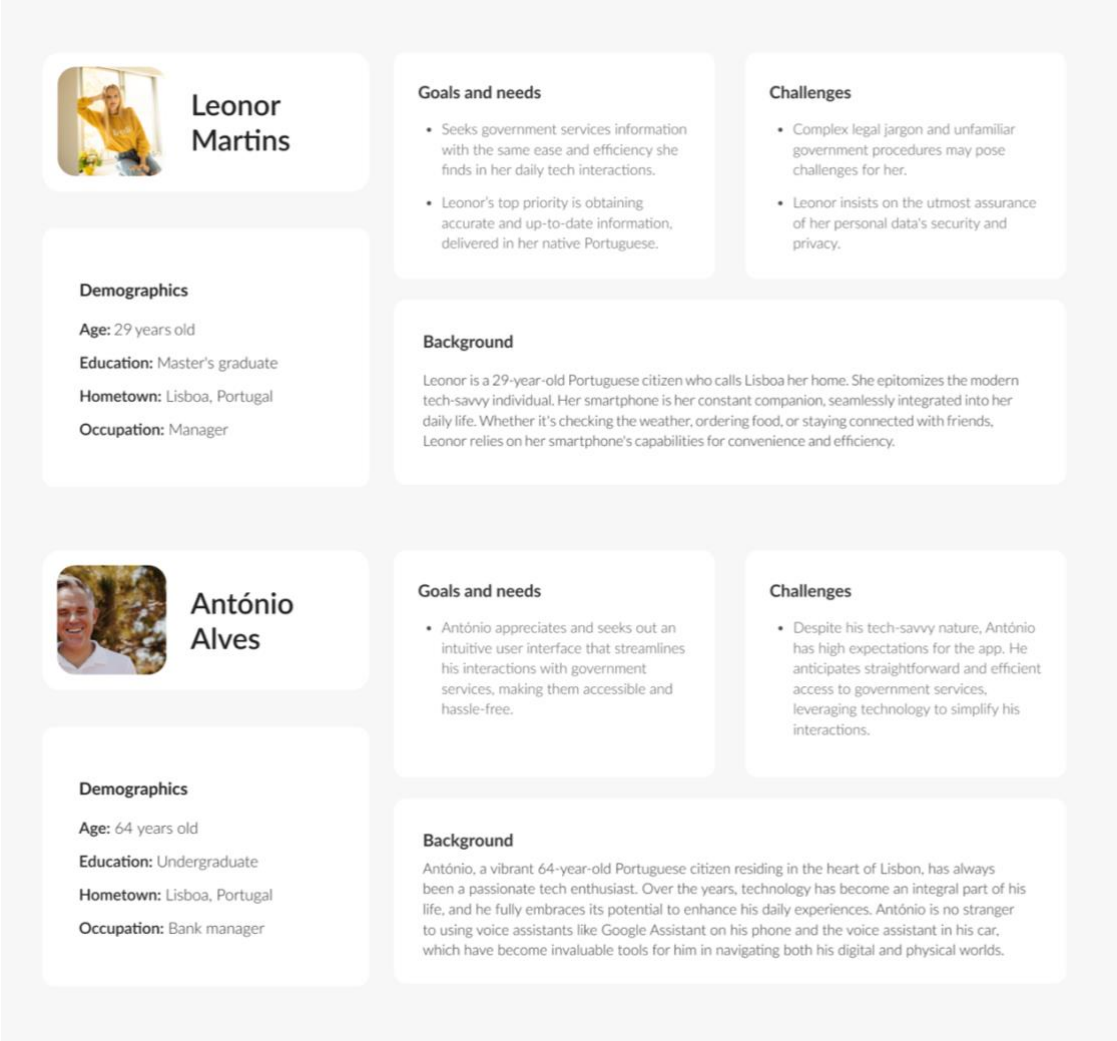

Figure 2 - User personas

4.1.2.3 Benchmarking

In order to determine what is currently being used, a brief benchmarking exercise was conducted. This benchmarking analysis serves the dual purpose of discerning the prevailing preferences and expectations of users while concurrently evaluating a diverse array of Portuguese and international applications dedicated to State services. This analysis encompasses a diverse range of applications, including SNS 24, e-fatura, MyTSA, and MyGov India. Its primary objective is to identify potential differentiators that could serve as unique selling propositions, to draw inspiration from other examples, and to build a comprehensive understanding of user expectations in this area.

a) SNS 24: Is the official Portuguese National Health Service mobile application. Its primarily focused on providing healthcare services. Its functionality includes features such vaccine card access,

medication information, and more, making it a comprehensive tool for managing health-related needs in Portugal. The app is available in both Portuguese and English. The users can securely access the app by logging in with their patient national registry or digital mobile key.

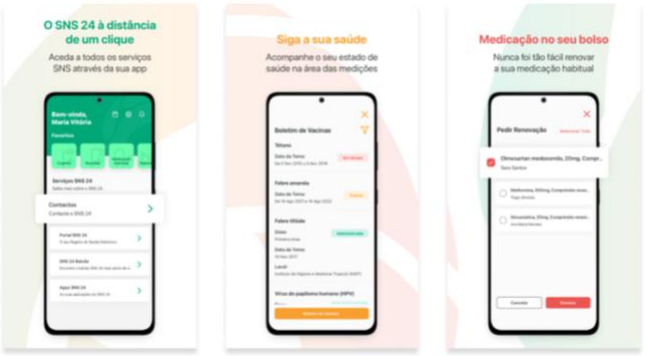

Figure 3 – SNS 24 mobile application

b) e-fatura: Is the official Portuguese Tax and Customs Authority app for consumers to manage their invoices in Portugal. It is possible to classify the type of invoice it is and consult the benefits that are associated. Furthermore, users have the capability to effortlessly register invoices simply by scanning the QR code imprinted on them. The mobile application is only available in Portuguese. Users can securely access the app by logging in with their taxpayer identification number.

