

**Interface design of a mobile application
oriented to packaging sustainability**

Sergio Ereira Marques Junior

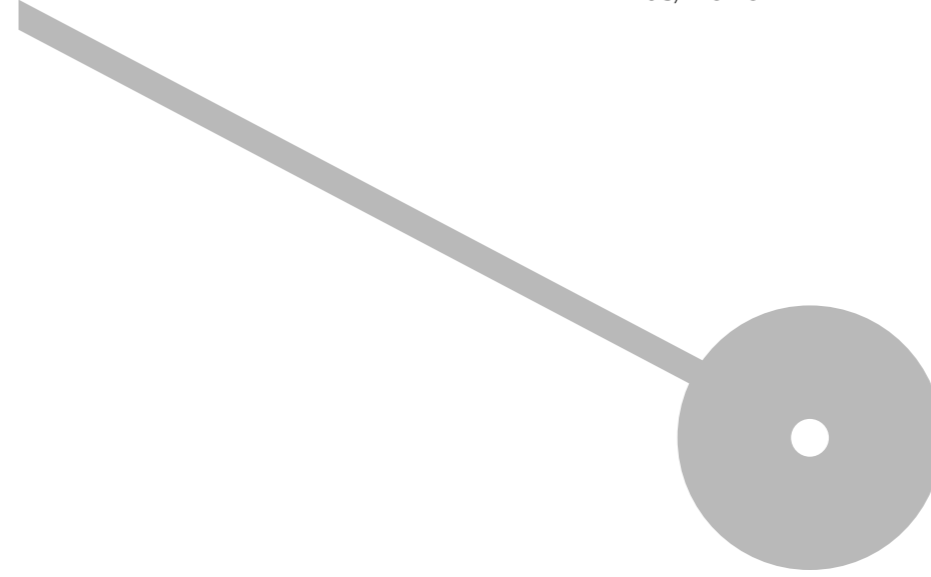
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Escola Superior de Media Artes e Design

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Trabalho de Projeto
Mestrado em Sistemas e Media Interativos
Orientação: Prof.^o Doutor Rui Rodrigues

(esta versão é definitiva e posterior a apreciação do júri)

Vila do Conde, setembro de 2020

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RESUMO

Este projeto tem como principal finalidade reunir informações sobre materiais utilizados em embalagens e suas características relacionadas com a sustentabilidade, a fim de serem aplicadas na aplicação móvel que é desenvolvida em um estágio futuro. Metodologia e técnicas de User Experience Design (UX) são também descritas, sendo fundamentais ao processo de desenvolvimento. Um resumo sobre comportamento humano também é abordado, assim como a criação de uma categorização simples que classifica diferentes tipos de embalagens de acordo com seus níveis de sustentabilidade. O propósito deste projeto é idealizar, desenhar e prototipar uma aplicação móvel de modo a simplificar este tema e assim disponibilizar futuramente esta aplicação ao público em geral. Uma série de técnicas de UX e seus resultados estão disponíveis neste documento para servir como suporte ao desenvolvimento da aplicação. O produto final é um protótipo parcialmente funcional pronto a ser programado. A aplicação demonstra um potencial significativo com impactos positivos sobre o meio-ambiente através de seus objetivos.

Palavras-chave: Mobile application; Interface design; User experience design; Sustainability; Packaging; Circular economy.

ABSTRACT

This project firstly has the purpose of gathering information about packaging materials and their characteristics related to sustainability in order to be applied in a mobile application that is developed in a future stage. Methodology and applied User Experience Design (UX) techniques are described as well, as those are fundamental to the application development process. An overview of people's behaviour is also approached, as well as the creation of a simple categorised system to classify different packaging types according to how sustainable they are. The purpose of this project is to simplify the theme and make it available to the general public through the proposed mobile application. Series of UX techniques and its results are available in this document in order to support the application development. The final product is a partially functional prototype ready to be developed in terms of coding. The application shows significant potential for positive environmental impacts through its purpose.

Keywords: Mobile application; Interface design; User experience design; Sustainability; Packaging; Circular economy.

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Symbols and abbreviations

App - Mobile application app

HCI - Human-computer interaction

HF - Human factors

IxD - Interaction design

UCD - User centred design

UI - User Interface design

UX - User Experience design

1 INTRODUCTION

1.1 Context

The world we are living on today is facing several nature related problems and it is believed that we as a society, have been triggering part of those problems, like the increasing temperature in the planet over the last decades being related to air pollution for example. But not only, and between many problems is the presence of packaging materials on natural environment. With an initial idea of changing that panorama, this project consists in developing an application prototype and its interface design based on studies about retail packaging, packaging materials as well as design studies through related concepts.

The application, also called by “app” has its concept based on the idea of allowing the user to read a product’s barcode and easily find information about its packaging, such as which materials compose it, how to dispose and how long does it take to degrade. The main goal of the application is to inform and influence people in their decision while choosing a specific product, considering environmental related aspects, such as its level of sustainability. Having a tool like that, easily accessible, drives thoughts to a possible behaviour change where an individual adds sustainability to its list of considerations when purchasing a product.

1.2 Motivation

Environmental issues are increasing generically on the planet and this matter is in need of innovative solutions. Packaging has become the reason for innumerable problems around the planet related to nature pollution like toxic elements, poor water quality and the increasing world temperature. Particular concerns and interests about that matter allied with a passion to visual design were the main motivations for this project. A feeling of need and eager to get to know deeper and apply User Interface, User Experience Design and Mobile design to a system created individually are a heavy reason that can be mentioned as it can become an important step in terms of professional career. Mobile applications are extremely flexible in terms of development, as we know

countless games, financial related apps, health related systems and others. Those are created, most of the times, to bring something positive into human lives, being pleasure, simplifying tasks, improving knowledge or helping on financial management. Then why not using that technology in order to reduce environmental problems as well?

Developing a mobile application involving concept, structure and interface has been a challenge that was wanted for a few years. Not only by enjoying the variety of mobile apps, but the professional knowledge attached to the whole development process.

1.3 Objectives

This document aims to synthesize the problem presented delivering a good overview of the actual situation related to packaging management in order to justify the application concept. Seeks understanding all related design concepts, so they can be applied at the development phases.

Focusing on the mobile application pretended, which is the outcome of this project, specific objectives are listed below:

1. To create an easy to use and understand mobile application;
2. To achieve a high-quality interface design product;
3. Provide solutions to user needs when using the system;
4. To motivate the user when using the application.

1.4 Methodology

The first phase of this document is based on analysis from a variety of articles and books referred to retail packaging, main materials and related environmental impacts. The information discussed defines the problem approached. Design fields of study that are relevant to this project are addressed as well, composing a set of concepts that are present in the empirical phase.

The second phase approach the application design development methodology, techniques applied and their detailed description as well as results. Techniques involves user research in order to validate the project's ideal. In the same phase, the product is

also available in its first version, the one used on a usability testing that is also presented in detail.

Reflexions are exposed at the final phase, where future work and work limitations are. Conclusions are established based on all outcome explored during development.

1.5 Document Structure

This document is structured in four chapters. First, the “INTRODUCTION”, presenting the project’s context, motivations, main objectives pretended. Document methodology is approached as well as how it is structured.

The second chapter is called “LITERATURE REVIEW” where there is an introduction to the problem and related questions, followed by design studies that are considered and applied in the project.

The third chapter is “METHODOLOGY AND PROTOTYPE DESIGN”, it comprehends the design research, methodology and all prototype development stages. The final first version of the prototype is available in this chapter, as usability testing description, analysis and results.

As the fourth and final chapter, “CONCLUSION” contains future work, process limitations faced and final considerations.

2 LITERATURE REVIEW

2.1 The problem - Impacts of packaging over the environment

The subject that is being approached in this project – and it will be used accordingly the fundamentals of User Interface Design within a prototype - is the impact of plastic and other packaging materials over the environment. Other materials such as metals, papers and glass are concerning as well, but plastic has a longer life and its recyclability is a bit more complex than the majority of other materials.

Plastic is defined by being a chemical compound that uses polymeric material and has the capability of being moulded or shaped, usually by the application of heat and pressure (Rodriguez, 2019). This flexibility is only one of the positive characteristics of plastic, it is a lasting material, reliable and it requires low production costs as well. There are different types of plastic with different features, each of them directed for a specific industrial field of use.

The main use of plastic is seen on packages applied in all kinds of products such as food, beauty, medicine, electronics, etc. An example of a type of packaging very commonly used is the plastic bag, it is estimated that one trillion single-used bags are used per year (Larsen, 2014). A plastic bag potentialize environmental pollution and can take 1.000 years to degrade, causing a number of problems such as the death of wild animals, blockage of sewerage systems, rivers and seas pollution and deterioration of a natural landscape (Riyad, Maher Ali., 2014). It is not hard to imagine other materials and its consequences, as hundreds of them have their end at landfills or the ocean, as plastic bags. As a real example of the impact of materials – specially types of plastic – on the environment, there is this photographic register at Praia Paredes da Vitória located in Leiria, Portugal. The photo was taken on 24th of December 2019.



Image 1 - Packaging residuals at the beach.

In the image it is possible to see different materials that were in the ocean and during high tide, they were left at the beach. The presence of those materials in the ocean and beaches cause a series of problems, affecting negatively not only the whole sea life, but all the fauna found at the coast. Animals as seagulls for example, ingests plastic, causing their deaths. Maritime animals are facing the same problems and consequently, as another example, the fishing industry is being affected, which leads to us, humans.

The mobile application proposed in this project pretends to act as one of many needed answers to this question: how to reduce the disposal of packaging on the environment?

2.1.1 People and packaging

People's behaviour changes constantly, specially based on their environment. Packaging is – sometimes unconsciousness - part of our lives, every day we shop for food, cleaning and hygienic products at supermarkets for example. It is important to acknowledge the relation people have with packaging and identify questions such as “do

most people think about the packaging?” or “do they often think about how to dispose of packaging?”.

Inside the sustainability universe there is a system called Circular Economy, which is directly connected to this project. It is defined by being a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling (Geissdoerfer, Savaget, Bocken, Hultink., 2017). The engagement to the Circular Economy can work as a measure to be analysed. These indicators were studied by the European Commission (2018) and a Final Report about the study was released in October 2018. The conclusion of this study is relevant for this project and part of it follows:

The consumer survey found that most EU consumers claim to frequently engage with the Circular Economy. The majority of survey respondents reported that they keep things they own for a long time (93%), recycle unwanted possessions (78%), and repair possessions if they break (64%) (see section 3.4). Respondents also reported that their peers display similar levels of engagement in the Circular Economy. A lower yet substantial proportion of respondents reported being willing to engage with novel Circular Economy practices such as leasing products or buying second-hand products. [...] Previous research has found that consumers' willingness to engage in Circular Economy activities differs with the nature of the product. [...] A majority of respondents also claimed to be aware of the durability of products they purchased (64%) as well as repair services (58%). Respondents reported that they frequently looked for durability/reparability information on products (62% for durability and 55% for reparability). Respondents, however, often felt that this information was difficult to find, and that they would like better information on these features.

