USABILITY EVALUATION OF THE

HEALTH SMART HOME ADVANCED ASSISTANT DESIGN

ZAHRA SOLTANI

JUNE, 2022

USABILITY EVALUATION OF THE

HEALTH SMART HOME ADVANCED ASSISTANT DESIGN

BY

ZAHRA SOLTANI

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

IN

INTERACTION DESIGN

YEDITEPE UNIVERSITY

JUNE, 2022

PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Zahra Soltani

28-06-2022

ABSTRACT

A smart home is both practical and appealing to user in terms of connecting devices reconfiguring them to do things on their own. However, such approach necessitates a new perspective for who has disabilities or who require particular care. This research proposes a smart home assistant that will support people manage their work in an innovative way while focusing on their wellness at home. To accomplish this, fifteen nominees from the target society were interviewed and the trends associated with PACT data were obtained and validated. The evaluations were based on a questionnaire analysis. As a result, the fundamental concepts and structural components of the UI/UX design system, as well as solutions that can take advantage of the most recent technology, are discussed. Based on the facts and circumstances, a number of findings and recommendations that reflect the current state of health are drawn in order to deliver a unique smart life experience.

Keywords: Health smart home, user interface design, user experience design, interaction design

ÖZET

Akıllı ev, cihazları kendi başlarına yapacak şekilde yeniden yapılandırmaları açısından hem pratik hem de kullanıcı için çekici. Ancak böyle bir yaklaşım, engelli veya özel bakıma ihtiyacı olan kişiler için yeni bir bakış açısı gerektirmektedir. Bu araştırma, insanların evdeki sağlıklarına odaklanırken işlerini yenilikçi bir şekilde yönetmelerini destekleyecek bir akıllı ev asistanı önermektedir. Bunu başarmak için, hedef topluluktan on beş adayla röportaj yapıldı ve PACT verileriyle ilgili eğilimler elde edildi ve doğrulandı. Değerlendirmeler bir anket analizine dayanıyordu. Sonuç olarak, UI/UX tasarım sisteminin temel kavramları ve yapısal bileşenleri ile en son teknolojiden yararlanabilecek çözümler tartışılmaktadır. Olgulara ve koşullara dayalı olarak, benzersiz bir akıllı yaşam deneyimi sunmak için mevcut sağlık durumunu yansıtan bir dizi bulgu ve öneri geliştirilmiştir.

Anahtar Kelimeler: Sağlıklı akıllı ev, kullanıcı arayüz tasarımı, kullanıcı deneyimi tasarımı, etkileşim tasarımı

This thesis is dedicated to those who have and continue to mean so much to me. First and foremost, to my parents, who loved me unconditionally and taught me the value of hard work. Then there were my younger sisters, who grew with me, loved me, and showed me how to care for others. I'd also like to thank everyone who contributed to my work by participating in the research and interviews. Last but not least, I'm dedicating this to myself; I've always wanted to make a positive difference in people's lives, hopefully, this study will change their life experience for the better.

ACKNOWLEDGMENTS

I would want to express my gratitude to my supervisor, Assistant Prof. Dr. İrem Tekin Yücesoy, for allowing me to work on this study by directing, supporting, and providing comments during the research. Throughout the investigation, I learned a lot about health smart home advanced assistant. I'd also like to express my appreciation to our department's head, Assistant Prof. Dr. Merve Çaşkurlu for her kind and professional supporting.

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

Every day, technology improves, and having a smart home is becoming a need. Smart homes have been supposed to be exclusive for the wealthy because of their price, but now they have already become a common aspect of people's lives. Users may operate several gadgets or devices with a single touch button, or will be able to control home temperature as well as turn on and off lights with a single click from anywhere in the house using the smart phone. This is not only a useful process, but it will also save energy and resources.

A smart home allows you to control the shades, turn on the lights, and monitor security. The smart home's listed benefits are enough to persuade a person to make their homes smart as well. They make life easier by eliminating the need for the user to go around the house to conduct numerous tasks. All household chores may be performed through applications while sitting comfortably on the chair or in bed with smart devices; it is also a significant way to provide mental peace; the user can use the smartphone to check the doors, windows, water spill sensors, and so on. Fire and robbery are only two examples of incidents that can damage a home or put a family's lives in jeopardy. Alarms and notifications from smart home devices can alert the user to such situations, which may be enough to rescue lives.

Sedentary habits, on the other hand, are growing more popular recently, which will have an impact on health and productivity. Meanwhile, as technology advanced, health professionals began to look into the prospects of smart home goods for a better way of life. Even ordinary everyday routines become healthier experiences with the monitoring

and analysis of a home automation system. It's also about obtaining a better insight of how people utilize their houses and evaluating how they might live healthier lives.

1.1. Problem statement and motivations

A smart home is a residence that employs technologies like the Internet of Things to add value and enhance people's lifestyles (Haje, 2018). In a bigger view, home automation components are always in contact with one another in order to do tasks and make decisions automatically or to send notifications in the event of an emergency (Mshali et al., 2018). Lately, the concept of Health Smart Home (HSH) entered the industry by the patients' preference for staying at home rather than in the hospital, this system is a combination of advanced information and communication technologies that can intelligently monitor home environments all the time (H. J. Kang et al., 2019; Rialle et al., 2002). To organize subjective factors in the design decision-making process and improve the objectivity of smart product design, Kang H, Han J, Yun B, and Kwon G (2020; 2017) developed a multi environmental comprehensive evaluation model called smart service scape wheel (SSW). It can be used as a map or a list of candidates to show a variety of possible smart environment options.

However, when a user is not aware of having unhealthy habits or need some special care, the concept of a smart house necessitates a new approach. What are the criteria for determining "smart health"? What's the connection between smart home products and home health-care technologies? Can they collaborate effectively with an assistant

program? Is it possible for this assistant to encourage users to track their health data and motivate them to adopt healthier habits?

1.2. Scope, objectives and contribution of the research

This research suggests an advanced assistant design approach for smart homes that will help individuals manage their activities in new ways while focusing on their wellness at home. The goal of this research is to look at users' health-care demands at residence while offering solutions via smart home devices and home health-care technologies. In addition, to showcase the design aspects that go along with the proposed assistant model, the following objectives are listed:

- Innovative design improves health by encouraging good habits.
- Providing users with healthy future plans based on clinically relevant issues that motivate them to improve with the assistant.
- Smart evaluation with personalized journeys by simultaneously monitoring and analyzing (Smart schedule).
- To achieve better performance, boost productivity by customizing activities based on individual needs (Smart diagnosis).
- Using wearable technology and bed sensors to analyze users' health while sleeping.

- Users' socialization and personal communication with specialists.
- Users can benefit from a distinctive guidance system for immediate health treatment while keeping exclusive communication with doctors using a toolkit of telemedicine gadgets and diagnosis sensors.
- Food analysis technology is available to track components and vitamin intake.
- Using smart laser projection technology to display the interface in a larger format on any surface while remaining compatible with the primary app's futures.

Researchers interested in analyzing, exploring, applying, and assessing the effectiveness of health smart homes will find the findings of this study to be a valuable resource. As a result, the study's conceptual and practical contributions can be summarized:

- Scholars interested in researching and implementing smart home technologies from health perspective.
- Implementing optimum multifunctional health smart home for individuals.

1.3. Research flow

Based on the above, this study divided into six chapters that will explain the entire process and flow of this project. The thesis is included the introduction, literature review, research methodology, findings, discussion and conclusion.

The second chapter focuses on the literature review and discusses all of the details to referred project. The literature review also implies that, based on the references, each part or process, theory, and fact used in this project is analyzed.

In the third chapter, the research methodology is introduced and explained within three methodologies; Firstly, design thinking methodology which included trend analysis and PACT analysis. Secondly, user research and interview. Third, UX research methodology by user stories, features list, information architecture, desirability and usability testing.

In chapter four, the findings of the research decoded into three sections including design thinking process, user research and interview, planning the UI and UX design.

In the fifth chapter, Wisy as a proposal for increasing the health smart home system presented to finalize the project's outcome and implementation, and it is described in detail with a discussion of the literature.

Finally, the sixth chapter is the project conclusion. This chapter summarized the whole study with the results. Besides, to enhance the project, recommendations are also included.

