Design Methodology for a Shared Mobility App

Ana Filomena Curralo[1,2(✉)], Sara Paiva[1,3], Catarina Fernandes[1], and Luís Barreto[1,3]

[1] Instituto Politécnico de Viana do Castelo, Rua da Escola Industrial e Comercial de Nun'Alvares, 4900-347 Viana do Castelo, Portugal
anacurralo@estg.ipvc.pt
[2] ID+ Instituto de Investigação em Design, Media e Cultura, 3810-193 Aveiro, Portugal
[3] ADiT-LAB, Instituto Politécnico de Viana Do Castelo, Rua Escola Industrial e Comercial de Nun'Alvares, 4900-347 Viana Do Castelo, Portugal

Abstract. Nowadays, mobile applications (app) have become allies and indispensable in people's everyday life. Problems that previously required some time to be solved are now solved with a few taps on, i.e., a smartphone screen. The work presented in this paper is part of a master's project that consists of developing a user-centered procedure for a mobile application. Thus, this article focuses on studying a methodology for the user-centered interface design of an app, with the aim of making the process based on interaction design principles, considering usability aspects in order to favor the user's work. Based on the perceived needs of the Polytechnic Institute of Viana do Castelo, and with the aim to develop a broader Academic Mobility as a Service (AMaaS), this project consists of studying a work methodology for the development of a prototype of an app with the aim of encouraging sustainable and healthy mobility within the academic community and campuses.

Keywords: Mobile Interface · User-Centered Development · Mobility as a Service

1 Introduction

Considering providing the convenience and ease, allowed by current technologies, the Polytechnic Institute of Viana do Castelo decided to challenge the academy to promote and foster a more active and more sustainable mobility patterns specially regarding commuting trips to the campuses, thus creating the new concept of an Academic Mobility as a Service (AMaaS). For this purpose, a mobile application (app) called On.Move started to be developed, with the main goal to contribute to the promotion of shared mobility in the academic community and, more specifically, through ride- sharing, bike-sharing, cycling and walking, with the aim of facilitating travel of the user, in order to contribute to sustainable mobility and reduce the number of transports. Road transport is the transportation subsector that most contributes to global warming, through the emission of pollutants and greenhouse gases. About 25% of total carbon dioxide (CO2) emissions result from the use of fossil fuels [1]. This project was not only related to the development of an app for shared mobility, but also to incorporate a health module mechanism,

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with the main objective to promote a more active lifestyle and mobility. In this regard, the application aims to collect data that allows: classifying cardiovascular risk in view of the initial health survey; identifying the type of activity, time and distance covered daily and with the health information obtained from the survey produce a report with the correspondent MET (Metabolic Equivalents) of the user's activity, contributing to the prevention of cardiovascular diseases, type 2 diabetes, cancer, dementia, depression, and reduced life-expectancy [2].

In conclusion, the On.Move app can provide several ride sharing services, and recommend the use of active mobility systems, registering the users daily activity regarding the health, promoting healthier and more sustainable commuting trips. The aim is thus to increase a systematized methodology as a digital product development process, supported by usability analysis and interaction design principles, making it possible to design a digital interface based on the user's needs. This will in turn result in a higher number of calories burned by users, with its consequent impact in the health, but also an economic impact as such users will decrease their expenses in health-related services, allowing the public health system to reduce costs and improve its services [2].

The rest of the paper is structured as follows. Section 2 introduces the definitions of interaction design and user experience. Section 3 presents the methodology adopted in the On.Move application. Section 4 presents conclusions and future work.

2 Interaction Design and User Experience (UX)

The development of a digital product is becoming a demanding process for a designer, as it involves understanding human beings and their relationship with the product itself. Its aim is to provide means of interaction with the object that support and help the human behavior. Interaction design (iD) is defined by the design of interactive products that help users in their daily lives, creating experiences that help in human communication and interaction [3]. This area opposes its role with the role of software engineering, which aims to create solutions for software as opposed to interaction design that focuses on the user much beyond the software. In interaction design, multidisciplinary integration is necessary to successfully develop a product, since all the factors that are addressed by the surrounding areas require a sharing of knowledge, such as behavioral factors, for example, sometimes obtained by psychologists and sociologists [3]. Thus, the interaction design process involves the steps shown in the Fig. 1.

Interaction design is based on defining the user's motivational needs to design a system that allows helping the user. Interactive products cause reactions to the user, thus being opportune to develop ways to help the user and the software behavior, through the study and creation of avatars, as a way of understanding the objectives and motivations of the user [4].