These findings are in line with previous research which finds that consumers are generally willing to engage in sustainable consumption, and that this is particularly driven by their concerns about the environment. (Cerulli-Harms et al., 2018).

According to the results, most part of the European society is concerned about the environment and it is willing to adjust their behaviour in order to achieve an “eco-friendlier” way of living. This data is aligned with the mobile application’s concept where it tends to influence people on changing their behaviour based on a product’s sustainability information.

2.1.2 Types of packaging materials

The selection of packaging materials is essential to keep product quality during distribution and storage. The function of packaging is to contain a product safely considering its storage and transportation. In case of food packaging, the goal is to contain food in a cost-effective way that satisfies industry requirements and consumer desires, maintains food safety, and minimizes environmental impact (Marsh, Bugusu., 2007). Materials most used in packaging industry are detailed below.

Glass;

Glass has a long history in food packaging. This material is impermeable to liquids, gases and vapor, so it keeps product freshness for a long period of time. It is resistant to high temperatures and it can be sterilised avoiding food poisoning. The containers made by glass can be shaped in different forms and are transparent – the product can be seen inside the container – and colour variations can be applied for light sensitive contents. Glass is fully recyclable and reusable. The downside of this material is that it is heavy weight, adding costs to transportation (more fuel to be used resulting in higher levels of pollution).

Metal;

Aluminium;

Aluminium is a lightweight metal commonly used in cans, foil and laminated paper or plastic. It is highly resistant to corrosion, being a safe solution to protect its content from the effects of air, temperature and moisture. The main disadvantage of the aluminium is its high production cost compared to other materials.

Aluminium foil;

It has the same characteristics of the aluminium; the only difference is that the foil cannot be made from recycled aluminium without pinhole forms in the sheets.

Laminates and metalized films;

Laminated aluminium is attached to paper and plastic containers, due to its high value it is usually used with high value products such as spices and dried food. As a cheapest alternative there are the laminated films which are more flexible. These materials are recyclable but there is a difficulty in separating materials in order to proceed with this process.

Tinplate;

Tinplate is an easy recyclable material made from low carbon steel. It is considered a strong material and it is also light. It can be hermetically sealed and sterilised due to its tolerance to a certain high temperature. This packaging is mostly used for processed food, drinks and aerosols.

Tin-free steel;

Like tinplate it has a good strength and formability. It has a good adhesion for inks and coating, even not being suitable for welding. Another quality is that this material is highly resistant to corrosion.

Plastic;

Plastic is a chemical compound that can be moulded or shaped usually by the application of heat and pressure. Plastics used in food packaging has grown due to the low-cost materials and advantages over tinplate and glass. Following, the different types of plastic are described in detail.

Polyolefins;

This is the most used packaging type of plastic. Its qualities include flexibility, strength, lightness, stability, chemical resistance, easy processability and well suitable for recycling and reuse. There are two types of derivatives from this type of plastic, the high- and low-density ones. The high-density polyethylene containers, specially used for milk, are the most recyclable plastic packages.

Polyesters;

The most known used polyester in food packaging is PETE (or PET). The main applications for this type of plastic are bottles, jars and tubes (mineral water, for example), trays and blisters, and bags and snacks food wrappers. It exists as a transparent material as well as white and opaque, so it can work similar as a glass container and to protect light sensitive products. Recycled PETE (from soda bottles, for example) is used as fibres, insulation and another non-food packaging. Polycarbonate and polyethylene naphthalate (PEN) are polyesters as well. Polycarbonate is clear, heat resistant and durable, it is mostly used as a replacement to glass, as returnable / reifiable water bottles and sterilizable baby bottles. PEN has a superior resistance to high temperatures, allowing hot refills, rewashing and reuse. The downside of PEN is that it is 3 to 4 times more expensive than PET. This variation is suitable for manufacturing bottles for beverages such as beer.

Polyvinyl chloride;

Called by PVC, polyvinyl chloride is a medium strong material, it has a good resistance to chemicals (as acids and bases), grease and oil. It is used in non-food and medical applications. This material is difficult to recycle because it is hard to identify and separate. Incineration of PVC is harmful to the environment because of its chlorine content.

Poly Vinylidene chloride;

PVdC serves as an excellent barrier to water vapor, gases and fatty and oily products. It is commonly in packages for cheese, cured meats, snack foods, coffee and snack foods. It contains twice the amount of chlorides as PVC, presenting problems with incineration as well.

Polystyrene;

Polystyrene has a relatively low melting point, but it is clear and hard. It can be moulded by injection and foamed producing a range of different products. Applications include egg cartons, containers, disposable plastic cutlery, cups and plates. This material can be recycled or incinerated.

Polyamide;

Originally used in textiles, it is commonly known as nylon. It has similar thermal properties as PET, so similar qualities. It also provides good chemical resistance, low gas permeability and toughness.

Ethylene vinyl alcohol;

This type of plastic - EVOH - offers an excellent barrier to oil, fat and oxygen. It is moisture sensitive and by that, is mostly used in multi-layered co-extruded films in situations where it is not directly in contact with liquids.

Laminates and co-extrusions;

These are the two ways of combining different types of plastic. Lamination bonds together two or more plastics, or other materials as aluminium or paper, as mentioned in the metal section. In co-extrusions, two or more layers of plastic are combined, it requires materials that contain similar thermal properties. Both processes combine different types of materials and due to that reason, these are complicated to be recyclable. An advantage is the fact that these processes reduce the amount of packaging material required so they are considered good for packaging reduction.

Paper;

Paper has poor barrier properties, so it is not used to protect food for long periods of time. When used in contact with food, is commonly treated, coated, laminated or combined with other materials such as waxes and resins to improve its properties.

Paperboard;

Often made by multiple layers, paperboard is heavier and thicker than paper. It is commonly used to make boxes for transport.

Paper laminates.

Based on kraft or sulphite, those can be coated or uncoated papers. To improve functionality, they are often laminated with plastic or aluminium, which increases production costs.

2.1.3 Categorising packaging

In order to consider a package sustainable, there are several characteristics to be considered such as all recycling process costs, possibilities of reuse and the number of times a certain material can be recycled. Analysing materials characteristics mentioned, a scale from A to F was created to give materials a grade based on their level of sustainability.



Image 2 - A to F sustainability scale.

That structure was chosen based on the idea of creating a connection with the energy efficiency labels found in home appliances due to consumer's familiarity. Colours were picked with the intention of representing stages from "safe" or "sustainable" (light green) to "unsafe" or just "bad for the environment" (red). The hexagonal shape is a form found in nature (bee's hives for example) and it was chosen with the idea of it standing out among other information that will be available in the application, besides its nature representation. The specifications for this scale are detailed below:

Table 1 - Packaging categories.

Category	Specification
A	Short to mid-term biodegradable packaging.
B	Fully recyclable at low cost (more than two or three times), mid-term degradable, can be re-used and non-toxic.
C	Easy and available to recycle more than two or three times.
D	Materials that have a complex or expansive recycling process such as the need of separating materials and are toxic.
E	Long-lasting materials that are complex to process, non-recyclable and mid-toxic.
F	Non-recyclable, non-degradable and highly toxic.

The goal of this scale is to be used in the application as the main method of evaluation regarding the product researched. It will help the user on understanding and thinking about the associated characteristics of a specific product before purchase.

2.1.4 Actual situation

According to the European Parliament (2018), the production of plastic per year in the whole planet was 1.5 million tonnes in 1950 and in 2015 this number increased to 322 million tonnes. The same source shows that 40% of all plastic production in the European Union is designated to packaging, followed by consumer and household goods (22%), building and construction (20%), cars and lorries (9%), electrical and electronic equipment (6%) and agriculture (3%). Plastic is the majority of the packaging industry, and based on research, the most aggressive material in general. Recycling levels are acceptable in some of the European countries but as seen at the EU plastic waste facts

and figures (European Parliament, 2018) there is a lot to progress. Spain in 2015, for example, registered less than 30% of plastic packaging waste recycling, but this data was much higher in Lithuania achieving more than 70%, which is a reference of an ideal situation for a country to be in.

In Portugal there are a few activities happening in that area, like Smart Waste Portugal, which is a non-profit association with the following objectives:

- Generate opportunities to waste sector and industry;
- Produce and disseminate knowledge in the field of waste sector and circular economy;
- Stimulate actions highlighting the cooperation between the entities operating in the waste sector;
- Establish preferred contacts with universities, companies, research institutes and other organizations, public or private, and with similar national, foreign and international associations;
- Promote dialogue and involvement;
- Stimulate the research and exchange of ideas and projects;
- Implement solutions to the market;
- Provide support and sharing;
- Have common purposes and motivations;
- Create reciprocity, benefits and mutual value;
- Create value and shared talent to compete and win.

The organization developed a study on the Relevance and Impact of the Waste Industry in Portugal (Mateus., 2018) in the perspective of the Circular Economy. This study presents a detailed analysis of the sector and proposes a roadmap to 2030, with actions and recommendations, in the circular economy area.

The studies mentioned show that this matter is vast and in need of action, every year we can see more people and companies implementing solutions and achieving good results, but those are slow meaning that we have a long path ahead of us as society, and every minor action taken is part of a great change in the planet.

2.2 Design fundamentals applied

2.2.1 Mobile Design

This project comprehends a prototype development for a mobile application, meaning that the objective will be designing for smartphone devices and not desktops, tablets, smart TV's or other digital devices, even though, it could potentially be adapted to some of those devices in the future. There are three types of mobile applications, mobile web sites, web apps and native apps. A mobile-optimized web site is an iteration of your computer web site that has been optimised for the mobile context and a mobile web app is a mobile application that users can access via mobile browser (Hinman, 2012). The application that is being developed in this project is thought to be a native app, which is a custom-made application that users can download onto their mobile phones (Hinman, 2012).

An important element to be studied and considered while developing a mobile application is responsive design, which stands for designing an adaptive interface that looks efficient on every device considering many different mobile phone screen sizes in the market. In other words, responsive design is generically defined by Hinman: "Responsive Web design is a Web design and development approach that asserts that a site should respond to the screen size, platform, and orientation of the device. As a user moves from his laptop to an iPad or to a smartphone, the Web site should automatically reform to accommodate the screen size and functionality of the device." (2012).