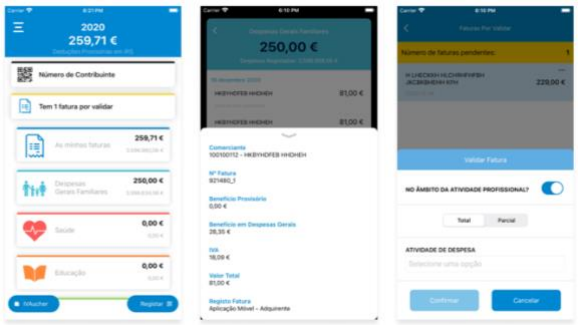

Figure 4 – e-Fatura mobile application

c) MyTSA: Is a mobile application designed to provide information and services related to air travel security in the United States of America (USA). Its functionality includes offering travellers' essential information about security procedures and wait times. A paramount focus lies on the

timely and precise delivery of information, and the application is optimized for real-time updates, thereby elevating the overall travel experience. The app is designed for universal accessibility, eliminating the need for user login, ensuring it caters to all travellers within the USA. The information in the application is only available in English.

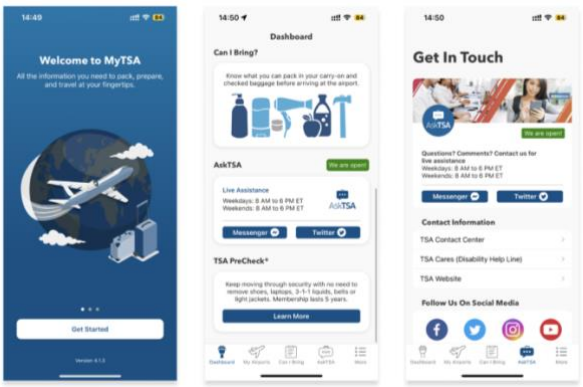

Figure 5 - MyTSA mobile application

d) MyGov India: Is an Indian mobile application that offers access to a wide range of government services, news, and information. Is designed to engage citizens directly in the governance process. It serves as a channel for citizens to share their ideas, comments, and creative suggestions with Central Ministries and related organizations. The platform aims to promote direct participatory democracy by involving citizens in decision-making and fostering a closer connection between the government and the people it serves. The app is available in Hindi and English. Users can easily access the app by logging in with their email, mobile number, or even as a guest.

Figure 6 - MyGov India mobile application

4.1.2.4 Definition of requirements and functionalities

Through a comprehensive analysis of the functionalities within various mobile applications, gathered from the benchmarking analysis and enriched by insights garnered from the interviews, it was determined which functionalities were most relevant to be integrated into the product, aligning it with its intended purpose and user expectations.

a) *Login*: Users can create an account for a personalized experience, or simply use the app as guests. Guest users will be seamlessly redirected to the login screen when needed.
b) *Search*: Enable users to search for content, services, or information using keywords.
c) *Categories:* Organize content into various categories or themes. Allow users to easily browse and explore content by selecting specific categories of interest.
d) *Digital assistant*: Incorporate voice recognition technology for users to interact with the digital assistant using voice commands. Allow users to type their queries and receive responses from the digital assistant. Keep the digital assistant visible and accessible throughout the user's interaction with the app. Have a history of previous interactions
e) *Feedback and support*: Include forms for users to submit feedback, report issues, or request assistance.

4.1.2.5 User flow

A user flow is a structured sequence of interactions that outlines the precise steps required to accomplish a specific task within a product or application. It focusses on the accomplishment of purpose-driven objectives, usually within a brief timeframe and with a limited number of actions (Kaplan, 2023). User flows are represented visually using artifacts like flow charts or diagrams and capture key user steps and system responses (Kaplan, 2023). In essence, user flows provide a detailed and procedural perspective on user interactions within a product, emphasizing efficiency and task completion.

In the context of the current project, a user flow has been devised to streamline interactions with the app's digital assistant. The goal is to understand the path that users need to take in order to locate and effectively engage with the digital assistant. For the purpose of the initial design, it will focus primarily on the *happy path*, which represents the smooth and ideal user journey without errors or complications.

The users are presented with three options to enter the app: signing in, signing up, or entering as a guest. When a user selects the "sign in" or "sign up" option, they are directed to the *autenticação.gov* platform for authentication, ensuring a secure and trusted login process. Following the successful authentication, the

user is automatically redirected to the app's homepage. Inside the app, users can access the digital assistant in two ways: either through a dismissible banner on the homepage or via the app's navigation bar.

