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Designing Applications for Bigger Multi-Touch Displays

DISSERTAÇÃO DE MESTRADO

Hugo Daniel Vasconcelos Pestana Leão

MESTRADO EM ENGENHARIA INFORMÁTICA



UNIVERSIDADE da MADEIRA

A Nossa Universidade

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ABSTRACT

This project intended to create a relevant application for the users of the Madeira Airport. They needed new ways of communication and interaction with their passengers.

It could have been developed an application for a mobile device, such as a smartphone or a tablet that would allow the users of the Airport to communicate and interact with it differently. However, they had these bigger multi-touch devices, also known as kiosks that were not being used to their fullest potential. With that, it was given the task to make better use of these bigger devices, and develop the application for it.

Upon starting the project, the first challenge that appeared was a clear lack of standardization when it comes to designing applications for these bigger multi-touch devices.

Besides the lack of standardization, there is not a lot of user experience. It cannot be expected that the user will transition easily, nor smoothly, from the common touch devices (smartphones and tablet) to a touch platform of bigger dimensions. The touch technology is not something out of the ordinary nowadays, nor is for the user to interact using this so called natural way, so some of the experience from the smaller devices can be reused, but the interaction with kiosks has to be carefully designed, because all of its limitations need to be taken into account. In particular the biggest limitation of these kiosks was the surface of the screen. It created a lot of friction therefore not allowing easy drag gestures.

There is also the actual size factor of the device itself. Working on a bigger scale brought up important and interesting interaction design aspects that had to be solved.

This document describes all the design work done for the kiosk application. It covers the methods and the decisions that were made so that all the work done for it can replicated and applied to other projects. From user interfaces to interaction design, different screen modes, graphical development and some programming, everything is explained throughout this document.

KEYWORDS

Multi-Touch

Kiosk

Public Space

Design

User Interface

Interaction

ACRONYMS

UI – User Interface

UX – User Experience

XAML – Extensible Application Markup Language

SVG – Scalable Vector Graphics

RESUMO

Este foi um projecto que tinha o objectivo de criar uma aplicação que fosse relevante para os utilizadores do aeroporto da Madeira. Era importante para o aeroporto da Madeira ter novas formas de comunicação e interação com os seus passageiros.

Para este projecto poderia ser desenvolvida uma aplicação para ser utilizada em dispositivos móveis como smartphones ou tablets. Esta aplicação iria permitir novas formas de interação e comunicação com os passageiros. Contudo, no aeroporto existiam dispositivos multi-toque de grandes dimensões, também conhecidos como kiosks, que não estavam a ser utilizados ao seu máximo potencial. Tendo isso em conta, foi lançado o desafio de desenvolver uma aplicação para ser usada nos kiosks, tirando assim partido dos equipamentos.

No início do projecto o primeiro desafio que apareceu foi a falta de standards no que toca a desenvolver e desenhar aplicações para este tipo de dispositivos multi-toque de grandes dimensões.

Para além da falta de standards, também não existe experiência de utilização por parte dos utilizadores. Não podia ser esperado que os utilizadores transicionassem facilmente dos dispositivos de toque mais comuns (smartphones e tablets) para uma plataforma de toque de grandes dimensões. A tecnologia de multi-toque não é algo fora do normal nos dias de hoje, por isso alguma experiência de utilização dos dispositivos de toque mais pequenos pode ser reutilizada, mas a interação com os kiosks tem de ser desenhada tendo em especial atenção todas as suas limitações. A maior limitação encontrada nestes kiosks foi a superfície do ecrã. O material não permitia gestos suaves devido ao atrito.

Havia também o factor do tamanho do dispositivo. Trabalhar numa escala tão grande como esta fez com que surgissem questões de desenho muito importantes e interessantes que tiveram de ser resolvidos.

Este documento descreve todo o trabalho de desenho feito para esta aplicação desenvolvida para o kiosk. São abordados os métodos e as decisões tomadas, para que todo o trabalho feito possa vir a ser replicado e aplicado em projectos da mesma natureza. Desde interfaces de utilizador, desenho de interação,

diferentes modos de ecrã, desenvolvimento gráfico e alguma programação, tudo isto é explicado ao longo do documento.

PALAVRAS CHAVE

Multi-Toque

Kiosk

Espaço Público

Desenho

Interface de Utilizador

Interacção

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1 INTRODUCTION

The Madeira Airport wanted to have a more dynamic way of interacting and communicating with its passengers, providing them with services that would be both relevant and actually useful. In order to do that an application for devices such as smartphones or tablets could be developed. An application that would have all these needed services and could create a new channel between the airport and the passengers. However the challenge was to make use of these bigger multi-touch devices, also known as kiosks (see figure 1 – kiosk found at the madeira airport), that were already placed on the Airport floors. There were three of these devices spread out through the Madeira airport, one on each floor, and one more in the Airport of Porto Santo. Up until then these devices were not being used to their fullest potential. They were being used to simply display a webpage, so here rose the opportunity to design and develop the application for these bigger devices, following the Airport strategy of improving the interaction with the users, and that's what this Masters project is all about.



Figure 1 – Kiosk found at the Madeira Airport

1.1 Problems and Challenges

The technology to work with was already chosen from the beginning, and since it is not the sort of device that has become that common, there were many challenges and problems that appeared. But it was asked that it was worked on these particular devices, following the Airport strategy which was to create new services that would be useful for the passengers.

Nowadays smartphones and tablets are common, users do not have zero experience with touch devices. Some of this experience can be translated into the bigger multi-touch devices, but not all of it. Even though the touch experience has become common and there are well established platforms for small devices, with this kind of bigger displays there is basically a white canvas to work with.

Despite there being a few experiments with bigger multi-touch displays, there really is not a standard nor a framework to work with, and nothing has ever been developed, which has left a lot of room to innovate, and it was on that perspective that the challenge was accepted.

The size of the devices itself adds several types of physical restrictions. Because of the bigger scale there are interaction matters that also need to be tended to. The comfort of the gestures and the placement of the elements.

Besides all these challenges, there was also the surface of the display. Because of the undesired friction it was hard to do drag gestures. So this was something that we had to take into consideration when designing the gestures and interactions as well.

Quite often kiosks like this either pass as not being interactive or are not interesting enough for people to use them. So it was imperative that the application itself would be able to attract users and make them want to use it.

Since this device was located at an airport, the users would most likely be passengers and probably would not have much time to learn how to use the application, so it had to be easy and fast for them to learn how to use it.

There were many restrictions, but as a result, the opportunity to create.

1.2 Approach

The method used to approach this project was based on an agile method in which there were several iterations of planning, designing, prototyping and validation (see figure 2 – development cycle).

It was a creative cycle and controlled approach, every decision and every step that was taken always had a reason behind it.

There was a lot of user involvement throughout the several validation cycles.

Recurring to brainstorm sessions it was possible to identify the types of services that were more on demand and should be created.

Paper prototypes were developed in order to get some validation with the users.

After the paper prototype it was developed an actual prototype with the services requested, which was again used to validate with other users.

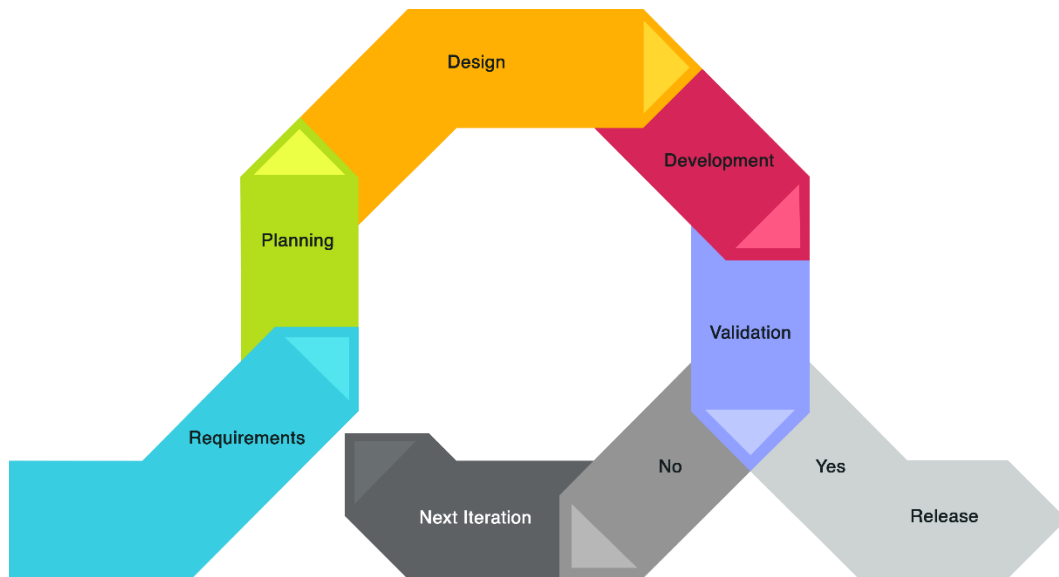


Figure 2 – Development Cycle

1.3 Team

This project was developed by a team of three people. Each member had its role. Professor Leonel Nóbrega was the Masters advisor who guided the rest of the team throughout the whole project, Bruno Quintanilha was the programmer and Hugo Leão had the designer role.

1.4 Contributions

It is hoped that this project can help other people who are developing a similar application or project. This report shows all the steps that were taken as well as the decisions made and reasoning behind them, therefore it can work as a guide in recreating everything that was done. It is stated all the problems and respective solutions. This was a full-fledged project with a small team of 3, so understanding the approached methodology and the team mechanics might help the process design for future projects. Furthermore, the outcome design of this project points to a possible standardized interface and interaction design, for bigger multi-touch displays as the ones referred throughout the entire project.

1.5 Structure

This document is structured as follows: It was done some literature review in order to know more about the current state of the art when it comes to designing

application for bigger multi-touch devices. After that it is described the process, the stages and the methods that were used throughout the project so that anyone can follow the steps and replicate what was done. Following the process comes the development chapter where it is identified the problems of each stage of the project and how they were solved. In this chapter it is also mentioned what influenced the decisions made. After talking about the design comes the evaluation of the project. This chapter tells about how the application was evaluated, what went wrong and what worked for it. Finally there are the conclusions and future work where the work done is critically reviewed and is mentioned what could be done in the future so that the application can be improved and contribute even further to the field.

2 LITERATURE REVIEW

Multi-touch is a technology that has become extremely common in devices for the past few years, especially in smartphones and tablets. This technology allows for users to interact with devices using more than one finger at a time, or even using both hands at the same time. [1] Multi-touch may also imply multi-user, in which multiple users can collaborate on projects jointly. [2] Even though this technology is widely seen in portable devices, it is also available for bigger touch displays. These displays are becoming increasingly popular in public spaces in the form of kiosks, tabletops and through wall displays. [3] [4] There have been some studies to try to come up with new types of multi-touch displays like the Sphere [5]. Thanks to the technological development, these devices are cheaper and easier to develop. [6] [3] Research has been done in specific areas of multi-touch interaction in order to determine which interactions work best on these bigger devices. [7] It is shown that there is a lack of consistency when it comes to multi-touch interactions in these devices [8] because there is no standard or agreed-upon multi-touch user interface language. [7] The meaning of touch might be different in two different applications. "Different users and/or different cultures may have different ways they operate and interpret a touch". [9] This lack of standardization makes the user interfaces difficult to understand and use. [7] It has also been shown that the studies of large multi-touch displays are mostly done in controlled settings and in private places [3]. The results obtained from the design of multi-touch applications that are tested in private settings might enter in conflict with what should have been the design for public settings. So it is important that the multi-touch device is brought into public spaces. A good quality of doing a study in a public space is the diversity of users. [6] The MuTable [7], the Multi-Touch Table in the Museum [6] and the CityWall [3] are examples of studies done on multi-touch devices in public spaces. The results from the MuTable study show that interaction details must be provided, and that the users

should have guidance because in this study they couldn't find all the gestures and functionalities of the table in an intuitive and seamless way. The guidance should be non-intrusive so the user can explore the system. For multi-touch systems that are in public spaces, and the user can just walk and use it might be fun to explore and be good for the using experience. [7] If the user can't find the functionality it's looking for, that's when the guidance can come in and prevent the exploration from turning into frustration. [7] Users that can't achieve what they want will simply give up on it. [8] In the Multi-Touch Table in the Museum there should have been a clear indication and invitation to interact with the table because the museum visitors didn't realize right way the table was interactive. [6] The same thing happened in the CityWall study, the system was hard to notice if no one was using it. [3] So for these multi-touch devices it's important to design the applications in a way that invites the users, and it has to be clear that it is an interactive device. The device itself needs to get attention from people, and motivate them to interact with it. [10] [11] As for guidance of multi-touch interfaces, it was studied and created guides like TouchGhosts [4] and ShadowGuides [12]. These guides help the users with demonstrating visually the available interactions. In order to get the guidance needed the user would have to press a picture component, which might not be intuitive or be too intrusive. [4] So a better way of guiding the user should be designed. It is stated in the TouchGhost study that "most users are not familiar with the interface" and that "first-time users have a difficult time figuring out what can be done", which takes us again to the lack of standardization of a multi-touch user interface language. This standardization might be missing because multi-touch interfaces are seen as natural user interfaces [7], in which the input method, is considered to be one of the most intuitive things in the world, so it is assumed that multi-touch interfaces should be natural and easy to use without guidance. [13] "Are natural user interfaces natural? No." [14] This because gestures aren't easy to remember or learn. So it's important to give aid and remind the user what can be done. Feedback is extremely important for intuitive interactions so the user knows what's happening and can make sense of the system. [8] Besides having guides, having gestures that follow certain logical sequences might make interaction

easier and more fluid. [15] The lack of standardization might also come from the increase of devices and different platforms. [16] Even though some gestures might seem to have become somewhat standardized, like zooming (pinching) or panning (single finger slide), these gestures might do something different in different contexts. So Designers must take into consideration the context and practicality of the systems. [16] On a more technical, and more developer oriented side, there has been a few studies that tried to formalize multi-touch gestures at a high level. [17] One example is the GeForMT [18] (example of this formalization is: "1F(HOLD(o))" - One finger, hold object). Eunomia [19] is the result of another study that's more on the developer side. It gives basic services such as support for simple physical interactions and simultaneous access to multimedia objects. Multi-Touch Surfaces: A Technical Guide [20] is a great guide, especially for developers that are seeking to build their own multi-touch surfaces. In conclusion, there is a clear lack of standardization when it comes to bigger multi-touch displays. Gestures and interfaces should be standardized so users can identify these devices as interactive, be attracted to them and use them easily and intuitively, no matter the platform or type of device.

3 PROCESS

Regarding the followed approach, it could almost be classified as a form of agile development. The working method cannot be specifically named due to the fact that the development team was quite small, which made it unrealistic to follow a strict methodology. Since a specific working method or process was not followed, it was tried to develop this project in an iterative way. However, it was a controlled approach and a creative cycle that also had a lot of user involvement. This sort of agile development allowed to assess the direction of the project throughout the several iterations. Every aspect of the development would be continually revised, tested and improved, the solutions would evolve until the desired result was reached.

Weekly meetings with the all of the team would be scheduled. With the user testing sessions and a couple of presentations it was possible to acquire the feedback needed to make the necessary changes in order to improve the project. It was mandatory to actually go to the airport to get to know the space and the device that the application was being developing for. At the time what the device was showing was a simple webpage that had some information about the airport. The first impressions obtain from the device, was that the screen was quite big and that the glass on the surface made it hard to do gestures like swiping and pinching. Which again, are the challenges that need to be thought of when designing for it.

3.1 Brainstorm

The whole process started with a brainstorm meeting that brought in some of the people that were directly related to the project (airport staff) and people that could have some interest in the development or use of it. During this meeting was identified who the main users of this system would be, and what services would be the most important.

Methodologically speaking, when it came down to the user identification, it was asked to all of the meeting participants to write down on index cards who they thought that would most likely use the system the most. The participants were then asked to order these possible users by relevance (see figure 3 – user ordered by relevance) and then frequency. Relevance being the most important possible users, and frequency being the user that would use the system the most.

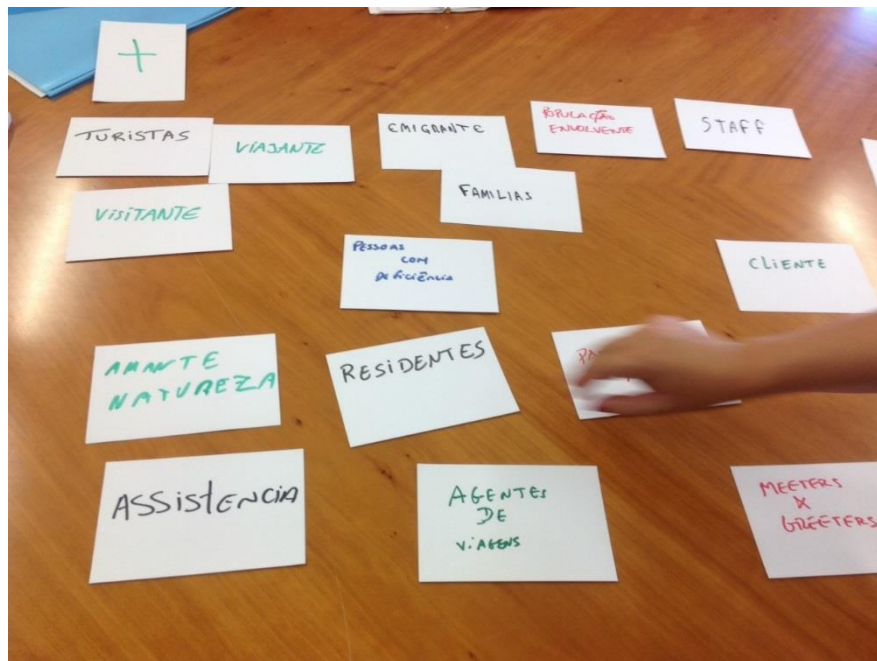


Figure 3 – User ordered by relevance

This experiment revealed that the users who would most likely use the system would be tourists. The table below (table 1 – system users) show the identified users and the scores they got when ordered by relevance and frequency.

User	Relevance	Frequency
Tourist	1	1
Traveler	3	2
Emigrant	6	3
Nature lover	4	4
Assistance	5	5
Reduced mobility people	8	6
Families	7	7
Travel agents	9	8
Visitors	2	9
Surrounding population	10	10

Table 1 – System users

In order to develop a system that would be indeed relevant and useful for the users inside of the airport, it was also asked to the participants of the meeting to identify if these users would most likely be people that had arrived to the airport, or if they would be departing (see figure 4 – users ordered by arrival/departure). It was found that these users would be more likely departing.



Figure 4 – Users ordered by arrival/departure

3.2 Activities

During the meeting was also identified what the users of the airport did. The participants identified the activities on the table below (table 2 – user activities), using the same method as they did before for the user identification.

Internet access	Events	Entertainment
Visit infra structures	Get updates	Search for transportation
Search for information	Search for bathroom	What to do?
Check-in	Flight schedule	Available services
Weather information	Destination information	Assistance
Where to eat?	Shopping	Information
Kill time	Play	

Table 2 – User activities

From all of these activities it was agreed upon that the most important, or main, ones were: Internet access, Events, Entertainment, Get updates, Search for information, What to do?, Flight schedule, Weather information, Destination information and Assistance.

3.3 Services

With all these main activities identified, it was then time to decide on what services the system would provide to the users. Taking into consideration the time frame available to work with, the services that were agreed upon for this application to have were: Wi-Fi, News, Weather, Flight Information and Locations Map.

3.4 Application Structure

At this point it was known the possible users of the system, as well as what it should provide, service wise. But before these services could be designed, the visual structure and base that would hold the services, and how the user would interact with the system, had to be given some thought.

So it was time to start conceptualizing the way the base application would be structured and how it would look. Various layouts for the arrangement of the services on the screen were designed until it reached to a point where it was thought a good design was found.

3.5 Paper Prototype

As said previously the device itself had some characteristics that made the interaction design quite a challenge, so in order to test if the designed base layout would be good to interact it, it was scheduled a user testing session where a prototype made out of paper was used.

This prototype had loose pieces that could be rearranged in order to change the interface design. This prototype was to scale so that the experience would be more life-like and as close to the real thing, size wise. The users were asked to do some tasks, and it was asked of them to think aloud while they were doing it. The base layout that was designed had two modes that were called attraction mode and interaction mode.

For the attraction mode we gave the users the task of selecting a service by asking “What would you do to select an application?”.

For the interaction mode we asked the users the following questions:

- How would you change to another service application?
- How to close an application?
- How to logout your session?
- Where the persistent information should be displayed?
- How to find a hidden application?
- Where should advertisement go?
- Where warning messages should be displayed?

The testing session allowed to validate that having the two mode, attraction and interaction, was a good idea. The users gave us enough feedback and ideas to improve the design layout even further and to have new interactions. A recurring

interaction and feature that was the ability to change between screen modes, which meant that the users wanted to be able to change effortlessly between the attraction mode and the interaction mode.

The testing users also rearranged the different pieces in order to be able to interact more comfortably, and it was noticed that the rearranged layouts of each participant all pointed in the same direction, which was a validation as for how the final base layout should look like.

3.6 Services Application Design

After the previous paper prototype testing session it was time to design the base interface and to come to a decision regarding the interactions.

With the base interface down, it was time to design the interfaces for the actual service applications which were given the name of plugins. The plugins were all pretty much designed side by side evolving at the same time.

3.7 Graphics Development

As the designer element of the project, it was required to design and produce several graphical elements. These elements were created alongside the design of each plugin.

During the design stage of a plugin in particular, the locations map plugin, it was required to do a 3D representation of the airport (see figure 5 – floor 0 airport 3d representation) so that there could be a raster image of it to work with the locations.

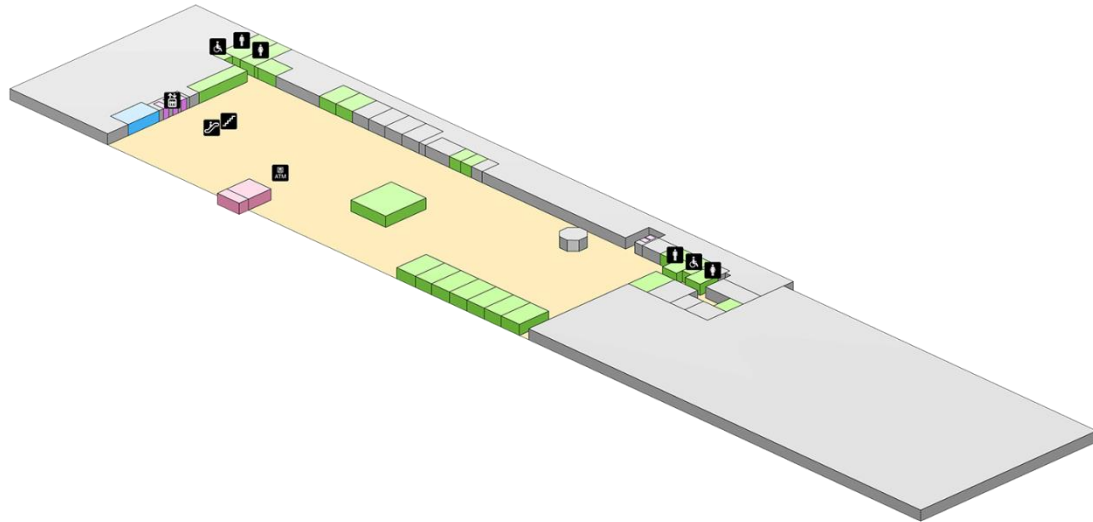


Figure 5 – Floor 0 Airport 3D representation

As stated previously, this was a project that followed an agile development method, with that weekly meetings with all of the team were scheduled. The interfaces and graphical elements propositions would be displayed, and the other members would validate if what was shown was good to go, or if changes were necessary. This design process was iterative and evolved every week.

There was a time in the process, when implementation of the project was more serious and real, so it was required to do some web based programming, some xaml implementation and some vector-based graphics in XML format.

3.8 User Testing

With a working prototype that was at a stage where most of the application services were completed, it was time for another user testing.

Once again, in this testing session the users were given some tasks to do, but this time the user had to pretend that it was a passenger that was already in the boarding area.

After completing the task the testing users were given a questionnaire that measured the usability of the system, and the entire testing session was recorded for future reference.

This user testing session was useful because once again it allowed to validate that the project development was on the right path. There was evidence that the

presented services were useful and easy to interact with. It also allowed to detect a few smaller issues that had to be fine-tuned in order to present a higher quality product.

3.9 Conclusion

It's crucial to be able to evolve and adapt every single aspect of the project in order to have a reliable and high quality result, and something that in the end actually works and is useful. Having the involvement of the users and doing iterative cycles of analysis, testing, redesign and implementation is definitely a good way of processing the development of a project.

4 DESIGN AND DEVELOPMENT

This is a chapter about how the elements of the project were designed. It goes into the decisions that were made, the problems and challenges that appeared in each phase and how they were solved. It is also about what influenced these decisions and why one solution was chosen over another.