With those in mind, the fields of study presented will be analysed and applied focused on mobile platforms also considering responsive design. As follow, there are analysis over User Interface Design, User Experience Design and Interaction Design directed to the project in question.

2.2.2 User interface design & User experience design

User interface design (UI) is the mean of communication that a system needs to be able to interact with its user. It is extremely connected to a field of study called *human-*

computer interaction (HCI). Human-computer interaction is the study, planning and design of how people and computers work together so that a person's needs are satisfied in the most effective way (Galitz., 2007). An interface has the objective of being easily understood by its user as well as to be easy to manipulate. Through an interface people can see, touch, hear, and even talk, those actions will be recognized by a specific system and give a response. All possibilities need to be considered and studied accordingly in order to achieve its objective as its best.

When researching on User Interface Design, User experience design (UX) has to be considered. According with the Interaction Design Foundation, UX design is more than interaction design, it also involves user research (finding out who the users are in the first place), creating user personas (why, and under what conditions, would they use the product), performing user testing and usability testing, etc. These aspects need to be defined before the Interface development starts as they support the actual interface guiding on design decisions.

UX can also be defined as the experience a product or service delivers to people, so it is not about its function but the way a user interacts with it in order to achieve a certain objective. In other words, Garrett (2011) explains this definition in his book: "User experience is not about the inner workings of a product or service. User experience is about how it works on the outside, where a person comes into contact with it. When someone asks you what it's like to use a product or service, they're asking about the user experience. Is it hard to do simple things? Is it easy to figure out? How does it feel to interact with the product?". Another definition according with Hassenzahl (2013) is that UX is a field of study that focus on the user and its context of interaction with a product or service. It considers the psychologic and emotional aspects related to the interaction and it is analysed in two parts. One, focusing in a particular interaction moment, considering the action, thoughts and feelings. The second focus on the experience as a narrative that can vary between users and those outcomes can be incorporated in the final product.

In this project, UI and UX are applied during the whole development process. UX research through several techniques that are vital to understand the user, to structure information and to collect data in order to be analysed and applied at the actual UI

development. UI fundamentals well translated and applied meaning a higher chance of having a successful final project.

2.2.3 Interaction design

Interaction design (IXD) can be defined as designing interactive products to support the way people communicate and interact in their everyday and working lives (Preece, Rogers, Sharp., 2015). It is about designing experiences that improves the way people interact, communicate and work. Another definition made by the Interaction Design Foundation¹ adds that IxD is the design of interactive products and services which a designer's focus goes beyond the item in development to include the way users will interact with it. The foundation defends the idea that IxD has five dimensions to be considered when designing interactions.

Table 2 - Interface design dimensions.

Dimension	Description
First dimension	Text, like all information provided and button labels.
Second dimension	Visual representation meaning any graphical elements like images and icons.
Third dimension	Physical space, like a physical device i.e. a smartphone that provides interaction through fingers.
Fourth dimension	Time, representing any media like animations, sounds and videos that changes with time.
Fifth dimension	Behaviour, that concerns how the previous four dimensions define a product or service interaction as well as how the product reacts to human inputs and provides feedback.

¹ <https://www.interaction-design.org/> las consulted on August 2020.

The project described in this document has as its first dimension, all digital text displayed through the application. The second comprehends all graphical elements such as icons, illustrations, photos and representative forms. The third one is represented by user's physical device, being a smartphone for example. The fourth represents small interactive animations like swipes and the transitions in the application, and the fifth comprehends the whole product as an interactive human tool.

IxD is considered fundamental to all disciplines and fields that are concerned when researching and designing computer-based systems for people (Preece, Rogers, Sharp., 2015) and is compound by several components that are directly related to interaction design such as Academic disciplines, Ergonomics psychology/Cognitive science, Social sciences, Computer science, Human-computer interaction (HCI), Human factors (HF), Industrial design, Graphic design and others.

In this project, IxD is approached obviously because it concerns a mobile application, but we can relate some non-obvious elements to some of those components listed above. Ergonomics psychology/cognitive science is an element considered when designing a button and deciding its colour, for example. Social sciences help on understanding users and their behaviour. Computer science/software engineering is completely related to a technical side of developing a project like this, just imagining what has to be programmed in a possible future stage, after design. HCI supporting human behaviour towards a digital system. Graphic design, which is a base element used for branding, for example. These are just a few examples of how all those elements are directly connected to the project by all interaction studies.

IxD studies will be present at mostly stages of the development process of the mobile application.

2.3 Similar applications

2.3.1 "BinGo" by Amarsul, Valorlis, Valorsul e Algar (2018).

BinGo is an interesting Portuguese application that incentivises the habit of recycling through gaming features allied with its objectives. It is available in certain cities of

Portugal where the recycling spots are mapped. The user needs to create an account and it will be able to collect points by completing missions (tasks) such as checking-in an “ecoponto”(recycling station) when depositing the right materials to their respective bins. Points can be exchanged to prizes as supermarket vouchers or cinema tickets. Every user has its cards as well (reference to a bingo game) and filling up the card, prizes can be won. There is also a “Ranking” that intrigues competitiveness working as another incentive to the user.

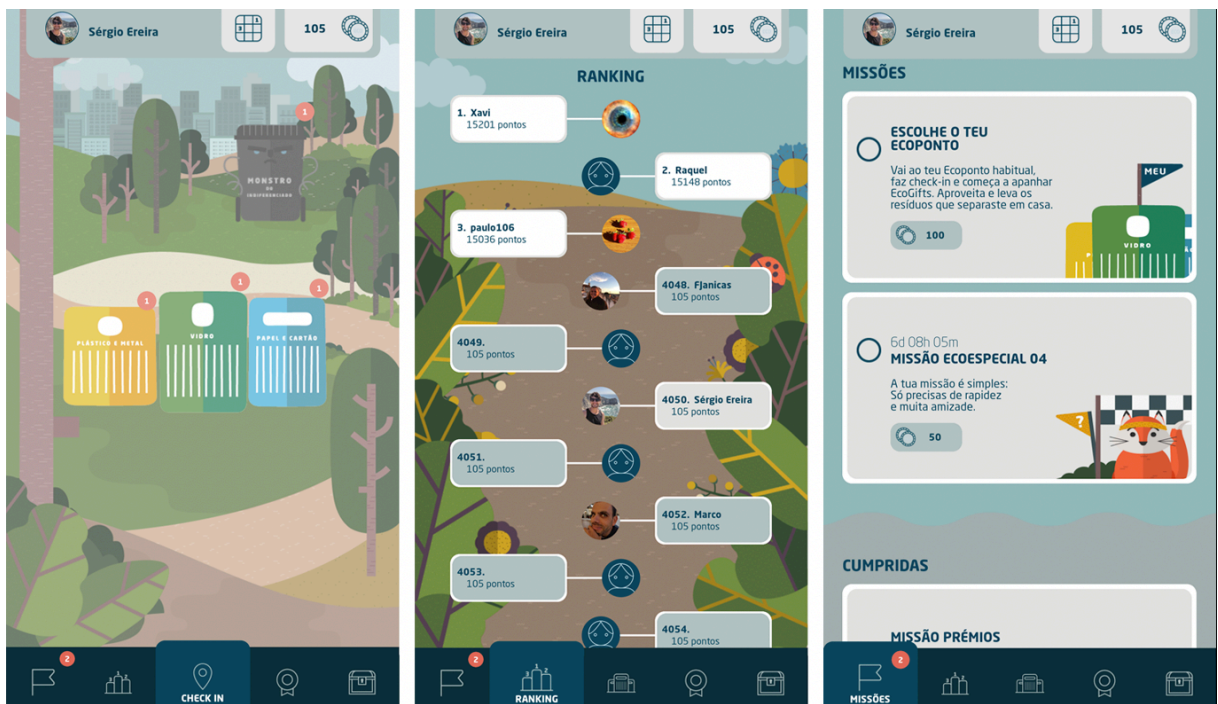


Image 3 - BinGo mobile application screenshots.

Some features from BinGo can be adapted and used in this project, as partnerships in the future, making real prizes available like supermarket coupons. Guidance they provide on how to recycle and the interface are very interesting aspects to consider as well.

2.3.2 “MyFitnessPal” by My Fitness Pal Inc. (2010).

My Fitness Pal is an application that has the objective of helping people track their diets, independently of their objectives. As part of this research this example does not have a relative theme associated, but it does work as an important technical reference

since the beginning of the idea as it contains a barcode reader that displays all nutritional information about a specific product. In case of not having this data in the database, any person using the app can introduce missing details. This functionality works within a collaborative database and is the main reference to the same functionality in the mobile application developed in this project.

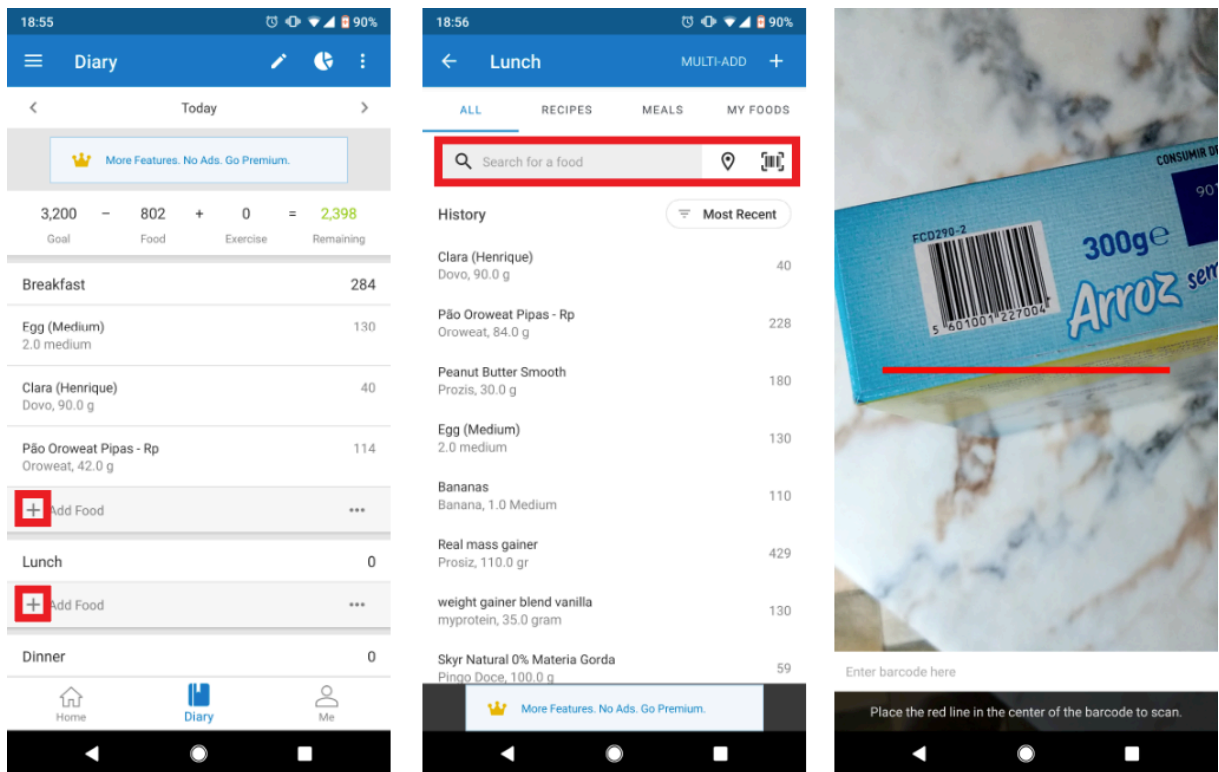


Image 4 - My fitness pal mobile application screenshots.