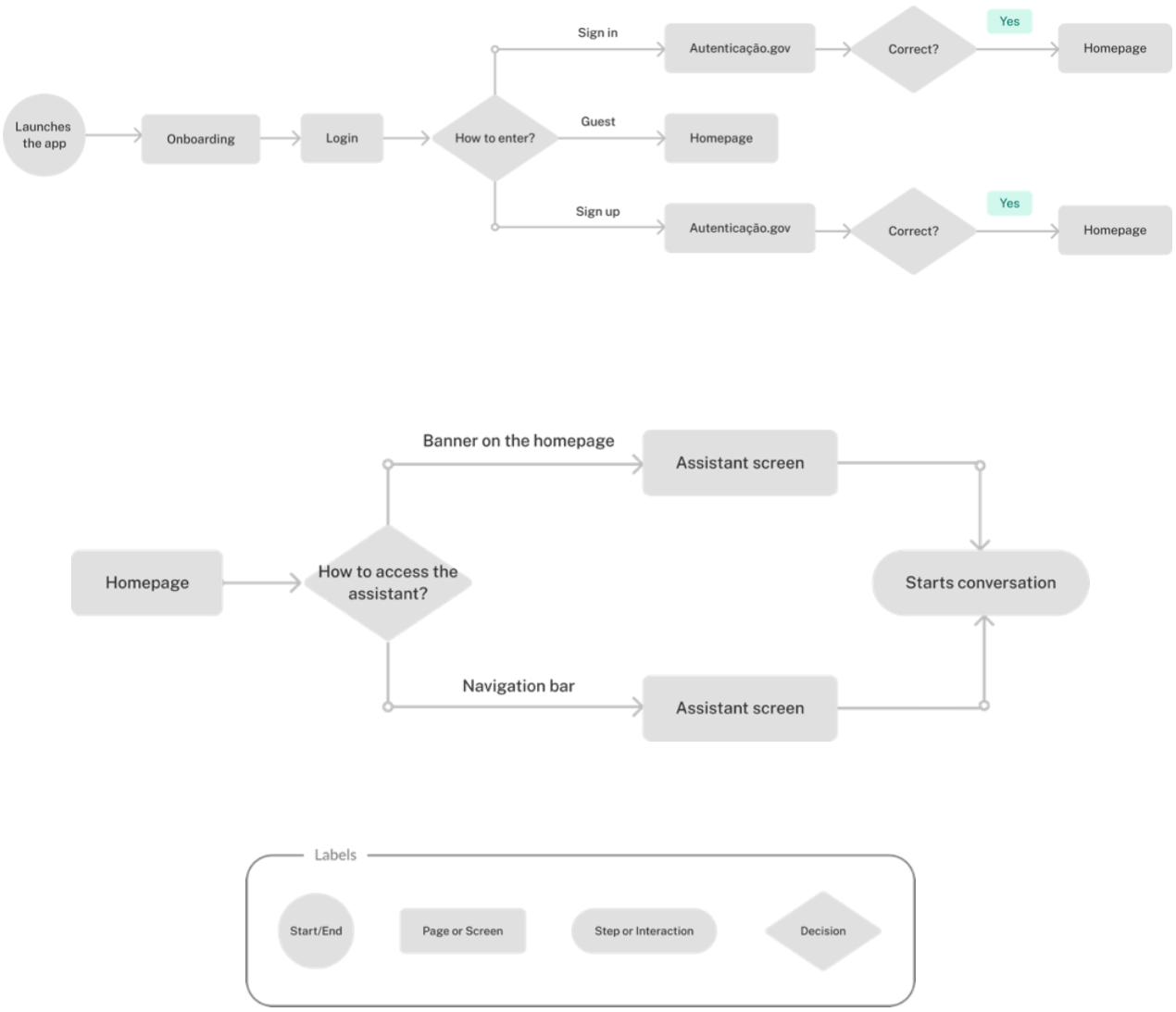

Figure 7 - User flow

4.1.2.6 Design process

After analysing the content of the questionnaire and interviews, defining the personas, and establishing the user flow, the iOS operating system (Apple) was selected to develop the mobile application. It's important to note that due to time constraints, not all screens of the app were created, and the focus was on designing the core functionality of the digital assistant.

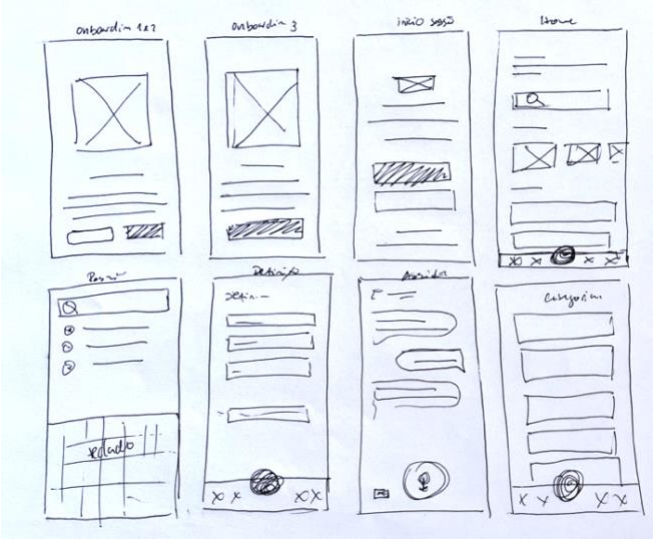

Figure 8 - Low-fidelity wireframes

In the initial phase, sketches were produced, which were basic and low-fidelity wireframes of the screens to be developed, providing a better understanding of the layout of elements and their visual hierarchy.

Following the sketching phase, medium-fidelity wireframes were build using Figma as a tool. Regarding the application's navigation bar, it is consisting of five sections:

a) *Home*: Serves as the app's main landing page, providing users with a starting point to access various features. On the home page, users can conveniently use the search function, explore highlighted categories, find answers to frequently asked questions, and access practical guides.
b) *Categories*: This section allows users to effortlessly navigate through content that has been organized into different themes, enhancing the ease of content discovery.
c) *Digital Assistant*: Users can engage with a digital assistant using either voice commands or text queries, offering a versatile and intuitive way to interact with the application.
d) *Search*: Allows users to find specific services, or information by entering keywords, making information retrieval quick and efficient.

e) *Profile*: Users can manage their account settings, request help and support, access the history of their conversations with the digital assistant, and log out of their account. It centralizes important account-related actions and support options for a user's convenience.

Upon downloading the mobile app, users will see a loading screen with the ePortugal logo, intended to introduce the brand while the application loads on the device. The goal is to help to reduce the perception of the waiting time. Following the app's first launch, an onboarding screen will be displayed, offering an introduction to the primary features. This information will be presented across three consecutive screens.