The problems and challenges that appeared during the development of this project are mentioned previously, but this section of the report goes much deeper into these problems and how they actually represent concrete challenges, so that there is a clear reasoning and understanding as to how they were overcome.

This part of the document is purely design oriented and about how things were built, and so is the majority of this report. It tries to go over all the aspects worked on, in a storytelling fashion, so that it is easier to understand how things happened chronologically.

4.1 Starting Point

Once all of the requirements of the system were known, that is who would be using it, and which services it should have, that's when the actual designing process started. A visual base structure started to be worked on before the services could be actually designed themselves. For this base structure it was desired that it would display all of the services, it should be easy to identify and then select the desired service to use. So it would only seem instinctive to have two major screen styles, one that would display all the services, and another one where the user would actually use the service. The decision as for what the screen, that displays all the services, would look like was pretty straight forward. It was thought of having each service represented as a colorful tile, and each of these tiles could have different sizes and could be organized in a way that would make the screen

look appealing and modern (see Figure 6 – Screen that displays all the services concept).

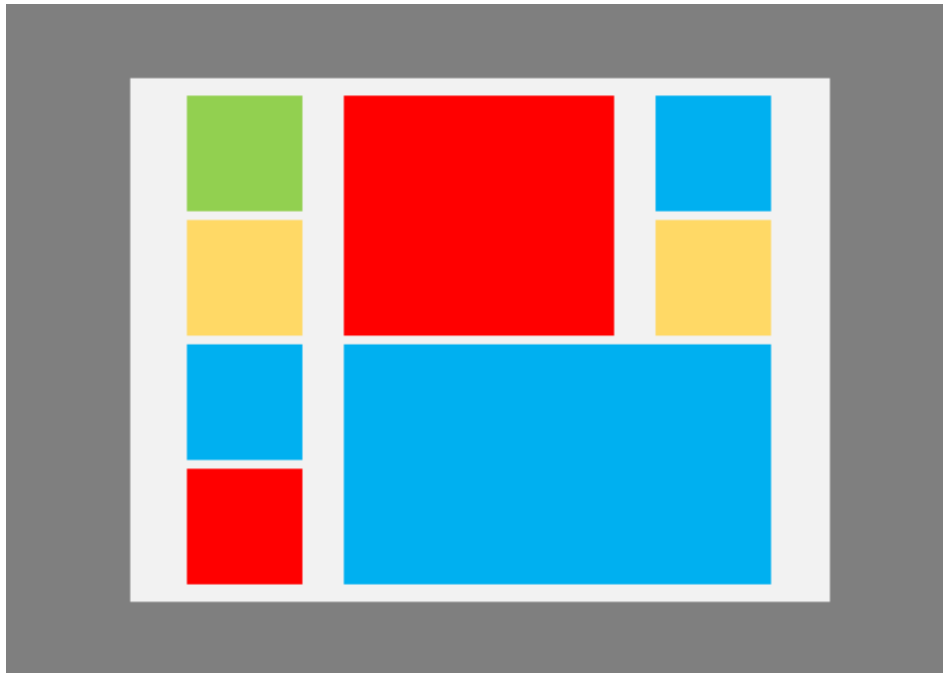


Figure 6 – Screen that displays all the services concept

On the other hand, the design process for the screen that would have the service running was not as straight forward as the previous. There were several iterations for this screen that produced different alternatives as for what the layout should look like. The first concept for this screen was that upon touching the tile of the desired service, this tile would expand and hold the contents inside the actual thing (see Figure 7 – Screen with running service, first design concept).

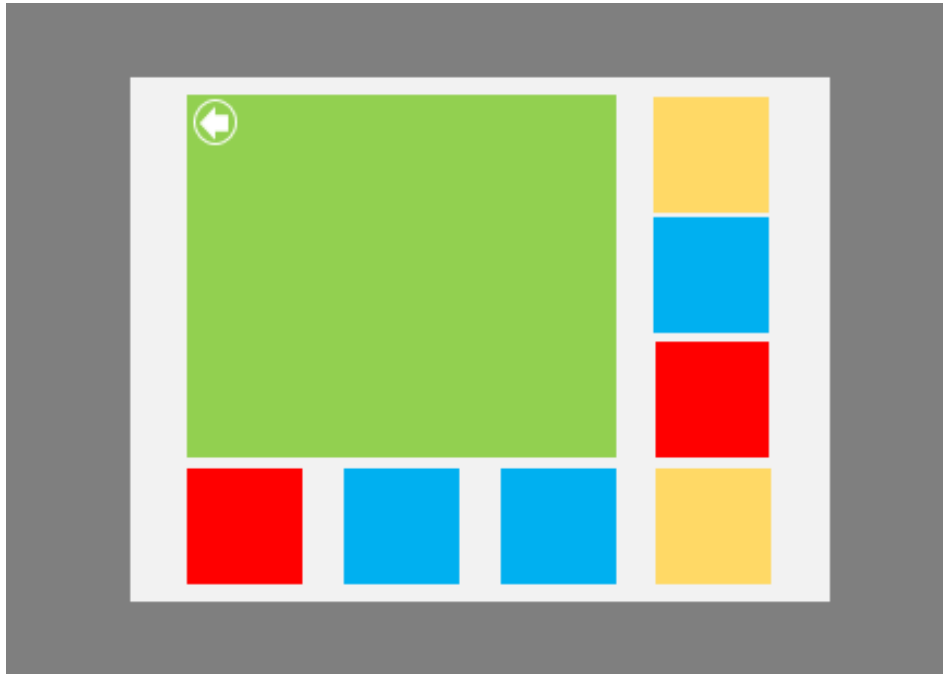


Figure 7 – Screen with running service, first design concept

The tile would expand and the other would arrange themselves so that they could all fit. If the user wanted to close the service it was currently seeing it would just have to press the back button on the top left corner of the tile, or touch on another service, which would immediately open that service. This screen layout allowed to have all of the services visible, however, a problem rose. What would happen if there were many services, or if there isn't enough space for the tile to show the desired content? From this came another alternative. The full screen layout (see Figure 8 – Screen with running service, second design concept). On this one, the selected service would appear on a full screen. This layout was perfect to show all of the contents of the service. The only thing about it was that it was easy to lose track of the other available services.

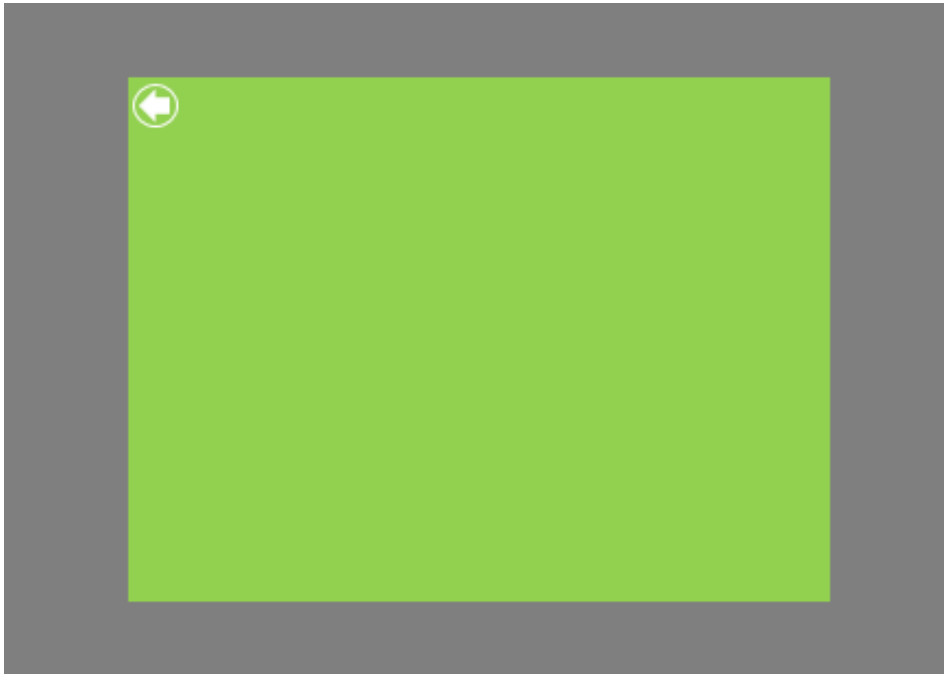


Figure 8 – Screen with running service, second design concept

Another layout that was considered was having the tile of the service expand, like in the layout explained previously, but on this one the tile would appear on top of the others (see Figure 9 – Screen with running service, third design concept).

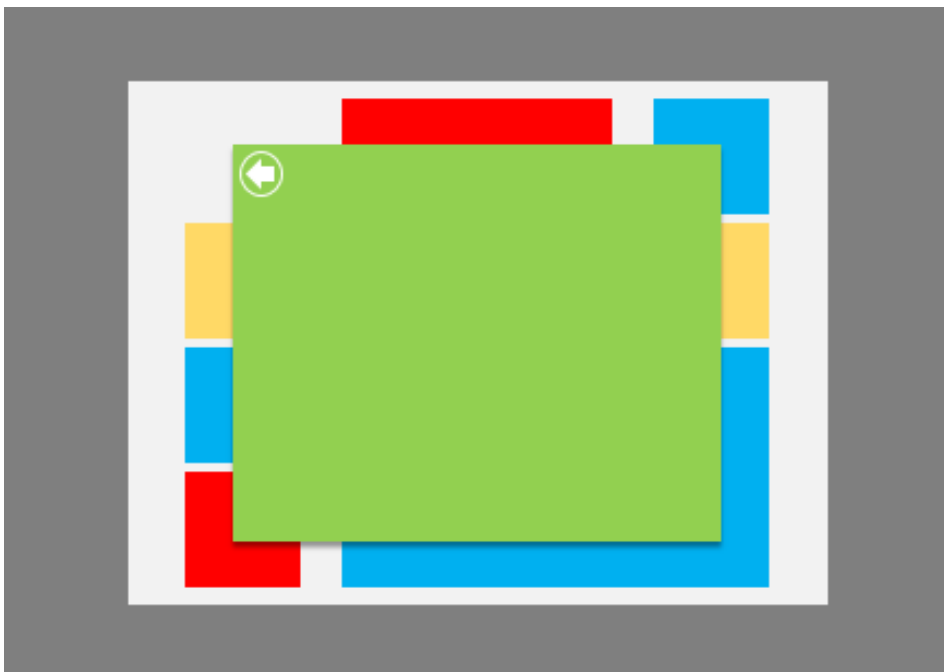


Figure 9 – Screen with running service, third design concept

Another alternative layout was having an area of the screen just to display the services, and another one that would show their contents (see Figure 10 – Screen with running service, forth design concept). So there would be a bar on either side of the screen to display the services available, and the rest would be for the contents.

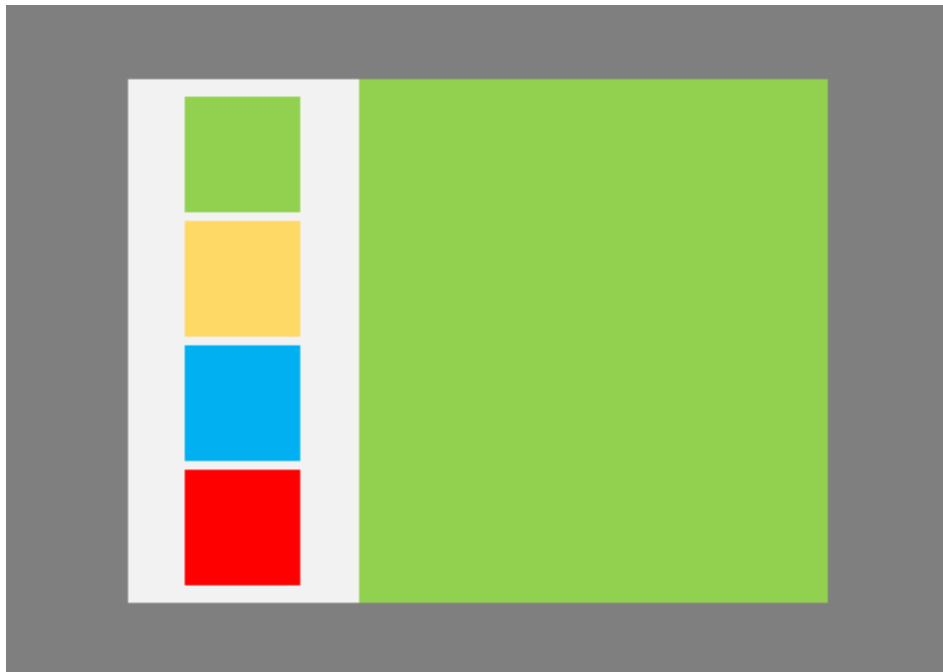


Figure 10 – Screen with running service, forth design concept

This seemed to be a great solution because the services were always visible and the area to show the contents was big enough. There was a problem that rose with this layout. The size of the device screen. Due to the screen being quite big, it could be somewhat hard to reach to top areas. With all that in mind, it was time to test all of these alternatives, so a user testing session happened using an up-to-scale paper prototype (see Figure 11 – Paper prototype session).



Figure 11 – Paper prototype session

From the testing session with the users it was easy to understand which screen layout should be used. It was easy to validate this because the paper prototype was made of loose elements that could be rearranged, and as the experiment went on, it was asked out of the participants to arrange the elements in the most comfortable way for them to interact to. By the end of each session all the layouts pointed out in the same direction.

After the testing session it was clear that the users wanted to have the screen that had the tiles with the services, and another one where the services were displayed in a bar with the contents of the service in the center. With that it was definitely easy to understand that the layout to use should look like something like the next image (Figure 12 – Screen with running service, final design concept).



Figure 12 – Screen with running service, final design concept

After realizing that there should be two types of screen layouts, it was decided that the application would have two interaction modes. This strategy would allow to attract users to the device, and after that have some interaction. With that, these two modes were called the Attraction Mode, and the Interaction Mode.

4.2 Attraction Mode

It was important that this device would be able to attract the users' attention so they would come closer and use it. Devices like kiosks do not always capture people's attention either because they're not interesting, do not provide useful features or do not pass as being interactive.

Since it had been established that there would be a screen layout that would have the services represented as colorful tiles, these would be what would attract the user's attention. With the combination of vibrant colors, animations and by strategically making the most relevant tiles bigger it should make user attraction easier.

Other ways of calling for attention could be used, like using catch phrases of the sort "Touch to start your using session", but these wouldn't make such a big impact.

Images or video could also be used, but could it could be risky because that would imply the need to have high quality images and video footage that maybe would not be as easy or reliable to produce.

What would also most likely attract people to the device would be its useful features, so by displaying the big service tiles and animating them the user would know right away that it wanted to use it.

The attraction mode is a state that isn't usable per say, instead, it's supposed to just attract the users and let them know that the device is actually interactive.

In this mode the services are displayed in a way that makes it easy to see what kind of information can be obtained with just a single glance (see Figure 13 – Attraction mode screen).

Once the device has caught the users' attention, and the user starts interacting, the mode changes into the interaction mode.

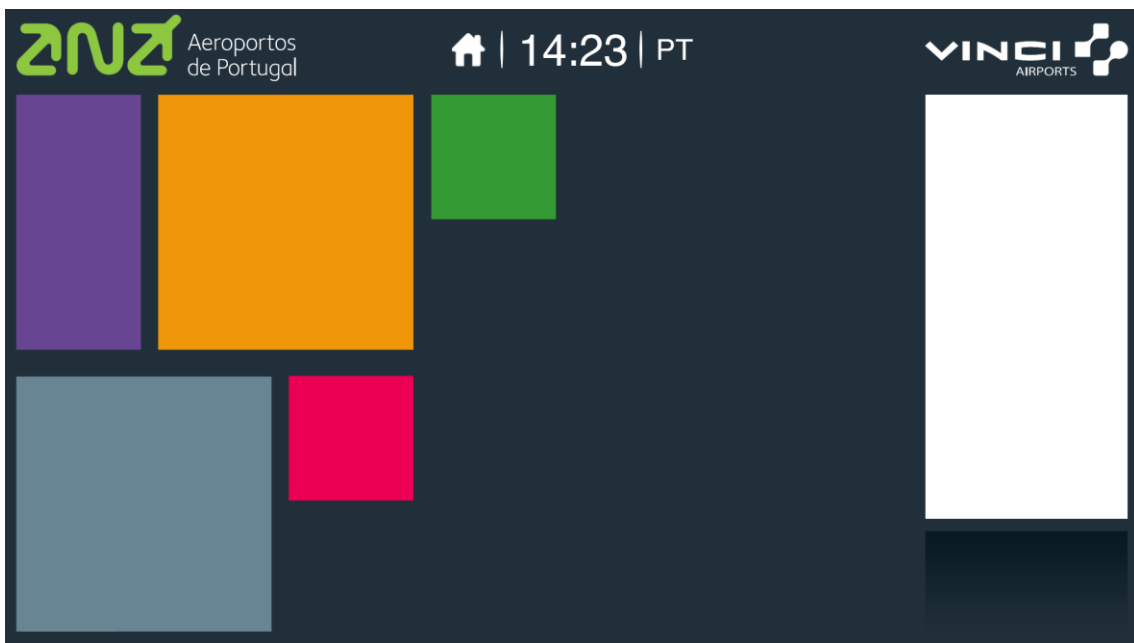


Figure 13 – Attraction mode screen

4.3 Interaction Mode

The interaction mode is when the screen layout changes to show the contents of the services and when the user can actually interact with the system and do all the operations (see Figure 14 – Interaction mode screen).

Depending on the service that the user has selected there is a different set of interactions that can be done. A few interactions that are always available are the ability to change the system language, and the ability to go back to the attraction mode.

This last interaction where the user is able to go back into the attraction mode was not something considered relevant at the beginning, but the testing users from the paper prototype session all pointed that it would be good to have such thing. The user involvement was once again something that highly influences the design decisions.

The interaction mode interface elements were placed in a strategic way so that the user can have a good using experience.

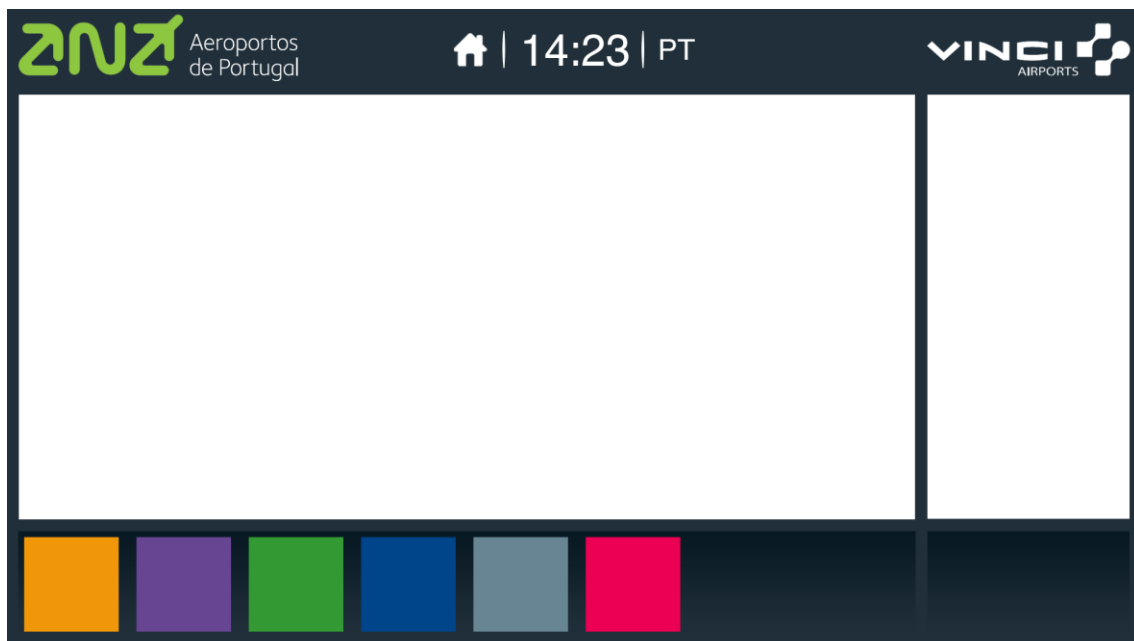


Figure 14 – Interaction mode screen

4.4 Elements Placement

Due to the size of the device itself and the scale that was being worked with, it was important to place all the interface elements in such a way so that the user would have a good experience with the application.

It was noted that through the paper prototype experiment the users would very often find it difficult to reach to the top of the prototype, and that many of the times they would cover some of the information on the screen either with their hands or

arms. This made it easy to understand that there are some areas on the display that are more appropriate to display information, and that some other areas are better for interaction.

The area of the screen closer to the user, which is the bottom part, is where the controls for the user should be, and this is where most of the operations should be done. As the content moves up the screen, it becomes harder to interact with, so the upper part of the devices should only display information and have operations that are not executed too often.

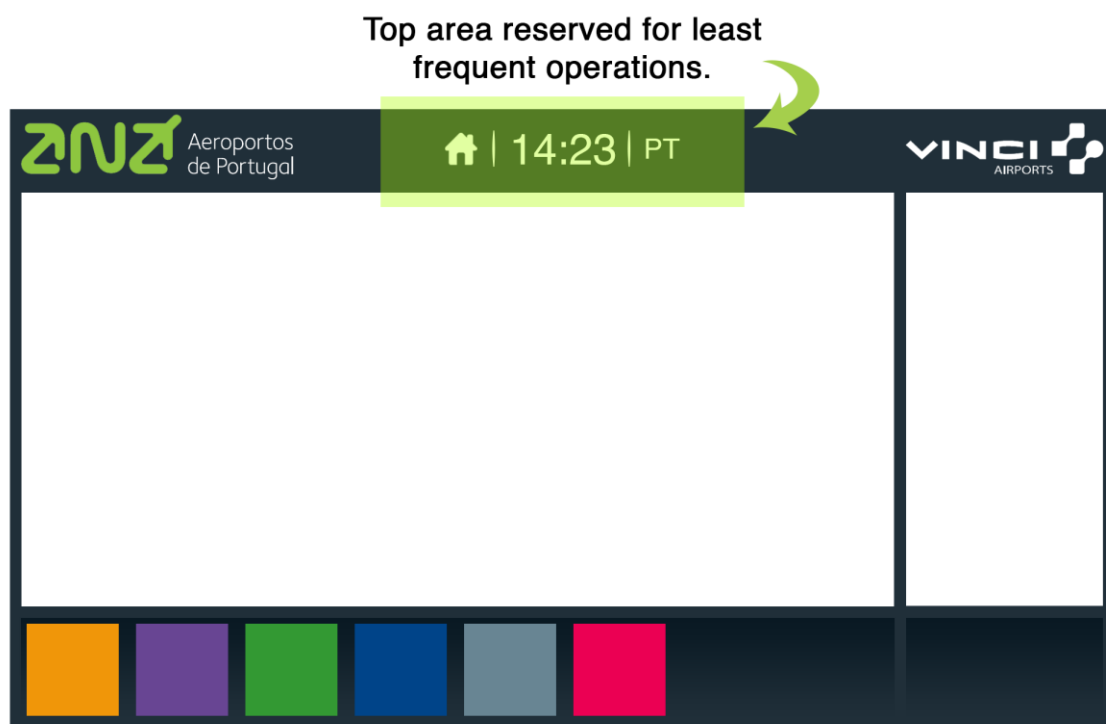


Figure 15 – Top area of interaction mode

Placing the interface elements this way would avoid the user having to lean on top of the kiosk therefore providing a much more comfortable user experience.

In the previous image (see Figure 15 – Top area of interaction mode) it is possible to see that up top there is a button that leads back to the attraction mode, and another one that allows to change languages. The appearance of these two evolved as they were not looking as good as they should. But it is important to

notice that there we already have a structure well defined. There's an area for the application, and below that a bar with all of the applications.

The bar at the bottom would allow the user to switch applications effortlessly without having to go back to the attraction mode (see Figure 16 – Bottom area of interaction mode).