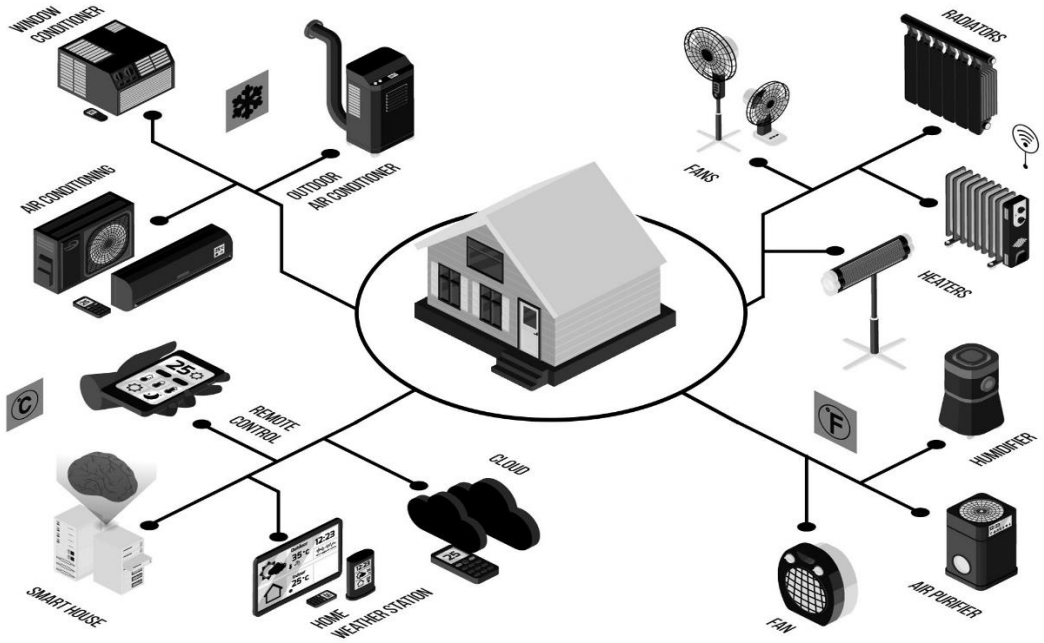
2. LITERATURE REVIEW

2.1. Smart home concept

Smart home denotes the use of technical systems, automated processes and connected, remote-controlled devices in apartments and houses. The main objective of the functions is to improve the quality of life and convenience in the home. Other goals are greater security and more efficient use of energy thanks to connected, remote-controllable devices. A smart home is a residence that uses internet of things (IoT) to enable the remote monitoring and management of systems and connected devices by sharing consumer usage data among themselves and automating actions based on the homeowners' preferences, that is illustrated in Figure 1 (Haje, 2018).

Figure 1

Smart home concept



The owner can control other devices remotely using a smartphone or tablet through an internet connection. Smart homes can be set up through wireless or hardwired systems. It provides homeowners with convenience and cost savings (Haje, 2018).

The term 'smart' refers to self-monitoring, analysis, and reporting technology (Rachdi et al., 2019). Some models can learn and determine the best settings for the house. They start, control, and monitor specific processes in the home on their own, depending on the scenario or the basis of how they programmed. Home appliances, such as the washing machine, lights or the coffee maker, can be time-controlled. Devices like motion sensors, cameras, shutters or thermostats initiate user-programmed processes. The heart of the smart home is the central control unit, with which various smart components are connected and can be controlled from the PC, smartphone or tablet. Common wireless standards such as Wi-Fi, Bluetooth, ZigBee or Z-Wave are used for communication or controlling devices. The central control unit is also termed a hub or gateway.

It has been argued that smart home as an integrated technology contains of four main components of:

1. **Home automation** that will monitor and remotely control home attributes such as lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems.

2. **Communication networks** between the devices and local intelligence unit.

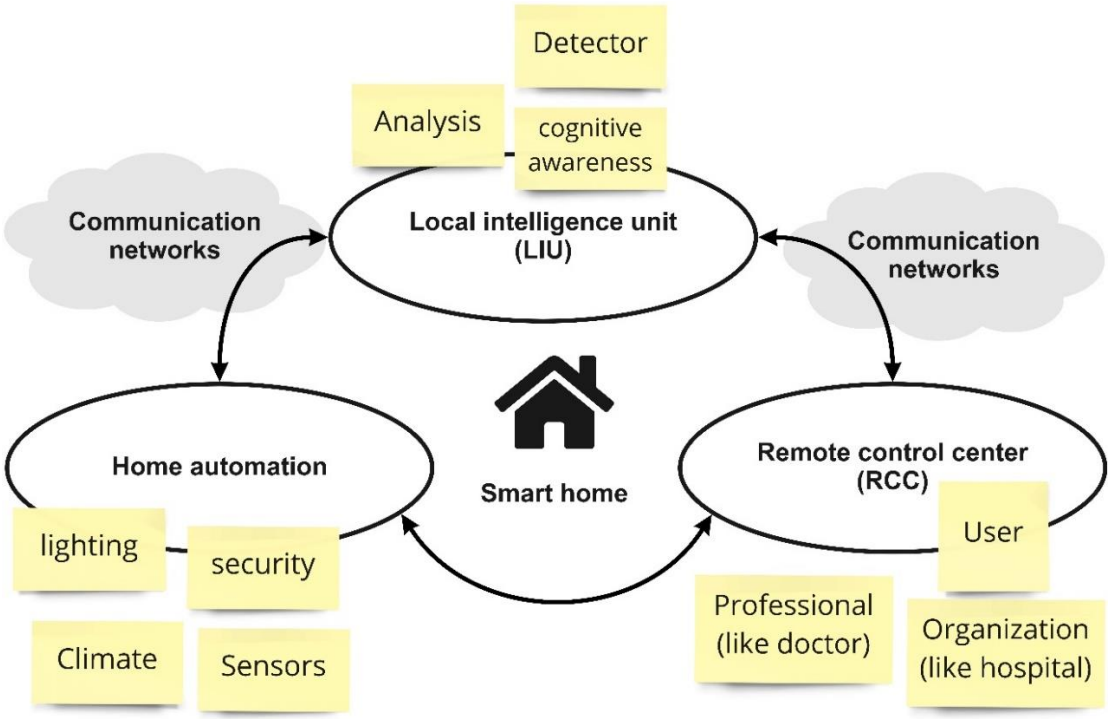
3. **Local intelligence unit (LIU)** which is responsible for providing cognitive awareness by analyzing sensor data and recognizing critical situations using machine learning and big data analysis.

4. **Remote control center (RCC)** that ensures response in case of emergency and it is the connector between both parties and could be controlled by the user itself or a professional a like doctor or hospital (H. J. Kang et al., 2019; Mshali et al., 2018; Rialle et al., 2002)

As shown in Figure 2, smart home components are always be in contact with each other to take decisions simultaneously.

Figure 2

Smart home component relations



2.1.1 The history of smart home technology

It is human nature to find ways that make everyday life easier and more pleasant. The area of 'home automation' – in effect the predecessor of the smart home – was brought to life through technological progress, in particular through the Internet and computer. Between 1901 and 1920, although home appliances were not what now we would consider 'smart', they were an incredible achievement in the early twentieth century. These achievements began with the first engine-powered vacuum cleaner in 1901, Hubert Cecil Booth invented the first successful vacuum cleaner. His first machine, 'Puffing Billy' (see Figure 3) had a 5 hp piston pump driven by a fuel or electric motor. A more practical electricity-powered vacuum was invented in 1907. Throughout two decades refrigerators would be invented, as well as clothes dryers, washing machines, irons, toasters, and so much more (Haje, 2018).

Figure 3

'Puffing Billy' the first engine-power vacuum cleaner.

Note. From (Science Museum, n.d.)

In 1966 ECHO IV unveiled, although it was never commercially sold. the 'ECHO IV' was the first smart device (see Figure 4). This clever device could compute shopping lists, control the homes' temperature and turn appliances on and off. The Kitchen Computer, developed a year later, could store recipes, but had the unfortunate tagline, "If she can only cook as well as Honeywell can computer" and therefore sold no models (Tomkayo, 1994).

Figure 4

ECHO IV system

Note. ECHO IV system is at the back of the room and family use the keyboard to make commands from (*ECHO IV Article - Cortesi*, n.d.)

In the 1990s, there was a lot of new research and technology in home automation field called Gerontechnology, which is a combination of gerontology (aging studies) and technology to support or improve the lives of the elderly at home environments (Bouma, 1998; Fozard et al., 2000).

Smart homes, or home automation, began to increase in popularity in the early 2000s. As such, different technology began to emerge. Smart homes suddenly became a more affordable option, and therefore a viable technology for consumers. Domestic technologies, home networking, and other gadgets began to appear on store shelves. Today's smart homes are more about security and living greener. Our smart homes are sustainable, and they help to ensure that our homes are not expending unnecessary energy. Current trends in home automation include remote mobile control, automated lights, automated thermostat adjustment, scheduling appliances, mobile/email/text notifications, and remote video surveillance (Davies & Anireh, 2019).