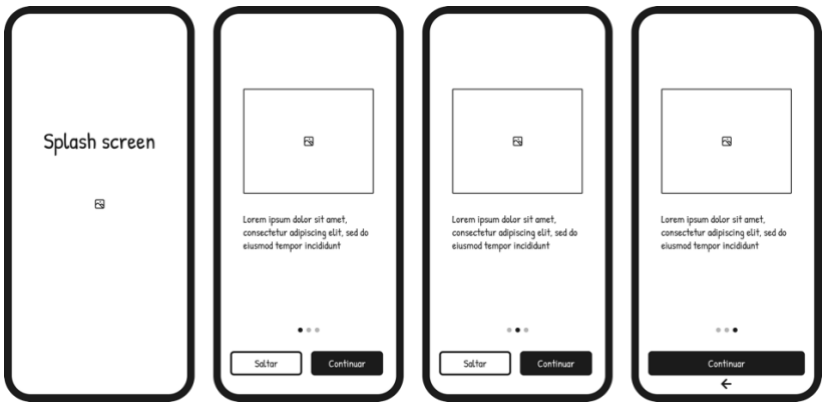

Figure 9 - Medium-fidelity wireframes: app launch and onboarding screens

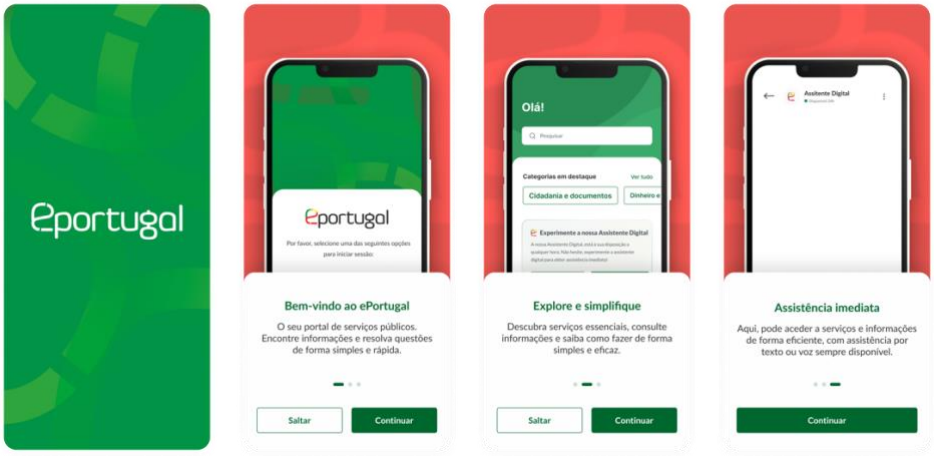

Figure 10 - High-fidelity wireframes: app launch and onboarding screens

Before proceeding to the authentication screen, users will be required to read and acknowledge the terms and conditions. This aligns with common practice observed in other Portuguese state platforms, emphasizing the importance of user agreement with the app's terms and policies.

After accepting the terms and conditions, users will encounter the authentication screen, where they will have several options. They can either log in using the digital mobile key, create a new account, or proceed as a guest. Opting for the guest option will redirect them to the home page, where they can access general information about Portuguese services. However, they will not have access to a more personalized experience within the app. If users choose to log in with the digital mobile key or create an account, they will be directed to the *autenticação.gov* platform for authentication. This approach ensures a secure and trusted login process, aligning with established authentication practices for Portuguese State platforms.

Figure 11 - Medium-fidelity wireframes: Login screens

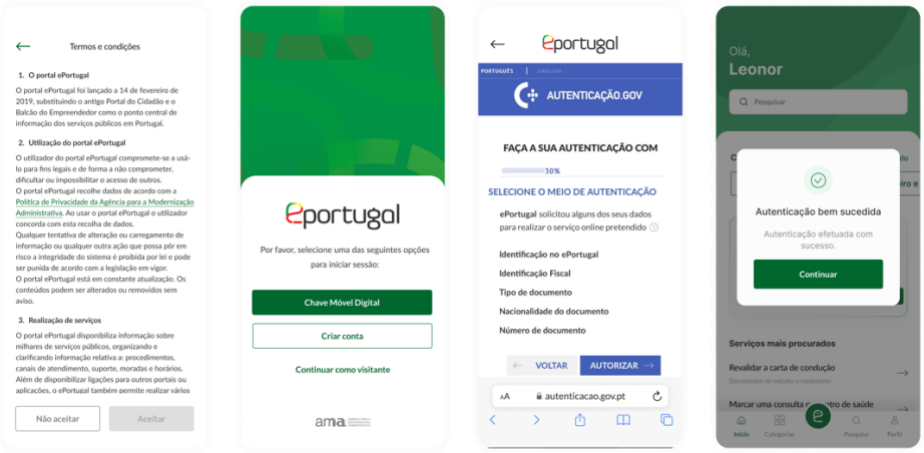

Figure 12 - High-fidelity wireframes: Login screens

After logging into the app, users are granted access to all information that the app has to offer. This access facilitates a highly personalized and engaging experience. One standout aspect of this personalized experience is the warm welcome that users receive. As soon as they land on the home page, they are greeted with a friendly and individualized message that addresses them by their name. This greeting isn't limited to just the home page, it also extends to interactions with the app's digital assistant as well. This level of

personalization plays an important role in making users feel valued and appreciated, leaving a positive and lasting impression. The objective to have a personalised greetings is that users can feel they are not treated as generic entities but as individuals with their own identities.

Figure 13 - Medium-fidelity wireframes: Homepage and digital assistant screens

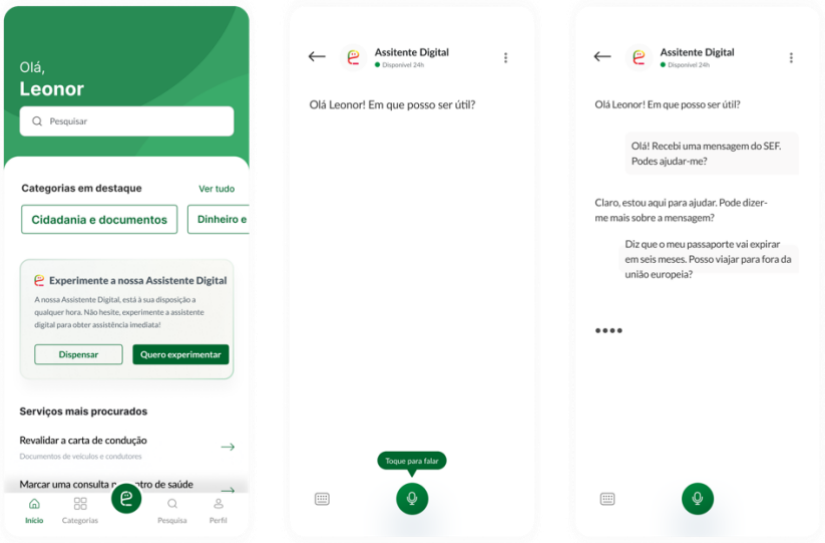

Figure 14 - High-fidelity wireframes: Homepage and digital assistant screens

Although it is not explicitly outlined in the user flow, three more screens were developed:

a) *Categories*: This section allows users to navigate through content organized into different themes; organized into different themes.
b) *Search*: Users can search for specific services or information, ensuring quick access to the exact content they are looking for.
c) *Profile*: The profile section is thoughtfully divided into three distinct areas:

a. *Account settings*: Users have the flexibility to choose their preferred language and review the privacy policy, giving them control over their personalization and data.
b. *Help and support*: In this section, users can access comprehensive information about the app and report any issues or problems they encounter.
c. *Conversation history:* Users can access a log of their previous conversations with the digital assistant, allowing them to review past interactions
d. *Log out*: Users can securely log out of their account whenever they choose, providing them with full control over their session.