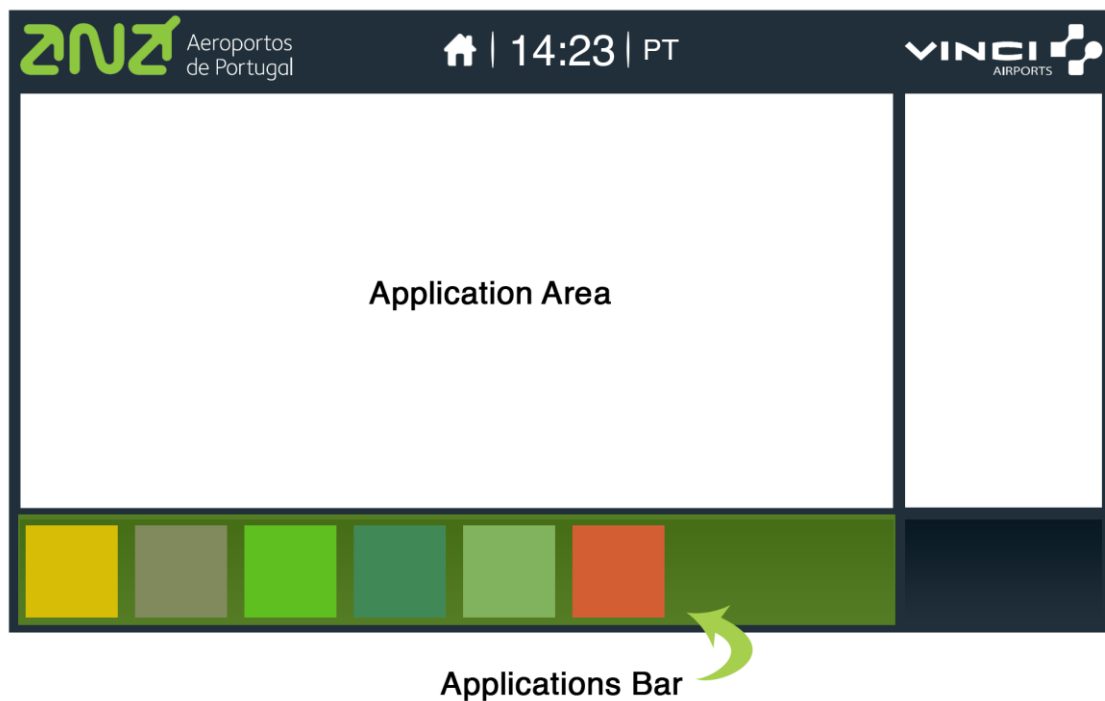


Figure 16 – Bottom area of interaction mode

The existence of the arrows on both ends of the applications bar would suggest and give feedback that there were more applications than those visible, if that were the case.

It was also mandatory to have an advertisement area, so a small space had to be reserved for that (see Figure 17 – Advertisement area of interaction mode).

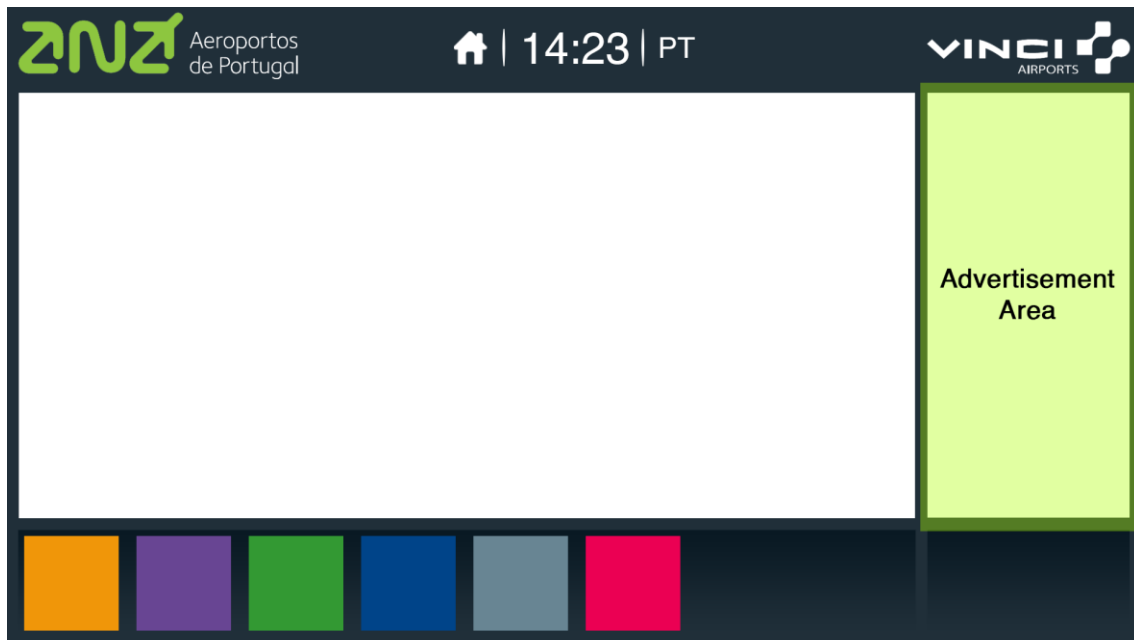


Figure 17 – Advertisement area of interaction mode

This is the base structure that would appear and hold every service, which in this project is also called plugin. Having such base makes it easier for anyone who wants to develop a service/plugin because they do not have to worry about thinking where things should go, or how they should be displayed. They just need to focus on the content of the service itself.

Because of the working method that this project undergone, because it was a creative process, the looks of the base structure evolved. The placement of the elements was kept the same, but the colors, dimensions and graphics changed in order to look appealing and to have high quality visuals. The following images show the evolution that the interface undergone.

In Figure 18 – Interaction Mode Design V1, it is possible to see that all the previous elements (bottom bar, application area, advertisement area and top bar) are placed in their correct places. What is to note in this version of the design is that the languages available are represented by flags, and they are displayed inline. This would look good if there were only two languages, but a bad solution in case there were many more as there could be a chance of “running out of space”, and having too many flags would not look so good.

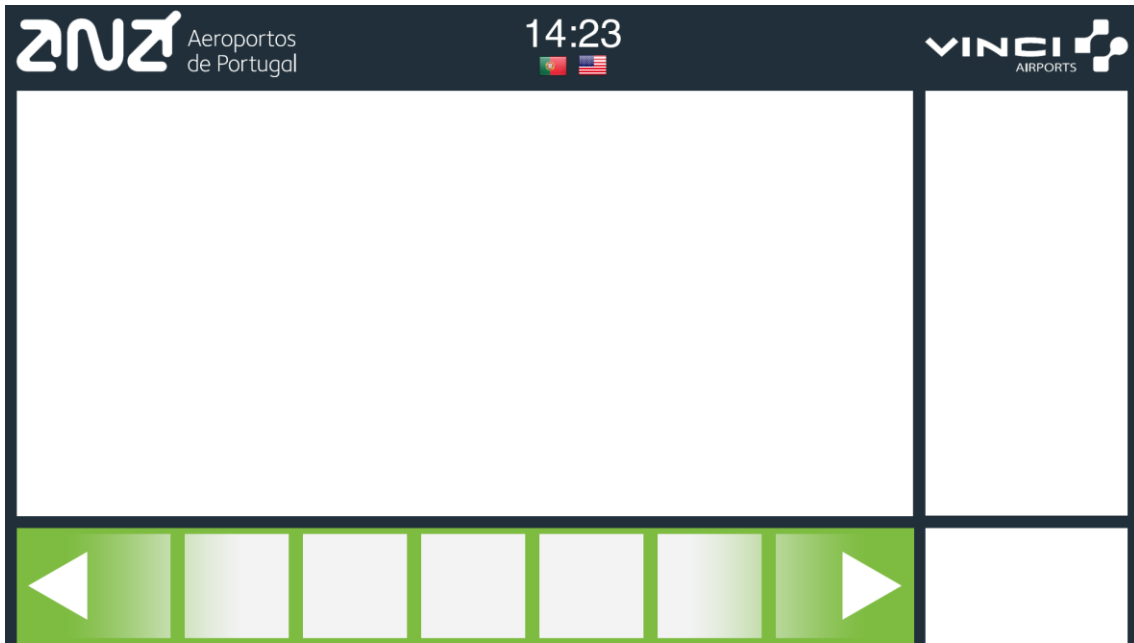


Figure 18 – Interaction Mode Design V1

Figure 19 – Interaction Mode Design V1 (Alternative Colors) shows exactly the same design as Figure 18 – Interaction Mode Design V1, except that it a different color scheme. This light color scheme made the interface harder to read and a bit more distracting, so it was decided to use the previous dark color pallet.

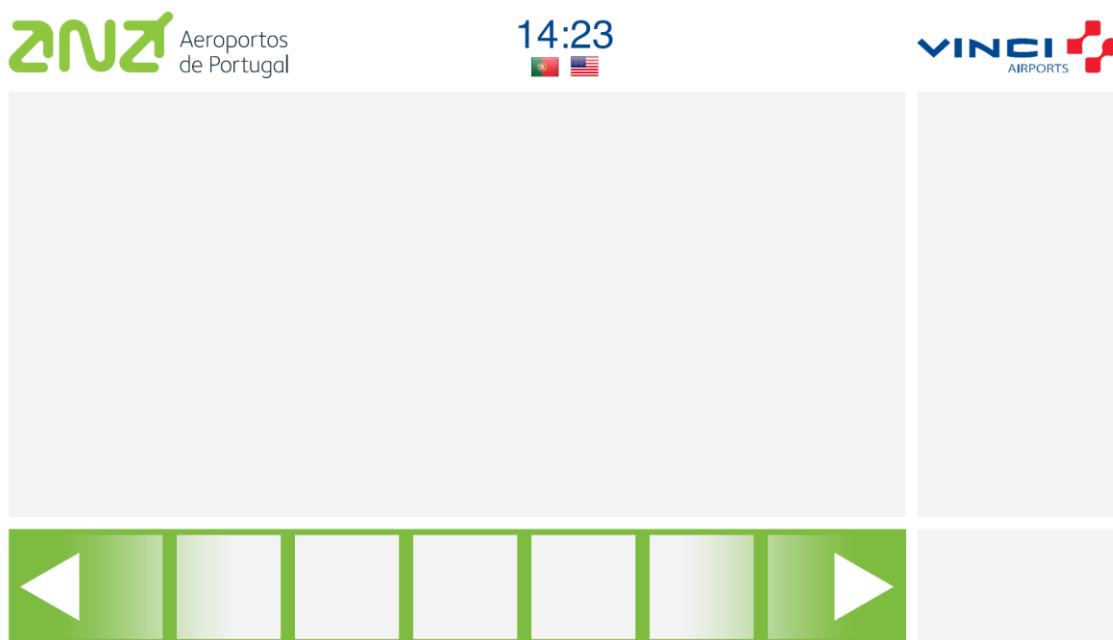


Figure 19 – Interaction Mode Design V1 (Alternative Colors)

As for the next version of the design, it was changed the position of the language switcher as well the home button (see Figure 20 – Interaction Mode Design V2). These buttons were placed on the same line as the time, and now the language switcher would work as a dropdown menu. For this version a dark blue tint was applied to the language flag in order to see if it would blend in better with the interface. Also the home and language icons were given white backgrounds, but these modifications didn't look attractive.

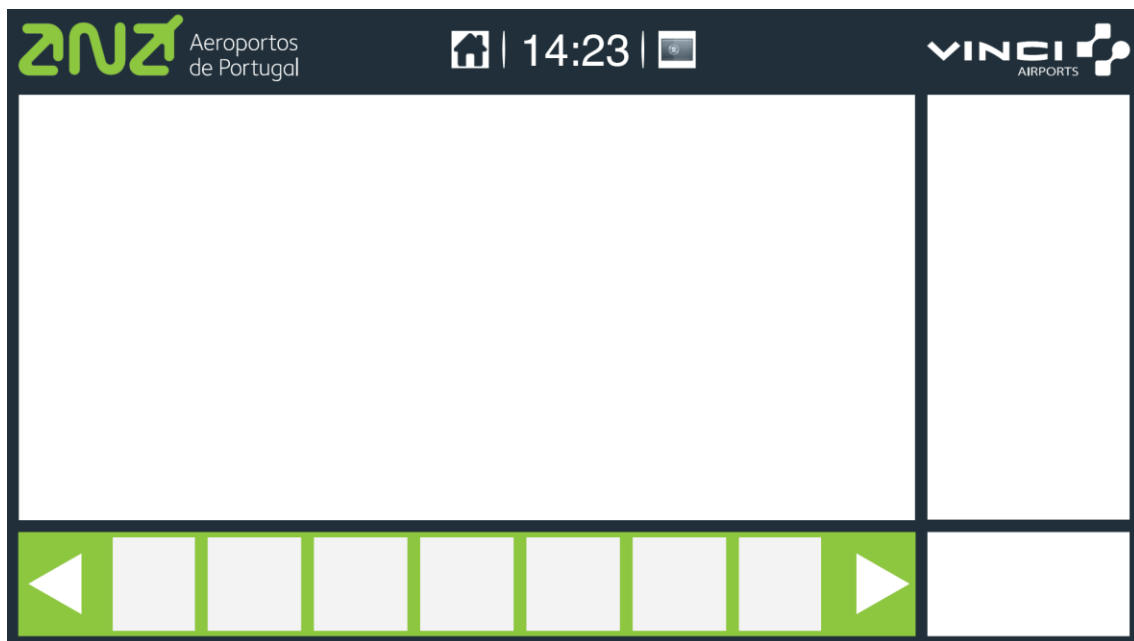


Figure 20 – Interaction Mode Design V2

On the third version of the interface design the position of the home and language buttons was altered again (see Figure 21 – Interaction Mode Design V3). This time they were placed on a bar that stayed on the top of the application area. This idea was immediately scratched out because the home and language buttons should not take away any space from the application area. There was something that was kept from this design, which was the language representation. Instead of using a flag it was decided to use the language acronym. The acronym is much more accurate than the flag and avoids the mistake of using the wrong flag for some languages.

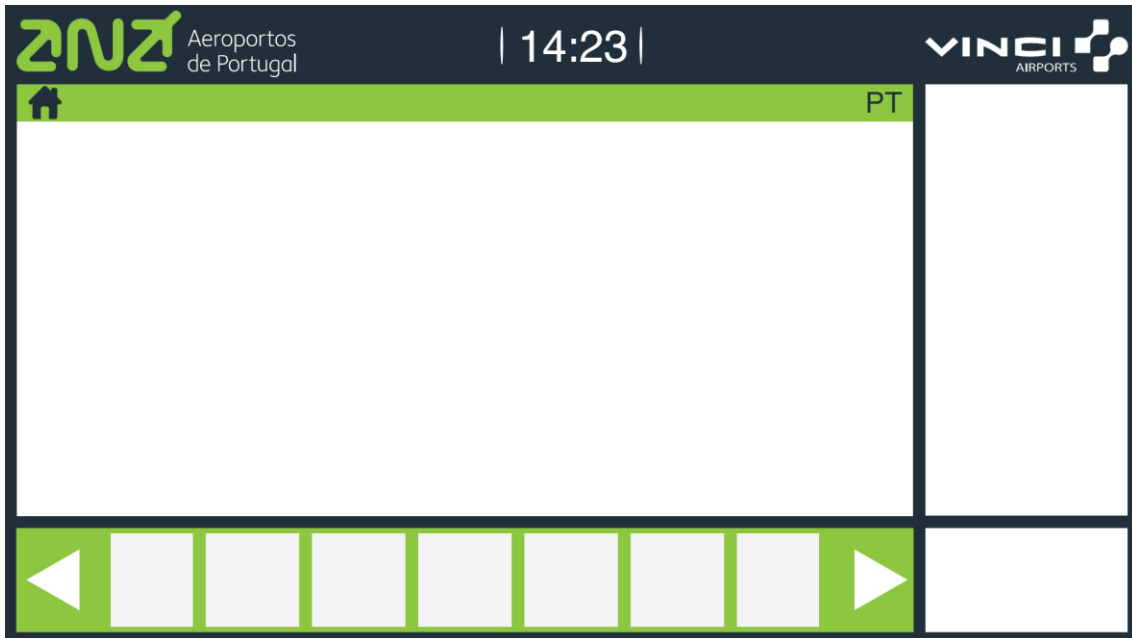


Figure 21 – Interaction Mode Design V3

Figure 22 – Interaction Mode Design V4 show a final version of the top bar, and almost finalized version of the overall design. The home and language buttons returned to the same location as they were on the second version of the design (Figure 20 – Interaction Mode Design V2), except that this time the buttons were redesigned. They don't have a white background anymore, instead their actual color was changed to white.

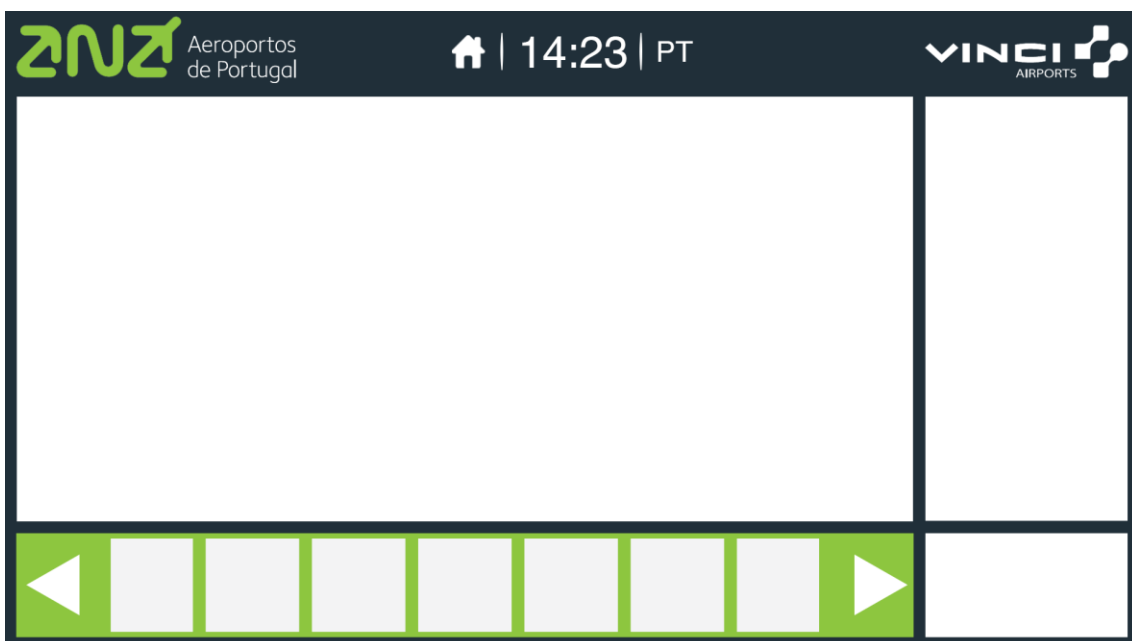


Figure 22 – Interaction Mode Design V4

In Figure 23 – Interaction Mode Final Design is the finalized design version of the interaction mode. What changed from the previous design (Figure 22 – Interaction Mode Design V4) was the bottom bar. In this mode the application tiles have the same color as they did back in the attraction mode screen. This way it is easier to identify each application since it always has the same color. Also the background color of the bar was changed so that it would not clash with tiles colors.

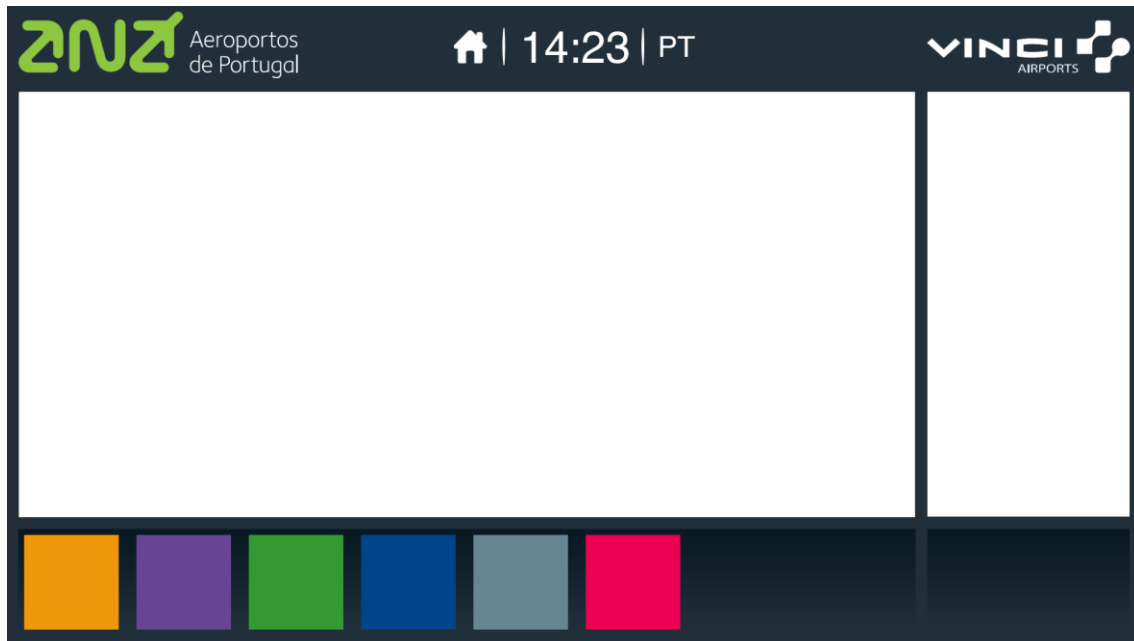


Figure 23 – Interaction Mode Final Design

4.5 Color Scheme

When the design process started it was important to have set the color pallet that would be worked with. Since this was a project developed for the airport, it was only normal to base the pallet on the airport brand colors. The pallet included the official colors of the company, which were documented and given out on the airports graphical norms report, and from those colors were created other swatches, some darker, some lighter and some neutrals.

Thus, the pallet is given on the next image (Figure 24 – Colors Pallet).

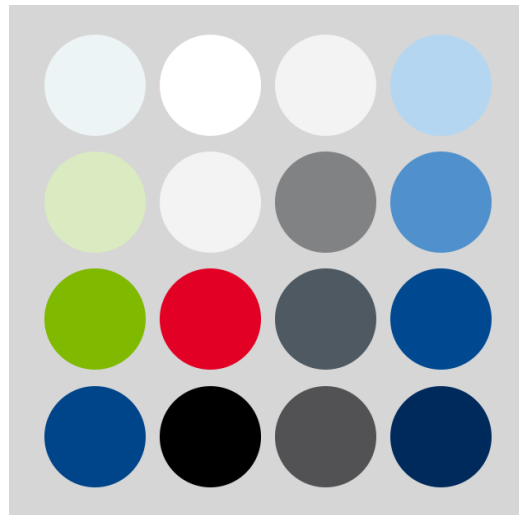


Figure 24 – Colors Pallet

4.6 User Feedback

As a part of a well-designed system, it was important to create user awareness. The user should be able to know what is happening at all time.

In order to create awareness, good feedback must be provided to the user at all time. It is imperative to always show what is active. If some items were hidden there had to be some sort of feedback that showed that those items were there.

In order to show the user that a service or an item was selected it was decided to mark it with a bar as seen in Figure 25 – Selected service feedback. The next image exemplifies that for two cases. The first case shows which service is selected. The second example, which showcases the weather service, shows which city the service is currently displaying the weather for.

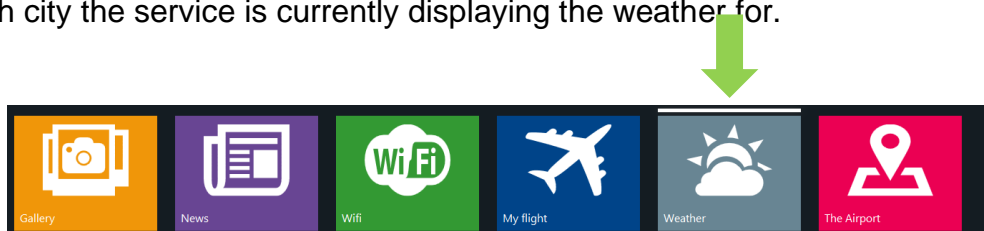


Figure 25 – Selected service feedback



Figure 26 – Selected city feedback

Besides the bar marking the item, it was also used the method of color contrast. The previous image (Figure 26 – Selected city feedback) shows just that. The active city has a contrasting color that makes it stand out, and gives an effect of tabbing.

When it comes to items that are not immediately visible, it is crucial to let the user know that they are there. In this project that was done making use of arrow icons and pagination. These two methods strike the user and it will know that something else is there, even though he cannot see it. The next image (Figure 27 – User feedback example) shows an example of the Gallery service that has both the pagination and arrow icons.