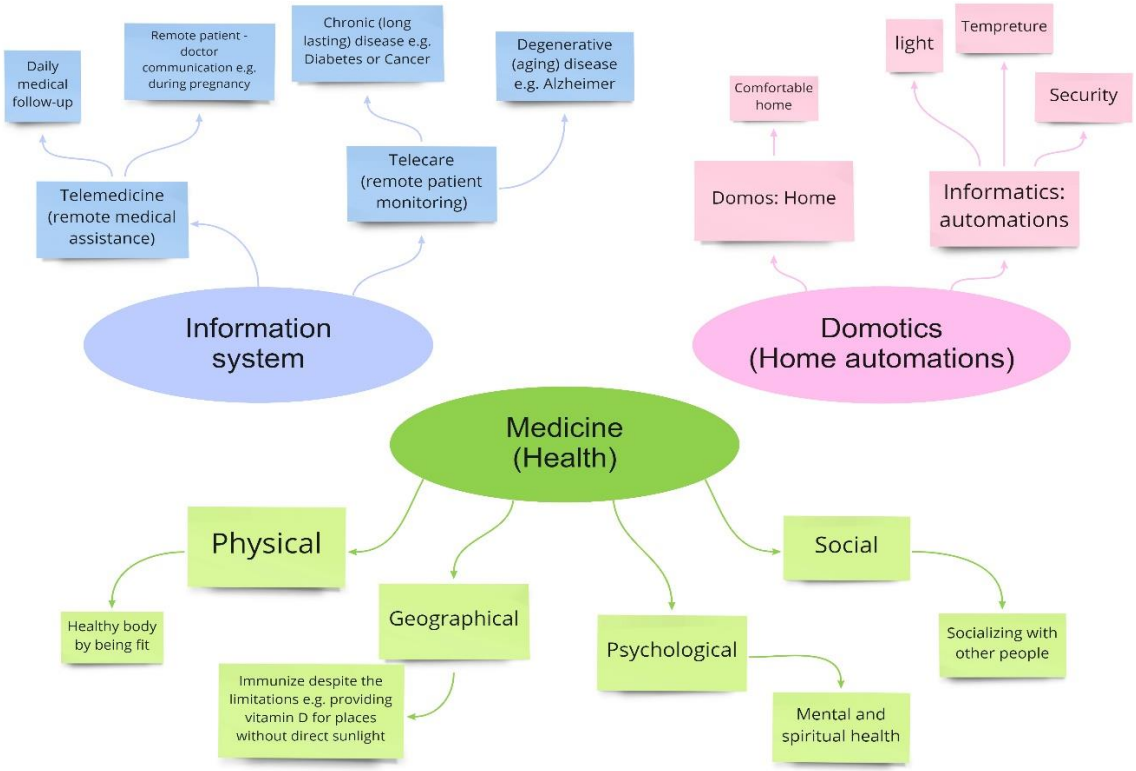
2.2. Smart home for health services

Increasing costs of treatment and hospitalization, the complexity of monitoring certain diseases, as well as patients' dissatisfaction with hospital stay have led to informal personal home environment treatment replacing formal hospital and care center treatment (Wilson et al., 2017). Smart homes are known as an effective solution for home health care services, **Health smart home (HSH)** is a combination of highly advanced information and communication technologies that can make home environments

intelligent and provide 24-hour and non-intrusive health care monitoring (Rialle et al., 2002). As shown in Figure 5, The concept of HSH emerged from a combination of three research areas: Medicine (all health aspects), Domotics (home) and informatics (automation), and the information system that is include Telemedicine (remote medical services for direct patient- doctor communications) or Telecare (remote patient monitoring specially for chronic or degenerative disease or even during pregnancy) to minimize risks while allowing them to continue living in their own homes. It designed and developed within patient-centered approach rather than focusing on technology itself (H. J. Kang et al., 2019).

Figure 5

Concept of the health smart home



2.2.1. The Smart service scape wheel (SSW)

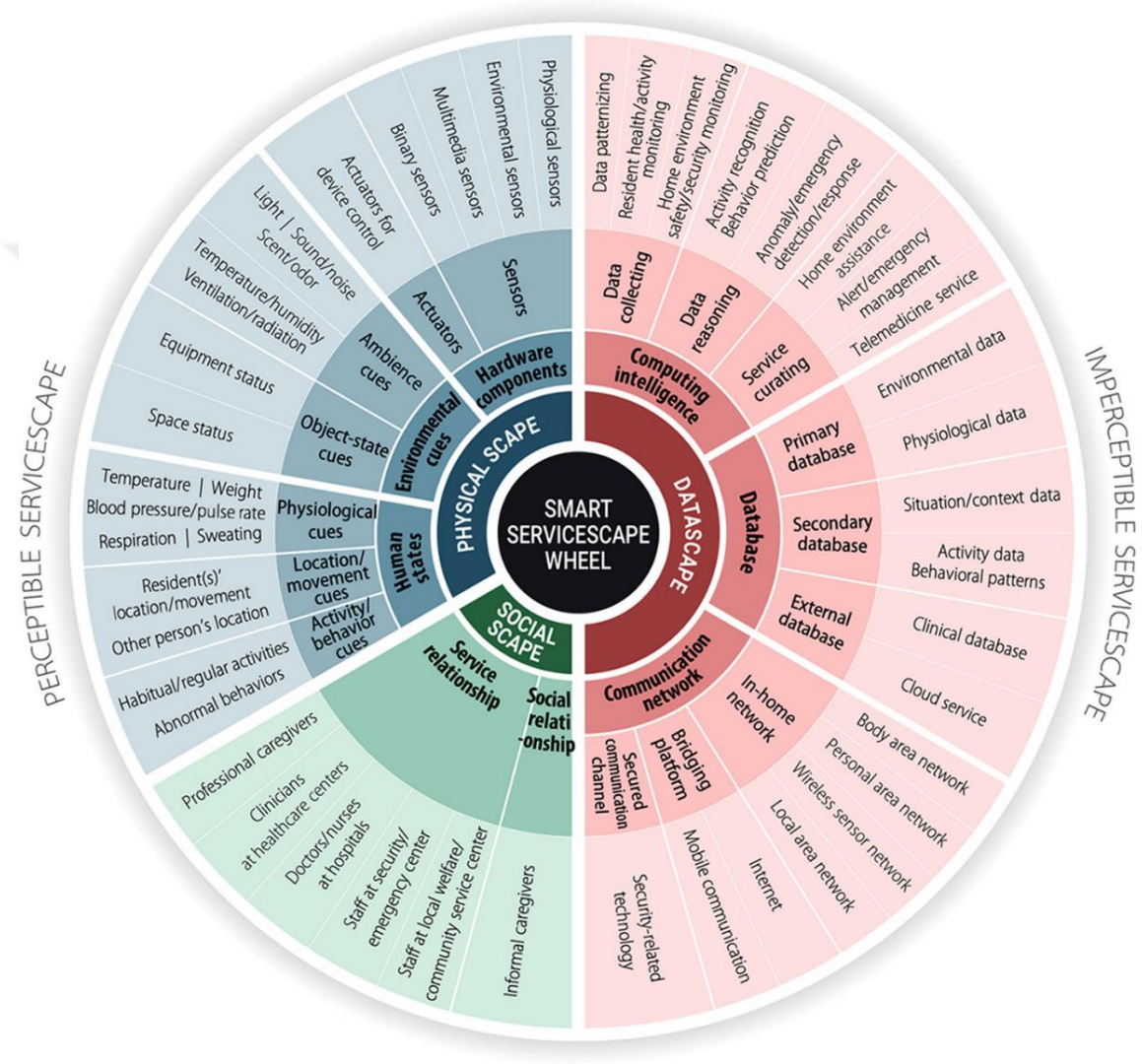
In point of fact, the patient's requirements arise from the problems and risks they face in their daily lives at home. We must examine the patient as a live human being in a social and geographic context, rather than focusing simply on the patient's health concerns. This patient-centered strategy has been widely adopted in the remote healthcare industry, by taking advantage of these emerged technologies and is presented globally by the model called Smart Service Scape Wheel (SSW) (H. J. Kang et al., 2019).

As shown in Figure 6, **Smart service scape wheel** for health smart homes breaks down the user needs into two servicescapes (environments): 1-Perceptible services: Includes two environments; Physical and Social and they are simply recognizable by the user. 2- Imperceptible services that occupies half the wheel, includes real-time data collection and the continuous data exchange of intelligent objects which are difficult for residents to understand (H.-J. Kang et al., 2017). This figure also categorized in a table format which is available in appendix A.

Smart servicescape elements must be declared at the component or function level. As a result of this principle, the **Physical scape** comprises (1) hardware components, (2) environmental cues, and (3) human states; the **Social scape** is consisting of (1) service relationships and (2) social relationships; and the **Data scape** composed of (1) computing intelligence, (2) databases, and (3) communication networks.

Figure 6

Smart service scape wheel for health smart homes



Note. From (H. J. Kang et al., 2019)

The Smart Service Scape Wheel (SSW) can be used as a map or a list of candidates to demonstrate diverse and viable possibilities for smart environments when service planners and product designers consider elements to deliver appropriate functions or

contexts and create their unique service combination. The SSW's broad range of contextual components might help predict potential behavioral patterns in the resident's service encounters. Using machine learning technologies, various combinations of smart servicescape components and their future patterns of user behavior can be collected in a database and understood of computing intelligence. As a result, this procedure can help health smart home systems increase the reliability of behavior prediction and the acceptability of service composition (H. J. Kang et al., 2020; H.-J. Kang et al., 2017).

2.3. Design system of the smart home application

Design for the health smart home represents a practice where designers apply their focus to mention the world’s major problems. It's a change from basic look to thinking about design as a way of solving complicated human problems. By finding root causes, they can co-create effective solutions. Products that provide a great user experience are designed with not only the product’s consumption or use in mind but also the entire process of acquiring, owning and even troubleshooting it. Therefore, in this section the meaning of the user interface and user experience and their contribution to design the application will be discussed (Arnowitz, 2017).