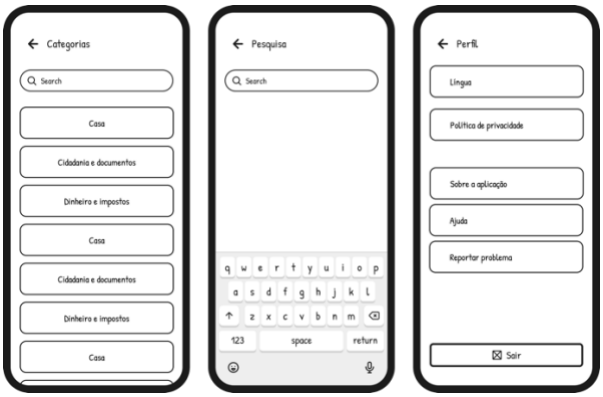

Figure 15 - Medium-fidelity wireframes: Categories, search and profile screens

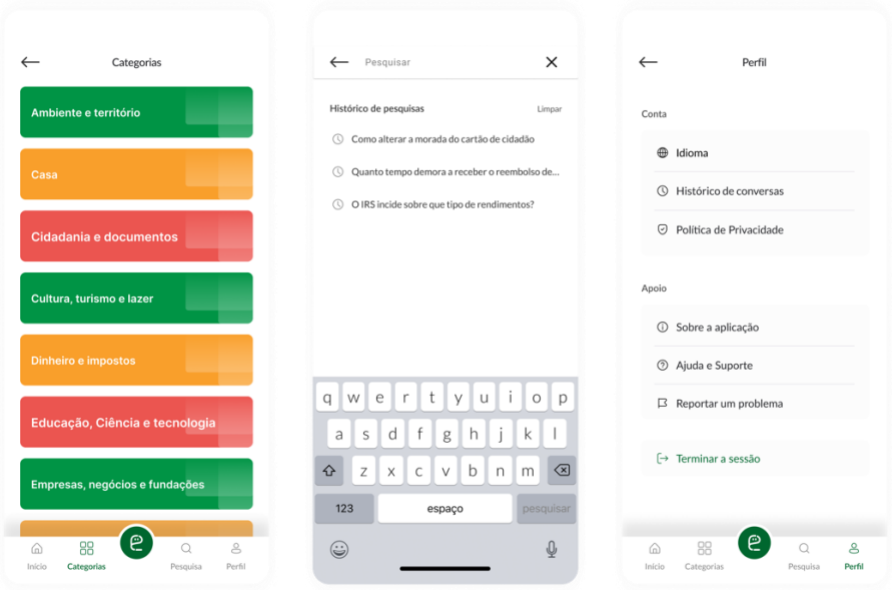

Figure 16 - Categories, search and profile screens

5 VISUAL IDENTITY OF THE USER INTERFACE

To maintain visual consistency, it was followed the design approach already established on the website. The app icon itself remains the one featured on the website, further reinforcing the brand's recognition and providing a seamless experience for users transitioning between the web platform and the mobile application.

Figure 17 - ePortugal logo

5.1 Grid

To achieve a more consistent design across all screens within the app, it was established a structured 4-column grid system. This grid framework includes 24dp margins, ensuring a comfortable safety zone around the content, and incorporates a 16dp gutter, the space between the columns. These specifications were calibrated and customized to perfectly suit the unique characteristics of iPhone screens, specifically targeting iPhone 13 and 14. This approach ensures not only design uniformity but also optimal visual presentation throughout the entire application.

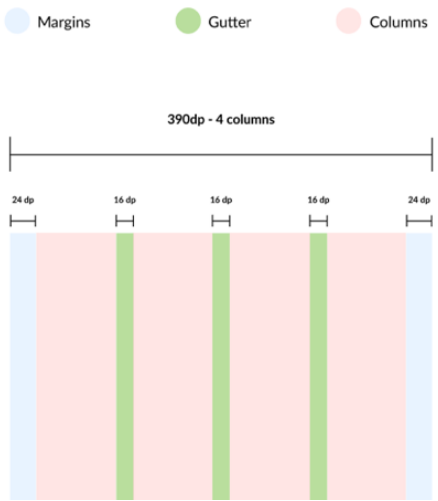

Figure 18 - Grid

5.2 Colours

In accordance with the design principles established on the ePortugal web platform, the selection of colours for the mobile application was made with great thought. The colour palette chosen includes shades of green, yellow and red. This decision was based not only on the pre-existing design, but also on a comprehensive analysis of existing mobile applications, namely *SNS 24* and *e-fatura*. White was used largely for the background, black for the text and, lastly, grey was used for text and graphic elements.

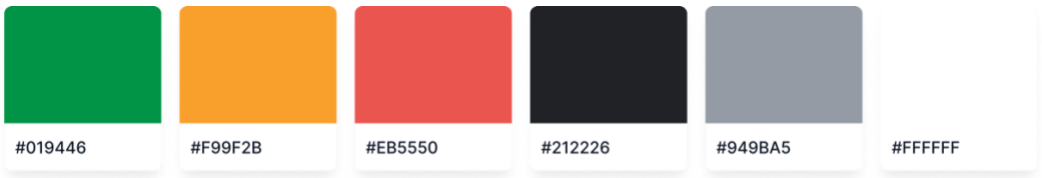

Figure 19 - Colour palette

5.3 Typography

The choice of typography is a pivotal decision in design, with implications for readability, versatility, and accessibility. In this context, the *Lato* typeface was selected.