2.3.3 “Think Dirty” by Think Dirty Inc. (2017)

During research on related applications Think Dirty was a surprise as this system works in a very similar way as the proposed system. The app allows the user to read a cosmetic product barcode, the system will display all ingredients used in that specific product and display their characteristics. Think Dirty was created based on the curiosity of its founder, who have been trying to find safer alternatives in the cosmetic industry as she discovered that toxic chemicals are used in personal care products, as well as hormone disruptor chemicals that could be linked to breast cancer. As the founder said,

“Think Dirty empowers and educates the consumer on the cosmetic industry by allowing them to make an informed decision on what products to purchase.”

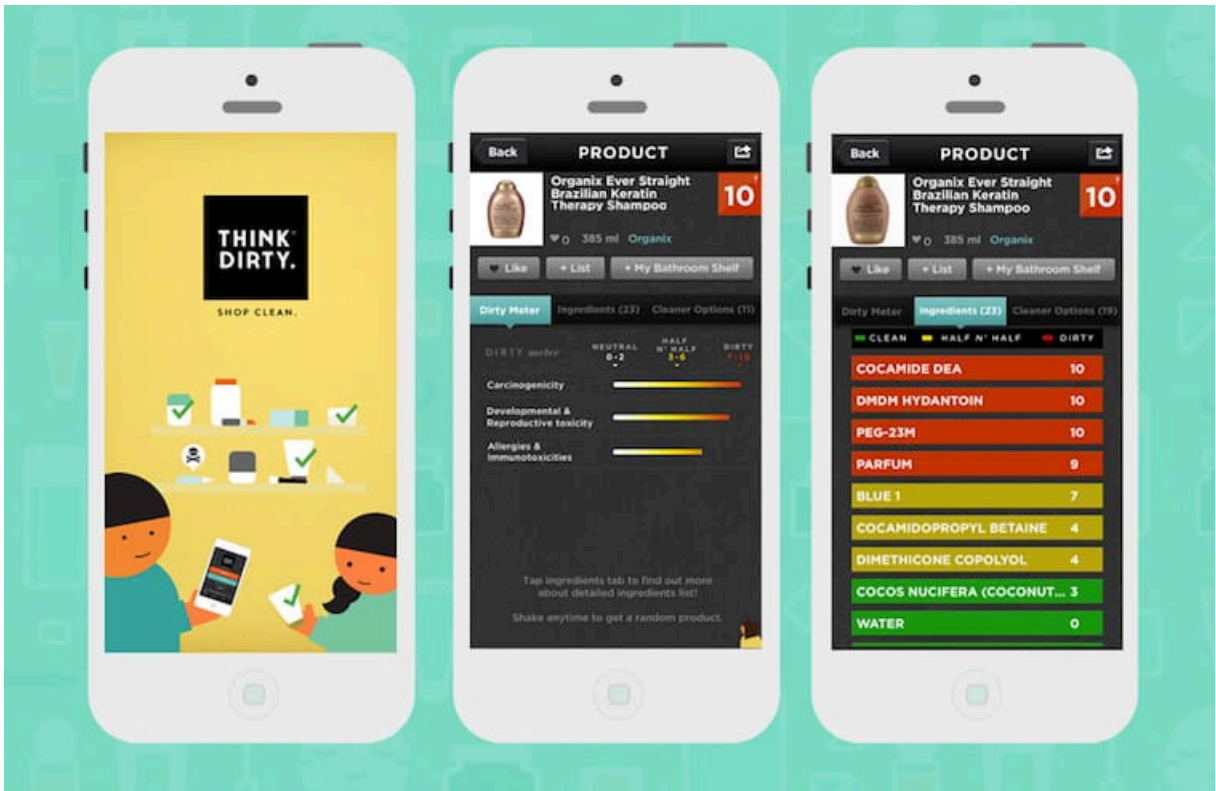


Image 5 - Think dirty mobile application.

2.4 Summary

This whole chapter was focused on researching all fields related to the project in question. Firstly, gather information about the environment in Europe and the world considering packaging pollution and packaging material studies. Those were extremely important in order to set the categorisation (A to F scale) shown that will be present in the app. The relation between people and packaging was explored as well in order to understand the importance general people actually gives to this matter.

In the second half of the chapter, design fields of study were defined and the connection between them was made in order to recognise that the app design development have its roots on those concepts. The next chapter exposes all empirical phases based on this research and associations are along the content.

3 METHODOLOGY AND PROTOTYPE DESIGN

3.1 User centred design

Methodology used to develop this project is called “user centred design” (UCD). It consists of considering the end-user of a product at every stage of the conception and design process (Allen, Chudley., 2012). The process can start by asking a few questions about the project, like “who will use the product?”, “why?” and “how?”. UCD is often used by designers as real users are considered to validate a product through testing procedures. Consulting the end-user as often as possible using specific techniques will help making decisions more assertively. The developing process based on UCD can be simply represented by the “virtuous circle” as it is called by Allen and Chudley (2012).

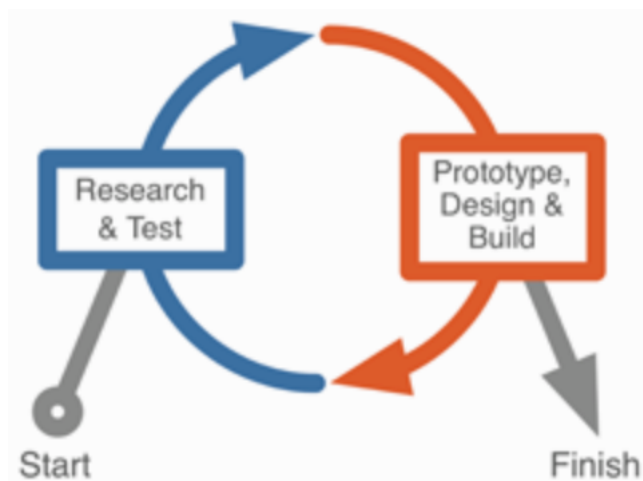


Image 6 – The virtuous circle (Allen, Chudley., 2012).

Research firstly starts with the main objective of knowing the user we will be designing for, so understanding user’s behaviours and needs will help on making design decisions. For this first stage, three techniques were chosen, a questionnaire, cards sorting and the creation of personas. The questionnaire asks certain questions mainly related to how the user is interested in the sustainability matter, if they would actually use the platform and what they would like to see in the application. Card sorting will help defining the architectural information of the application through user’s organisation thoughts. And personas are going to represent users. Those techniques were applied

during research and further details about each one of them can be seen at the following section.

With all data collected from research, the design process starts. When a prototype is ready, it will be tested with user's and based on feedback, new design changes are applied, and that circle is repeated until a faceted final product is achieved.

3.2 Design research techniques applied

There are several techniques known that could be applied in projects such as this. The selection of techniques to be used depends on project's objectives and development, analysing what are the ones that suits better to the process, as well as which ones are going to bring the most valuable results. Every technique should be adapted accordingly. Between a great variety of techniques, some of them are surveys card sorting, eye tracking, A/B testing, user-flows, system analytics.

The first technique chosen for this project is an initial questionnaire, with the intention of understanding people's feelings and ideas about the subject matter. A card sorting exercise is used as well in order to support informational architecture. Personas are created to represent the user. As a last technique before designing the application, a system map was created considering previous research results.

3.2.1 Questionnaire

With the idea of understanding people's behaviour and perception related to Sustainability and Circular Economy, a generic survey was created (Attachment 1). The survey will help to extract how possible users imagine functionalities in an application related to the theme. Those answers could potentially help to improve the functionalities of the interface.

Questions were created to understand how people are connected within the theme as well. Some final questions are related to the proposed system, asking people's opinions on how they would imagine a system like the one that's being developed. The survey was released on February 20th, 2020 to a range of people through social media

channels (e.g. Facebook) and the E.S.M.A.D.² secretary also spread it through an email directed to teachers and Polytechnic of Porto's students.

91 people answered the form. 86,8% of them have collaborated answering the form in Portugal, 9,9% in another European country and the remaining 3,3% outside Europe. In the following table, it is possible to see results for questions that have a scale from 1 to 5 as possible answers, where 1 means "strongly disagree/low/no" and 5, "strongly agree/high/yes". Other questions are described further.

Table 3 - Questionnaire quantitative answers.

Answers	1	2	3	4	5
"On a scale from 1 to 5, how much do you consider yourself a person that cares about the environment?"	1,1%	3,3%	17,6%	56,0%	22,0%
"Do you recycle regularly?"	1,1%	7,7%	14,3%	35,2%	41,8%
"On a scale from 1 to 5, how hard do you consider the act of recycling?"	19,8%	37,4%	13,2%	23,1%	6,6%
"How hard is for you to recognise a type of material and where should it be disposed?"	26,4%	42,9%	17,6%	8,8%	4,4%
"Do you consider yourself a person that thinks about the environment when disposing items that are no longer used?"	1,1%	2,2%	30,0%	40,7%	23,1%
"Do you try to fix broken goods before disposing them?"	3,3%	12,1%	24,2%	33,0%	27,5%
"Do you buy second-hand products?"	6,6%	26,4%	27,5%	33,0%	6,6%
"Do you think about product packaging before buying it?"	13,2%	25,3%	25,3%	24,2%	12,1%

² Escola Superior de Media Artes e Design - <https://www.esmad.ipp.pt>

Based on the answers, people considered themselves individuals that do care about the environment and the great majority of attendants do recycle. On “How hard do you consider the act of recycling?” there are some concerning numbers on “considerably hard”, the numbers show that there is room for improvement in terms of information about recycling, maybe clearer and more assertive information is needed. When asking if people know what circular economy is, 52,7% answered yes, while 47,3% answered no. Another proof that further information about this matter needs to reach the population. When questioned if they would be interested in having easy and free access to information about product packaging and its impacts over the environment, 69 (75,8%) participants said yes, 17 (18,7%) said maybe and 5 (5,5%) said no.