2.3.1. User experience (UX) design

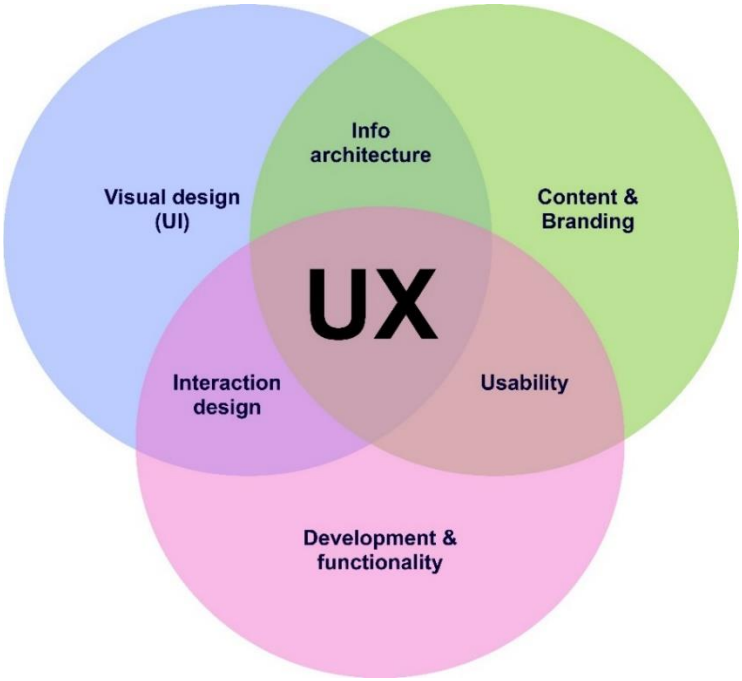
The process whereby the design team creates product that give users with meaningful and relevant experiences is known as user experience (UX) design. This includes features

of branding, design, usability, and function, as well as the full process of obtaining and integrating the product. Product designers do not just focus on creating products that are usable; they concentrate on other aspects of the user experience, such as pleasure, efficiency and fun, too. Consequently, there is no single definition of a good user experience. Instead, a good user experience is one that meets a particular user's needs in the specific context where he or she uses the product (Joo, 2017).

As shown in Figure 7, UX design encompasses a wide range of other topics, and is responsible for all parts of the product acquisition and integration process, including branding, design, usability, and function. It is a story that starts even before the user gets their hands on the device.

Figure 7

The main elements of the UX design



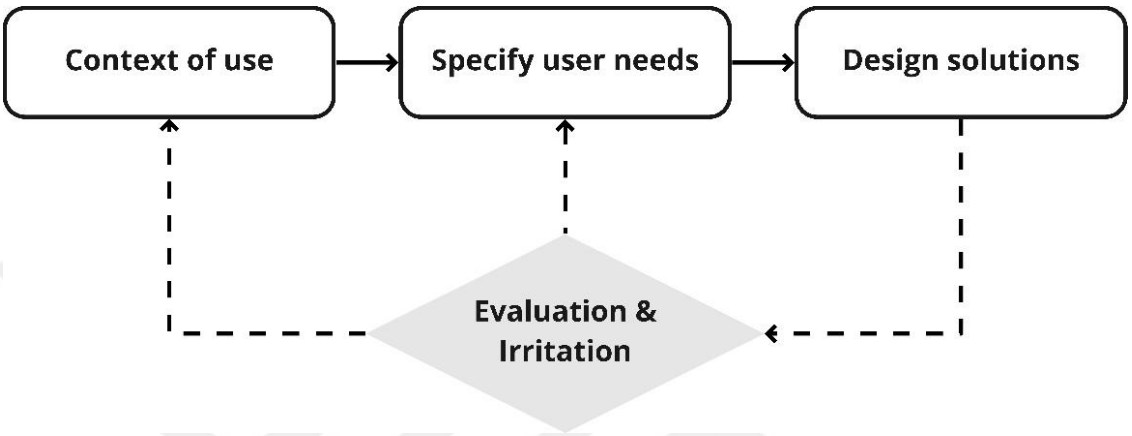
Samrgandi (2021) declared that user experience is an interdisciplinary field of study that encompasses several aspects of the experiential and efficient use of such a product, structure, or service. UX evaluation assists in determining the essential components that contribute to high-quality interactive product design and a favorable user experience. In communicating with a product, technology, or service, user experience includes the user's attitudes, choices, thoughts, emotions, and actions.

According to Ollenburg (2019) studies, the “Why”, “What”, and “How” of product use are all taken account. The “Why” refers to a user's motives for adopting a product, whether they are related to a task they want to accomplish with it or the values and perspectives they identify with product ownership and use. The “What” is concerned with what users can accomplish with a product's functionality. Finally, the “How” is concerned with the creation of useful design that is both accessible and pleasing to the eye.

In order to develop products with which consumers may construct meaningful experiences, From the Figure 8 we can see that the UX design begins with the seamless user journey. To design for human users, a broader range of accessibility issues and meet many possible users' physical limitations must be considered, such as difficulty reading small text. User-centered design is an iterative process in which every design and development begins with an awareness of the users and their surroundings.(Hui & See, 2015)

Figure 8

The UX design process



2.3.2. User interface (UI) design

Many recent studies (Malaka, 2008; Miraz et al., 2021) have shown that many of the interactions that contribute to the user experience take place through the User Interface (UI) design. The User Interface is the platform through which the user interacts with the device directly. Creating such a more difficult UI has the negative impact of engagement. Technological evolution, on the other hand, offers greater flexibility even while adding to the complexity of the interface's use and design. This demonstrates why user interface design is critical to the success of any product.

A good summary of the UI design characteristics that can be used for designing the health smart home interface has been provided in the work of Malaka (2008) that are:

1. Interface must be intelligently adaptive to the current technology; This allows the interface to better understand the user's needs and personalize or guide the interaction with the help of Ai.
2. Interface must be ubiquitous computing friendly; Which computers are shapeless or invisible, and computing is made to appear anytime and is available just about anywhere the user lives. Air, wind, and water are all ubiquitous resources.

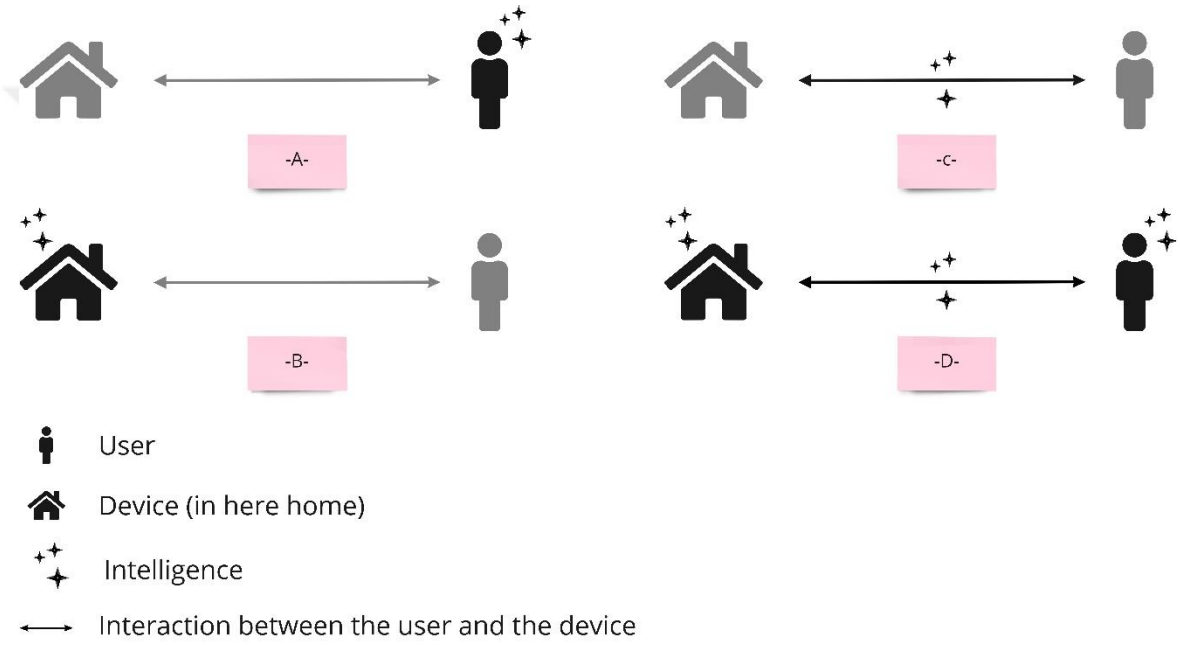
Demiris & Hensel (2008) argued that Ubiquitous Computing is a concept used in association with the Internet of Things (IoT) to describe the potential for connecting devices and their benefits to become mainstream. It is all about having computational capability in many different objects in the normal life environment. According to Mark Weiser's (1993) vision of ubiquitous computing involves 'invisible' interfaces that are so natural to use that they disappear from the user's conscious awareness. By pressing the elevator button, user does not interfere with the cycle that caused the elevator to move toward. The elements of this system are visible and usable, but they are hidden from the user's conscious awareness.