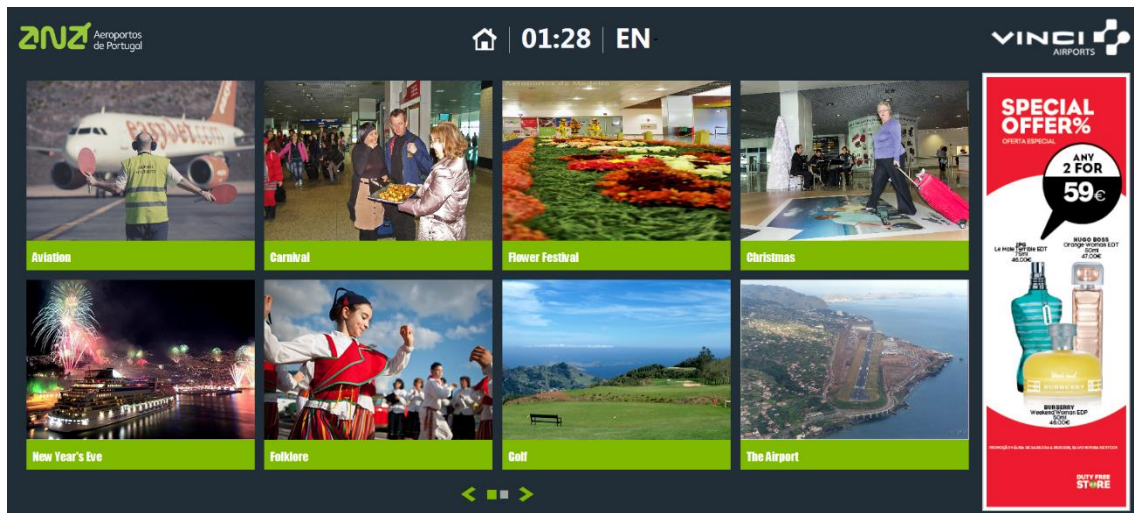


Figure 27 – User feedback example

As for the elements that the user can interact with, it was important to create a style and keep it consistent. In case of buttons, it was decided to have an icon with a circular shape. With this it should be clear that whenever the user sees this, it is something it can interact with. The following image exemplifies some buttons (Figure 28 – Buttons example).



Figure 28 – Buttons example

Consistency is something that was kept in mind throughout the whole design process. This was important in order to assure that not only things looked good, but also so the application was intuitive and easy.

There was discussion about creating some developer guidelines for the various elements of this project. A sort of standard with all of the considerations pointed out throughout this document, for anyone who would like to develop a plugin for the application to follow. This would make plugins creation and design easier, faster and much more consistent. This was something that wasn't developed at the time, but it could perfectly turn into a future project.

4.7 Interaction Design

It was previously stated that another one of the challenges with the device was that the surface glass of the display was not the easiest to work with. The thickness and texture of the glass created way too much friction when trying to do gestures that were a bit more elaborate. Gestures like dragging, pinching, using multiple fingers at a time. Because of that it was decided that it would be for the best to keep the single tap as the main gesture. Not only it is a simple gesture, it also something that most of the people is familiar with nowadays. With this it was avoided having unsuccessful interactions which might result in a much more enjoyable user experience.

5 PLUGIN DESIGN

This chapter is about the design process of each plugin of the system. It shows the initial design propositions and how they evolved.

It has been repeatedly stated that the development method of this project was iterative so it is only natural that each plugin has evolved and changed from iteration to iteration.

It is to be noted that as the project advanced and as it reached its final stages the design of pretty much every plugin pointed in the same direction. There is usually a bar that stays at the bottom of the application area. This bar contains the major controls for the user. The buttons all have the same design so that it is easy to understand that the user can interact with these. Finally the same color scheme is used pretty much in every application.

5.1 Plugin: Wi-Fi

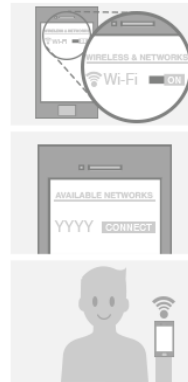
On the initial stages of the project it was discussed that Wi-Fi would be what would mostly attract users to the device, so it was important to have this plugin. Feature wise it was not supposed to do much. It just had to provide the information that the airport had free Wi-Fi, and give out the instructions on how to connect. The first design proposals for this was faithful to the color scheme that was previously discussed and it is possible to see the example in Figure 29 – Wi-Fi Plugin first design proposal), however, none of these proposals was followed.

Wi-Fi instructions on how to connect automatically

If you have a QR code scanner, you can connect to our Wi-Fi network automatically by scanning one of the code below.



manually



1. Turn on your wi-fi.
2. Search for the YYYYYY network.
3. Connect and enjoy.

Figure 29 – Wi-Fi Plugin first design proposal

It was asked by the airport staff that the design of this plugin should be based on some banners and advertisement that was already circulating the airport. The design outcome can be seen in the image below (Figure 30 – Wi-Fi Plugin second design proposal).

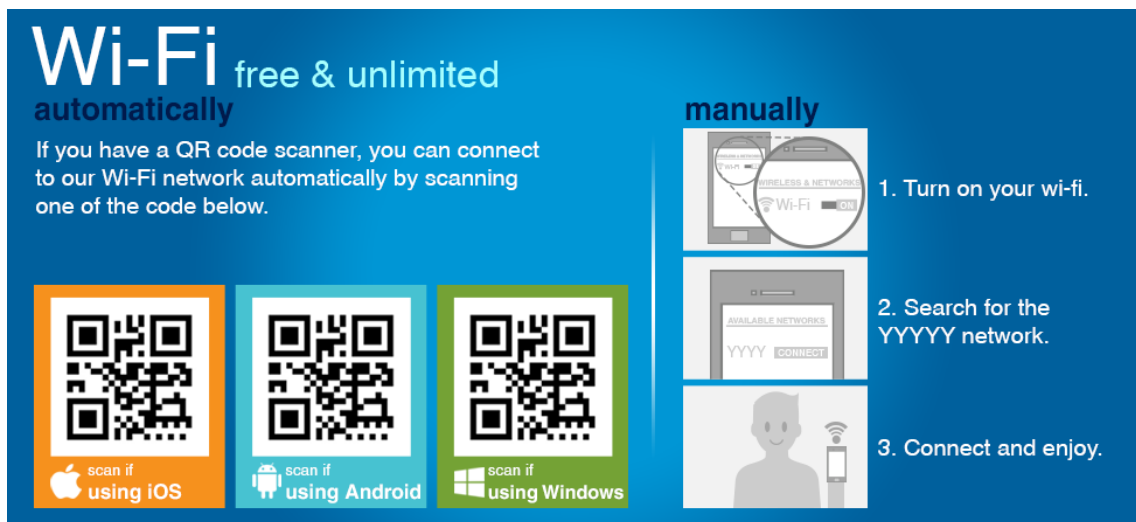


Figure 30 – Wi-Fi Plugin second design proposal

The information given was split into two, which were the two ways that the user could connect: manually or automatically using QR codes.

It is possible to see the final outcome of this application in Figure 31 – Wi-Fi Plugin final design.



Figure 31 – Wi-Fi Plugin final design

5.2 Plugin: My Flight

This plugin was probably the one that went through the biggest number of iterations and changes. The first version that was designed was heavily influenced on a mobile application that already existed (see Figure 32 – My Flight Plugin first design proposal). This interface had three tabs at the bottom, and each tab showed information about the flight, check-in and the boarding gate. While in the flight tab it was possible to see the number and status of the flight, the origin and destination, as well as the times.

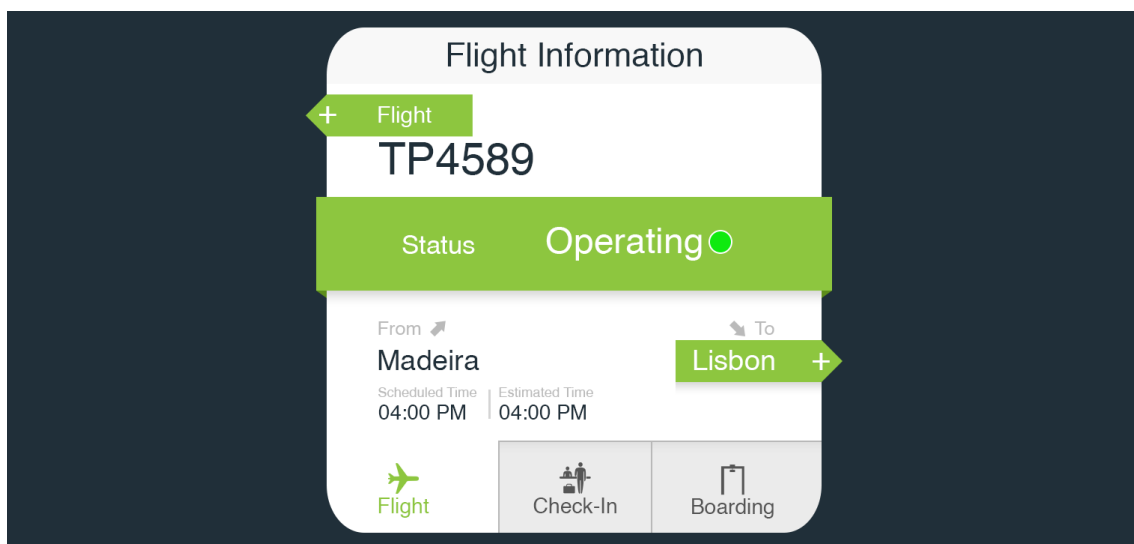


Figure 32 – My Flight Plugin first design proposal

Furthermore, in the flight tab, if the user pressed the + button it was possible to see information about the destination as it is exemplified on the next image (Figure 33 - My Flight Plugin first design proposal (open destination)).

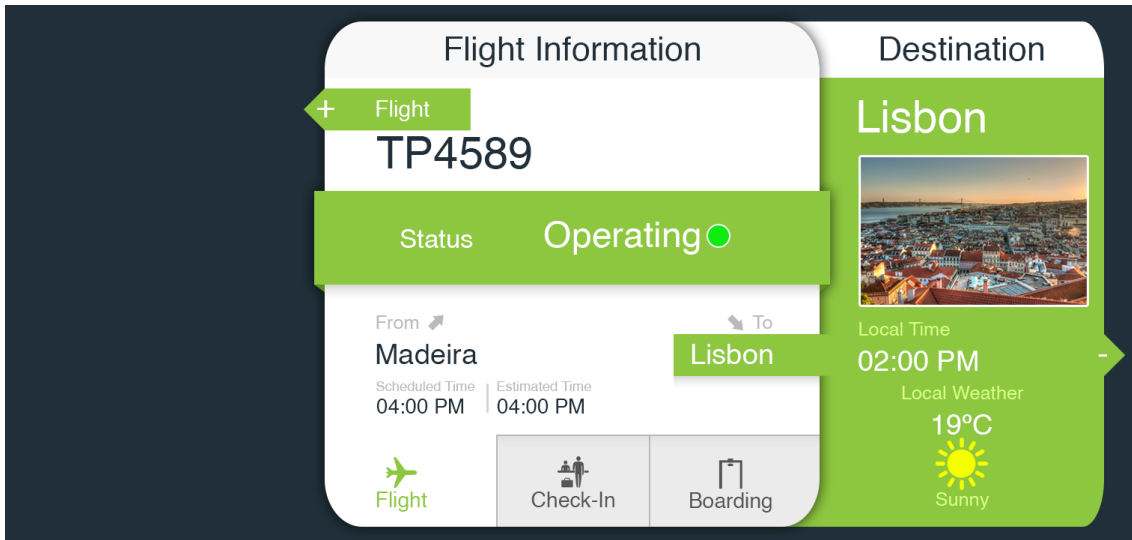


Figure 33 - My Flight Plugin first design proposal (open destination)

Beside the + button for the destination, there was a + button for the flight. This button showed information about the airline and the aircraft for the flight (see Figure 34 - My Flight Plugin first design proposal (open airline)).

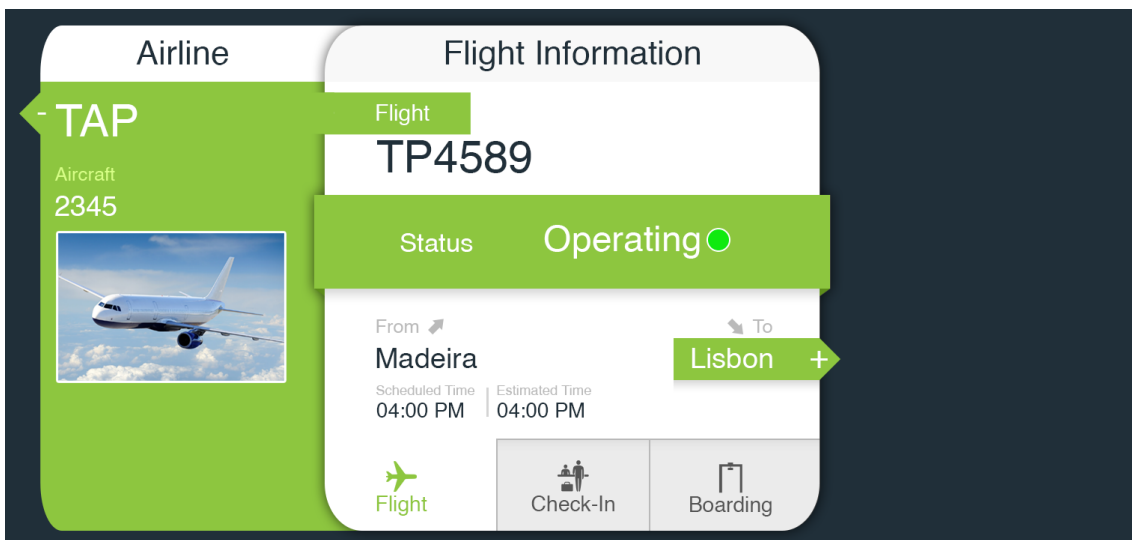


Figure 34 - My Flight Plugin first design proposal (open airline)

As for the check-in tab it had information about which were the check-in counters, if the check-in had already started or not and times (see Figure 35 - My Flight Plugin first design proposal (check-in info)).

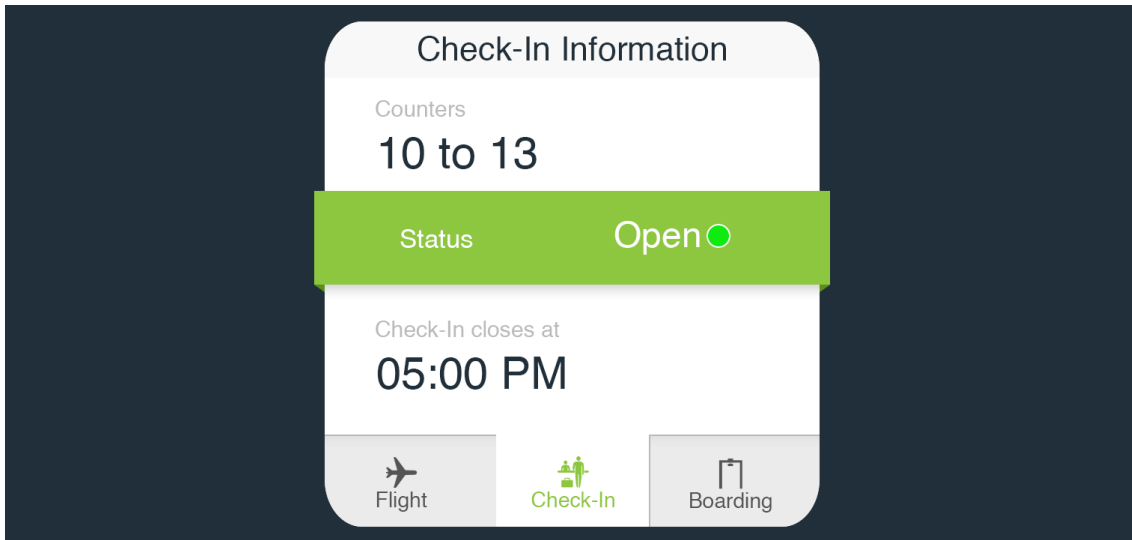


Figure 35 - My Flight Plugin first design proposal (check-in info)

The check-in tab had information about the boarding gate, if the gate was open or not, and times (see Figure 36 - My Flight Plugin first design proposal (boarding info)).

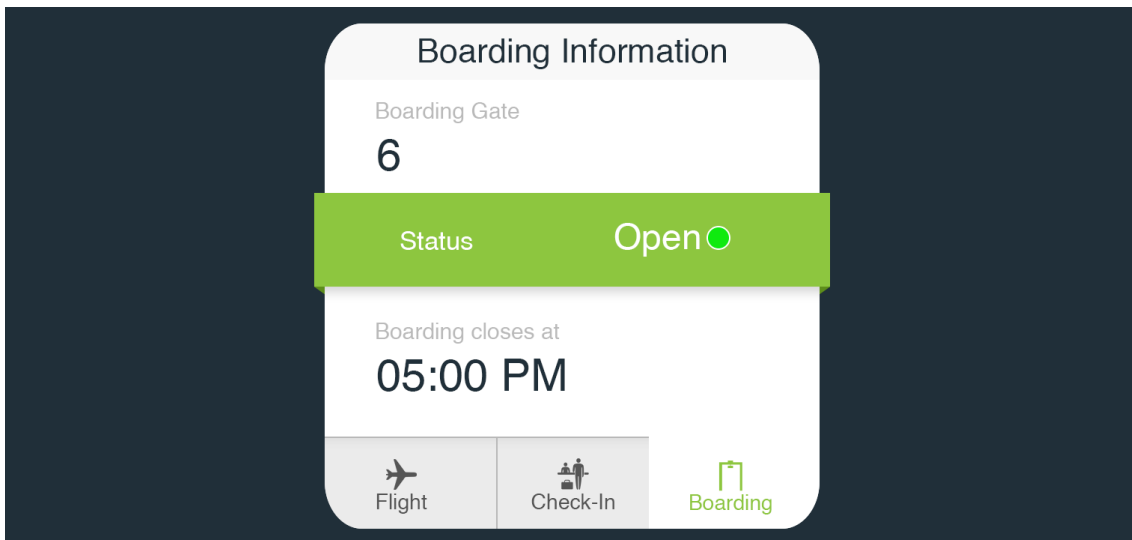


Figure 36 - My Flight Plugin first design proposal (boarding info)

This design had lots of relevant and useful information for the user, however this information should be easier to reach and much more readily available. This design requires many steps to reach the information as it was “hidden” in the tabs and buttons. With this in mind, the next design fused all the previous concepts

and made it into one piece, an interface that has the all the relevant information for the user just in one place (see Figure 37 - My Flight Plugin second design proposal).

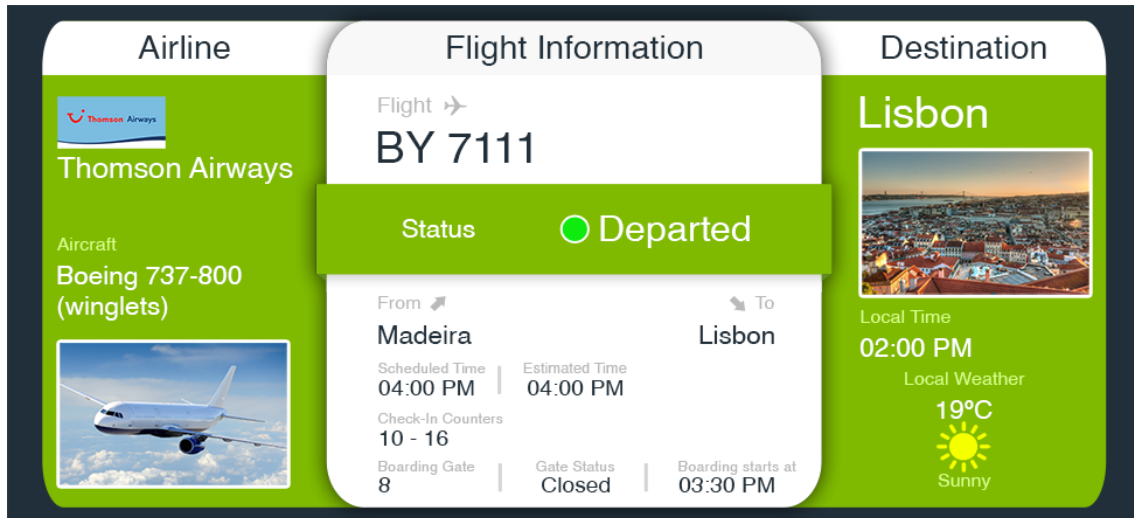


Figure 37 - My Flight Plugin second design proposal

Since this was a plugin that showed information about the user's flight, the idea of making it look like as if the interface was a boarding pass came up and all the information mentioned previously was rearranged in order to do that (see Figure 38 - My Flight Plugin third design proposal). A barcode scanner was installed on the device, and a new feature was introduced to the user. The user could scan its boarding pass and have information about its flight more easily. With this interface also came up the concept of showing the user the location within the airport for the boarding gates and passport control. This information would be provided on the Locations Map Plugin if the user pressed the green button with the location icon. The same idea was applied to the weather. If the user pressed the "more" button on the destination area, it would be able to access more information about the weather at the destination on the Weather Plugin.

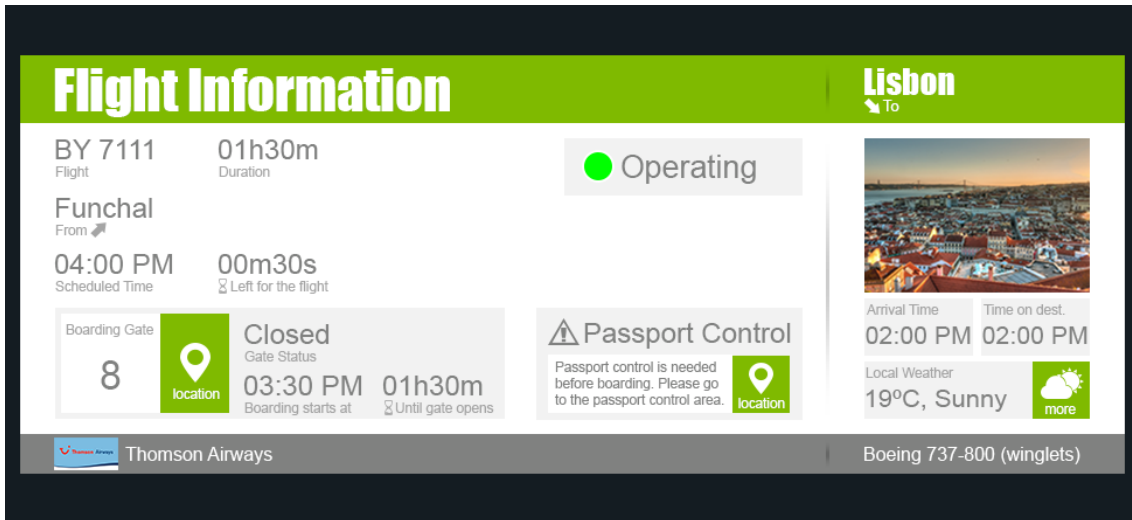


Figure 38 - My Flight Plugin third design proposal

Figure 39 - My Flight Plugin final design show the final design of the My Flight plugin after implementation. It was added a controls bar at the bottom of the application area so that the user could access a list of all the available flights.

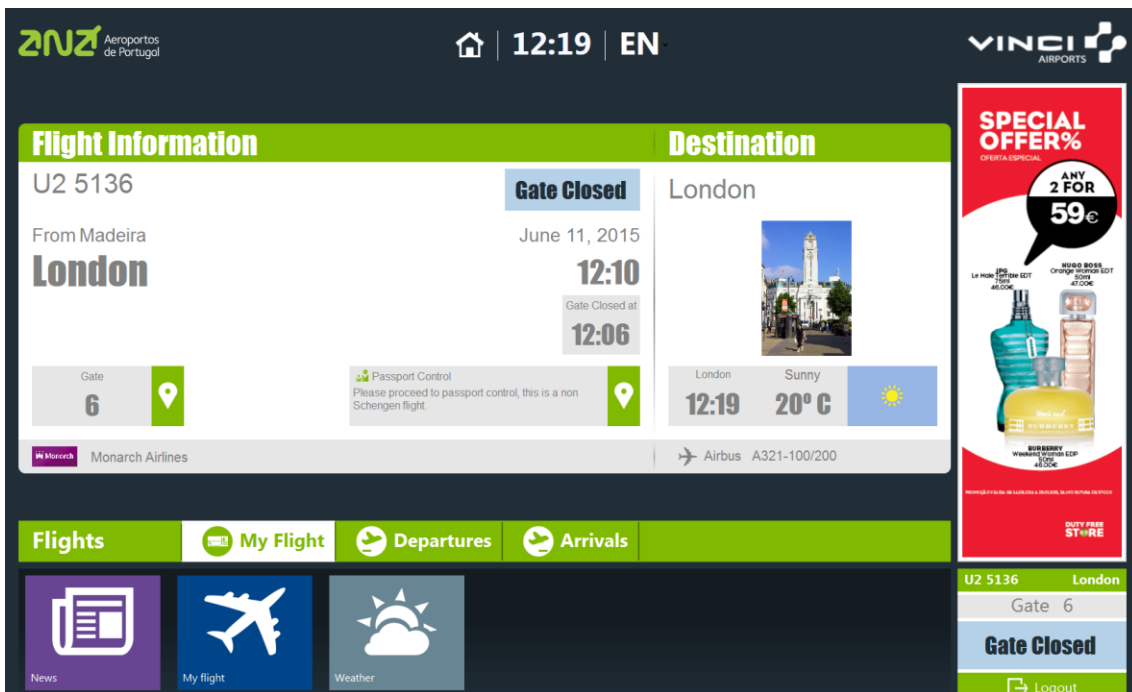


Figure 39 - My Flight Plugin final design

5.3 Plugin: Locations Map

This was a plugin that had the intention of showing the user which were the shop and available stops inside the airport. For this service in particular some more elaborate graphical development was required.