Lato's balanced letterforms and sans-serif style contribute to enhanced readability across both print and digital media. Its wide range of font weights and styles facilitates the establishment of a cohesive typographic hierarchy within design projects. This typeface also aligns with the accessibility standards and is conveniently accessible through Google Fonts, further bolstering its suitability for a diverse array of design applications.

Figure 20 - Typography

5.4 Iconography

Icons are another important factor in an interfaces, especially on small mobile screens. They symbolize actions, objectives, or ideas and should be instantly recognizable to avoid user confusion (Harley, Icon Usability, 2014). To attain this goal, icons should be simple, easy to read, visually appealing, and a consistent appearance.

Although there are universal icons, according to Harley (2014), it's wise to accompany them with labels to prevent any doubts about their purpose, as users may interpret them differently. Furthermore, maintaining uniform dimensions, line thickness, perspective, position, and optical weight among icons is essential for a cohesive design. In the application, *Moon Design System* icons were used to meet these criteria.

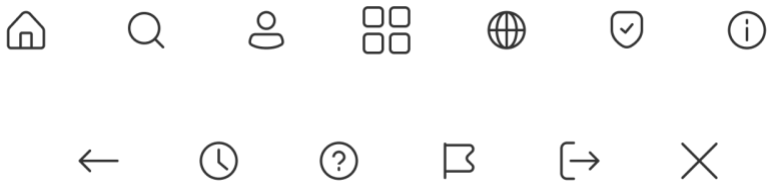

Figure 21 – Iconography

For user convenience, the navigation bar should be positioned at the screen's bottom, ensuring easy access. For the navigation bar of this application, it features five tabs, each representing a primary section of the app with both an icon and a clear label, simplifying user identification and navigation. As for the virtual assistant icon in the app, it mirrors the one used on the portal, ensuring a coherent synergy with the established identity of the web platform.

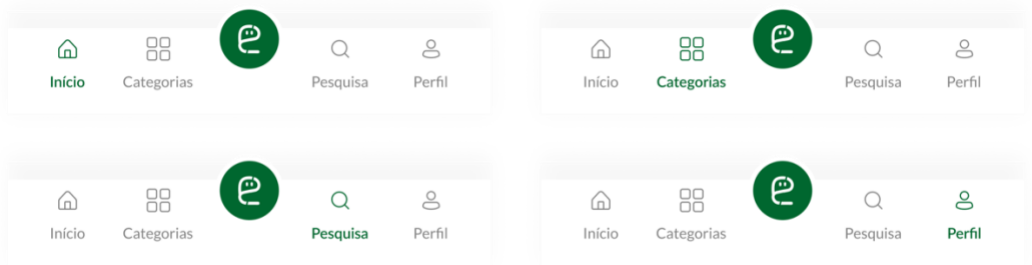

Figure 22 - Navigation bar

6 PROTOTYPE

After completing the visual design phase for the user interface, the subsequent step involved the development of a functional and interactive prototype using Figma. It's important to note that within Figma it's not possible to incorporate sound elements or simulate the responses of a voice assistant. For this reason, the interactions with the digital assistant within the prototype are carried out without sound.

However, to help understand how the digital assistant would work, a demonstration video is available on YouTube. In this video, edited with iMovie, you can hear how the assistant would work, simulating a more authentic user experience. The prototype is accessible through the following link, and the video demonstration is available through this link.

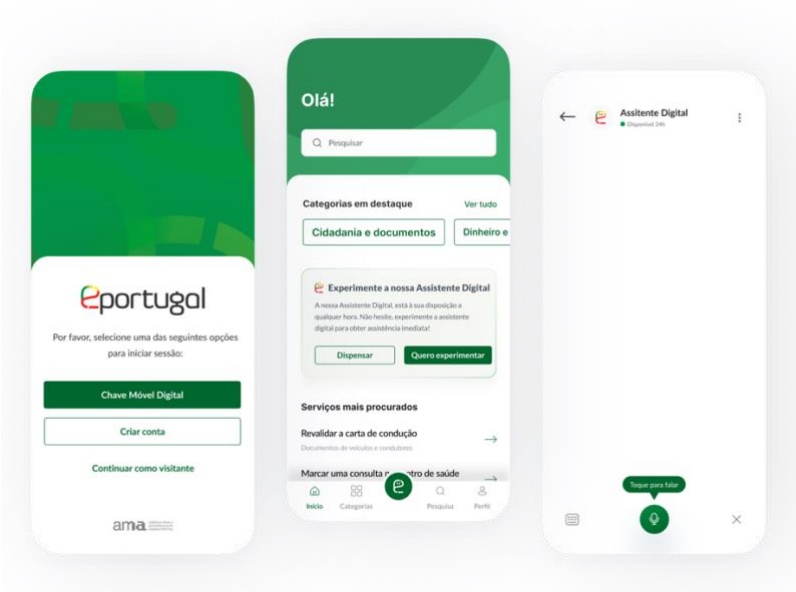

Figure 23 - Overview of the app

7 CONCLUSION AND FUTURE WORK

Against the backdrop of recent progress in artificial intelligence and the broader digital transformation landscape, this project sought to investigate the potential of AI-driven solutions in improving public service delivery. The public services domain has recently witnessed a surge in the prominence of AI, encouraged by the alluring possibility of bolstering the efficiency, effectiveness, and accessibility of public services.

In light of this context, European countries are giving precedence to the assimilation of AI and are making efforts to seamlessly implement innovative technologies to augment the standard of public amenities they offer to their populace. To modernise and rationalise administration, Portugal has launched the ePortugal portal. This portal functions as a centralized repository that provides citizens with an assorted range of public services and information. To enhance digital interactions with public services, the Portuguese government launched a novel virtual assistant in May 2023 on the ePortugal platform. This assistant transcends text-based interaction by offering voice capabilities and is complemented by a unique avatar. In its beta phase, the assistant encourages people to explore its evolving features, focusing initially on providing information about the digital mobile key.