Next, the product must guarantee its usability, highlighting the importance of the evaluation during the creation process, thus incorporating usability tests to understand and discover the strengths and weaknesses of carrying out all the necessary tasks, as well as their reactions and behaviors, visualizing and analyzing its interaction with the newly developed product [3]. The interaction is learned through the use or experience with other products, and those that people use intuitively are those that have similar

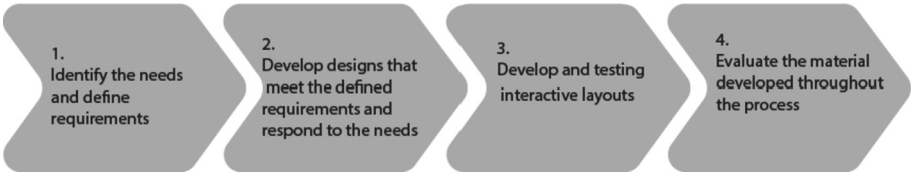

Fig. 1. Steps of the interaction design process. Source: Authors

characteristics to those previously developed/experienced. The past developments are also relevant in the experience, transferring between products and also probably between contexts, so that the performance is affected by the level of familiarity one may have about the technologies [5].

As for the study of user experience (UX), we must refer names such as Donald Norman (2004) [6], Marc Hassenzahl (2006) [7], Arrow Walter (2011) [8]. These authors are important in appreciative the concepts such as user experience, reaction, esthetics and, at the same time, in considerate how the user identifies the product.

UX is the experience that the user gets while using a product. In most product development projects, the focus of the designer is the practical factor, demonstrating what the product does, and making the product fulfill the purpose for which it was developed, but many times, they forget the user factor, and how he will use the product, and if he will be able to use it. UX is based on the relationship between the user and the product/service and on the experience that their interaction will provide. This factor proves to be extremely important for the success and failure of the product and/or service [9].

3 The Methodology Used for Developing the On.Move App

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Within the scope of the several methodologies developed in the field of UX design, we intend to use the methodology proposed by Jesse James Garrett (2011) [9], a specialist in the field of new technologies and the web. His work is the underlying basis for many other authors in the area of user experience and proposes a breakdown of the project into five phases that succeed from the abstract to the concrete: strategy, scope/intent, structure, skeleton and surface, as shown in the Fig. 2.

The choice of this methodology was because each stage must be restricted by the decisions made in the previous ones, however, it allows reviewing the decisions taken in the different stages of the project, as well as changing its direction and improve and correct previously found errors, thus leading to the importance of evaluating the process during its own execution [10]. This model is considered valuable due to its

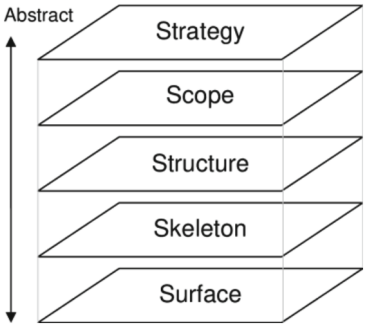

Fig. 2. Jesse James Garrett model. Source: Garrett (2011)

comprehensive framework, user-centered approach, adaptability, alignment with agile practices, and its role in facilitating effective communication and collaboration among design teams and stakeholders. It has played a significant role in shaping the field of user experience design and remains relevant in contemporary design practices. Also, this methodology has been embraced by professionals in the UX field for years. Its widespread adoption speaks to its practicality and effectiveness in helping designers plan and execute successful user-centered design projects.

3.1 The Strategy Plane

In this sense, it is described each step that must be followed to make this project viable: **The Strategy plane** is based on two factors, this is dominated by the definition of the product's objectives and knowledge regarding the user's needs, which automatically becomes one of its objectives. The responses to the user's needs will be based on the use of personas (avatars), which will help in the perception of the user's needs and consequently in the decision making of the designer and computer engineers to provide the best solution, meaning a good user experience. The persona is a character, or a profile, created to represent the characteristics and real needs of the user. Two personas were developed, a student and a teacher, who demonstrate to be available for the use of the functionality of sharing means of transport.

Persona 1 is a student who must make the trip daily, so it would be more convenient to travel by car, for greater comfort and not have the need to use various means of transport to reach your destination. Persona 2 is a professor at the Polytechnic Institute of Viana do Castelo. He lives in the distance and commutes daily to the Institution, so he intends to use the car sharing service, where he offers the ride to other users, but has some fears regarding adherence to the service. Both personas cover the transport sharing feature because it involves more questions, in relation to how users establish communication, what data they must provide to offer this service, how users will have access to information and how this service is safe.