As previously noted by Adams (2007), one of the key parts of an application is the user interface. If it is designed correctly, when communicating with the product, the user may feel relaxed. On the other hand, even if an application is capable of accomplishing the tasks for which it was designed, users will not accept it unless it can communicate with them in an understandable and functional manner. Enhancing communication

between the user and the machine is a major topic, and an intelligent interface would prefer to make the interaction in a smarter way.

Figure 9

various perspectives on intelligent user interfaces



What stands out in Figure 9, is various perspectives on intelligent user interfaces. Whereas intelligent element can be considered in either the device (B) like smart homes, the user (A) that become more intelligent by using technology through the time, the interaction (C) automated temperature adjustment is a good example for making the interaction intelligent. And also, we can add intelligent to all three parties (D) according to this theory, even basic entities can perform intelligent behavior, without full reflective and conscious awareness of the world. This concept fits well with a lot of recent AI

approaches, where intelligence is seen as a feature that develops through an intelligent agent's interaction with the environment (Fan, 2017).

2.4. Design for the future

Through clear focus and consideration, designers must prepare and gradually transform the present generation of products towards the direction of the future. There are no route maps on how doing that, but it's possible that the skepticism arises from relying on a single future mapping technique. There are various methods for calculating forecasts, but none of them is satisfactory. Vision becomes clearer and less abstract while many aspects are merged. Although the level of abstraction relies on the period of the estimate, the forecast becomes more intuitive and conceptual as we go deeper into the future. For long-term estimate, creative thinking techniques such as stories and scenarios are widely used (Malhotra et al., 2014).

Previous studies of Rehman et al. (2018) and Malhotra et al. (2014) show that there are numerous influencing elements that affect future design expectations:

- **Technology:** a modern technology can enhance an existing product line while also opening up new perspectives with endless potential.
- **People / Users:** Social connection, participation, and cultural impact can all play a significant part in designing future products. Tomorrow's products must be more accessible in order to satisfy a wider range of people while also keeping the

concept of culture in order to provide a meaningful experience. So, it is essential to research consumer behaviors in order to create a product that is more desirable and functional.

- **Environment:** interaction with the environment, and long-term consequences.

3.RESEARCH METHODOLOGY

After knowing what previous researchers have done, it is the time to start investigation for the health smart home advanced assistant. The first step is to utilize design thinking approaches such as trend and PACT analysis to construct a hypothetical framework for the project possibilities. This is useful in determining the users' basic needs for interacting with the assistant. The next stage is to gather real data on user expectations by interviewing the target audience and developing persona profiles based on the summary of those expectations. The final stage is to convert these qualitative findings into design language using UX research methods.

For the UX research, the end user's desire to experience the product is converted into stories and scenarios, and then a features list is provided to offer new solutions for the pain points or goals described in the stories. These are the required elements for the design planning part to build the UI/UX design architecture from all of the previous information. To ensure the best possible information architecture, it will be tested in terms of desirability and usability.

3.1. Design thinking methodology

Design thinking is a human-centered methodology that involves interdisciplinary approach working very closely to provide insights on a subject or a problem, through conception and the usage of contextual analysis (Nakano et al., 2018).

3.1.1. Trend analysis

Home automation system is called as smart home technology. That will monitor and remotely control home attributes such as lighting, climate, entertainment systems, and appliances (Wilson et al., 2017). Some models can 'learn' and determine the best settings for the house. They start, control and monitor specific processes on their own, depending on the scenario or on the basis of how they are programmed. With today's technology, to get the TV remote controller and change the show, we do not even have to move. All we have to do is speak to our television, and it will automatically switch channels. It is not just exclusive to the television system. Everything may be controlled, from the kitchen appliances to the garage door, from the lights to the curtains. Smart home technologies, together with smart mobile app development, are making life easier for common people.

- **Amazon's Alexa,** this application can Set up Amazon-enabled devices, create shopping lists, and listen to music with this app. The Alexa app works with a variety of other devices, including Philips Hue, Wemo smart plugs, Nest, and more.(AMZN Mobile LLC, 2022)

- **SmartThings by Samsung** allows faster access to many devices. It can control and monitor home IoT devices, group several devices together to operate them all at once, modify device settings, and receive notifications about various devices. It is compatible with practically all smart devices and includes the Samsung SmatThings hub, which allows you to control them all from a single app.(Samsung Electronics Co. Ltd., 2022)

- **Google Home** can connect to Google Home and Chromecast devices, as well as a variety of other smart home devices such as lights, cameras, and more. Nest thermostat, Philips Hue, Samsung SmartThings, and other third-party devices are compatible with Google Home apps. It creates shortcuts for the most used actions**.** (Google LLC, 2022)

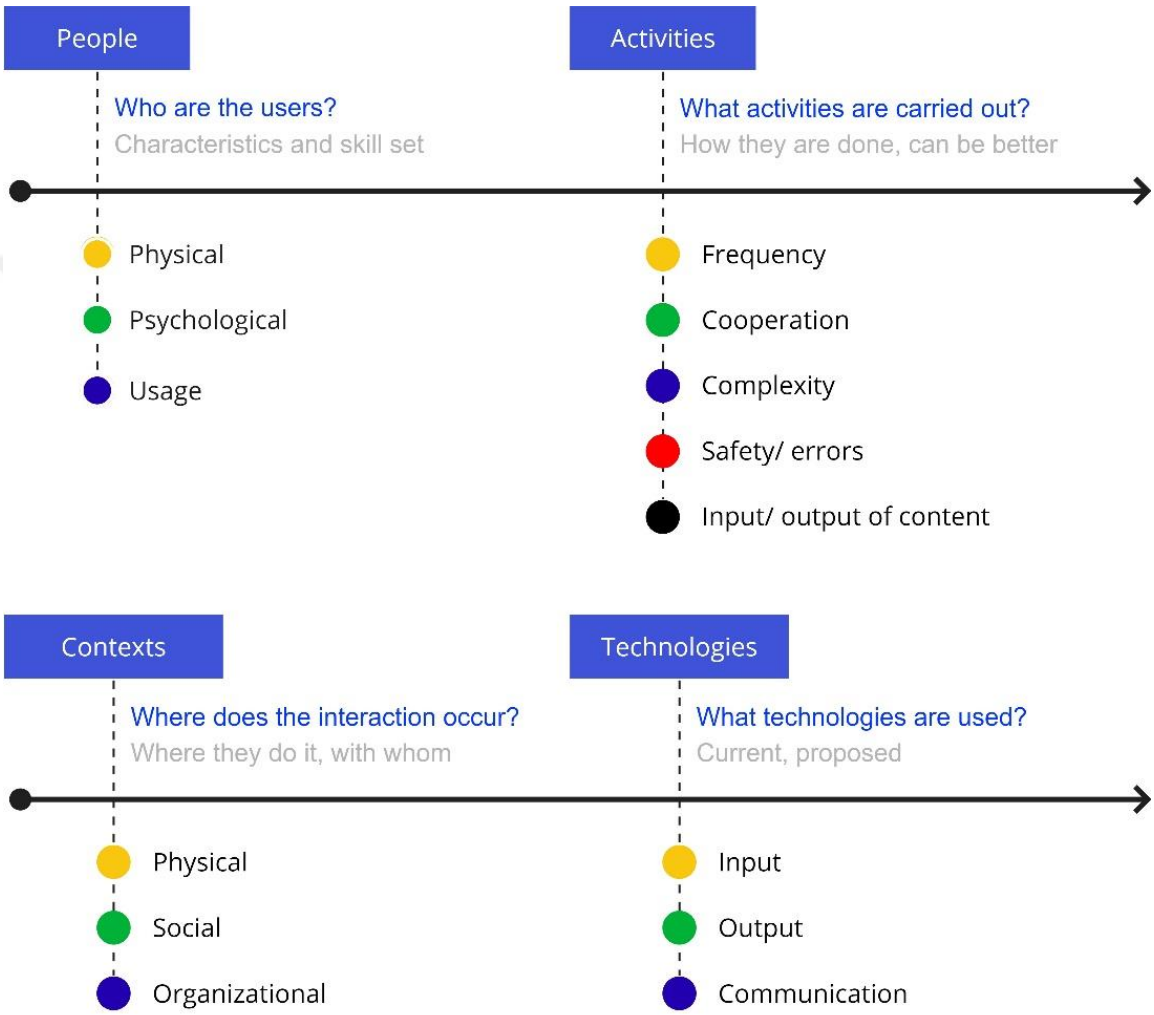
- **Apple Home** This program has a smart home dashboard that allows users to create ‘scenes' that perform several actions with a single swipe. There are over a hundred different brands of HomeKit-compatible products. (Apple, 2022)

3.1.2. PACT analysis

Humans require and desire to be changed by the time. So even though technology must move with humans, it cannot remain stationary. Designers should be able to comprehend the issues that users may face when using their programs. A designer should be familiar with the actions and the context in which they were carried out by the users. They should understand how to tackle a design problem and come up with better solutions to the issue at hand. The use of the PACT framework will allow them to create meaningful and effective designs (Becerrak, 2017).