In line with Portugal's ambitions, the primary objective of this project was the development of a prototype mobile application for the ePortugal platform. The prototype incorporates a digital assistant that seamlessly integrates both text and voice functions. The main objective was to enhance the user experience when accessing Portuguese State services. In addition, it was intended to provide a central platform providing easy access to comprehensive information on these services, thus promoting digital access to public services.

In order to perceive the relevance of the project, eight user interviews were conducted. The results provided a clear picture of the prevailing user tendencies, highlighting a strong preference for digital channels to engage with public services. As a result, the traditional methods of telephone and in-person interaction are now seen as secondary. The interviewees recognised the virtual assistants as tools that can improve and simplify interactions, enhancing and complementing the human engagement experience. In addition, the recently launched ePortugal virtual assistant was also covered in the conducted research. Interviewees responses to this new feature varied considerably, with a notable theme emerging around usability concerns, particularly when combining avatars and voice. These findings underscore the pressing need to improve usability and facilitate natural interaction to ensure the effective implementation of such features. Concerns about privacy were particularly prominent in the spectrum of user views. However, there was also a compelling subtext of confidence in the ability of the Portuguese State to diligently protect personal data.

In line with Portugal's efforts to digitally transform and address user needs, the project has resulted in the development of a prototype for the ePortugal mobile application, which is now ready for testing.

As future work, our focus includes conducting usability tests to enhance the user experience. Additionally, it would be interesting to explore the integration of advanced features, such as voice personalization, to further personalize and streamline interactions. Furthermore, as the project progresses, it would be pertinent to conduct further research in other key app features. These features include:

a) *Categories*: The aim is to create an intuitive content categorisation system that allows users to seamlessly explore information based on different themes, thereby increasing their ability to find relevant content.
b) *Search*: The focus is on refining the search functionality to ensure that users can easily and quickly find specific services and information within the app.
c) *Profile*: By allowing users to customise their language preferences and review the privacy policy, the aim is to provide a more personalised experience. In addition, the intention is to streamline user support by providing comprehensive information and an efficient reporting system. Users will also have access to the history of their conversations with the digital assistant and will be able to securely log out of the service whenever they want.

Moreover, the feasibility of expanding the ePortugal into a "unified service center" is also being considered. The focus is on conducting thorough research to determine the applicability of the concept, particularly in simplifying the user experience by providing a single solution for various tasks, including booking appointments and accessing documents.

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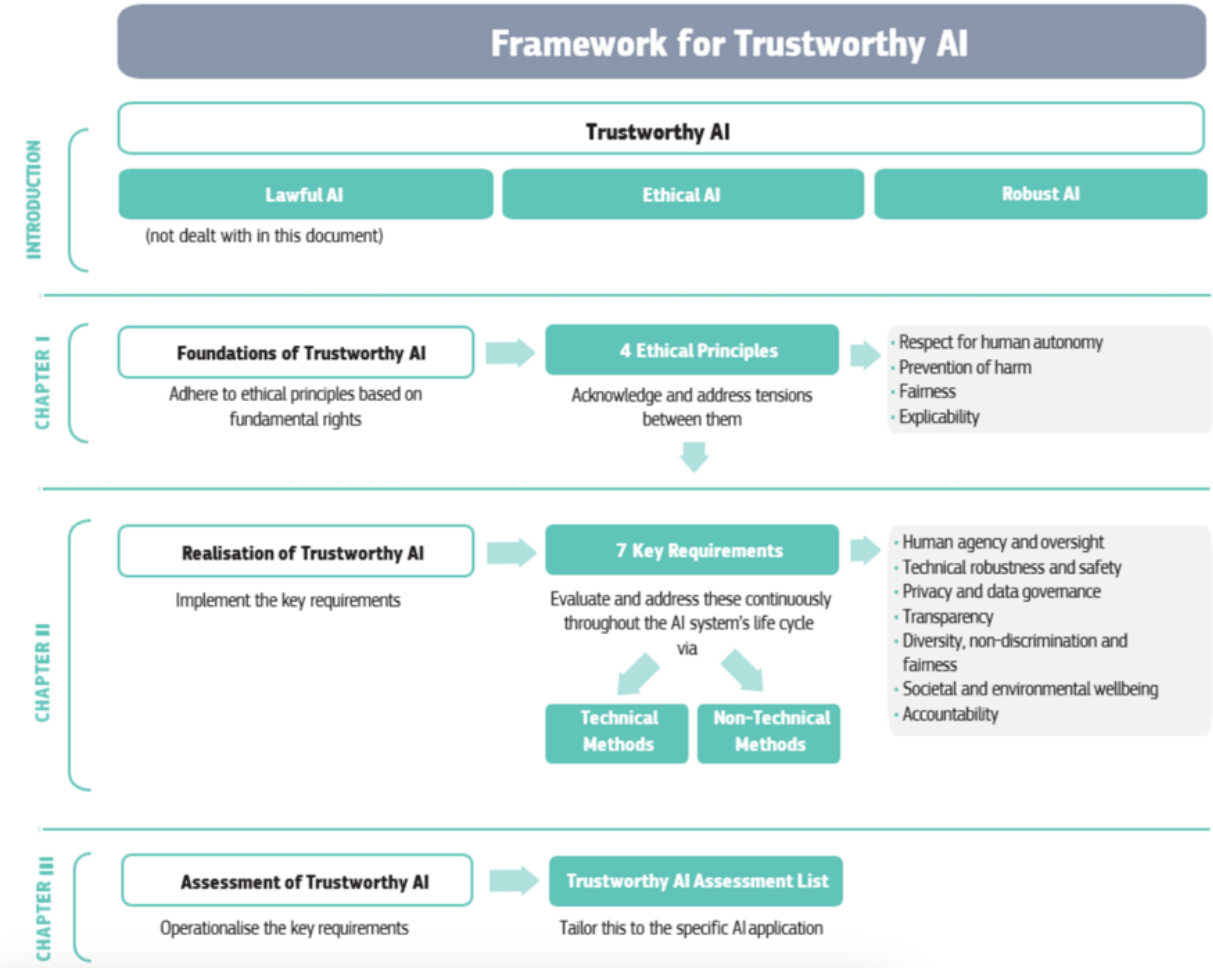
8 APPENDICES

Appendix I: European Union framework for trustworthy AI



Source: AI HLEG, 2019

Appendix II - Interview script

I'm a student in the master's degree in Audiovisual and Multimedia at the Escola Superior de Comunicação Social. First of all, I would like to thank you for your availability for this interview, which should last a maximum of 30 minutes.