The last question was not mandatory and suggested participants to add ideas of functionalities and information that they would like to see in an application related to sustainability.

This questionnaire filtered ideas about the application and worked as an initial guide when setting functionalities according with people’s needs and wills.

3.2.2 Card sorting

Card Sorting is a technique that comprehends how the user organises, categorises and group information (Cooper et al., 2014; Garrett, 2011). This technique is used to develop interface information architecture and can be executed in a laboratory, individually or in a group, through digital channels, in person or as a workshop (Cooper et al., 2014). The concept and process are simple, a series of cards are used within a name, a description, an image or a content. Later, these cards are mixed and distributed between the users that should group them by concept or category according to their ideas (Cooper et al., 2014; Garrett, 2011). It is not like having all clear answers from it but gathering patterns from the results helps to structure the information architecture. Using an online platform called Optimal Workshop³ an open card sorting – meaning that the participant can suggest new categories - was created with 15 cards representing the main

³ <https://www.optimalworkshop.com>

areas of the platform and 5 categories. 5 participants collaborated with this exercise and results follow.

Table 4 - Card sorting results.

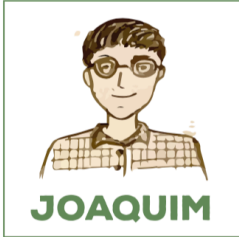
Cards/Categories	Feed	Find a product	Profile	Recycle	Not standardised
Add a product to the database		5			
Feed	5				
How to recycle	1			4	
Information of how long does a product's packaging takes to decompose in nature	1	1		2	1
Kinds of material used in a product's package		2		2	1
Map				5	
Product information		3		1	1
Product score/grade		2		2	1
Scan product barcode		3	1	1	
Search history	1	4			
Search product by name		5			
Suggestions of better choices	2			3	
Tutorial	2		3		
User level in the app			4	1	
User profile			5		

None of the participants suggested new categories, but as is visible at the table, one did not categorize 4 cards. The patterns (highlighted) recognised in this exercise were applied at project's architectural information, acting as another guide on the application's development.

3.2.3 Personas

“Personas are fictional characters created to represent an actual user” (Ilama, 2015). Personas have to be created based on investigation of potential users for a service or product with an approach centred on the user, using different techniques as in this project through the questionnaire and informal interviews. The quality of data collected has an effective impact on the efficiency of the personas in the design process of a product (Cooper, Reimann, Cronin, & Cooper, 2007). Based on research, the literature review and answers from the questionnaire, 3 personas were created.

PERSONA 01



JOAQUIM

30 years old | Architect
Lives in a studio apartment in Lisbon






DESCRIPTION

- Single
- Likes technology and to buy new gadgets
- Goes to the gym regularly
- Recycle
- Likes to sort things out online
- Uses Instagram and Youtube
- Likes to have a beer with friends and travel
- Has a mid-low purchase power
- Likes high quality products
- Usually buys online
- Sustainable thinking when possible

LEVEL OF KNOWLEDGE

Internet	1	2	3	4	5
General use of software	1	2	3	4	5
General use of smartphone	1	2	3	4	5
Social media	1	2	3	4	5

DEVICES

 Desktop	 Laptop	 Smartphone	 Tablet	 Smartwatch
--	---	---	---	---

USER EXPERIENCE OBJECTIVES


Fast	Helpful	Entertaining	Original	Useful	Safe
Motivational	Informative	Practical			

Image 7 - Persona 1.

Persona 1 (Joaquim). A 30 years old male, who lives in a studio apartment in Lisbon. He works as an architect in a small company. He likes technology and goes to the gym regularly, usually shop online, uses Instagram and YouTube, has a high level of internet knowledge and feels comfortable using general software, smartphones and social media. Joaquim uses a laptop, his smartphone and a smartwatch. Seeks for fast, entertaining,

safe, motivational and practical user experience. He usually recycles and considers the environment daily.

PERSONA 02



MARINA

45 years old | Teacher
Lives in a 3 bed house in Leiria


DESCRIPTION


- Married
- Likes to watch tv shows
- Goes to the gym
- Recycle
- Likes to sort things personally or through the phone
- Uses Instagram, Facebook and Youtube
- Likes to spend time with her 2 kids
- Has a mid-high purchase power
- Likes natural / bio / organic products
- Vegetarian
- Consider second-hand electronics


LEVEL OF KNOWLEDGE


Internet	1	2	3	4	5
General use of software	1	2	3	4	5
General use of smartphone	1	2	3	4	5
Social media	1	2	3	4	5


DEVICES


Desktop


Laptop


Smartphone


Tablet


Smartwatch

USER EXPERIENCE OBJECTIVES

Fast

Helpful

Entertaining

Original

Useful

Safe

Motivational

Informative

Practical

Image 8 - Persona 2.

Persona 2 (Marina). A 45 years old teacher, who lives in a 3-bedroom house in Leiria. She is married, has 2 kids and likes a peaceful lifestyle. Usually recycles, likes natural and organic products. She has a medium to high level of knowledge regarding the internet, the general use of software, smartphone and social media. Marina uses a laptop and a smartphone. She appreciates helpful, entertaining, original, useful, motivational and informative user experience.

PERSONA 03



60 years old | Retired
Lives in a 2 bed apartment in Coimbra

DESCRIPTION

- Single
- Likes esoterism and contact with nature
- Do morning walks regularly
- Recycle
- Don't feel confident to buy online
- Uses Facebook and Youtube
- Likes to meet friends for an afternoon coffee
- Has a mid purchase power
- Likes to sort things personally or through the phone
- Sustainable thinking

LEVEL OF KNOWLEDGE

Internet	1	2	3	4	5
General use of software	1	2	3	4	5
General use of smartphone	1	2	3	4	5
Social media	1	2	3	4	5

DEVICES



USER EXPERIENCE OBJECTIVES

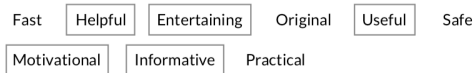


Image 9 - Persona 3.

Persona 3 (Eloisa). 60 years old, retired, and lives in a 2-bedroom apartment in Coimbra. She is single, likes to do morning walks regularly and esoterism. Nature is important for her, so she does recycle and cares about the environment. She avoids solving issues online, preferring talking through the phone or personally. She has a medium level of internet knowledge. She uses her desktop at home, likes to use her smartphone and has a tablet as well. Helpful, entertaining, useful, motivational and informative user experience are her main focus regarding digital systems.

Those fictional personas have the objective of representing the main user-targets for the application. The goal of using personas is not just describing their personality but to be capable of imagining the product from their point of view and understand their needs and wills related to the application.

3.2.4 System map

With all information collected from the techniques mentioned before, a system map was defined. Card sorting results were a great value in order to develop this map as it helped connecting sections and placing information into certain areas. The map represents the architecture of the application, the first structure of the system and is mandatory to the creation of the entire prototype.

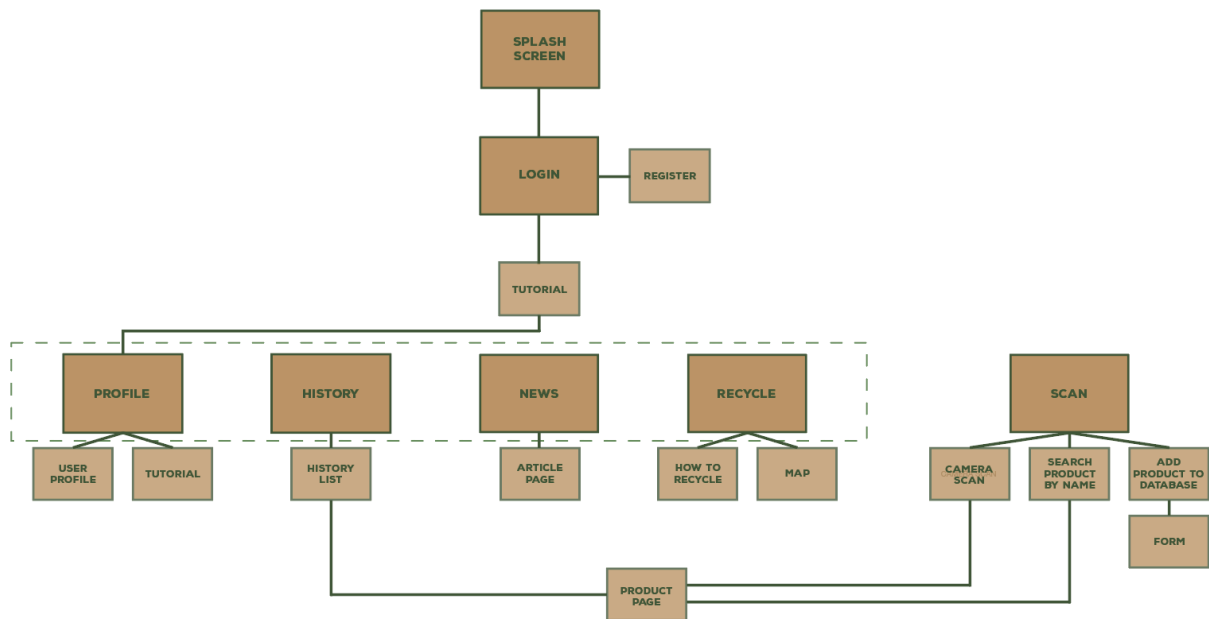


Image 10 - Application map.

It contains the most important navigation sections which are five. The main one is “Scan” which is the main functionality of the application, where the user will be able to find a product through its barcode or name. The other four sections are “profile”, “history”, “news” and “recycle”. The “profile” contains user’s personal information like its name, e-mail, photo and access to the tutorial. “History” will keep record of all product’s found in the “scan” section. “News” will display sustainability related news and “Recycle” is a dedicated area to inform about how to recycle based on user’s location. In this section is also possible to search for a recycling dock near based on GPS location.

This map is the base support to the wireframing development, as with the main structured defined the focus could be at the interface design of all screens.