In this plugin the user can see the different locations of the airport, but in a very static manner. It was desired for it to be designed in such a way that the user could dynamically interact it. But because of the time frame that we had to work with, that was not possible to accomplish.

The first few design proposals did not exactly follow the design standards that we ended up going for because at the time they still were not that well established. It is possible to see from the shape of the bottom bars as well as the usage of colors (see Figure 40 – Locations Map Plugin first design proposal). Through the images it is possible to see how the plugin evolved into the final design proposal that follows the standardized design guidelines we have established.

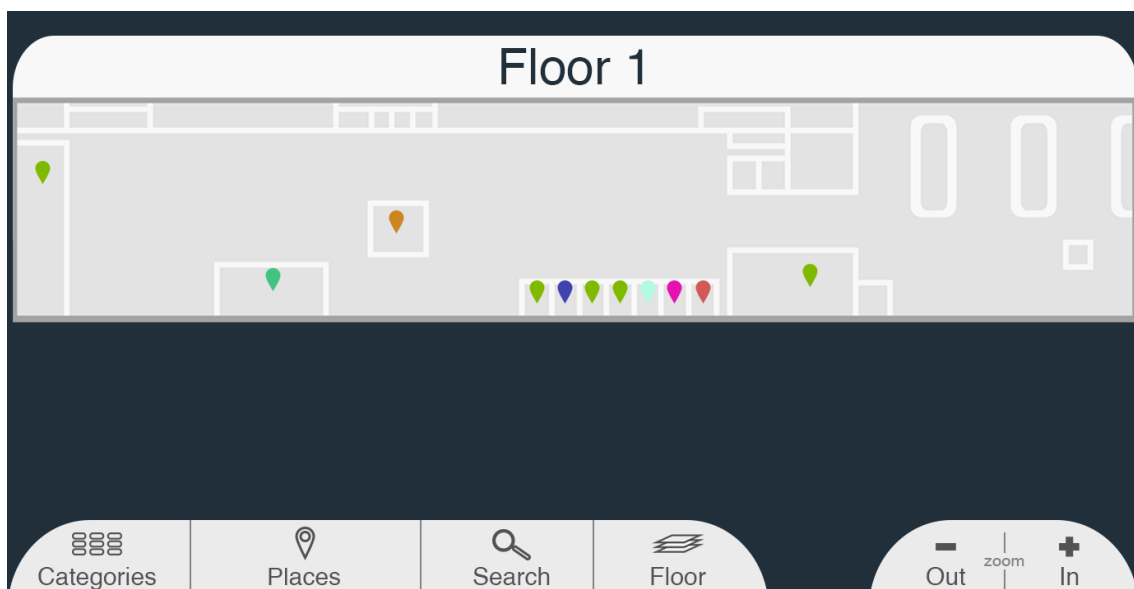


Figure 40 – Locations Map Plugin first design proposal

When moving on to the second design proposal it was the previously mentioned color scheme, however the buttons still did not follow the standardized look. The second design proposal is shown in Figure 41 - Locations Map Plugin second design proposal.



Figure 41 - Locations Map Plugin second design proposal

Figure 42 - Locations Map Plugin third design proposal shows how the design evolved into a much standardized version. The use of the color scheme, the buttons and placement of the elements all contribute for that.



Figure 42 - Locations Map Plugin third design proposal

The next image (Figure 43 - Locations Map Plugin final design) shows the final and implemented design of the plugin. It is possible for the user to change floors and see which places are available in each floor by category.

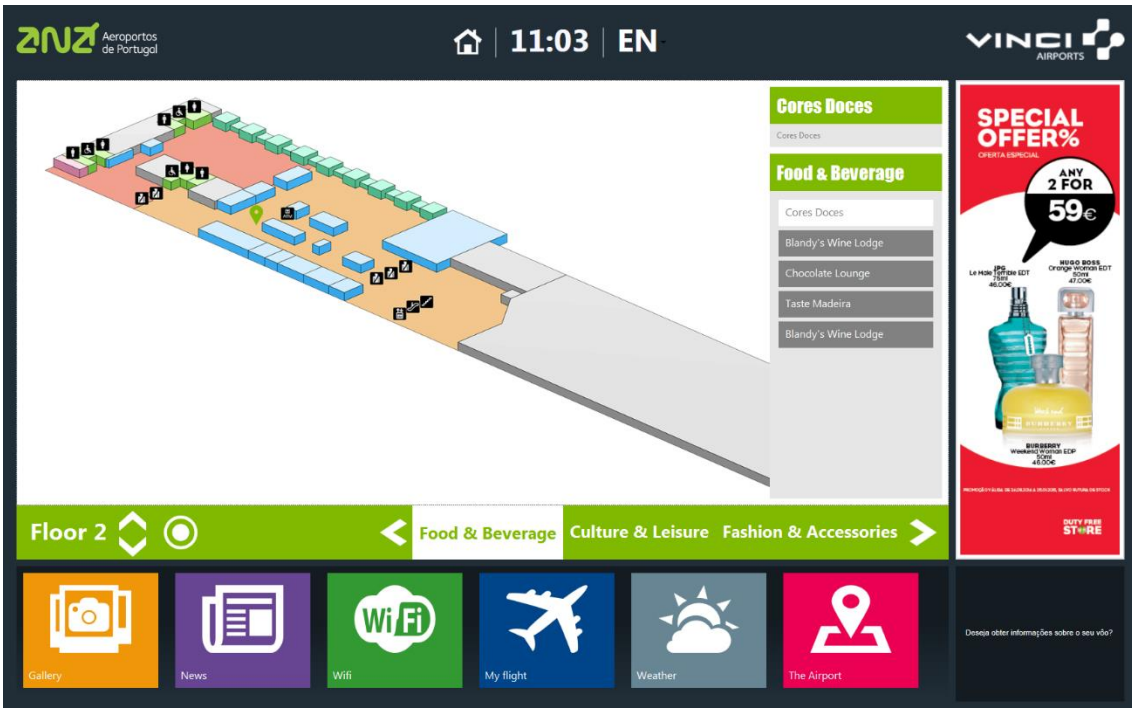


Figure 43 - Locations Map Plugin final design

5.4 Plugin: News

For this plugin it was hard to decide how the news would be displayed taking into consideration the interactions we had available.

The initial proposals were that the news would all appear in boxes that had all the same sizes, where 6 news would appear per page (see Figure 44 – News Plugin first design proposal).

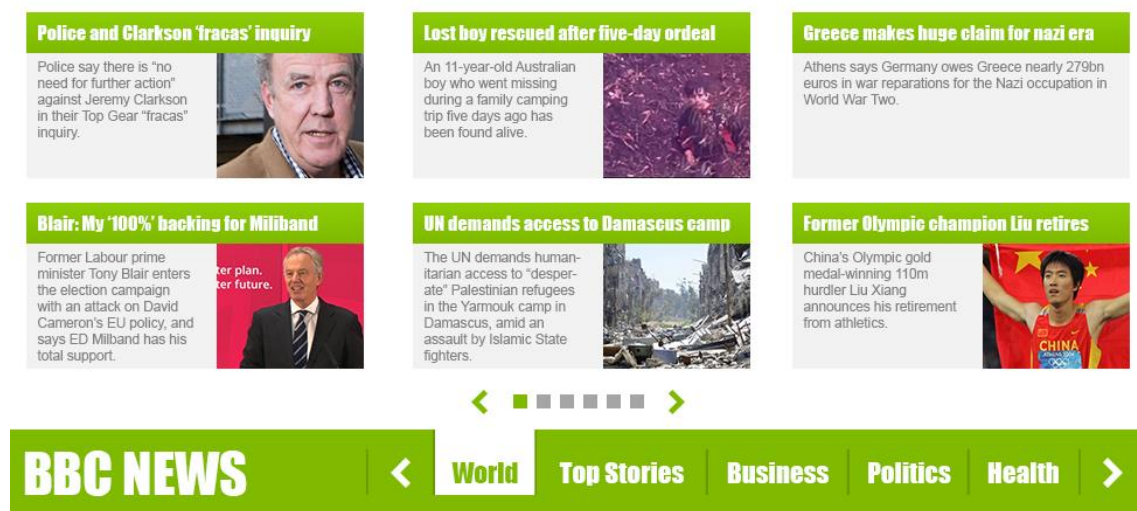


Figure 44 – News Plugin first design proposal

In the end it was decided that the interface would resemble an actual newspaper where each news takes the space it needs and things are not organized on an aligned manner (see Figure 45 - News Plugin final design).

Once again it is possible to see the evolution of the design, where in the beginning the design guidelines weren't that well established, and then in the final design the plugin looks much more consistent with all the others.

Desemprego recua para 13% em Abril



A taxa de desemprego terá caído 0,2 pontos percentuais face ao mês anterior.

Portugal poderá poupar 1.300 milhões em juros ao FMI



Presidente do IGCP, Cristina Casalinho, estima que o pagamento

Inflação em terreno positivo ao fim de seis meses



Preços na zona euro recuperaram depois de cinco meses a cair ou em estagnação. Serviços e alimentação ajudaram.

Espanha com Maio histórico para o desemprego



Assembleia Geral: Madeira deve ter mais tempo para pagar dívida?



Participe no programa Assembleia Geral, do Etv, através do número de telefone 21 323 68 98 ou por email para assembleia.geral@economico.pt. O programa vai para o ar todos os dias úteis às 17h15.

Merkel lidera cimeira de urgência em Berlim para evitar 'default' da Grécia

ETV: O dia num minuto



Num minuto, fique a conhecer as principais notícias e destaques do dia no Económico TV.

Desemprego na Alemanha recua pelo oitavo mês consecutivo



O desemprego na Alemanha voltou a recuar em Maio, marcando já a

"Presidente impõe condição que não está na Constituição"



António Costa critica Cavaco Silva por ter dito que não dava posse a Governo minoritário, diz que maioria do PS é possível mas não afasta compromissos alargados.

Moscovici reconhece progressos nas negociações com Grécia



Diário Económico



Portugal Mercados

Economia / Política

Últimas



Figure 45 - News Plugin final design

Plugin: Gallery

The gallery plugin was pretty straight forward to design.

The standards that pretty much everyone recognizes in a gallery were followed. First there are all the albums from which the user can pick one. Figure 46 – Gallery Plugin first design proposal (list of albums screen) shows the first design for the list of albums.

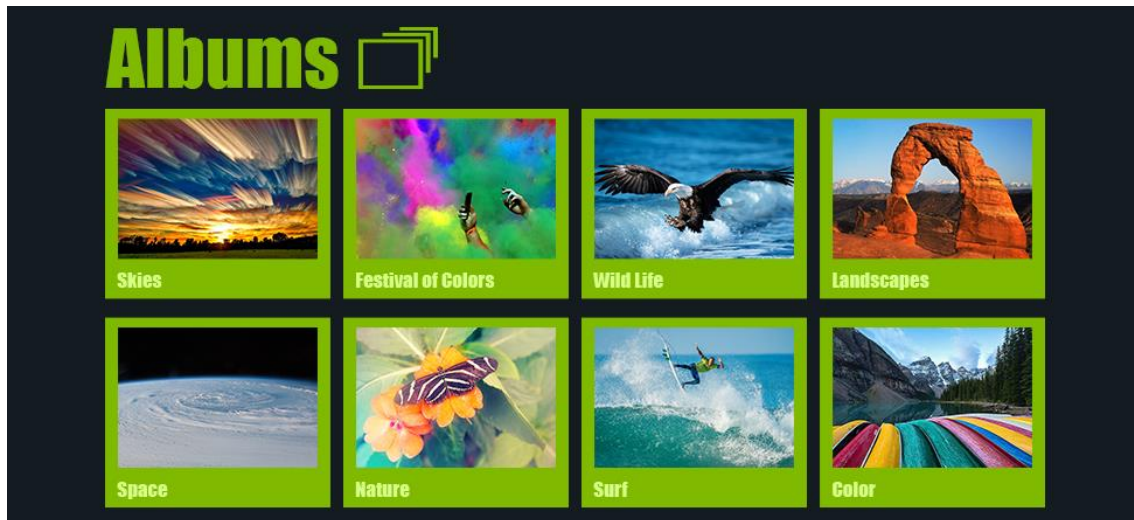


Figure 46 – Gallery Plugin first design proposal (list of albums screen)

Then there are the photos and videos inside an album, where once again one can be picked. The design proposal in Figure 47 - Gallery Plugin first design proposal (album screen) shows the first design proposal for the album screen. The photos are represented but simple thumbnails whereas the videos have a play button on top. This design also has a slideshow feature and a button to return to the albums list.

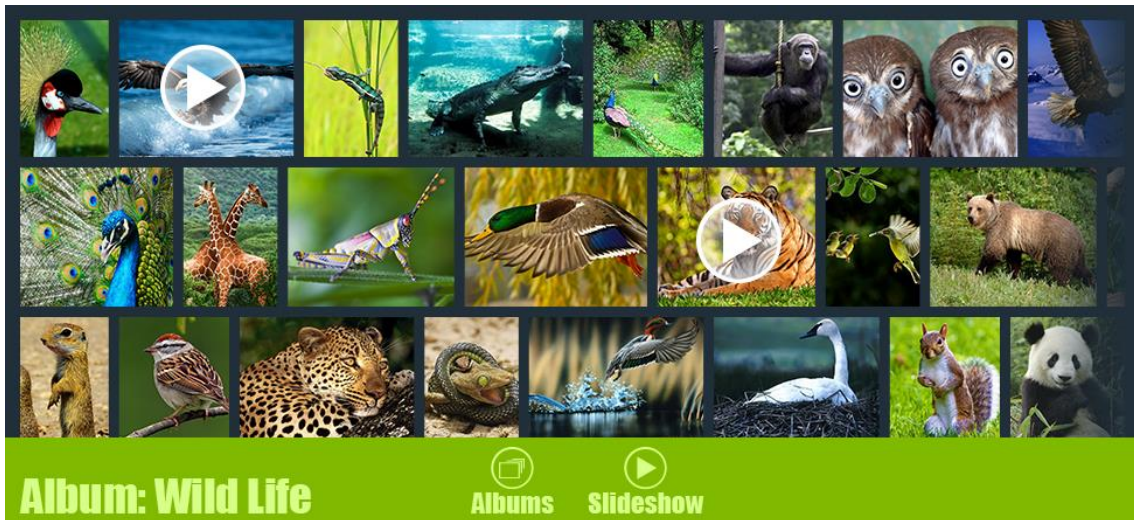


Figure 47 - Gallery Plugin first design proposal (album screen)

Figure 48 - Gallery Plugin first design proposal (photo screen) shows the screen of a single photo. Here the user could go back to the previous album screen, switch to the previous or next photo and play the slideshow. It is also possible to see a “Send by Email” button, but this was a feature that was scratched out as it did not seem too useful.

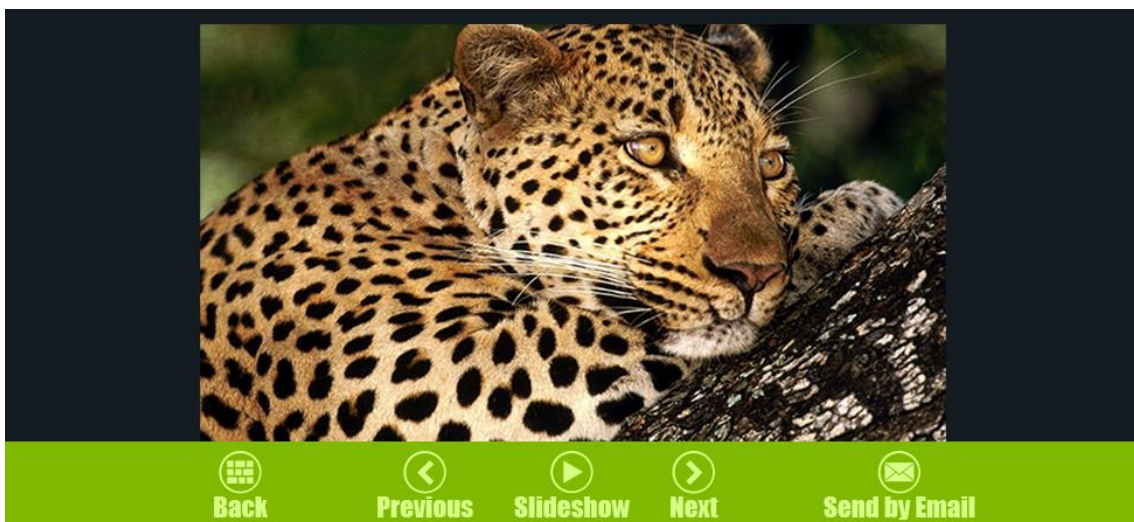


Figure 48 - Gallery Plugin first design proposal (photo screen)

For the first iteration of the gallery the design proposals for the several screens seemed to follow the design principles that have been shown so far, but looking closer to the design of the elements it is possible to see that they are not in their

final form. In example, the icons in the buttons in Figure 48 - Gallery Plugin first design proposal (photo screen) should have a white circular background, instead they are a light green color with a border. During the second design iteration these aspects were polished and converted into the final design form. Since this was a gallery it was tested a white background for this plugin in the second design iteration, but this idea was rejected in the final version.

Figure 49 - Gallery Plugin second design proposal (list of albums screen) show all the albums available, with the use of pagination indicating that there are more albums than those that can be seen. This figure also show how the plugin would look like if the background was white.

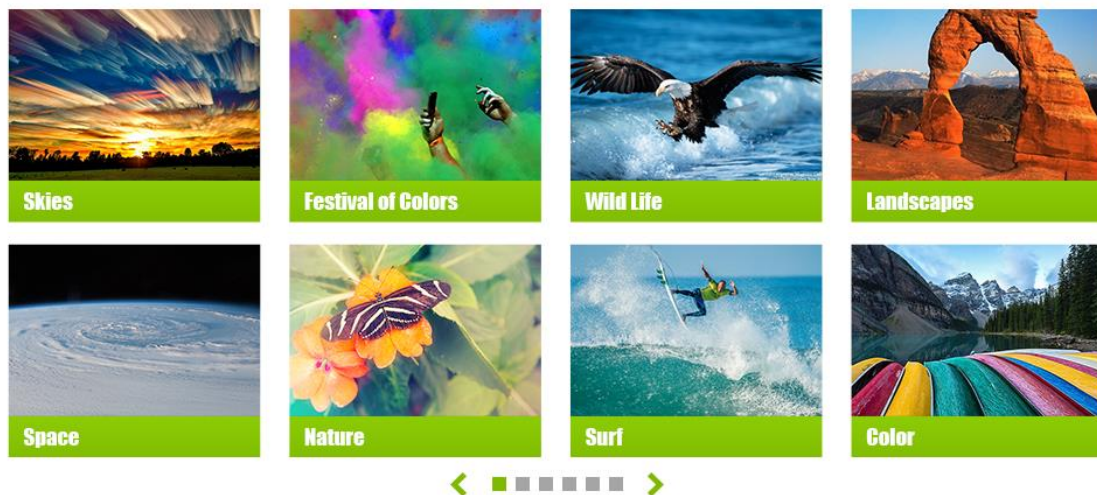


Figure 49 - Gallery Plugin second design proposal (list of albums screen)

In Figure 50 - Gallery Plugin second design proposal (album screen) can be seen the album screen with white background. It resembles Figure 47 - Gallery Plugin first design proposal (album screen), but in this version everything (except for the background) is in its final standardized form.

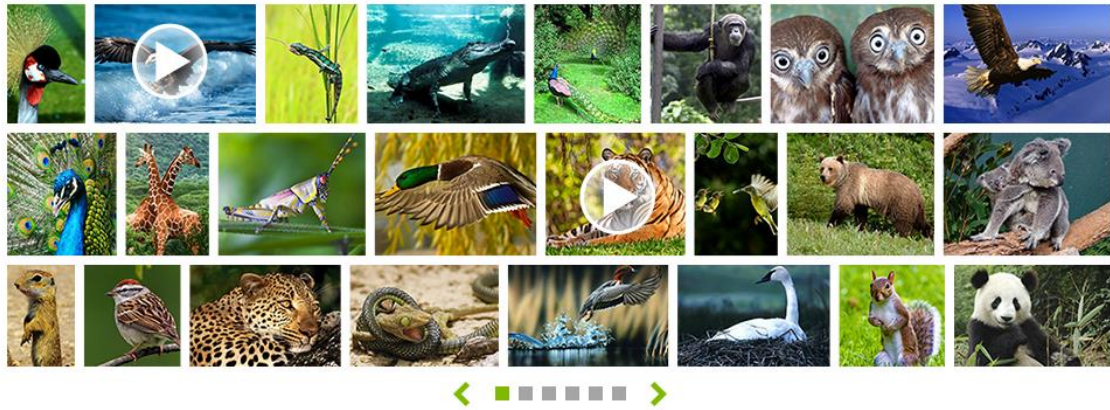


Figure 50 - Gallery Plugin second design proposal (album screen)

Once again, the photo screen from the first design iteration (Figure 48 - Gallery Plugin first design proposal (photo screen)) resembles the photo screen from the second iteration (Figure 51 - Gallery Plugin second design proposal (photo screen)), however it is possible to see that in the second iteration the elements follow the standardized design guidelines.



Figure 51 - Gallery Plugin second design proposal (photo screen)

When finally implemented the background color of the plugin was reverted back to dark blue, as seen in the next image (Figure 52 - Gallery Plugin final design (list of albums screen)).

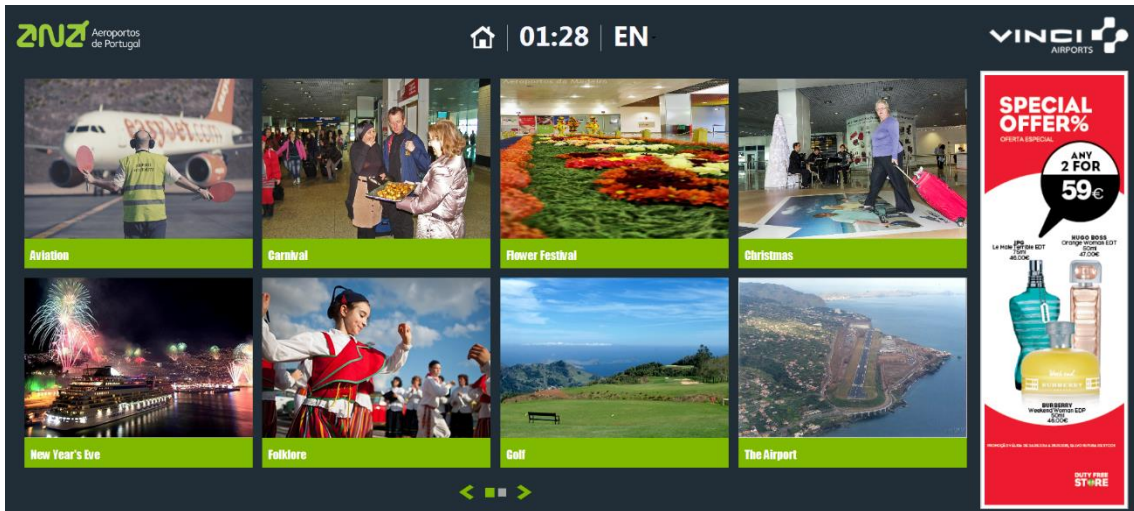


Figure 52 - Gallery Plugin final design (list of albums screen)

When seeing a single photo or video there is the ability to change directly to another photo, going back to the album or seeing all the photos as a slideshow. There is also something that can be seen a lot in social media sites these days which is the ability to leave a “like” in photo (Figure 53 - Gallery Plugin final design (photo screen)).

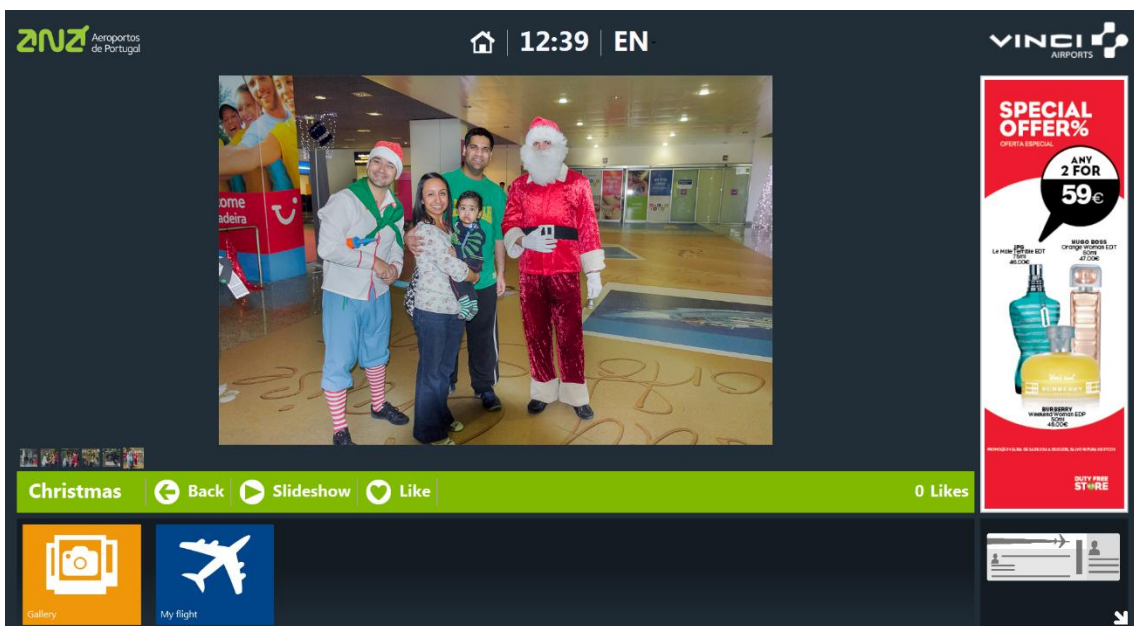


Figure 53 - Gallery Plugin final design (photo screen)

5.5 Plugin: Weather

For this plugin it was decided that since the user could scan its boarding pass, that it would show the weather information at the origin and destination. Despite this, it is also possible to see the weather in other places.