The personas are created based on the knowledge obtained by the research; however certain details of some personas are created to generate life in these characters [9].

The main objective of the application is to help solve problems related to health, environmental pollution and social inclusion, through the incorporation of functionalities that contribute to: promote active mobility, through recording physical activity and suggesting routes accessible on foot or bicycle, helping the user to perform the recommended exercise; promote sustainable mobility, through the use of the route system, together with vehicle sharing, public transportation and also active mobility, in order to contribute to the reduction of greenhouse gas emissions and reduce the number of vehicles in a city, thus reducing traffic and congestion; promote social inclusion, developing the application so that everyone can use it and have access to it.

Given the number of functionalities that the application has, it is essential to cover the object of study in the area of user experience, in order to: provide a product accessible to all types of users; design an intuitive and easy to navigate application; reach a larger number of users within the campus. These are extremely important factors for the foresee success of the application, as the experience provided to the user, while using the app, is what allows contributing to its possible use in the future, as well as enabling its dissemination if the user recommends its use to other users. It is intended to make it easier for the user, in pursuit of a positive reaction in relation to the products and the services it provides, thus encouraging and propelling its use, as well as its promotion by the user of the services and its dissemination to other potential users.

3.2 The Scope Plane

The Scope plane is the second phase of the process and consists of an objective analysis of the information obtained in the first phase, resulting in a written document that must present the content requirements and/or the functional specifications that the app must contain [11]. This step allows to analyze the situation, to clarify possible doubts and uncertainties and to establish goals for all the stages of the project [9]. In the scope plan, it is presented a table of requirements, where the requirements that the application must present are demonstrated (see Table 1).

For using the application, it is essential to have an account, which will lead to access to the vehicle sharing service functionality, to the route advisory system and to the health module.

In terms of health, and concerning its daily activity registration, the user will have to activate, in the app settings, the activity recognition mode and module. To effectively use the health module the user must fill out the health survey (this is an optional feature), thus enabling the app to efficiently register the physical activity and allowing the convenient health activity notifications (associated with the correspondent MET).

3.3 The Structure Plane

The Structure Plane aims to establish the order in which the content will be placed. After the phases of research and analysis of the collected information, the information architecture will be considered, that is, the structures and functions of the app, which should be represented through flowcharts and organizational charts.

When defining the structure, it is specifically determined how the content will be integrated, thus influencing the user experience and the final product. In the On.Move app,

Table 1. Table of features and requirements

Application Features	Content Requirements
Create the user account	To access to the personal data
Personal car sharing service	To have an account in the application
Route advisory system	To have an account in the application
Physical activity log	To enable the activity recognition mode
Statistics (activity and sustainability) report	To complete the health survey
Health survey	To read and allow the declaration of consent and access to personal data
Personal vehicle sharing creation	To register the vehicle

the data obtained is used to create a profile and also for the activity registration feature. After logging on into the account, the user will be able to access the functionality of the route advisory system, and access to the mobility sharing functionality, on the main page. Through the menu it is possible to access other screens such as the user profile, the daily activity statistics, the settings and, if not filled out during the registration process, to the health survey, which will be the initial basis to define the goals for the user's daily activity. The filling of the health survey is a mandatory requirement if the user intends to fully use the daily activity functionality.

3.4 The Skeleton Plane

The Skeleton Plane allows perfecting the structure developed in the previous phase, defining essential points for the interface, navigation, and information architecture. This step allows to define how the features will be presented. In terms of structure, app navigation is part of the proposal for information-oriented projects and refers to the design of screen elements that allow the user to move through the information architecture [11]. By structuring the content and defining the navigation of the application, it becomes possible to create the skeleton plan, where the layout of the screens is presented, together with all the interface elements. At this stage, it is possible to visualize how the application will be presented to users, and it is also possible to simulate how the user will interact with the product and how the user will perform the necessary tasks. The structure plan will be presented through *wireframes*, as shown in Fig. 3.

3.5 The Surface Plane

The Surface Plane is the final phase of the process. In this phase it is defined how the product will be presented to the users. The Surface phase focuses on the visual treatment of the app, as well as the elements of visual communication. Visual elements have the ability to be manipulated throughout visual communication techniques, corresponding to the purpose of a unique message [12]. These elements should interfere not only with the aesthetics but also with the functions of the program [11].