Figure 10

PACT analysis



From the Figure 10 we can see that PACT analysis is an effective guideline for considering human-centered design architecture. The short form PACT stands for People, Activities, Contexts, and Technologies. in this research, designers analyze the app idea in the context of each topic, then they will outline the objectives (Shaikh, 2020).

1. **People:** It is a common knowledge that humans are different to one another in many ways. There are some important factors that need to be considered:

    - Cognitive characteristics - level and duration of attention, memory, learning abilities, cognitive capabilities and personality.
    - Physical characteristics - age differences, physical abilities.
    - What motivates, pleases, engages or affect users.
    - Experience & expectations
    - Culture - For example, in Microsoft Excel there are two buttons, one labeled with a cross and the other a tick. In the US a tick is used for acceptance and the cross rejection, but in Ireland a tick or a cross can be used to show acceptance.
    - special needs - blindness, color blindness, deafness, wheel chair user
    - Infrequent vs frequent users - if users are normally infrequent, then interface must be particularly 'helpful' as users will forget how to complete complicated tasks.

2. **Activities:** Humans conduct many activities that the designers have to keep in mind for. Some activities tend to be highly complex and some to be simple. First, the designer should understand what is the purpose of the activity and then the main features that would support the main activity such as:

    - Goals, tasks and actions
    - Length of time on tasks - peaks and troughs of working or fast response

- Regular or unusual- frequent tasks should be easy to do; infrequent tasks should be easy to learn or remember
- Continuous or interrupted - user may need to 'find their place' again
- Current task practices quality vs quantity

3. **Context:** Activities happen in the context. Activities and context should be analyzed together. There are three main types of contexts to be distinguished:
    - Social context: A supportive environment will give plenty of support to the user to carry out the tasks in hand. It can vary from using a product to traveling on a train. If the environment is more supportive people can complete the activity in the context more easily.
    - Organizational context: It is important to understand the organizational context because the change of technology always impacts on communication and power structures and may have effects on jobs such as deskilling.
    - Physical circumstances: The physical environment which the action happens. (Noisy, cold, wet, dirty, stressful, uses dangerous materials or sunny)

4. **Technology:** In this phase, the key idea is to gain knowledge on what technology being used now, what are the problems with it and how to improve the technology.

    - Hardware, Software
    - Input: How to get data in or getting commands
    - Output: Characteristics of different displays and their data format (video, photograph, speech, text)
    - Communication: Between people, between devices, speed, etc.

3.2. User research and interview

Designing for a large number of people is not easy. All aspects of the users' experiences must be considered. PACT's wide-ranging analysis makes a valuable contribution with regard to persona profile information. Creating persona is the next step of providing a solution in application design process.

A persona is virtual person that presented a whole group of users that have similar preferences, frustrations, motivations and goals. In user experience design it is crucial to identify the potential users, research their behavior and create their persona profile for targeting those groups of people. This will help to have better results on designing for their expectations.(Huh et al., 2016)

Creating persona profile is generally classified into three phases:

1. **Categorize target society:** Each business has its unique group of users, which can be divided into groups and subgroups depending on their shared characteristics. For example, in the health smart homes industry, there are producers and consumers. However, in this study, we are just interested in consumers and will break down the prospective user segments. People with lower incomes, minimal interest in technology, and little concern for environmental issues are just a few examples. People with health issues or those who prefer a comfortable, easy life are examples of others. Another category could be wealthy individuals who are willing to pay for products and services that will assist them in managing their homes.

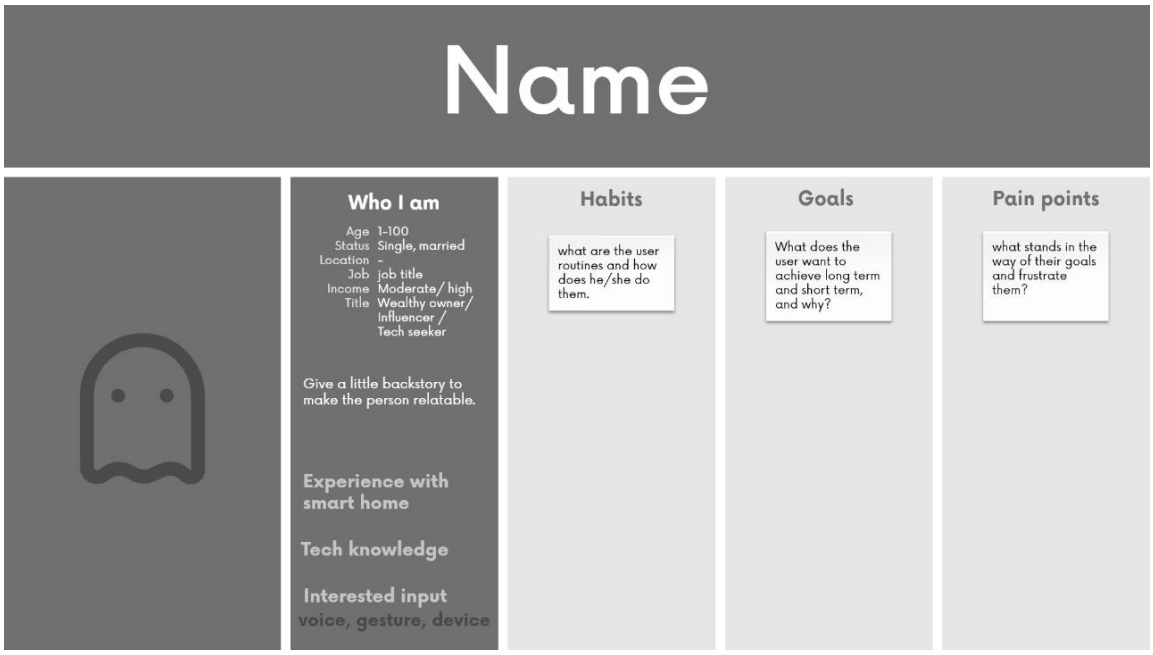
2. **Conducting interviews:** In this phase, in order to create the persona profile, we need to conduct sampling or have interviews with the chosen participants. The snowball sampling technique is used in this study's qualitative research with contextual inquiries and in-depth interviews to highlight elements related to the activity context. To identify the basic needs of designing the application, a participant of the three target segments was selected and then they linked me to four other colleagues. As a result, the sample group expands like a snowball, and fifteen participants were interviewed with open-ended questions about their thought and behavior patterns, which are available in appendix B, and their answers are available in appendix C.

3. **Generating persona layout:** To have a deep understanding of the target society, we must research and observe their behaviors and interactions to create the needed persona layout for developing the research method. Figure 11 displays the breakdown of suggested persona layout:

    - Who I am, to give a little backstory for making the person relatable.
    - Habits**:** determine what are the user routines and how?
    - Goals: what does the user want to achieve long or short term, and why?
    - Pain points: what stands in the way of their goals and frustrate them?

Figure 11

suggested persona layout for health smart home consumers



3.3. UX research methodology

User experience (UX) research is essential for developing a product that is relatable to users' requirements, simple and enjoyable to use while increases manufacturer's benefits. user study provides insight towards which features to emphasize throughout the development process (Lanius et al., 2021).

User research in this study begins with the extraction of persona stories, then defines story features, plans the info architecture based on these aspects, and uses desirability and usability testing to complete the design experience.

3.3.1. User stories

User Stories are an essential component of the user centered design. This ideology defines what benefits your product will bring to the target audience. A user story is the smallest unit of work in the design process. It is the potential user’s desire to experience the product, each user story is a division of a bigger goal which is extracted from personas into smaller stories (Raharjana et al., n.d.).

Overall, Lucassen’s (2015) study is a powerful explanation of determining every tiny action and collect them in a user story chart. Each story must have 3 criteria:

- Category: the segment that is affected by the story and may contain many stories.
- User story: the actual story that tells “As a [persona], I [want to], [so that].”
- Flow: the interaction zone.