To give a brief context, the purpose of this interview is to understand your experiences with digital public services in Portugal. This is intended to be an informal and relaxed conversation. Your answers and perspectives will not be evaluated or judged at any point - there are no right or wrong answers.

Before we start our interview, I would like to ask for permission to record this interview for internal purposes, to facilitate the collection and validation of notes - no personal information will be shared with. All recordings will be deleted at the end of the project. Do you agree to the interview being recorded?

Now, let me briefly outline how the interview is structured. It will consist of the following sections:

- Access to and Experience with Portuguese Public Services
- Use of Virtual Assistants
- Familiarity with ePortugal and the Relevance of a Mobile Application for the Platform
- Perspective on the ePortugal Virtual Assistant

If you have any questions or need further clarification during the interview, please feel free to ask.

Topic	Objectives	Questions
A. Introduction to the project	i. Specify research objectives. ii. Inform that data confidentiality and interviewee anonymity. iii. Request the recording of the interview and explain how the data will be used in the pursuit of the academic work. iv. Presentation of the interview structure.	1. Do you agree to the interview being recorded?

B. Demographic information	i. Gather demographic data.	1. First, tell me a bit about yourself (age, residence, etc.)
C. Access to and experience with Portuguese public services	i. Identify the primary electronic device used for accessing public services. ii. Determine the preferred method for accessing these services. iii. Familiarity with available digital public services. iv. Measure the frequency of digital public service usage. v. Determine which specific services are used most regularly. vi. Gather insights into the user's overall experience, noting any challenges or positive experiences.	1. What electronic device (PC, tablet, mobile phone) do you use the most? 2. When you need to access public services in Portugal, what is your preference? 3. Are you familiar with digitally available public services in Portugal? 4. How often do you use digital public services in Portugal? 5. Which services do you use most frequently or regularly on Portuguese public service digital platforms? 6. When using digital public services in Portugal, how has your overall experience been? Have you faced any difficulties or had any positive experiences you'd like to highlight? 7. Based on your experience, do you have any suggestions or ideas to improve the quality or efficiency of digital public services in Portugal?
D. Use of virtual assistants	i. Explore interviewee's familiarity with virtual assistants ii. Gather opinions on the ease of use of virtual assistants. iii. Understand the interviewee's perspective on the usefulness of voice assistants for interacting with public services.	1. Are you familiar with virtual assistants like Alexa, Google Assistant, or Siri? 2. Have you ever used a digital assistant to perform everyday tasks? 3. What is your opinion on the usefulness of voice assistants for

	iv. Identify the types of public services the interviewee wishes to access digital assistants. v. Explore scenarios in which the interviewee envisions using digital assistants for accessing public services.	interacting with public services in Portugal? 4. What type of public services would you like to access through voice-activated digital assistants? 5. In what situations do you see yourself using a voice-activated digital assistant to access public services?
E. Familiarity with ePortugal and the relevance of a mobile application for the platform	i. Determine the familiarity with ePortugal. ii. Explore interviewee's views on the benefits of an ePortugal app for accessing public services and the rationale behind their opinions. iii. Identify specific features they would like to have in the app. iv. Explore any concerns the interviewee may have regarding the security and privacy of their personal data when using the ePortugal or other digital public services.	1. Are you familiar with ePortugal? (Brief explanation of what ePortugal if needed) 2. Do you think it would be beneficial to have an ePortugal app to facilitate access to public services? Why? 3. What features would you like to see in the ePortugal app? 4. Do you have any concerns about the security and privacy of your personal data when using the ePortugal or other digital public services?
F. Perspective on the ePortugal virtual assistant	i. Determine the interviewee's awareness of the recently launched virtual assistant on the ePortugal website. ii. Encourage the interviewee to interact with the ePortugal virtual assistant and provide feedback. iii. Collect initial impressions of the virtual assistant, especially	1. Are you aware that a virtual assistant was recently launched on the ePortugal website? 2. Could you please try the ePortugal virtual assistant? (Provide a link) 3. What were your initial impressions of the digital assistant with an avatar and voice functionality on ePortugal?

	regarding its avatar and voice functionality. iv. Assess the interviewee's opinions on the combination of avatar and voice in the virtual assistant. v. Identify potential benefits and use scenarios for the ePortugal virtual assistant. vi. Evaluate whether the virtual assistant can enhance user interaction with the ePortugal. vii. Identify desired features and functionalities for the virtual assistant. viii. Understand the interviewee's expectations for an effective user experience with the virtual assistant. ix. Investigate any privacy and security concerns related to using the digital assistant. x. Collect insights on whether a digital assistant can surpass other support methods in terms of effectiveness and engagement. xi. Solicit recommendations and improvements based on user's experience and preferences to enhance the virtual assistant's effectiveness and experience.	4. What do you think of the combination of the avatar and voice? 5. In your opinion, what are the potential benefits of the virtual assistant on ePortugal? 6. In what situations can you imagine yourself using the voice assistant on the ePortugal website? 7. Do you think the virtual assistant can make user interaction with ePortugal easier? 8. Is there any feature or functionality you would like to see or expect to see in this virtual assistant? 9. What specific features or functionalities would you like to find on the ePortugal website with a voice assistant to make your experience more effective? 10. Do you have any concerns or hesitations about using a digital assistant on ePortugal? 11. Do you believe a digital assistant can be more effective and engaging than other forms of assistance or support, such as in-person or phone support? 12. Based on your experience and preferences, what recommendations or improvements would you suggest enhancing the effectiveness and user experience of the digital assistant?

G. Closing remarks		1. Would you like to add anything or do you have any questions?

Table 3 - Interview script