Fig. 3. First wireframe sketch for the On.Move app

At this stage, research was carried out concerning the colors, the contrasts, the typographies, the icons, and the dimensions that best suited the vast majority of users. In this sense, one of the first visual elements to be developed was the app icon.

The icon is a small graphic illustration, that is, it is a visual sign, that when combined with other signs, is used for the purpose of communication, and provide the successful flow of human machine interaction [13]. The icon is part of the composition of an interface, as well as other visual elements, and has become essential for everyone who uses a digital device. The appearance of icons in digital interfaces has transformed computational language into a common language for everybody, even if they do not have any technological knowledge. Since then, it has spread to various electronic devices that required the synthesis and display of some information on screens, as it is in the case with mobile phones.

Figure 4 shows the app's main icon, which seeks to graphically represent everything the app offers. For this purpose, this visual element is composed with the largest number of aggregated signs, namely: the heart and the *tag* that represent a location. This *tag* is

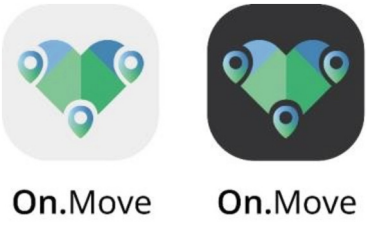

Fig. 4. Icon proposals for the On.Move app. Source: Authors

being used worldwide as a map marker in the digital environment, it also represents the idea of path/direction.

Color is a visual element that influences communication and the dissemination of information to the user, being used as a form of communication, since the human being captures information more quickly through it. In addition, colors affect people's emotions and propel different sensations [9]. With that, color performs several functions that allow the designer to use it as a tool in his favor, such as highlighting, drawing the user's attention to a more important element, organizing, and prioritizing information, directing the eye to a certain element, and creating environment.

The use of contrast is one of the ways to attract the user's attention, by highlighting the essential elements of the interface that require greater attention from the user, whether in highlighting information or helping in navigating throughout the product.

The On.Move app presents a color palette based on shades of blue and green because the color blue conveys calm and confidence, and the color green is linked to sustainability and the environment (Fig. 5).

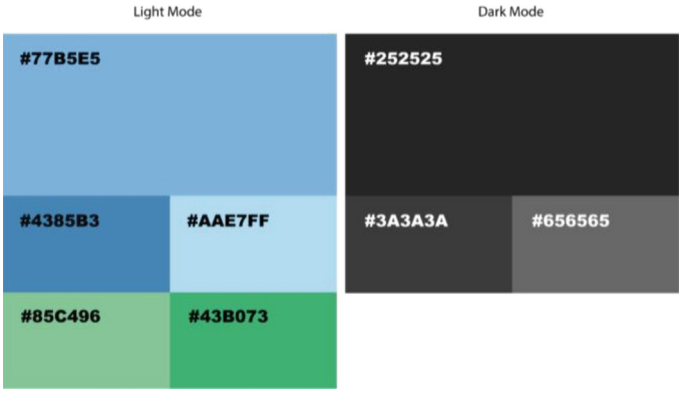

Fig. 5. First wireframe sketch for the On.Move app

After defining the color palette, tests were carried out to ensure good legibility in the application. For this, the *Adobe Color* website was used through its accessibility tools, thus being possible to check the contrast between tones, and to check if they are suitable for colorblind people. In the contrast check, background and text tones are entered and

then analyzed based on full-size text, large-size text, and by basic components. With this it is possible to visualize the proportions of contrast and verify if the tones are approved.

The use of typography on the screen as a communication factor requires one important aspect to be highlighted: legibility. The legibility is the ability of typography to be easily read, especially under normal reading conditions [13].

The legibility contributed not only as an element of distinction, by allowing easy recognition of a letter, but also by providing easy reading in the blocks of text. This factor contributes to a greater clarity of the message, allowing for greater ease of reading. A good legibility of the text displayed on the screen, is related to other factors than only selecting the font, namely: size, color, contrast, and its position [13].

The typography used must be based on uncomplicated fonts, so as not to impair the readability of the text, as the more ornate and serif fonts (with serif), in digital support, cause visual and cognitive fatigue [9]. In the development of this project, it was selected the *Open Sans* font, as it is a font without serif, available in different languages and in different styles. Being downloadable for free, it is characterized by having good legibility due to the letters' design, which include morphological characteristics, such as the body of the letter, the height, the width, and the thickness of its strokes.