3.3.2. Features list

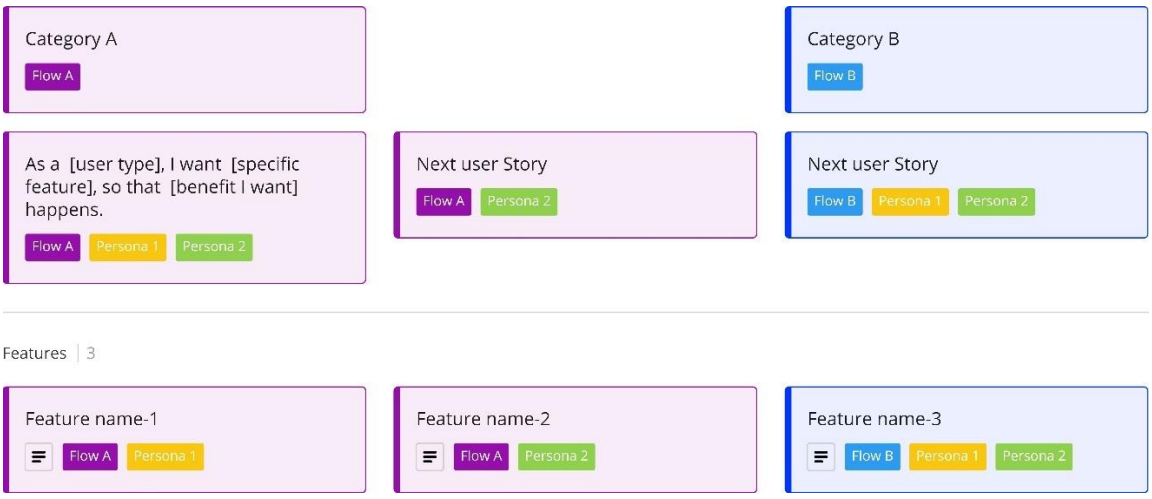
As mentioned above, A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. Creating features list is the next step in our research by excluding features from the stories and collect them in a list. According to Hasinoff & Bivens (2021) each feature must have this information:

- Feature name: to call this feature.
- Does it affect all the categories or personas?
- Feature description.

Figure 12 depicts the relationship between various user stories in the user story map and their extracted features.

Figure 12

User story map layout



3.3.3. Information architecture

According to Lacerda et al. (2019) Information architecture (IA) focuses on organizing, structuring, and labeling content in an effective and sustainable way. Information architecture aims at organizing content so that users would easily adjust to the functionality of the product and could find everything they need without big effort. The content structure depends on various factors.

After modifying the features list, it is the time for designing the best info architecture for the extracted features by considering the specifics of the target audience needs because information architecture puts user satisfaction as a priority. Also, the structure is determined by how elements interact within the system; to do so, firstly understand how the pieces fit together to form a greater image. Visual elements, functionality, interaction, and navigation will build according to the information architecture principles.

3.3.4. Desirability estimation

The creative industry (Yang et al., 2021) has recently concentrated on making products simpler to use. Emotional Design, on the other hand, examines the significant effect of emotion, from the desire to spend huge amounts of money on a product to the influence of this surprisingly basic idea on tomorrow's common products, as Norman explains. Nonliving artifacts will respond to human emotions in the future (Norman, 2003). Norman's work on emotional processes has demonstrated that appealing products

perform better, and desirability plays a crucial part in experience design since it encourages consumers to interact with the product and learn about its usefulness and functional features. Desirability is a preference for aesthetic and experience. Users are captivated to a desirable product. Emotional design is concerned with four aspects:

- **Physio pleasure** (short for physiological pleasure) this is about the body and the feelings. Touching or handling devices or their smell can cause physio-pleasure. This type of pleasure can also be obtained by using devices that perfectly fit with the physical body. As an example, try using a new keyboard and experiencing physio pleasure by touching keys and enjoying the touch of the fingertips while typing.

- **Socio pleasure** (short for sociological pleasure), relationships with others lead directly to socio pleasure. Socio pleasurable products and devices either assist socializing or enhance relationships with others. One obvious example is the important role that text messaging plays in improving social communication for many people, or the success of social networking websites like Facebook or Instagram.

- **Psycho pleasure** (short for psychological pleasure) refers to the mental or sentimental pleasure. This pleasure aspect is useful for connecting causes of pleasure such as the user satisfaction, efficiency and the enjoying learning new skills**.** A great example is experiencing pleasure while hearing the notification sound of an application's successful delivery.

- **Ideo pleasure** (short for ideological pleasure) is involved with people's values, things that are dear, meaningful to them, or ambitions. People are more likely to prefer using products that align with their values. A well-known example is using a cotton bag while shopping to provide ideo pleasure for an echo-friendly mindset.

3.3.5. Usability testing

Usability testing is the process of evaluating a product by putting it to the test on real users. It is also important for confirming hypotheses and specific design decisions. The goal of a usability test is to make people try something while carefully observing their behavior and feedback (Molich et al., 2020).

A usability test was conducted remotely with a moderator in this study. Five test participants were instructed to do two activities in their own environment while sharing their screen with a moderator, resulting in the product being utilized naturally.

The participants were provided a link to a design prototype, and asked them to first use the assistant to create a work routine, including a task to change the desk height at regular intervals. The second task was to create an iSurface. The objective was to observe how test participants interacted with the product while gathering information. Following the completion of usability test, it is time to incorporate ideas and adjust those features that were found to be ineffective, doing all possible to make the interface easier to use.

4. PROJECT FINDINGS FOR THE PROPOSED APPLICATION

This chapter describes the thesis findings, which are based on the research methodology described in Chapter 3 and these findings serve for development of an alternative project on the SHS (health smart home) assistant design. In the scope of this thesis a system called Wisy was designed by using findings presented in 3 steps; First, the founded requirements are explained using the design thinking process, second the user expectations are presented based of the interviews, and finally, the details of the UI/UX design are mapped and tested within desirability and usability functions in the planning section.

4.1. Design thinking process

Design thinking is a process that uses app technology to create a schema of the project possibilities such as analyzing trends capabilities and identifying the target audience, their desired activities within different contexts. These findings point the way forward for extracting real data on user expectations.

4.1.1 Trend analysis patterns

Analysis of the other competitors mentioned in chapter 3, revealed that they have not covered health services in much detail. They mostly focus on the IOT technology and to be compatible with the most recent smart products in the market that they may offer healthcare. Figure 13 presents the results obtained from the trend analysis for health smart homes.

Figure 13

Trend analysis of the smart homes

General pattern	Health pattern	Tech pattern	Design pattern
Connected from anywhere	Mental wellness	Digital health	Minimal and modern
Alarms and notifications	Air and water purifier	Food technology	Advanced microinteractions
Schedule & routine planner	Weather forecast	Wearable technology	Glassmorphism
Shopping list	Smart sleep	Ai based analytics	3D elements
Music player	Smart activity & fitness	Sports technology	Optimization for more screen sizes and pixels
Custom routines	Smart diet	Augmented & Virtual reality	Holographic/Neon
Different user profile	Pain management	Seamless monitoring	Personalized user experience and content
Grouping devices	Complex care	Smart diagnosis	Smooth gradients
Smart plug, light blind & tv		Telemedicine device	Gamification
Robots		Proprietary guidance technology	Voice-controlled interfaces (VUIs)
Smart temperature		Laser projection	Air Gesture

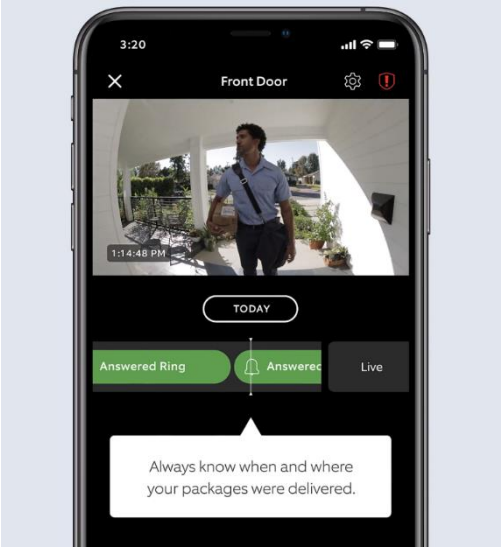
4.1.1.1. Patterns of the general trends

What stands out in the general pattern (pink column) of Figure 13, is the services that must be considered in the proposed design. These general countenances are mostly based on home automation for kitchen devices, home security, and remote control of available smart devices that will fulfill the minimum expectations of smart home. When home

technology is integrated into a single, easy-to-use system, it relieves some of the stresses of daily life. A proper smart home makes life easier to live in, by making it more convenient, safe, and comfortable. A smart home operating system links virtually all of household devices in simple and enjoyable ways. When leaving or arriving, a smart plug allows the user to turn on/off the entire house, start a playlist in every room instantly, receive feedback if unlocked doors require attention, and enjoy lights that control themselves so the user never returns home to a dark hallway again. Smart doorbell (see Figure 14) allows users to watch and greet visitors, turn on the lights, and unlock the door. Receive the delivery even if the user is not present. It contributes to a safer and more secure environment at home. Smart notification provides the user to be notified of events at home while they are gone, such as the arrival of their children safely (*Smart Doorbell Cameras to Monitor Your Door*, n.d.).

Figure 14

Smart Doorbell application screenshot



Note. With home automation system we have access to each smart device from everywhere (*Smart Doorbell Cameras to Monitor Your Door*, n.d.).