3.3 Visual identity

Visual identity is a necessary item in this project in order to create a brand identity to the proposed system. The results from this step will impact on the way people receive and, together with the interface design, interact with the application. References of systems in similar areas are valuable to understand and build a digital environment – based on visual elements, style, colours and typography - where the user will exercise its actions and probably achieve its objectives. According with Wheeler (2009), a strong brand identity will help build brand equity through increased recognition, awareness, and customer loyalty, which in turn helps make a company more successful. In this project's visual identity, those elements were initially created:

- Logo
- Colour palette
- Typography
- Iconography and interface elements

Together, those items will be the image of the application and the base of the User interface design elements as well.

3.3.1 Logo

The logo was created with the intention of representing rough natural elements aligned with a modern and young approach through the lettering style. The idea is to have a graphic form that not only represents the recycling subject, but to add other matters to it, like the circular economy and nature. This is a final version up to this point in the project, considering feedback from the user testing, the logo as some other visual elements can potentially be improved.



Image 11 - Logo.

3.3.2 Colour palette

The colour palette was defined based on the same main characteristics mentioned for the logo as they were built together. The values have to be clear through the colours as they will be applied through all identity from this point, specially the application's interface. The final palette can be seen as follow.



Image 12 - Colour palette.

3.3.3 Typography

Typography had to be defined as part of the visual identity. Circular family was chosen due to its great readability. For main titles, the indicated is Circular Black and for a text font, Circular Book, Book Italic and Bold. Readability in digital platforms is a great concern considering a whole application is going to be designed using it. Project fonts can be seen as follow.

CIRCULAR BLACK	ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
Circular Book	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
<i>Circular Book Italic</i>	<i>ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789</i>
Circular Bold	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789

Image 13 - Typography.

3.3.4 Iconography and interface elements

An initial iconography was created at this stage as well in order to support the interface design development further. The main navigation icons as well as how buttons are going to look are defined. Some interface ideas were created as well as a level-meter, secondary buttons and a slider meter. These basic interface elements can be seen at Image 6.

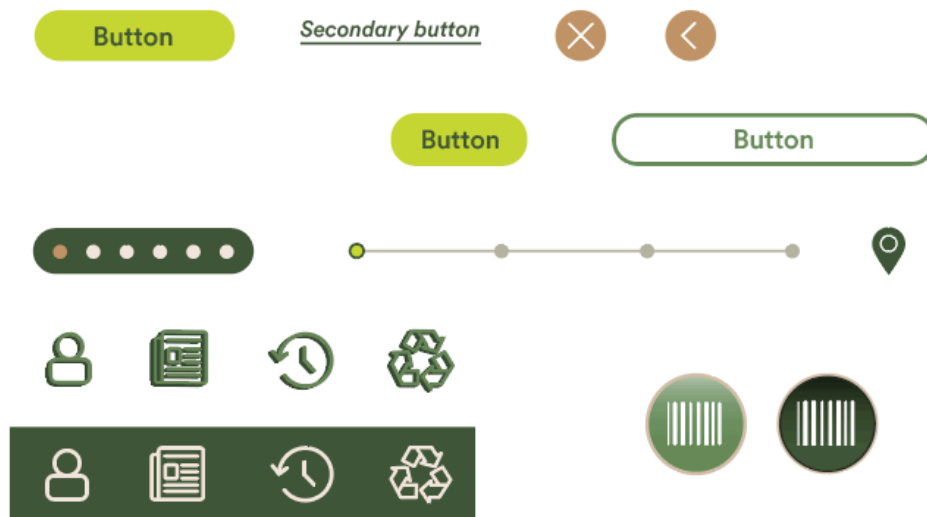


Image 14 - Iconography and interface elements.

The complete identity guide can be seen at Attachment 2. These visual concepts will be represented in the application where they are intended to transport this same feeling and meaning to the user.

3.4 Prototype and user-flow

Based on all research done until this point, the prototype was created. All outcome from the UX research through techniques described are applied in this design process. The system map is already a synthesised result from that data and together with all other applied techniques, they serve as a surface for this stage. First rough sketches done manually can be seen.

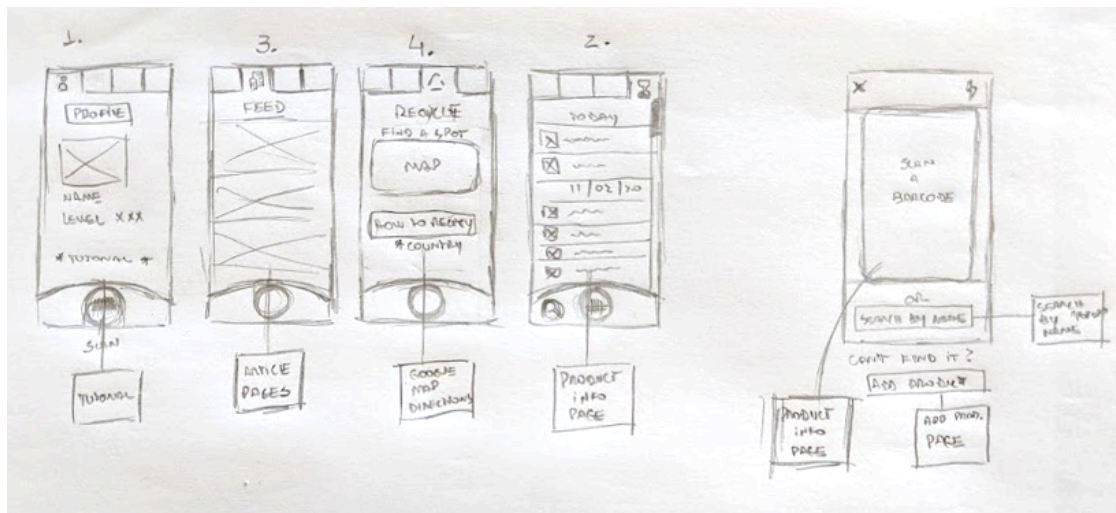


Image 15 - Prototype initial paper sketches.

The image above shows the first main design ideas based on the informational structure defined that can be seen at the system map. The main sections of the application are presented in the sketch being “profile”, “news”, “recycle”, “history” and the main functionality, “scan”. From this stage, the interface explorations were taken to digital software - Adobe Illustrator - where some screens were drawn in order to define a bit more how the information would be displayed.

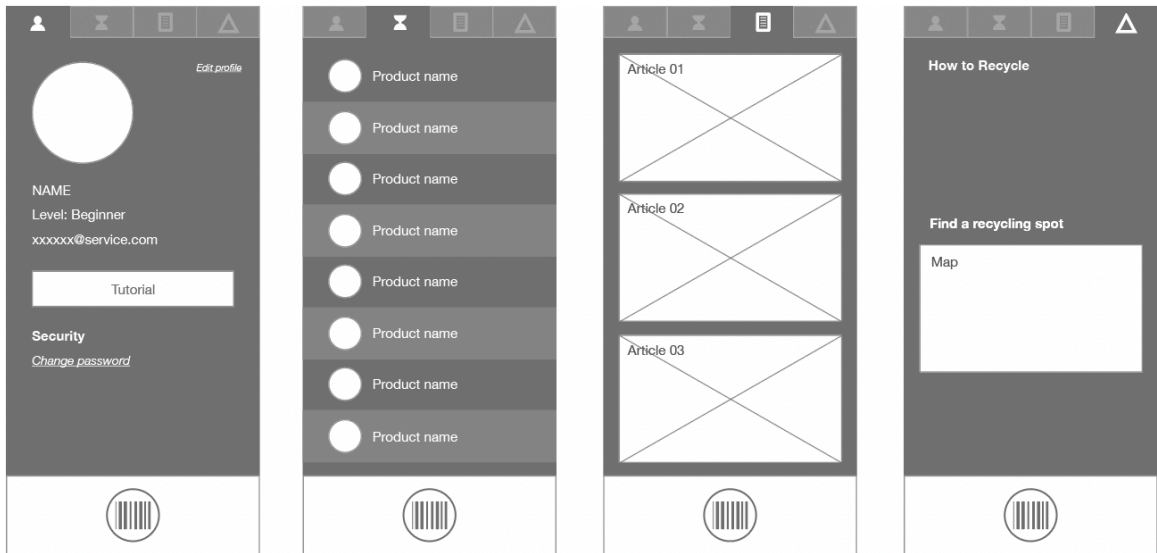


Image 16 - Prototype initial wireframes.

Exploring this idea and studying references it was decided that the tab at the top of the application would then move to the bottom due to its easier accessibility by the fingers while using a mobile device. At this stage, colour was applied together with some other visual elements, with references from the branding identity created earlier. Design experiments related to the tab can be seen at the next image. It is also possible to see the icons developed in an earlier stage, applied in the tab – in different colours, testing the selected section highlight.



Image 17 - Tab studies.

Following on the design process, first concepts of the main screens were created and is possible to see the path in terms of visual design.



Image 18 - Prototype Illustrator studies.

In the “profile” screen, user-levels were added as an extra feature. The idea is to encourage the user to be active when using the application by its will of achieving higher levels in the application. The levels will be measured initially by the number of times the user scans or finds a product as well as the number of new products that are added to the application. The levels created and its respective visual representation are in the next image.



Image 19 - User level badges.

Another visual element created to be in the application are the visual representation of recycling containers in Portugal (Image 20). The blue, yellow and green containers are illustrated, and they will be applied in certain sections of the app, where recycling

guidelines can be found and at product's page, where will be instructions for recycling specific packaging.



Image 20 - Recycling Portuguese containers illustrations.

As some screens were being drawn, the design was carried to a prototype software – Adobe Xd – where is possible to easily create interfaces and then, the prototype. At this phase, all secondary screens are created, meaning that not only the sections found on the system map were designed, but all co-related screens as well. Under that definition we can mention pop-ups and the tutorial, product search and categories screens as examples. The full user-flow is available further in this document (Image 21). The first version of the whole design was defined and in order to create the prototype, almost all buttons were activated and connected to its respective destination.

A prototype can be defined as a pre-production representation of some aspect of a concept or final design (Camburn, Viswanathan, Linsey, Anderson, Jensen, Crawford, Otto, Wood., 2017). According with the same author, prototyping often predetermines a large portion of resource deployment in development and influences design project success. In this project a high-fidelity prototype is being created, meaning that it gets as closer as it can be in terms of design and functionalities to a final – programmed - version of the application.

Screen transitions were added as swipe animations. The final user-flow can be visualised next. In the user-flow all interactions between sections are described, like taps and swipes. At this point the first version of the prototype is ready. This version is used for usability testing, its analysis and results are available in the following sections. A

prototype video was recorded being possible to see the same interactions tested at the usability testing. The video is available at <https://youtu.be/jRriejEUizE>.