Once again, the first design proposal did not exactly for the design standards we ended up with (see Figure 54 – Weather Plugin first design proposal).

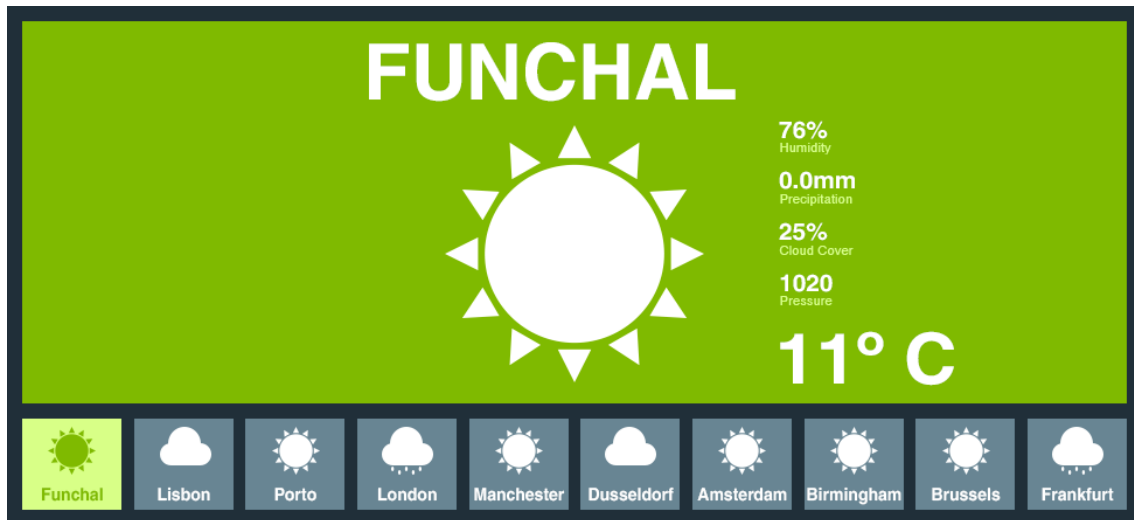


Figure 54 – Weather Plugin first design proposal

After the second design iteration things started to look more standardized. Figure 55 – Weather Plugin second design proposal show all the location available for user to select. This would be the screen if no boarding pass was scanned.

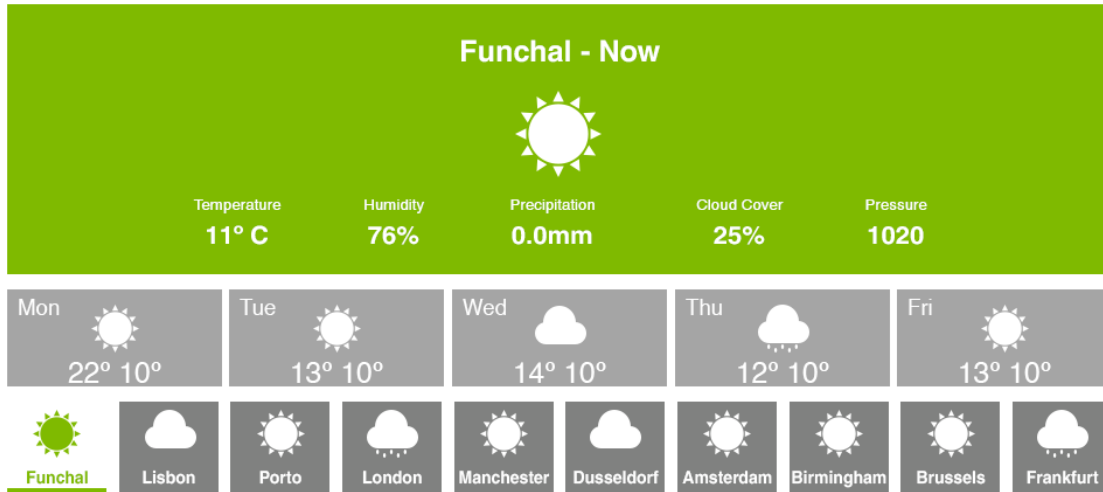


Figure 55 – Weather Plugin second design proposal

Still in the second design iteration, Figure 56 - Weather Plugin second design proposal (destination) would be what the user would see if it scanned a boarding pass. A sort of dual screen with the weather at the origin and destination. Despite showing the weather information at both locations, it was not easy to understand which was the origin and the destination with this design proposal.

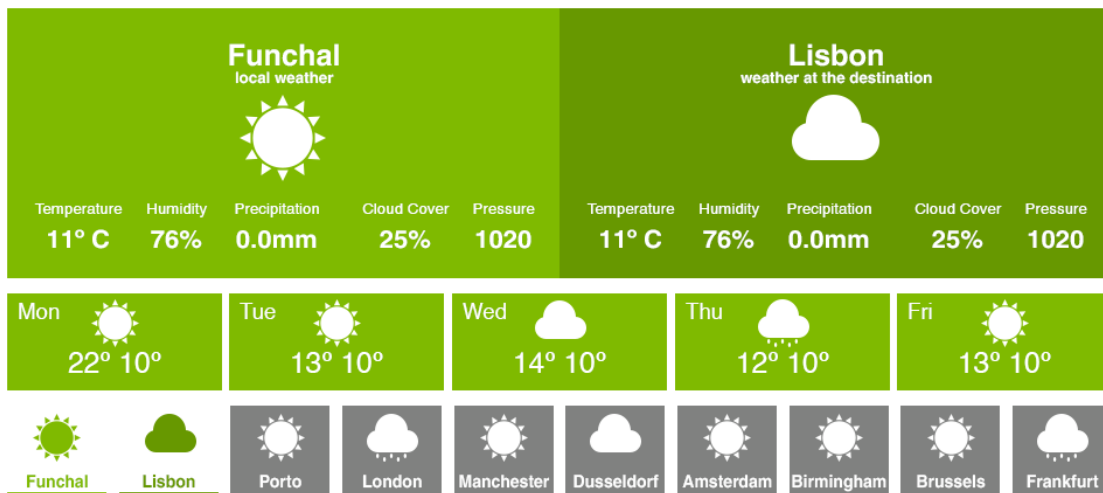


Figure 56 - Weather Plugin second design proposal (destination)

After some tinkering, the third design iteration clearly shows which tile represents the weather at the origin and the weather at the destination (see Figure 57 - Weather Plugin third design proposal). There was just one slight problem with

this proposal, the representation of the destination icon. It was used a plane that was inclined downwards. Having the plane inclined downwards goes against the flying culture and is seen as a bad omen, so this was fixed in the final implementation of the plugin with another representation of an airplane landing.

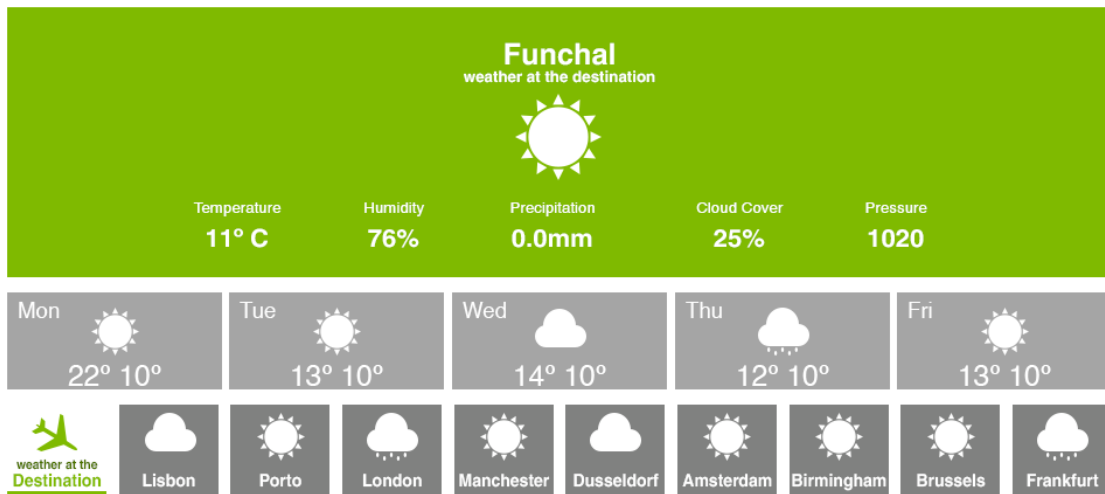


Figure 57 - Weather Plugin third design proposal

The next image (Figure 58 - Weather Plugin final design) shows the final design of the plugin, and what it looks like after implemented. This design follows the standardized design guidelines created throughout this project.



Figure 58 - Weather Plugin final design

6 GRAPHICAL DEVELOPMENT

6.1 3D Blueprints

Locations maps for this project were created. For some people this was a very important part of the project. They wanted to have a map with the locations of the airport. For that it was firstly done a 3D representation of the airport using Google SketcUp. It was decided to be done in 3D because it gave a better understanding of how the airport was laid out and it gave the user a better perspective of the space. It was done in isometric perspective in order for the user to get this better understanding of the space. Also, it looked much more appealing and attractive than just a plain 2D representation. With the 3D maps done, vibrant colors were added to the raster image to make it even more appealing and to label out the locations. The following image are examples of the maps (Higher resolution images are included in the appendices I through M).

Figure 59 – Madeira Airport Floor 0 3D Map show the Arrivals Floor (floor 0) of the Madeira Airport. The grayed out elements represent walls and private places. The nude colored floor indicates that that area is public. The green boxes are services. As for the pink it represents restaurants and the blue is shops.

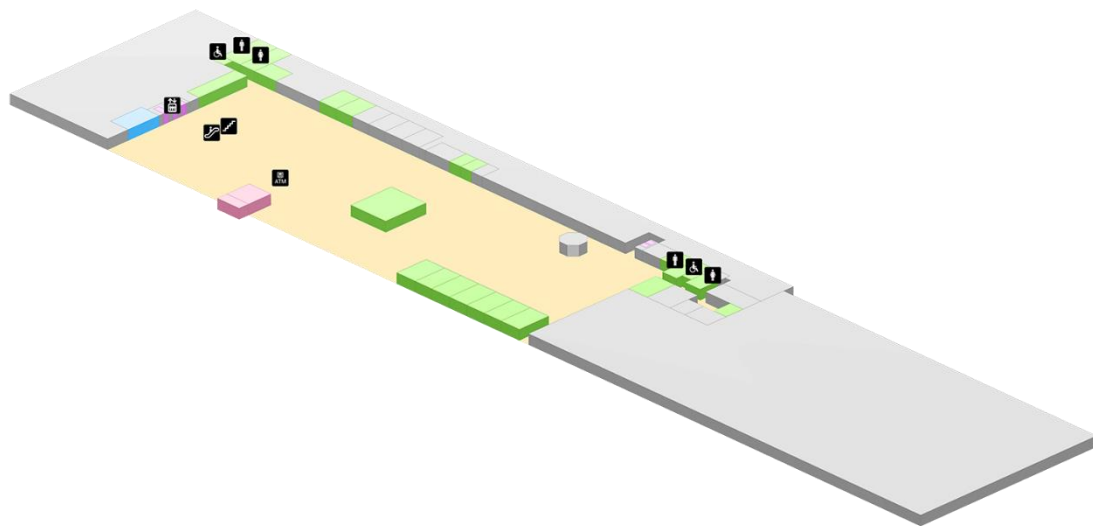


Figure 59 – Madeira Airport Floor 0 3D Map

Figure 60 - Madeira Airport Floor 1 3D Map is for the first floor of the Airport. It is the check-in floor, and it introduces two new colors. The yellow boxes indicate the check-in counters, and the orange floor represents the passenger only area.

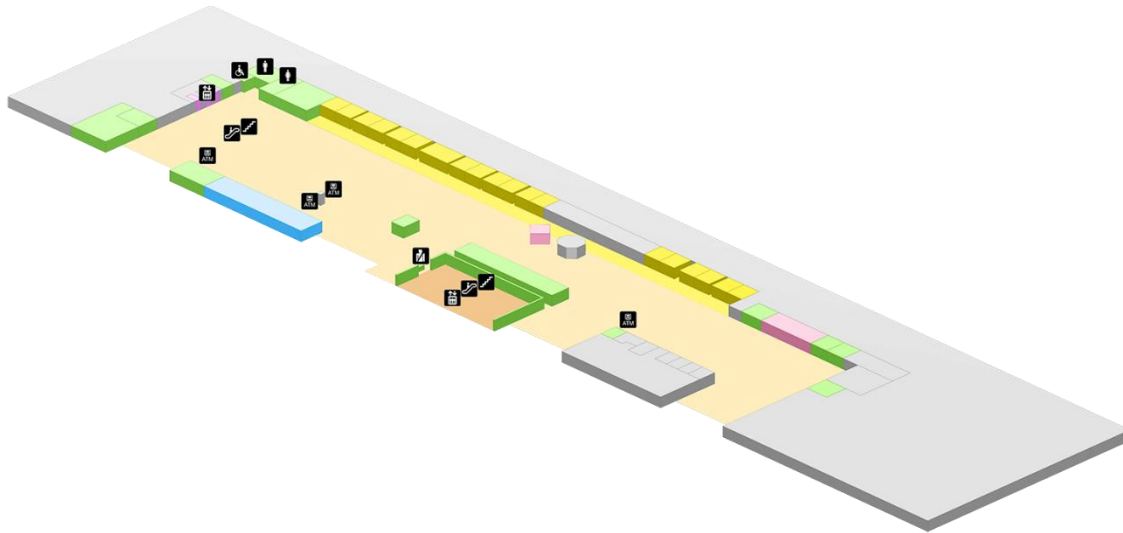


Figure 60 - Madeira Airport Floor 1 3D Map

The second floor map is in Figure 61 - Madeira Airport Floor 2 3D Map, once again this floor introduces two new colors. The turquoise colored boxes are the boarding gates, and the red floor is the non-Schengen area.

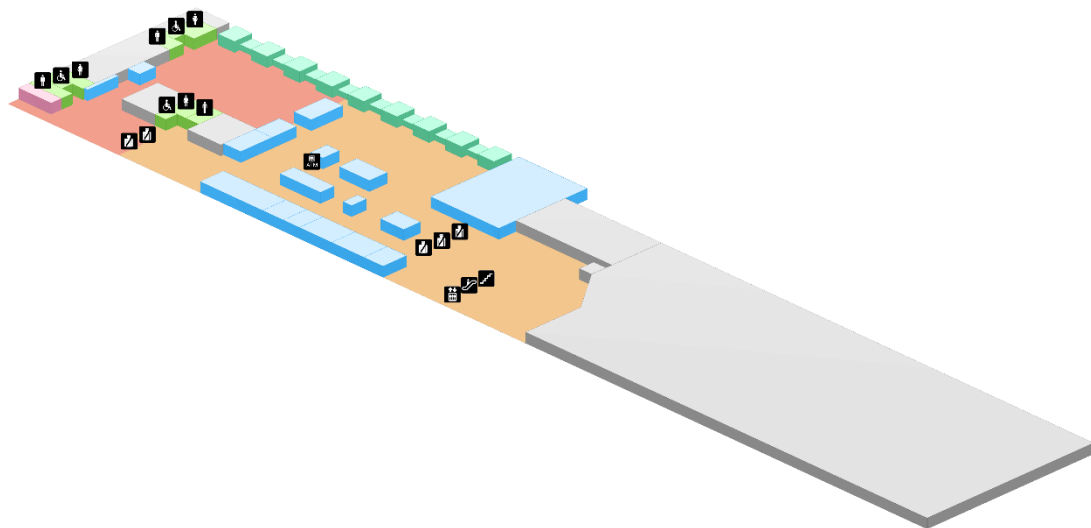


Figure 61 - Madeira Airport Floor 2 3D Map

The third floor (Figure 62 - Madeira Airport Floor 3 3D Map) also has a new color, the green floor indicates the playground areas.

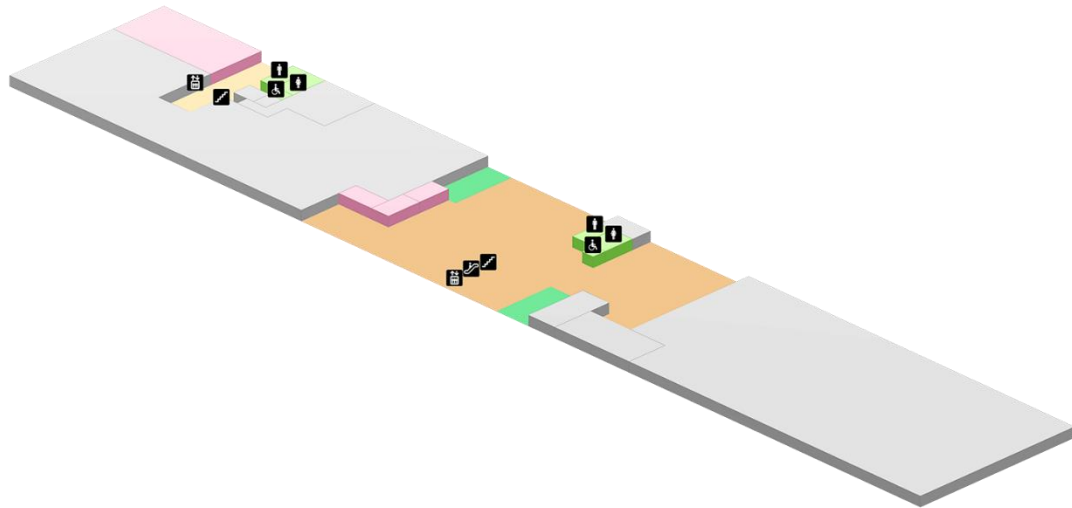


Figure 62 - Madeira Airport Floor 3 3D Map

Besides the Madeira airport, it was also created a representation for the airport of Porto Santo (Figure 63 – Porto Santo Airport Floor 0 3D Map).

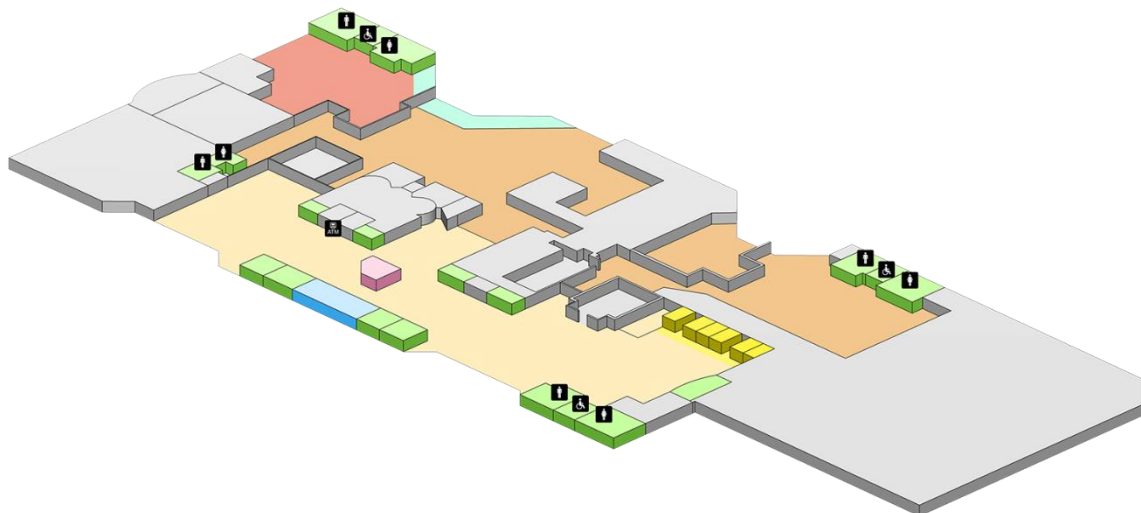


Figure 63 – Porto Santo Airport Floor 0 3D Map

6.2 Device Illustration

In order to have a representation of the device itself an illustration of it was done.

The following image shows just that (Figure 64 – Kiosk Illustration).



Figure 64 – Kiosk Illustration

6.3 Vector Icons

As graphical elements were needed they were developed in Adobe's Illustrator which were then converted into SVG code. These graphical elements are the ones that follow (Figure 65 – Arrow Vector Icon, Figure 66 – Boarding Pass Vector Icon, Figure 67 – Departure Vector Icon, Figure 68 – Arrival Vector Icon and Figure 69 – Wi-Fi Vector Icon):



Figure 65 – Arrow Vector Icon



Figure 66 – Boarding Pass Vector Icon



Figure 67 – Departure Vector Icon



Figure 68 – Arrival Vector Icon



Figure 69 – Wi-Fi Vector Icon

6.4 Boarding Pass

Because there is the ability to scan the boarding pass it was also designed a boarding pass illustration in order to represent it (Figure 70 – Boarding Pass Illustration).

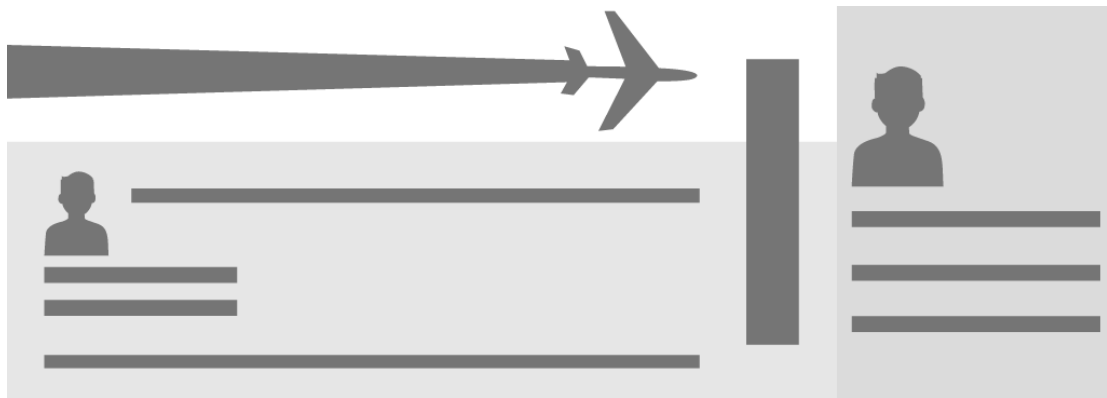


Figure 70 – Boarding Pass Illustration

7 EVALUATION

Before concluding this report it is important to look at some data that was collected, and discuss it. This data comes from two sources, the system logs and questionnaires that were filled out by the users throughout the several user testing sessions. This section will go about the means used to acquire the information.

It should be noted that the data showed and discussed in this section is data that was collected around the time the project was publically released. It was relevant to collect the information at this time as it was when the device would create more impact, therefore it would be possible to understand if the change was indeed good.

7.1 System Logs

Thanks to a logging mechanism that was implemented in the system it is possible to see all the user interactions with the device.

The system identifies different users through the usage of a timer. If there is a certain time of inactivity it assumes that the user has left, the timer is reset creating a new session once there is activity again. This logging system is useful in order to get statistical data about the number of sessions, the duration of a session, the number of times a plugin is used, the duration of usage of a plugin and the number of times a boarding pass is scanned. Besides, all this data might give some useful feedback and help in improving some aspects about each plugin and even in creating new ones.

It should be noted that the data collected from the system logs refer to one week of usage after the final release of the project.

7.1.1 Number of sessions

As mentioned previously it is considered to be a new session when there is some activity after some time of inactivity. It is assumed that it is a new user after five minutes of inactivity. The following chart (chart 1) shows the number of sessions throughout the week.