The layout is the structuring of visual components in different zones in order to help the visualization and navigation of an interface. The development of a layout is divided into sections, where the application contents and the region of the navigation elements are found. On one hand, it establishes a few limitations such as the minimum and the maximum dimensions for the screen borders, for the different sections. On the other hand, also establishes size limitations for the elements to be used. The established dimensions depend on the screen size and on the different devices used, thus being necessary to create a layout that allows adapting to the different types of interfaces. In addition, to establishing dimensions, there are some tools used in the development of a layout, such as the use of grids and the division of the screen by columns for the alignment of the elements, images and text, that results in the development of a consistent layout across all different screens. Alignment is an essential tool for visual design, as well as for the user experience, by presenting an organized and consistent interface, where the visual elements are displayed in line with each other, thus allowing to create a visual balance in order to facilitate the use of the app [12].

As an example, Fig. 6 shows two layouts of the On.Move app. The first corresponds to accessing to the functionality of the route advisory service and the notification of vehicle sharing trips. It is also possible to view the main menu icon in the upper left corner. The second screen corresponds to notifications, where the user has access to detailed information about the trip and can confirm whether he/she is interested in sharing the trip, or if not, it can reject it.

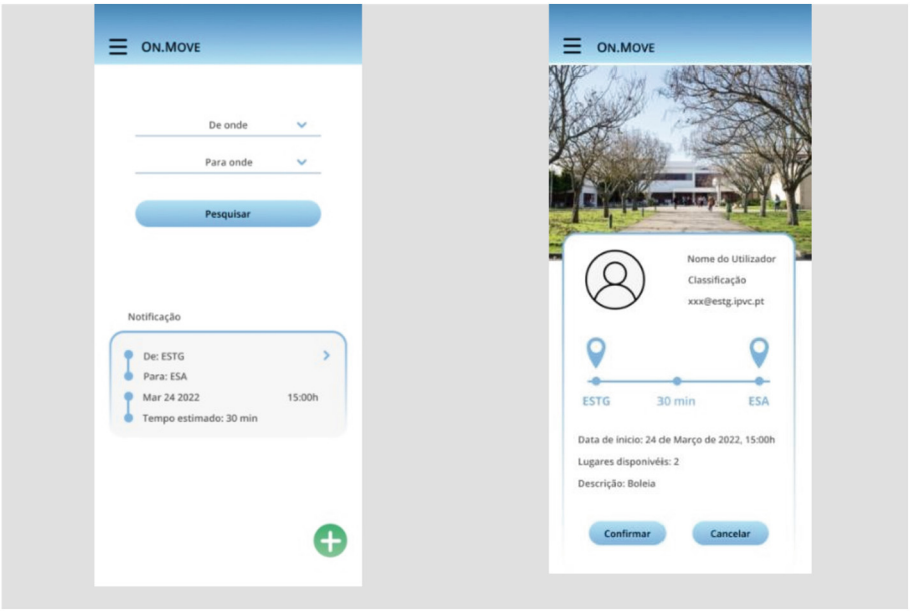

Fig. 6. First sketches of the layouts for the On.Move app. Source: Authors

4 Conclusions and Future Work

Garrett's methodology [9] is of great importance for the development of the app, as it is a well-structured process, which requires a great depth in each phase and mainly in relation to the user's needs. This methodology places a strong emphasis on understanding and addressing user needs and goals. By focusing on the user throughout each stage of the design process, encourages designers to create products that are intuitive, usable, and valuable to the intended audience. The user experience is determined by the different stages and participants involved in the process. The methodology presents a holistic framework that covers various aspects of user experience design, from high-level strategy to the detailed design of user interfaces. It provides a clear structure for designers to follow, ensuring that they consider all necessary elements during the design process.

Good usability is the starting point for triggering user satisfaction. In terms of the interface, it must be easy to use, and it must be pleasant for the user to use the product. A usability test with the target audience was also added to the author's original process, as this should be the central focus for creating a good product based on UX design.

Thus, through this study we contributed to the definition of good methodological practices, with the aim of creating a good user experience service and system. In the future, and using the methodology here presented, it will be developed an operational and high-definition prototype app and it will be performed the respective usability tests. Usability tests are useful to validate the interaction tools present in the interface, being effective in delimiting the actual selection of functionalities and features; the manner in which the information is organized; how efficiently the users are able to complete tasks and how users are able to perceive failures, that is where they occur and how often.

As future work, utilizing the approach demonstrated here, it is intended the development and the implementation of the On.Move app, making it accessible in all the IPVC's campus.

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