With a final version of the prototype, the next step is to run the user testing. Good quality feedback is expected from it, that will potentially be applied, generating an improved version of the app.

3.5 Usability testing

Usability testing is the process of learning about users from users by observing them using a product to accomplish specific goals of interest to them (Barnum., 2011). The user testing was designed based on results from all other UX techniques applied in order to gather the maximum information possible before creating the prototype. Personas created are extremely important in this phase where real users are testing the system. The objectives of the user test are to validate the application in terms of usability and graphical interface as well as to recognise possible flow issues and improvements.

3.5.1 Recruitment

Recruitment was done by the author of this project using social media channels and personal contacts, specific people that have interests in sustainability matters were found. Personas were considered at this stage as they represent the application users. The only information shared with participants was generic, mentioning that the test is about a prototype of a mobile application and the approximate length of it. It is important to mention that considering the Covid-19 pandemic situation, some difficulties were found due to testing limitations. That resulted in a low number of representatives for Persona 3, which is 60 years old.

3.5.2 Test description

The test was planned to happen during a real time video-call (moderated remote) due to the actual Covid-19 situation where is advised from the General Health Direction to avoid human contact. A main requisite is that the participant uses its smartphone to test the application while the video call is happening in another device. This was applied to all participants in order to achieve consistency through the process. As soon as the video call starts, the interviewer explains that the test is about a sustainability application but that no further information will be provided as the participant perception will be taken into consideration in a future stage. It is asked to all participants to video record their interaction with the application and that every thought they might have during the

experiment, to be said out loud. This last technique described is called “think aloud protocol” and is a unique source of information as it generates direct data through the performance (Jaspers, Steen, Bos, Geenen. 2004). Prototype limitations are also described such as non-working text fields and external links, being examples of how they will look in a final version of the system. There is no specific goal for the user to achieve, the idea is to explore all sections with a free navigation and get conclusions by themselves. It is also explained that the final stage of the test is a post-test questionnaire that they are asked to answer after using the prototype. The questionnaire is available at Attachment 3. When all those steps are concluded, the interviewer provides a link to the prototype and the participant can start recording its smartphone screen, and finally click on the link to start the experience. The questionnaire is available at attachment 2.

The interviewer is available and present all the time during the experience for possible questions, concerns or technical issues. Only the questionnaire was usually answered by the participant after the video call, where the participant has its own time and no additional pressure to answer the questions.

3.5.3 Participants

The prototype valuation was realised with a convenience sample of 18 participants aged from 24 to 55, the average age is 33.44 and the median is 33.5. They are all people concerned about the environment at a certain level and that have knowledge about the Portuguese language, as primarily the application is built towards the Portuguese market. The educational level of all participants is superior, meaning they all have a bachelor’s degree and their technological level vary from mid-low to high.

3.5.4 Technical restrictions

A few technical issues were faced while doing the tests and their root is related to the software used, but the exact cause is not known as the prototype works perfectly at a desktop environment. The first issue was the disappearance of the bottom tab on screens with scroll, like “news” and “history”, that happened in 5 devices. In those devices, some destinations were malfunctioning as well, for example a non-clickable

button was directing the user to the “product search” section. Adobe Xd was checked while running the test and that connection did not exist. The one with a higher incidence of issues was a Nexus 5 Android device, but the tab issue was found on an iPhone8 as well, meaning that the operational system is not related to the problem. The participant using the iPhone 8 tried to access the prototype through Safari and Chrome web browsers and the tab issue persisted on both.

The second issue was that the prototype is not compatible with iPhone 6 or lower Apple devices, which caused one participant to use the application on desktop as there were not alternatives.

3.5.5 Analysis and results

Results show a medium experience time actually navigating through the application of 9 minutes and 30 seconds approximately. From the outcome, is possible to say that in general, participants found that the application is easy and pleasant to navigate.

The objective of this stage is to organise and analyse all feedback received in order to implement improvements to the application, this process is part of the project methodology and can be easily recognised at the virtuous circle presented earlier in this document. All collected content from screen recording videos with audio comments and answers to the questionnaire is organised in order to deliver clear results that can lead into objective conclusion.

Firstly, some sections that are not extremely obvious like the “categories”, “user levels” and “product suggestion” were chosen in order to identify if people were able to access them. Due to its importance in the application, the main functionality, “scan” and the “product page” are added to the selected sections as well. Results are described at the following table.

Table 5 - User-testing results of sections access.

Participant	Scan	Product page	Categories	User levels	Product suggestions
01	Yes	Yes	Yes	Yes	Yes
02	Yes	Yes	No	No	Yes
03	Yes	Yes	Yes	Yes	Yes
04	Yes	Yes	Yes	No	Yes
05	Yes	Yes	Yes	Yes	Yes
06	Yes	Yes	No	Yes	Yes
07	Yes	Yes	Yes	Yes	Yes
08	Yes	Yes	Yes	No	Yes
09	Yes	Yes	Yes	No	Yes
10	Yes	Yes	No	No	Yes
11	Yes	Yes	Yes	No	Yes
12	Yes	Yes	No	Yes	Yes
13	Yes	Yes	Yes	Yes	Yes
14	Yes	Yes	Yes	No	Yes
15	Yes	Yes	Yes	Yes	Yes
16	Yes	Yes	No	No	Yes
17	No	Yes	No	No	Yes
18	Yes	Yes	No	No	Yes

Analysing the data from this table is possible to identify that “categories” and “user-levels” are not easy to access as 10 out of 18 participants did not found the user-levels information and 7 did not found the “categories” page. It is also relevant that the older participant did not click at the “scan” button and even representing approximately only 5.5% of testers, considering its age, this is a matter to register.

Another valuation method is based on the most common types of comments made during the test. It is important to mention that even inputting the think aloud into the test, some participants do not express a good amount of information. In the next two tables is possible to see how many participants were thinking similarly. The issues related comments are listed in the first one and the positive ones, in the second.

Table 6 - Incidence of issue related comments during test.

Comments	Number of times mentioned
Doubts about the meaning of categories and the need of finding it earlier.	8
Ways of closing the tutorial with no need to see it all over.	2
Confused about the “suggestion” product tab.	4
Miss further information when editing profile.	2

Table 7 - Incidence of positive comments during test.

Comments	Number of times mentioned
Like categories.	2
Appreciation of the recycling tab.	2
Appreciation of suggested products tab.	4
Positive comments about the scan function.	3

The most common comment while testing the application was about understanding the packaging categorisation. The categories section is only available at a product’s informational page. These comments are extremely helpful as they are a clear fact that those categories should be available in an easier accessible area in the application. Another relevant comment happened when participants saw the “suggestion” tab on a product’s page, where they were unsure about what they would find in that tab, it is not clear that the content is displaying eco-friendlier products compared to the one in question. Some participants initially thought that they could give their own suggestions in that area.

Despite participants doubts about the “suggestion” section, they rapidly understood the correct function of that tab and positive comments about it were given. Participants

also did positive comments about the scanning function, saying that they would definitely use the app.

An interesting behaviour through participants is that around half of them firstly accessed the product's page through the "history" section and not the "scan". The reason for that can be that they initially explored same level sections at the tab and later, they tried the "scan" which is accessible via a unique centred button, designed to attract more attention and centred positioned, giving its level of importance in the app.

With the focus on the post-test questionnaire, there were a variety of answers from the first and second questions. The first question asked, "What do you like the most about the application?" and answers are all related to the positive environmental impact and about the application usability. The second question asked, "What do you like the least about the application?" and the most relevant answers are about the categories being clearer, 2 answers mentioned the use of colour and 6 were not able to answer, saying that they liked everything about the application. That feedback enhances the need of making access to the categories easier. A slightly adjust to some colours through the app might need some attention as well. The next question is "Which feature would you likely use the most?" and 66,66% of participants mentioned the scan feature and that is a positive feedback from users, meaning that the scan is at its correct place in the app and its functional idea is well designed, but together with minor comments made through the tests, there is room for improvements.

When questioned about how often would they use it, most of answers just said that they would use every time they go shopping and this will actually depend on everyone's lifestyle, but is important to acknowledge that the participants recognise the application as an easy tool that can be accessed in their pockets. The questionnaire follows with a question about any features that they think could be missing in the application and some answers were simply "no" and apart from those, the most mentioned was about real rewards, like discount coupons for example, that would highly incentive users.

From quantitative questions, 66,7% of participants said that the navigation of the app is good, while 33,3% answered as being very good, being a good feedback when considering navigation.

The next three questions are based on a linear scale from 1 to 5, 1 representing the extreme negative and 5, the extreme positive. They are: “On a scale of 1 to 5, rate your experience using the mobile application”, “On a scale of 1 to 5, rate the interface of the mobile application” and “On a scale of 1 to 5, rate the intuitiveness of the icons”.

The answers can be seen as follow.

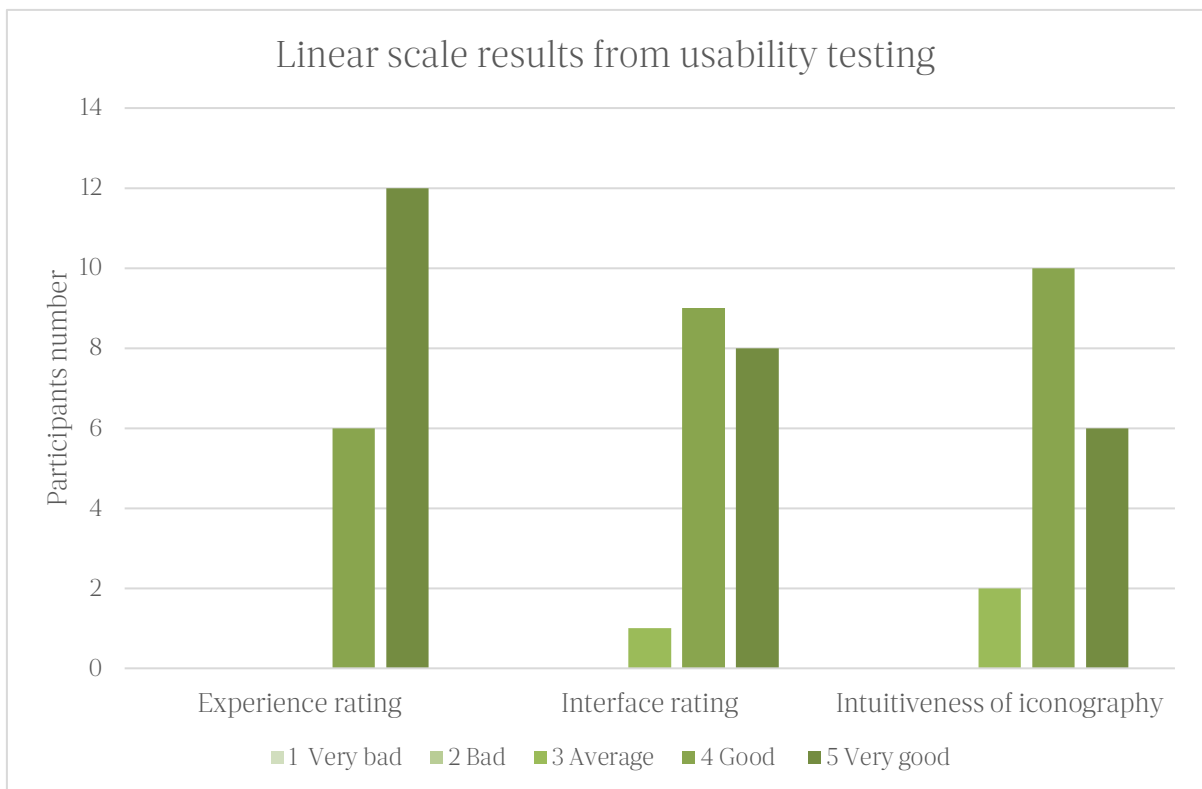


Image 22 - Linear scale results from usability testing.