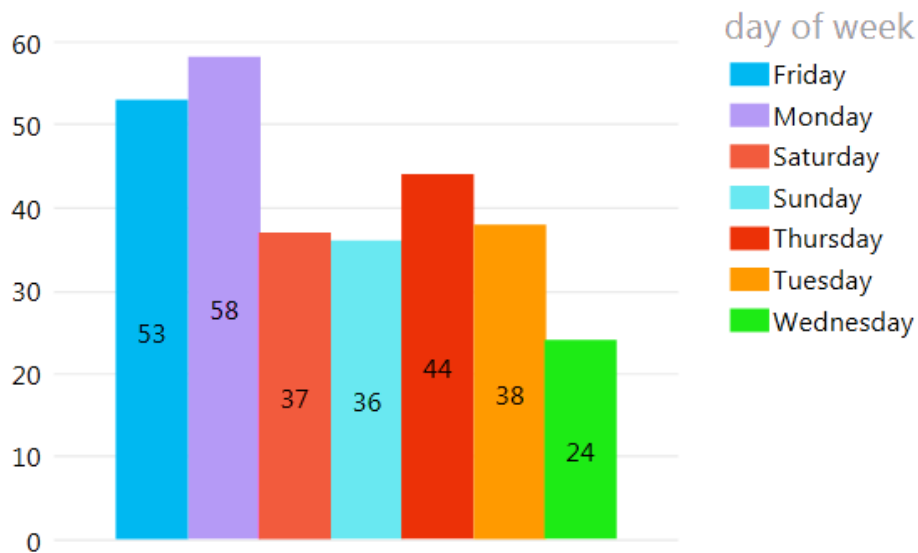


Chart 1 – Number of sessions in a week

Chart 1 shows that in just a week 290 different sessions were recorded. It is possible to see that the day of the week with the most sessions is Monday with a number of 58. This does not come as a surprise since the busiest day at the airport are actually Mondays. Second to Monday is Friday, with 53 distinct sessions. The day of the week with the least number of sessions is Wednesday with a number of 24.

7.1.2 Duration of the sessions

It is relevant to record and know how much time a user spends interacting with the device. The calculated overall session time of this discussed week had a value of 4 minutes and 45 seconds. The next chart (chart 2) shows the average session time by day of the week.

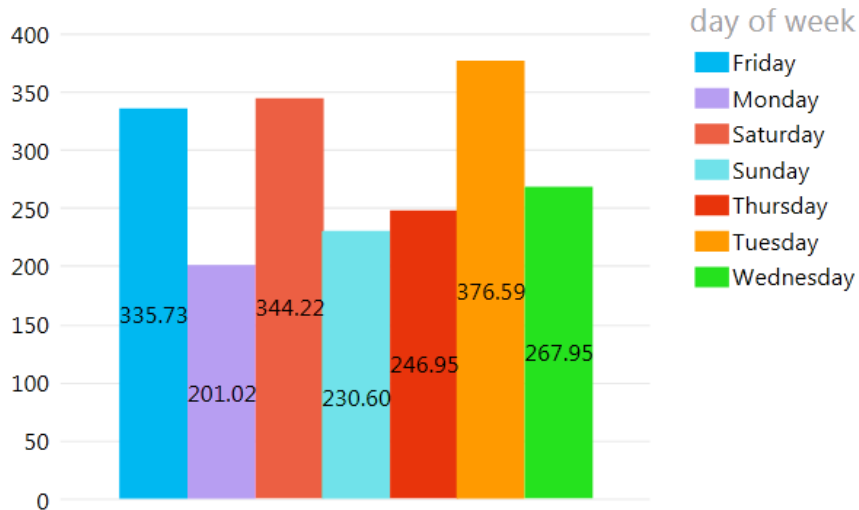


Chart 2 – Average session time by day of the week

From chart 2 it is possible to see that the day with the longest average session time was Tuesday with a value of 376.59 seconds. Saturday and Friday come in second and third places respectively. Even though Monday was the day of the week with the bigger number of collected sessions it does not have the longest average session time, falling in the last place with an average session time of 201,02 seconds.

7.1.3 Plugins usage

Knowing which plugin was mostly used is extremely relevant because it tells which of the developed services had the biggest impact and acceptance. The following chart (chart 3) shows the plugin usage throughout the week.

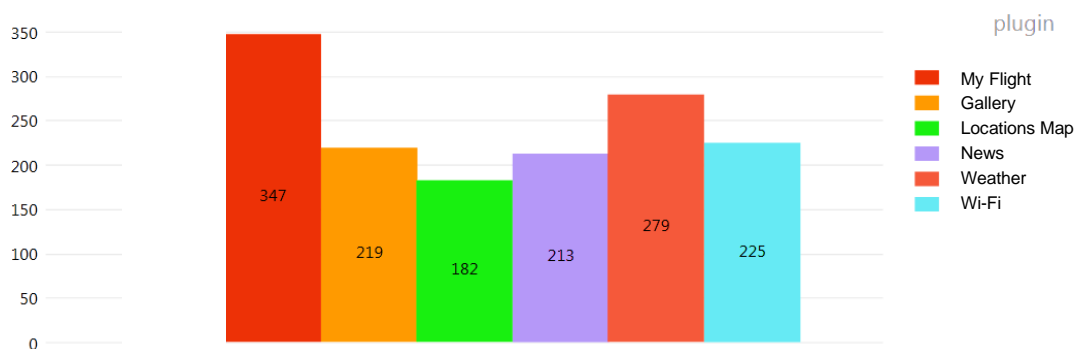


Chart 3 – Plugin Usage

The plugin with the highest rate of usage was the My Flight plugin with a total number of 347 uses. Surprisingly the plugin that comes in second is the Weather plugin. The plugin that was expected to have the highest number of uses was the Wi-Fi plugin, but this one comes in third place with a number of 225 uses.

7.1.4 Plugins duration

Besides knowing which plugin is used the most, it might also be relevant to know how much time users spend in each plugin. The next chart (chart 4) shows the average time users spend in the plugins.

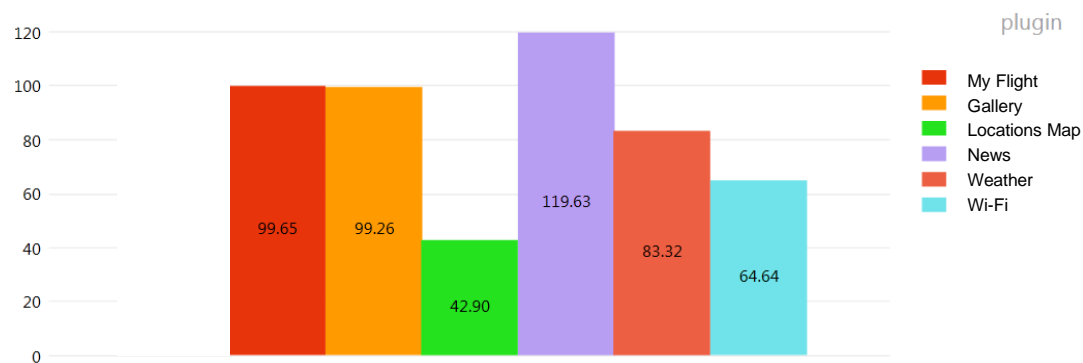


Chart 4 – Average time spent in plugins

Despite being the plugin with the highest number of uses, the My Flight plugin is not the plugin with the highest average time. My Flight comes in second place with 99.65 seconds, followed right by the Gallery plugin that has an average time of 99.26. These two almost come to a tie. The plugin that has the highest average time is the News plugin, which comes as a surprise.

7.1.5 Boarding pass scans

With the new feature of boarding pass scan available, it might interesting to see which day of the week gets the most scans. Chart 5 shows just that.

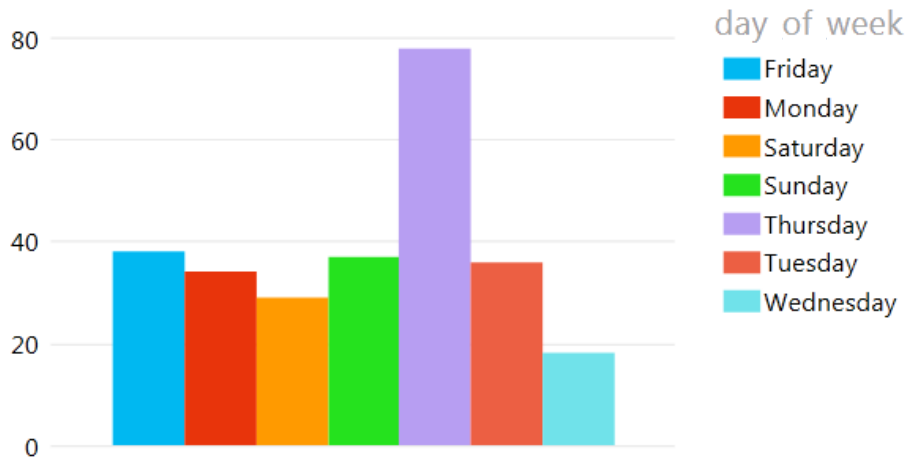


Chart 5 – Boarding Pass scans

During this period 261 boarding passes were scanned. Thursdays are clearly the day with the highest number of scans. This might reveal that Thursday is the day of the week when passengers have more free time and are able to scan their passes.

7.2 Questionnaires

There were two stages of collecting data through the usage of questionnaires. This first stage made use of the System Usability Scale questionnaire, which can be found in Appendix N. This stage had 9 participants. The second stage of questionnaires made use of a custom questionnaire that was based on the USE questionnaire (Appendix O), and it had a total of 20 participants. The main goal of these questionnaires was to understand if the system was easy and intuitive to use.

7.2.1 SUS Questionnaire

The System Usability Questionnaire (SUS) is a tool that allows to collect data about the usability of the system. The participants that were given this questionnaire had to answer 10 questions with scores from 1 to 5, where 1

corresponds to strongly disagree and 5 was strongly agree. The next table (Table 3 – SUS Questionnaire Results) shows the acquired results.

Participant	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
P1	5	1	5	1	5	1	5	1	5	1	100
P2	4	2	5	1	5	1	5	1	5	1	95
P3	3	3	4	2	4	2	4	3	3	2	65
P4	4	2	4	2	4	2	4	2	4	2	75
P5	4	3	4	3	4	3	4	2	3	3	60
P6	3	2	4	1	4	3	4	2	4	1	72.5
P7	5	2	4	3	3	3	3	2	4	2	70
P8	4	1	5	1	5	1	5	1	5	1	97.5
P9	5	2	5	1	5	2	5	1	5	1	92.5

Table 3 – SUS Questionnaire Results

The average SUS score is of 80.83, which indicates that the usability of the system is quite above the average. Despite being a small sample, the SUS can be used for both small and big samples with reliable results.

7.2.2 Custom Questionnaire

In the second stage of questionnaires 20 participants had to fill out the questionnaire. The questionnaire used in this stage included the Ease of Use question domain from the USE questionnaire. The Ease of Use domain fit perfectly on the scope of the study, being that the reason why this questionnaire was chosen. The answers were given on a scale from 1 to 7 (1 being strongly disagree and 7 being strongly agree).

The data collected is in the following table (Table 4 – USE Questionnaire Results).

Participants	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Ease of Use Scores
P1	6	6	3	5	4	6	5	3	7	5	5	5
P2	6	6	5	5	5	6	7	4	5	6	5	5
P3	7	7	6	6	6	7	7	6	6	6	6	6
P4	7	7	7	7	7	7	7	7	7	7	7	7
P5	7	7	7	7	7	6	7	6	7	7	7	7
P6	7	7	7	7	5	7	7	7	7	7	7	7
P7	6	5	6	6	5	6	6	4	6	6	6	6
P8	6	6	6	7	6	6	6	6	6	6	6	6
P9	3	3	3	7	7	7	1	1	7	7	7	7
P10	7	7	2	5	7	7	3	7	6	6	5	6
P11	7	7	1	6	6	7	4	4	7	7	7	7
P12	6	6	7	7	6	7	7	6	6	6	6	6
P13	7	7	7	7	7	7	7	7	7	7	7	7
P14	7	7	7	7	7	7	7	7	7	7	7	7
P15	4	2	2	5	1	6	4	4	3	4	4	4
P16	7	7	7	7	7	7	7	7	7	7	7	7
P17	3	4	3	2	2	5	2	1	4	2	1	2
P18	7	7	7	7	6	7	6	7	7	6	6	7
P19	7	7	5	5	4	7	5	2	4	4	7	5
P20	7	7	7	7	7	7	7	7	7	7	7	7

Table 4 – USE Questionnaire Results (Ease of Use Domain)

The collected data from the questionnaires was of ordinal nature, and only the Ease of Use domain from the USE questionnaire was used. Since there was not a predetermined way of calculating scores by the original USE questionnaire, the calculations were made by getting the median of the questions (due to the nature of the data). After having the scores a frequency analysis was done to obtain the final median which turned out to be a value of 6.5. This is a value that is pretty close to 7, which indicates that the majority of the users found the system easy to use.

7.3 Conclusions

It is possible to tell from the system logs of one week that the plugin that is mostly used is the My Flight Plugin. This is a service that is considered to be novelty, and maybe that is why it caused so much impact. Interestingly enough it was initially discussed that the Wi-Fi plugin would be the most important one, however it falls in third place when it comes to usage. Still usage wise, the Locations Map seems to be the plugin that least interests the users as it comes in the last place. Not only does it come in last place in usage, but it also is the plugin where users spend less time using. This might be a sign that this plugin needs to be further worked on to interest more the users and make them want to use it more.

As far as the results from both questionnaires go, it is pretty safe to say that this is a system that users find very usable.

8 CONCLUSIONS

This was a project that had the ultimate objective of creating something that would make the Madeira Airport have a new way of interacting, communicating and providing useful services to its users. In order to do this, it was asked to use a sort of technology, a bigger multi-touch display, and create an application for it. When there must be developed an application for a sort of technology that does not have a standard development method or guidelines, it becomes a challenge doing it while making sure that the results will turn out as expected.

It also becomes a challenge if the technology itself presents physical characteristics that create usability barriers. These characteristics in this project in particular were the size of the device, and the material that surface of the device was made of. These factors heavily influenced how the interface elements had to be placed and how the user interactions should be designed.

Despite all the challenges and problems, in the end it all worked out. The project required a lot of dedication and hard work from all of the members of the team. On the design side of things it was always important to not only make sure that things looked good, but also that things were designed in a way that was easy, intuitive and actually useful. In order to create a design and evolve it, it is a great practice to always provide more than one proposal. This way different ideas from different proposals can be merged and new designs created.

The project evolved and improved thanks to the followed methodology which was pretty much based on an agile development method. This method allowed to have several different iterations in which the development progress was assessed. Through the weekly meetings, analysis, design and redesign sessions, testing and implementation the project was indeed able to have a high quality result.

The project had also a great outcome thanks to the users' involvement. The many user testing sessions allowed to validate if the provided solutions were indeed the

best for the challenges in hand. The testing users provided enough feedback and new ideas that definitely made the project follow a better path.

Thanks to the all of the design solutions and the architecture that was implemented, it is now easy for other developers to create new plugins for this application. Everything is designed in such a way these developers should not worry about how the plugin should look. Instead the main focus should be just in the features and usability.

Through the studies that were made, and questionnaires, it was possible to see that people liked the end result of the application. Not only it received a positive feedback, but also compliments on the way it looked and also on the overall usability that improved a lot.

Design solutions for all of the problems mentioned before were found, which made the whole experience a success.

9 FUTURE WORK

It has been previously stated on this report that there are no standards when it comes to developing applications for bigger multi-touch devices such as kiosks, so some future work that can be done is actually developing one.

With all of the design solutions that were found while doing this project it should be easier to come up with a standard that is suitable for any bigger multi-touch display (kiosk).

There was a certain point in this project where pretty much all the visual solutions for the various interface elements started going in the same direction. An interface development guideline could have been created. Guidelines that could help people who would want to create new plugins for this system. Which colors to use, font sizes, how icons should be, how to place the contents. Despite not being able to create such guidelines at the time due to the timeframe that was imposed, this could be something that could and should be worked on the future.

There is also the opportunity to create new plugins for this system. Thanks to its architecture development and implementation is quite easy. New plugins that create new services and provide useful information and features to the Madeira Airport users.

10 REFERENCES

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Appendix A. BOARDING PASS ICON XML

```
<Canvas x:Name="Layer_1" Height="167.862" Canvas.Left="22.471"
Canvas.Top="165.815" Width="455.608">
    <Path Data="M449.817,94.888L345.69,94.888 345.69,84.664
449.817,84.664z M449.817,118.24L345.69,118.24 345.69,108.017
449.817,108.017z M449.817,141.589L345.69,141.589 345.69,131.367
449.817,131.367z M323.993,141.589L303.732,141.589 303.732,23.367
323.993,23.367z M286.374,84.664L47.732,84.664 47.732,75.907
286.374,75.907z M286.374,154.719L13.019,154.719 13.019,147.43
286.374,147.43z M13.018,122.609L91.118,122.609 91.118,129.917
13.018,129.917z M13.018,108.017L91.118,108.017 91.118,115.321
13.018,115.321z M14.463,70.071L39.056,70.071 39.056,105.098
14.463,105.098z M347.123,23.368L386.178,23.368 386.178,75.908
347.123,75.908z M0,167.862L455.608,167.862 455.608,0 0,0z" Fill="White"
Height="167.862" Canvas.Left="0" Canvas.Top="0" Width="455.608"/>
</Canvas>
```


Appendix B. LANDED PLANE ICON XML

```
<Canvas      x:Name="Layer_2"      Height="201"      Canvas.Left="9.116"
Canvas.Top="177" Width="484.199">
    <Path      Data="F1M120.923,97L434.673,97C434.673,97
486.311,117.916      484.132,136.438      481.953,154.958      462.342,153
446.002,153L133.997,153C133.997,153      18.303,131.696      13.944,124.717
13.944,124.717 5.883,114.811 17.648,110.563 29.414,106.313 39.218,103.161
39.218,103.161L0,0 25.492,0z" Fill="White" Height="153.06" Canvas.Left="0"
Canvas.Top="0" Width="484.199"/>
    <Path      Data="F1M0,12.092C0,18.77  5.415,24.185  12.094,24.185
18.771,24.185 24.185,18.77 24.185,12.092 24.185,5.414 18.771,0 12.094,0
5.415,0 0,5.414 0,12.092" Fill="White" Height="24.185" Canvas.Left="415.716"
Canvas.Top="159.167" Width="24.185"/>
    <Path      Data="F1M0,12.092C0,18.77  5.414,24.185  12.092,24.185
18.771,24.185 24.185,18.77 24.185,12.092 24.185,5.414 18.771,0 12.092,0
5.414,0 0,5.414 0,12.092" Fill="White" Height="24.185" Canvas.Left="227.467"
Canvas.Top="159.167" Width="24.185"/>
    <Path      Data="F1M0,12.092C0,18.77  5.414,24.185  12.092,24.185
18.771,24.185 24.185,18.77 24.185,12.092 24.185,5.414 18.771,0 12.092,0
5.414,0 0,5.414 0,12.092" Fill="White" Height="24.185" Canvas.Left="198.707"
Canvas.Top="159.167" Width="24.185"/>
    <Path      Data="F1M0,14L444,14 444,0 0,0z" Fill="White" Height="14"
Canvas.Left="25.884" Canvas.Top="187" Width="444"/>
</Canvas>
```


Appendix C. LANDING PLANE ICON XML

```
<Canvas x:Name="Layer_1" Height="378.061" Canvas.Left="29.111"
Canvas.Top="61.439" Width="458.041">
    <Path Data="F1M192,42L0,42 0,0 192,0z" Fill="White" Height="42"
Canvas.Left="235.889" Canvas.Top="336.061" Width="192"/>
    <Path Data="F1M87.389,246.561C96.056,251.873 384.389,163.219
440.889,143.14 497.389,123.061 399.874,63.51 356.4,74.598 328.059,82.938
282.095,96.466 282.095,96.466 282.095,96.465 198.739,32.127
198.739,32.127 198.739,32.127 145.556,-17.439 111.889,6.561 78.222,30.561
121.619,77.582 121.619,77.582L166.099,130.604
74.889,158.061C74.889,158.061 39.559,138.707 24.474,134.384
9.389,130.061 -10.468,164.904 6.525,185.082 23.518,205.259 78.722,241.249
87.389,246.561" Fill="White" Height="246.79" Canvas.Left="0" Canvas.Top="0"
Width="458.041"/>
    <Path Data="F1M27,13.5C27,20.956 20.956,27 13.5,27 6.044,27
0,20.956 0,13.5 0,6.044 6.044,0 13.5,0 20.956,0 27,6.044 27,13.5" Fill="White"
Height="27" Canvas.Left="305.889" Canvas.Top="192.394" Width="27"/>
    <Path Data="F1M27,13.5C27,20.956 20.956,27 13.5,27 6.044,27
0,20.956 0,13.5 0,6.044 6.044,0 13.5,0 20.956,0 27,6.044 27,13.5" Fill="White"
Height="27" Canvas.Left="268.556" Canvas.Top="203.894" Width="27"/>
</Canvas>
```


Appendix D. LOGOUT ICON XML

```
<Canvas Width="400" Height="400">  
  <Path Stretch="Fill" Fill="White" Data="M0,22 L22,22 L22,6 L15.5,6 L15.5,8  
L20,8 L20,20 L2,20 L2,8 L6.5,8 L6.5,6 L0,6 L0,22 Z M6,3 L6,5 L10,2.5 L10,14  
L12,14 L12,2.5 L16,5 L16,3 L11,0 L6,3 Z" RenderTransformOrigin="0.5,0.5" >  
  <Path.RenderTransform>  
    <TransformGroup>  
      <ScaleTransform/>  
      <SkewTransform/>  
      <RotateTransform Angle="90"/>  
      <TranslateTransform/>  
    </TransformGroup>  
  </Path.RenderTransform>  
</Path>  
</Canvas>
```


Appendix E. PLAY ICON XML

```
<Canvas xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
x:Name="appbar_base" Width="76" Height="76" Clip="F1 M 0,0L 76,0L 76,76L
0,76L 0,0">
    <Path Width="74.4167" Height="74.4167" Canvas.Left="0.791662"
Canvas.Top="0.791664" Stretch="Fill" Data="F1 M 38,0.791664C
58.5496,0.791664 75.2083,17.4504 75.2083,38C 75.2083,58.5496
58.5496,75.2083 38,75.2083C 17.4504,75.2083 0.791662,58.5496
0.791662,38C 0.791662,17.4504 17.4504,0.791664 38,0.791664 Z">
        <Path.Fill>
            <RadialGradientBrush>
                <GradientStop Color="White" Offset="0"/>
                <GradientStop Offset="1"/>
            </RadialGradientBrush>
        </Path.Fill>
    </Path>
    <Path Width="74.4167" Height="74.4167" Canvas.Left="0.791662"
Canvas.Top="0.791664" Stretch="Fill" Fill="White" Data="F1 M 38,0.791664C
58.5496,0.791664 75.2083,17.4504 75.2083,38C 75.2083,58.5496
58.5496,75.2083 38,75.2083C 17.4504,75.2083 0.791662,58.5496
0.791662,38C 0.791662,17.4504 17.4504,0.791664 38,0.791664 Z M
38,5.54166C 20.0738,5.54166 5.54167,20.0738 5.54167,38C 5.54167,55.9262
20.0738,70.4583 38,70.4583C 55.9262,70.4583 70.4583,55.9262 70.4583,38C
70.4583,20.0738 55.9262,5.54166 38,5.54166 Z "/>
        <Path Width="29.017" Height="44.64" Canvas.Left="25.866"
Canvas.Top="15.68" Stretch="Fill" Fill="White" Data="F1 M 30.0833,22.1667L
50.6665,37.6043L 50.6665,38.7918L 30.0833,53.8333L 30.0833,22.1667 Z "/>
    </Canvas>
```


Appendix F. ARROW ICONS XML

```
<Canvas x:Key="appbar_chevron_down" Width="400" Height="400" Clip="F1 M 0,0L 76,0L 76,76L 0,76L 0,0">
```

```
  <Path Width="28.5" Height="25.3333" Canvas.Left="23.6016" Canvas.Top="24.9375" Stretch="Fill" Fill="{DynamicResource BlackBrush}" Data="M0 200 L70 130 L200 270 L330 130 L400 200 L200 400 Z"/>
```

```
</Canvas>
```

```
<Canvas x:Key="appbar_chevron_left" Width="400" Height="400" Clip="F1 M 0,0L 76,0L 76,76L 0,76L 0,0">
```

```
  <Path Width="25.3333" Height="28.5" Canvas.Left="25.1849" Canvas.Top="23.3542" Stretch="Fill" Fill="{DynamicResource BlackBrush}" Data="M0 200 L200 0 L270 70 L130 200 L270 330 L200 400 Z"/>
```

```
</Canvas>
```

```
<Canvas x:Key="appbar_chevron_right" Width="400" Height="400" Clip="F1 M 0,0L 76,0L 76,76L 0,76L 0,0">
```

```
  <Path Width="25.3333" Height="28.5" Canvas.Left="25.1849" Canvas.Top="23.3542" Stretch="Fill" Fill="{DynamicResource BlackBrush}" Data="M200 0 L400 200 L200 400 L130 330 L270 200 L130 70 Z"/>
```

```
</Canvas>
```

```
<Canvas x:Key="appbar_chevron_up" Width="400" Height="400" Clip="F1 M 0,0L 76,0L 76,76L 0,76L 0,0">
```

```
  <Path Width="28.5" Height="25.3333" Canvas.Left="23.6016" Canvas.Top="24.9375" Stretch="Fill" Fill="{DynamicResource BlackBrush}" Data="M0 200 L200 0 L400 200 L330 270 L200 130 L70 270 Z"/>
```

```
</Canvas>
```


Appendix G. TAKEOFF PLANE ICON XML

```
<Canvas x:Name="Layer_1" Height="378.061" Canvas.Left="29.111"
Canvas.Top="61.439" Width="458.041">
    <Path Data="F1M192,42L0,42 0,0 192,0z" Fill="White" Height="42"
Canvas.Left="14.889" Canvas.Top="336.061" Width="192"/>
    <Path Data="F1M87.389,246.561C96.056,251.873 384.389,163.219
440.889,143.14 497.389,123.061 399.874,63.51 356.4,74.598 328.059,82.938
282.095,96.466 282.095,96.466 282.095,96.465 198.739,32.127
198.739,32.127 198.739,32.127 145.556,-17.439 111.889,6.561 78.222,30.561
121.619,77.582 121.619,77.582L166.099,130.604
74.889,158.061C74.889,158.061 39.559,138.707 24.474,134.384
9.389,130.061 -10.468,164.904 6.525,185.082 23.518,205.259 78.722,241.249
87.389,246.561" Fill="White" Height="246.79" Canvas.Left="0" Canvas.Top="0"
Width="458.041"/>
</Canvas>
```


Appendix H. Wi-Fi Icon XML

```
<Canvas x:Name="Wi-Fi_Icon" Height="226.486" Canvas.Left="0"
Canvas.Top="-0.486" Width="203.002">
```

```
    <Path Data="F1M199.642,17.456L199.653,17.467C201.707,15.636
203.002,12.969 203.002,10 203.002,4.477 198.524,0 193.002,0 189.963,0
185.415,3.502 185.415,3.502 183.092,5.438 141.811,26.667 101.828,26.949
60.295,27.243 17.594,4.494 17.594,4.494 15.761,2.355 13.039,1 10,1 4.479,1
0,5.477 0,11 0,13.969 1.295,16.636 3.35,18.467L3.361,18.456C7.988,24.023
54.638,48.56 101.338,48.317 148.147,48.073 195.004,23.036 199.642,17.456"
Fill="White" Height="48.319" Canvas.Left="0" Canvas.Top="178.167"
Width="203.002"/>
```

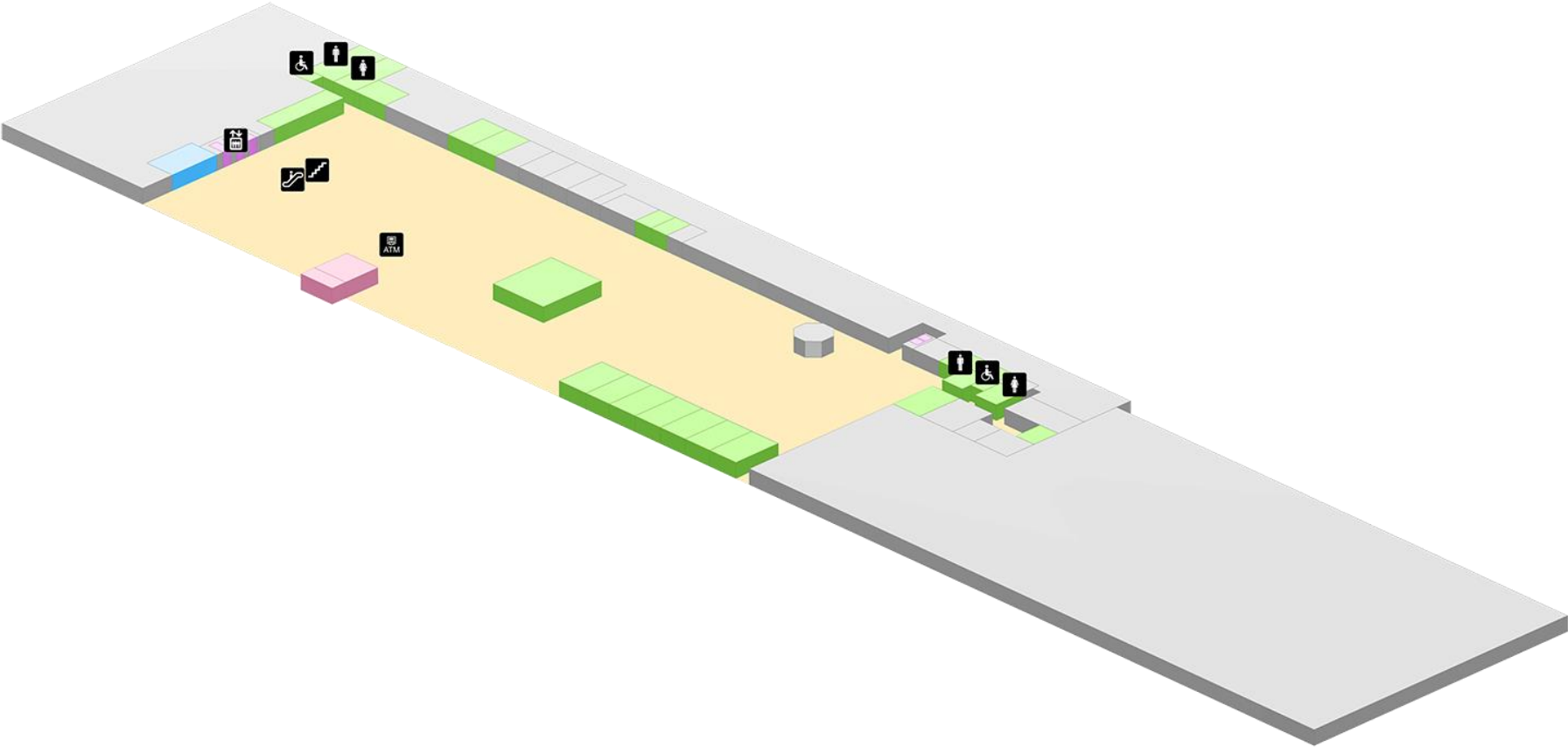
```
    <Path Data="F1M159.642,17.456L159.653,17.467C161.707,15.636
163.002,12.969 163.002,10 163.002,4.477 158.524,0 153.002,0 151.5,0
116.266,22 81.668,22 46.292,22 11.537,0 10,0 4.479,0 0,4.477 0,10 0,12.969
1.295,15.636 3.35,17.467L3.361,17.456C8.057,23.105 44.755,43.892
82.003,43.814 118.25,43.739 155.073,22.953 159.642,17.456" Fill="White"
Height="43.814" Canvas.Left="20" Canvas.Top="140.167" Width="163.002"/>
```

```
    <Path Data="F1M119.642,17.456L119.653,17.467C121.707,15.636
123.002,12.969 123.002,10 123.002,4.477 118.524,0 113.002,0 109.963,0
105.415,3.501 105.415,3.501 100.88,7.281 79.591,17.443 59.657,16.584
37.914,15.647 17.594,3.494 17.594,3.494 15.761,1.355 13.039,0 10,0 4.479,0
0,4.477 0,10 0,12.969 1.295,15.636 3.35,17.467L3.361,17.456C7.964,22.994
34.414,38.781 61.001,38.815 87.921,38.851 114.981,23.064 119.642,17.456"
Fill="White" Height="38.815" Canvas.Left="40" Canvas.Top="103.167"
Width="123.002"/>
```

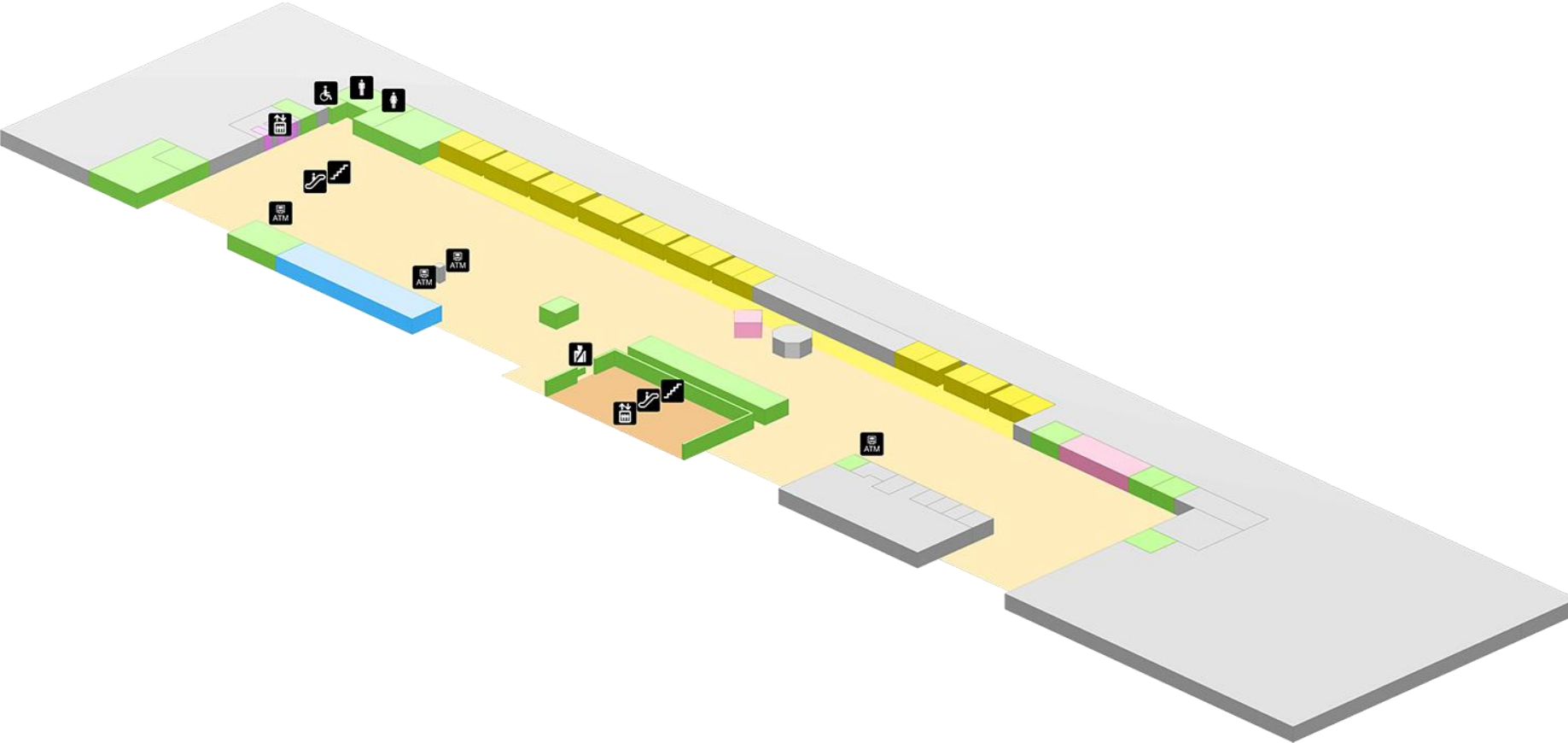
```
    <Path Data="F1M36.167,32.167C36.167,25.334 37.5,23.667 41.667,18
45.834,12.334 46.834,9.834 41.667,0 54.5,3.667 58.5,8.5 61.5,13 64.5,17.5
63.834,29.667 62.167,32.167 69.834,28 75.834,32.834 79.167,33.834
82.5,34.834 91,34 94.5,26.5 94.5,26.5 94.666,42.834 90.5,47.167 86.334,51.5
84.167,54.834 71.167,56.167 75.5,62.834 74.167,64.667 74.334,69.667
```

```
74.334,69.667 72.625,80.917 84.75,85.667 77,91.917 69.125,89.917
62.625,87.042 56.125,84.167 51.25,77.417 50.375,72.167 44.375,80.292
40.334,78.167 36.167,80.292 32,82.417 26.75,86.292 26.125,94.042
18.5,86.292 18.5,79.417 18.125,75.042 18.125,75.042 17,66.167 28.25,57.542
19.125,55.042 21.5,50.917 15.625,45.917 9.75,40.917 6.25,39.667 0,42.167
4.625,30.417 16.25,27.292 18.875,27.292 21.5,27.292 28.709,27.167
36.167,32.167" Fill="White" Height="94.042" Canvas.Left="54.334"
Canvas.Top="0" Width="94.501"/>
</Canvas>
```

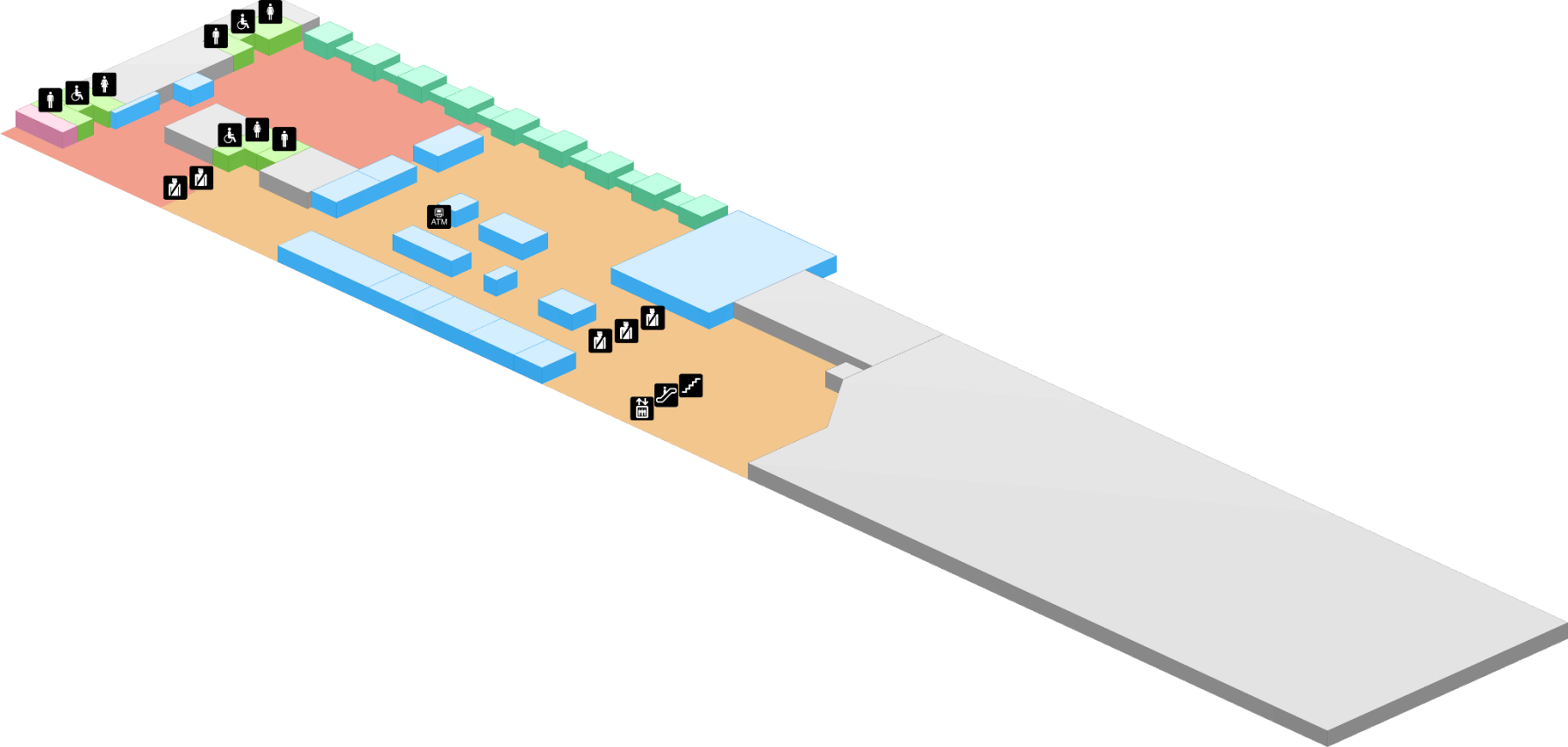

Appendix I. MADEIRA AIRPORT FLOOR 0 3D MAP



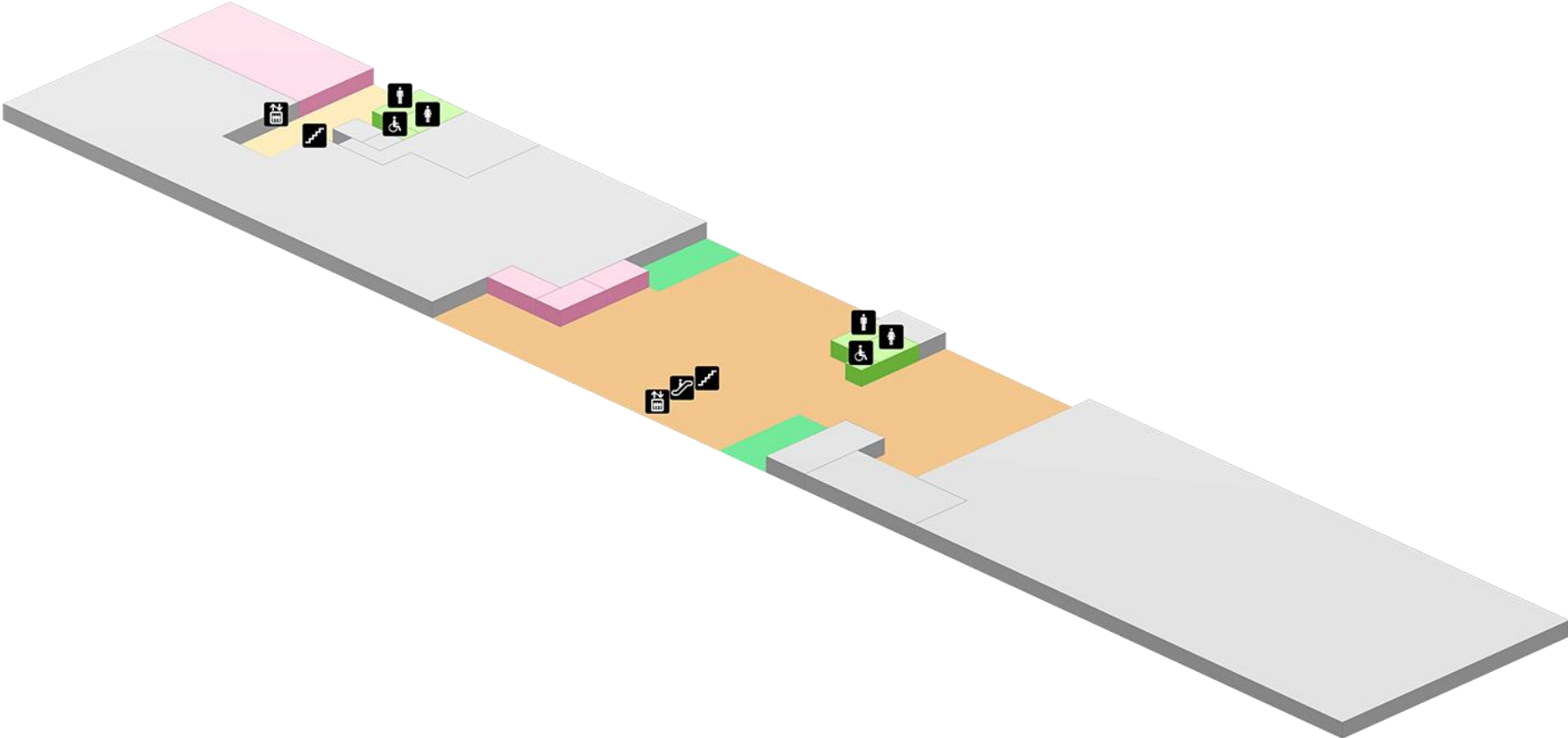
Appendix J. MADEIRA AIRPORT FLOOR 1 3D MAP



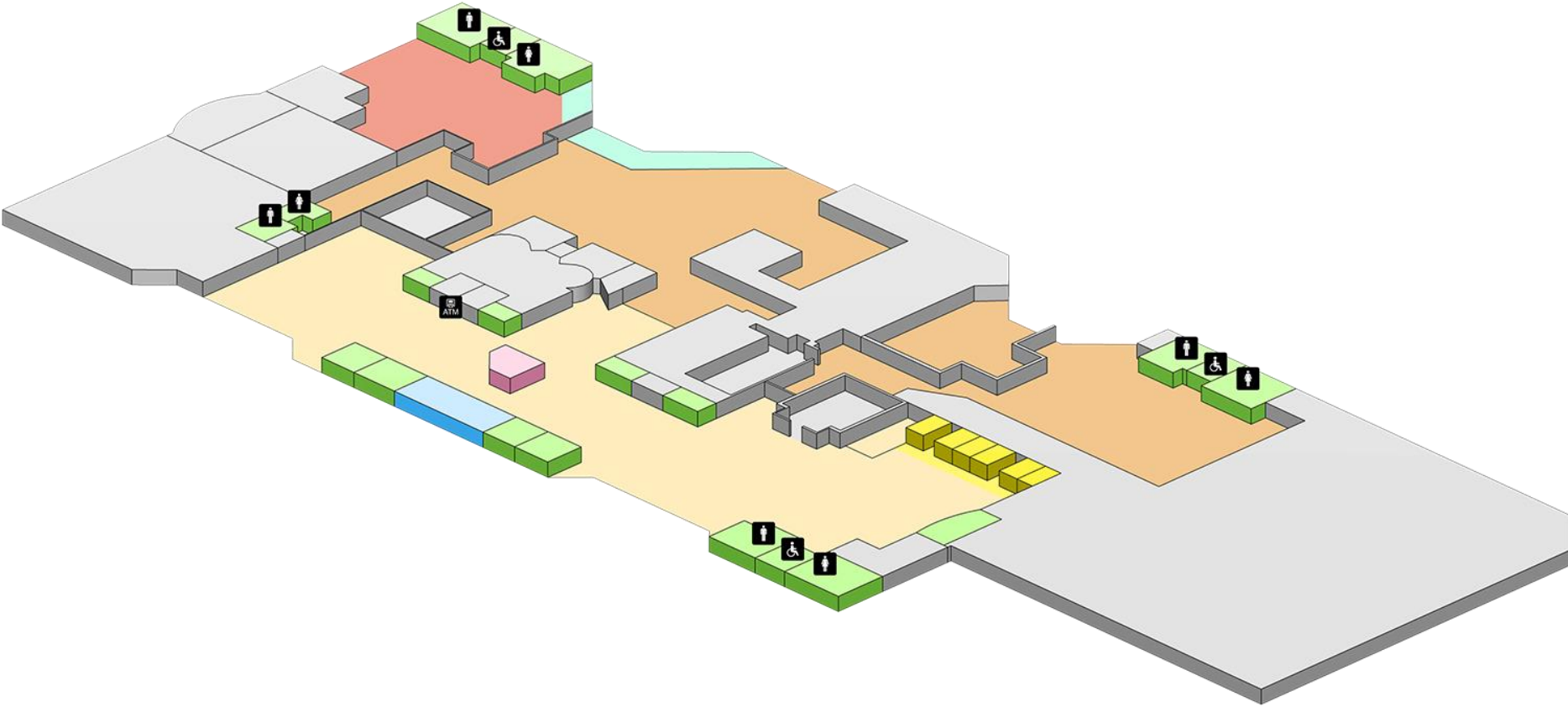
Appendix K. MADEIRA AIRPORT FLOOR 2 3D MAP



Appendix L. MADEIRA AIRPORT FLOOR 3 3D MAP



Appendix M. PORTO SANTO AIRPORT FLOOR 0 3D MAP



Appendix N. SYSTEM USABILITY SCALE QUESTIONNAIRE

System Usability Scale

© Digital Equipment Corporation, 1986.

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5

Appendix O. USE QUESTIONNAIRE

Base on the USE questionnaire at <http://garyperlman.com/>

EASE OF USE		1	2	3	4	5	6	7	NA
It is easy to use.	strongly disagree								strongly agree
It is simple to use.	strongly disagree								strongly agree
It is user friendly.	strongly disagree								strongly agree
It requires the fewest steps possible to accomplish what I want to do with it.	strongly disagree								strongly agree
It is flexible.	strongly disagree								strongly agree
Using it is effortless.	strongly disagree								strongly agree
I can use it without instructions.	strongly disagree								strongly agree
I don't notice any inconsistencies as I use it.	strongly disagree								strongly agree
Both occasional and regular users would like it.	strongly disagree								strongly agree
I can recover from mistakes quickly and easily.	strongly disagree								strongly agree
I can use it successfully every time.	strongly disagree								strongly agree