These answers are mainly positive, but a minor number of participants had an average experience with the interface meaning that not all information is well structured and there might be some areas in need of interface improvements.

The questionnaire only re-enforced the feedback from the screen recording and conversations along the test and made it possible to synthetise all data collected clearer.

3.6 Summary

This chapter expresses the outcomes from all research, which is now applied, done at the Literature review. Initially approaching design fields of study and techniques, to the point of actually implementing a series of techniques, which were adapted to fit this project. Results led to the next stage of this chapter, building an initial visual identity. But most important, those results guided the prototype and user-flow construction.

The final user-flow presented in this document represent the whole application and its functionalities as they actually are on the prototype. The latest part of the chapter describes all phases from the usability testing. From its conception, detailed description, to analysed results. The outcome from the test is one of the most valuable data collected in this project as it carries all the research made before this step. This outcome, which is centred in the user, will lead the future work of the mobile application, guiding the following work into the most recommended path in order to achieve a high-quality experience to users.

4 CONCLUSION

4.1 Study limitations

On March 2020, quarantine was imposed in European Union as a measure against proliferation of the SARS-CoV-2, a coronavirus never identified in humans so far. Those measures partially limited presential research, such as face to face card sorting and the prototype user testing. Those were done remotely through existent tools that made them possible. This limitation interfered on the recruitment of representative participants to the Persona 3, which has 60 years old.

During development stages, it could be said that a lack of experience in terms of UX and UI was a boundary in certain situations, not impeding any stage, but requesting further investigation and seek for references. This aspect is described as a limitation but is a positive outcome from this project as it was mentioned on “Motivations” that one of the great personal objectives were to develop professional experience in the field. The mentor of this project has been a key piece, providing quality feedback and guiding the project very well.

A software limitation, as mentioned briefly before, delivered issues while running user-testing. Almost 25% of participants had some kind of interactive problems while testing the prototype facing buttons disappearing and wrong connections inside the application. Those were not major, but the experience of those participants was prejudicated, as they had to find other ways of entering a specific section for example.

4.2 Future work

“[...] design and iterations aren’t finished just because a product is shipped. And with many of our products going digital, pushing updates is easier than ever. We should always be looking to measure and improve the products we deliver.”(Nunnally, Farkas., 2017).

The future work of this project is firstly to keep the virtuous circle ongoing, meaning that all feedback from the user testing will be applied to the interface and new user tests

will applied, until a higher quality product is achieved. The main improvements to be done are:

- Create a clearer and earlier access to the categories section.
- Change the “suggestion” tab title.
- Add profile photo at “edit profile”.
- Add a close button to the tutorial, so it’s possible to close it at any stage.
- User-level area to be recognised as a clickable area.

Those might interfere in certain aspects of the actual application state creating the need to adjust other elements or screens in the interface, but those are certainly needed and will impact positively the project.

Focusing on a commercial side, partnerships could be set, working along with retail brands that are actually on the market could add a great value to the application. Through partners, the app could also offer higher incentives to the user as mentioned before, to include real prizes as compensation could increase the number of users, reaching a wider public.

4.3 Final considerations

Through the presented document all project development stages are described, from research and applied design techniques, to the final prototype and its results when tested by real users.

Based on the research presented in this document, the application developed has potential of guiding users on their buying decision, presenting information about a product’s package sustainability level. If used on a large scale, the platform can have positive impacts on the environment, reducing the presence of toxic and non-biodegradable materials on the environment.

Considering the initial objectives related to the mobile application, at this phase is possible to say that they were all achieve at a certain level. It is important to recognise

the improvements needed in certain aspects of this project and those are clear now thankfully to the usability testing and further UX techniques. All those objectives are connected, as so, is recognisable that they all have great areas of improvement.

The UX techniques applied during research phase generated series of results that helped on product development. Questionnaire results show an interest in an application as the one developed as well as the necessity of more information channels regarding the environmental matter. When asked if you consider yourself a person that thinks about the environment when disposing of items that are no longer used, almost 100% of answers were placed on medium to a high level of concern about the environment. Generically, the results from the questionnaire show a high potential of users to the application, which can be seen as a motivational factor for the future work already mentioned.

The mobile application presented is also thought to be implemented outside Portugal, as the recycling guidance is designed to work based on GPS location, adapting itself to the local market. The language is something that could easily be adapted as well, elevating the potential of the app to a higher level.

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ATTACHMENTS

Attachment 1 – Questionnaire.

Sustainability and Circular Economy

Research about social behaviour related to Sustainability and Circular Economy

***Obrigatório**

Where do you live? *

Portugal

Other European country

In a country outside Europe

In a scale from 1 to 5, how much do you consider yourself a person that cares about the environment? *

1 2 3 4 5

Don't care Cares a lot

Do you recycle regularly? *

1 2 3 4 5

No, never Yes, always

In a scale from 1 to 5, how hard do you consider the act of recycling? *

1 2 3 4 5

Very easy Very hard

How hard is for you to recognise a type of material and where should it be disposed? *

1 2 3 4 5

Very easy Very hard

Do you know what Circular Economy is? *

Yes

No

Do you consider yourself a person that thinks about the environment when disposing items that are no longer used? *

1 2 3 4 5

Never Always

Do you try to fix broken goods before disposing them? *

1 2 3 4 5

Never Always

Do you buy second-hand products? *

	1	2	3	4	5	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Do you think about a products packaging before buying it? *

	1	2	3	4	5	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Would you consider buying a product with low or none environment impact packaging instead of a normal product that you usually buy? *

- Yes
- No
- Maybe

Would you be interested in having easy and free access to information about products packaging and its impacts over the environment? *

- Yes
- No
- Maybe

Would you use an application while you are shopping, in order to check how sustainable packagings are - so you could make your decision about what product to buy?

- Yes
- No
- Maybe

What would you like to see in an Application for your smartphone created with the objective of simplifying and informing people about packaging and its impacts over the environment? Maybe describe functionalities that you believe are necessary or what kind of information should it be available... anything is valid here.

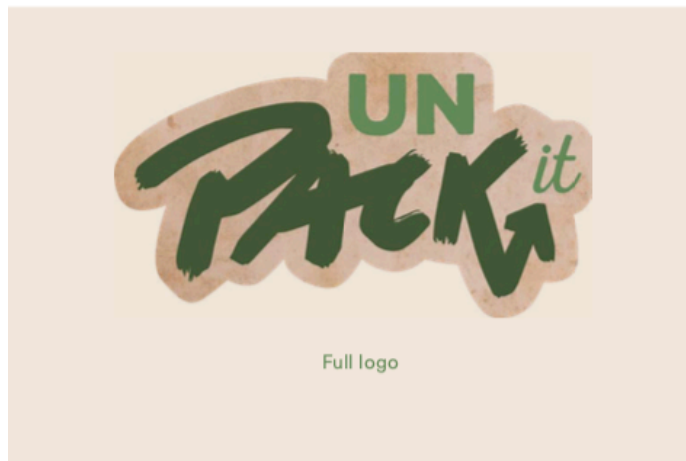
A sua resposta

Submeter

Attachment 2 – Visual identity guide.



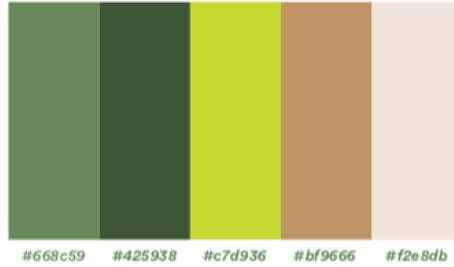
LOGO



LOGO VARIATIONS



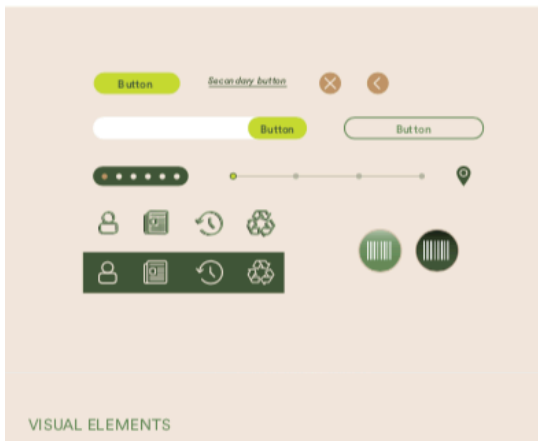
COLOURS



FONTS



ICONOGRAPHY



VISUAL ELEMENTS



Attachment 3 – Post-test questionnaire.

Pack it Up - User testing

Questions about the user testing

***Obrigatório**

Please provide your name and age. *

A sua resposta _____

What do you like most about the application? *

A sua resposta _____

What do you like the least about the application? *

A sua resposta _____

Which feature would you likely use the most? *

A sua resposta _____

How often would you use it? *

A sua resposta _____

Are there any features that you think you need but are missing in the mobile application? Describe. *

A sua resposta _____

How is the navigation of the mobile application? *

- Very bad
- Bad
- Reasonable
- Good
- Very good

On a scale of 1 to 5, rate your experience using the mobile application. *

	1	2	3	4	5	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

On a scale of 1 to 5, rate the interface of the mobile application. *

	1	2	3	4	5	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

On a scale of 1 to 5, rate the intuitiveness of the icons. *

	1	2	3	4	5	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

What do you think the mobile application should improve on? *

A sua resposta

Submeter

Página 1 de 1