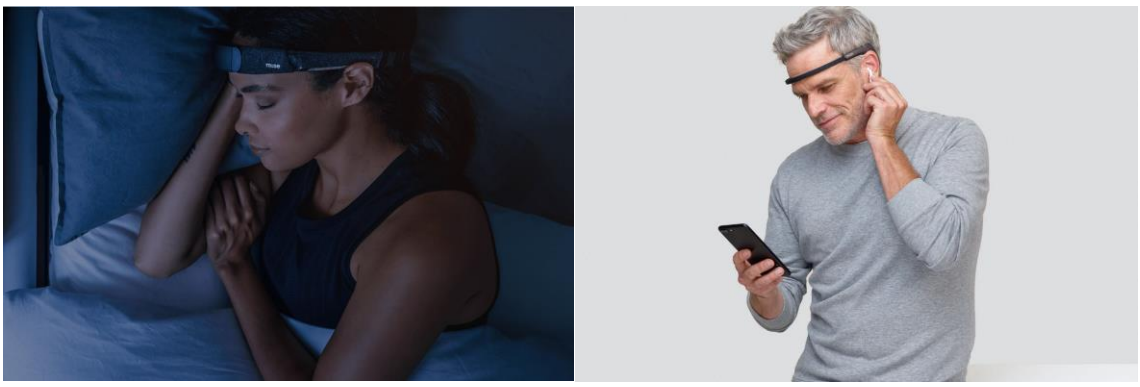
4.1.1.2. Patterns of the healthcare trends

The healthcare patterns (green column) of Figure 13, summarizes the suggested solutions for balancing work from home and family life. Consumers are calling for creative technologies that make life healthier, happier and more convenient. These are the findings of emerging tech trends and innovations designed for adults and children.

Health smart home is about changing consumers' lives, making it healthier more efficient and simpler. Mental wellness is a large part of self-care and health that can now be elevated by many smart products to manage and reduce stress, a brain-sensing headband (see Figure 15) that tracks brain activity and transmits the data to the computer or mobile device in real-time via Bluetooth to reduce stress, meditation, concentration and better sleep quality (Muse, 2019).

Figure 15

Brain-sensing headband



Note. Brain-sensing headband for real-time biofeedback to refocus during the day and recover overnight, Image from Muse™ EEG-Powered Meditation & Sleep Headband

As shown in Figure 16, smart mirrors are available in a variety of configurations to suit a wide range of applications; some offer users with daily news and weather as they get ready for work, while others lead users through a workout session. Others are more straightforward, with features such as built-in lighting, temperature monitors, and speakers (MIRROR, 2021).

Figure 16

Smart mirror

Note. Smart mirror, the interactive smart gym at the home from MIRROR | The Smart Home Gym

To improve sleep quality, a bed sensor (see Figure 17) quickly slipped beneath the mattress to provide the user a good night sleep with some insights. Breathing, heart rate, movements, snoring, environment, and sleep patterns are all monitored by the sleep and

wellness device. Following that, it will send statistics to the mobile device as well as some personalized sleep coaching advice (Eight Sleep, 2021; Sleep Number, 2022).

Figure 17

Smart Bed

Note. Sleep smart with applying different settings for each side of the bed (Sleep Number, 2022).

Foods Knowledge allows users to log food into the app to learn about the effects of various foods on the digestive system. The most intriguing feature is that after eating, the user can take a breath test, and the device will measure metabolism in real time. Users with special needs can easily develop their own digestion profiles this way (FoodMarble, 2020; TellSpec Inc., 2015).

4.1.1.3. Patterns of the technological trends

New technologies that make healthcare more caring and accurate with the help of AI are shown in the technological patters (blue column) of Figure 13. The most interesting aspect of these patterns is that they won't stop leaning their users and will grow with them, so over time, their decisions and performance will become more efficient.

Digital health, often known as digital healthcare, is a wide, multidisciplinary term that encompasses ideas from the interaction of technology and medicine. Digital health is the implementation of digitalization in the field of healthcare, which includes software, hardware, and services (Benis et al., 2021).

Food, water, air, and medical specimens are just a few of the solid and liquid samples that intelligent sensors (see Figure 18) analyze quickly. The ingredients in a meal or whatever the user points the device at, can have the results on smartphone app. This product is beneficial to persons who have a variety of food allergies or who want to better control their diet (TellSpec Inc., 2015).

Figure 18

Smart sensors

Note. Smart sensors can analyze every material quickly (TellSpec Inc., 2015).

Figure 19 depicts that, with the help of the telemedicine gadget individuals can undertake a comprehensive checkup at home and share results with a virtual physician for a quick, convenient diagnosis thanks to a proprietary guidance technology that uses AI-based analytics. The at-home diagnostic kit is equipped with a digital camera and thermometer, and also includes accessories like a tongue depressor for examining throat, an otoscope for ears, and a stethoscope for heart, lungs, and abdomens. Patients will be able to effortlessly collect accurate exam results, giving them confidence that the remote diagnosis is correct (Tyto Care, 2021).

Figure 19

Telemedicine gadget

Note. Smart diagnosis thanks to a proprietary guidance technology that uses AI-based analytics (Tyto Care, 2021).

As can be seen in Figure 20, the interactive laser throw projectors have no limits for presentations, and they provide clearer and deeper images with contrast ratio technology that makes bright areas brighter and dark areas darker, so there is no difference between

using the projector in daylight and at night, with an integrated Android computer that includes a virtual touchscreen, and built-in speakers.

Figure 20

Interactive laser throw projector

Note. Interactive laser throw projector top image (Rettinger, 2018) bottom image (Pattison Tuohy, 2021)

Wearable technology, is a class of electrical gadgets that can be worn as jewelry, embedded in clothing, implanted in the user's body, or even tattooed on the skin. This device measures health attributes and sends the reports to the smart phone via Bluetooth that for analyzing in the application or send them to other professional (Ferreira et al., 2021). The following are the most prevalent forms of wearable technology currently available:

- Smart watches, allow the wearer to answer phone calls, track fitness, track sleep.
- As shown in Figure 21, smart rings are pieces of technology that combine the capabilities of a smart watch into a single ring (Xenxo, 2018).

Figure 21

Smart ring

Note. Smart ring is an intelligent sensor with the ability of answering the calls image from (Xenxo, 2018).

- VR headsets and other displays that create a more immersive experience are known as head-mounted displays (HMDs) (Reducept, 2019).
- Wearable electrocardiograms that convey heart rhythm to the cardiologist and other life-saving on-body equipment are examples of advanced medical technology (AliveCor, 2021).
- As can be seen in Figure 22, clothing made of tech-infused fabric that can shuffle the playlist or track the user's biometric data, is known as smart clothing (Skiin, 2021).

Figure 22

Clothing with tech-infused fabric

Note. Image from *Myant Health*

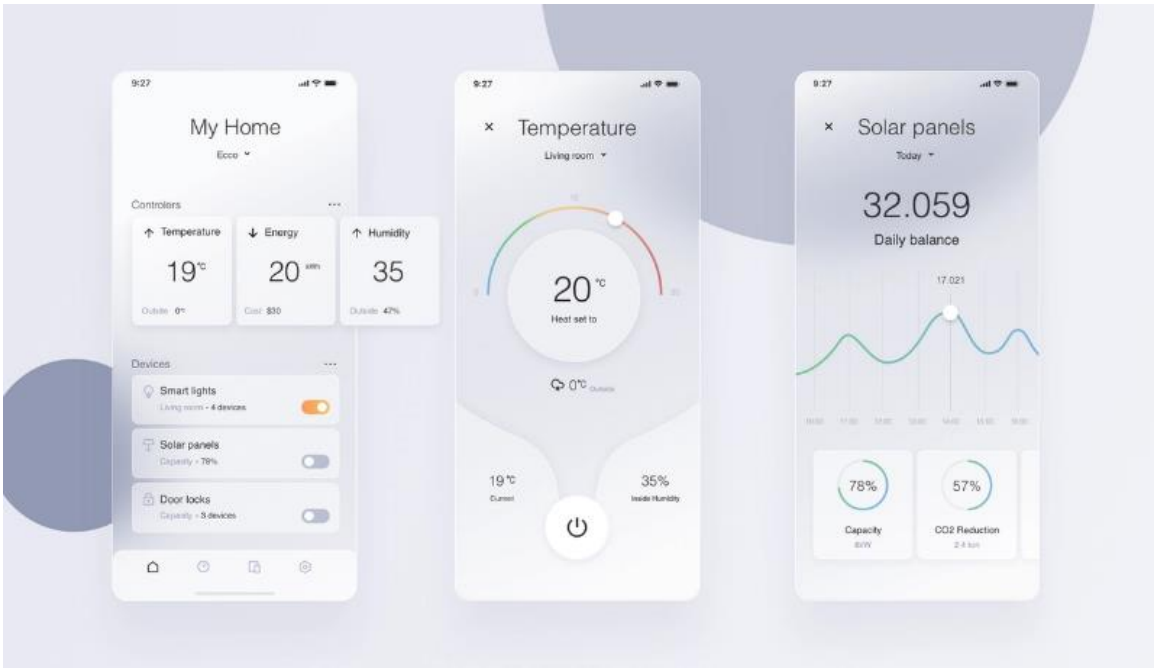
4.1.1.4. Patterns of the design trends

As can be seen from the design trend analysis which is presented in Figure 13 (orange column), the evolution of design components has paralleled the advancement of technology, tends to result in a one-of-a-kind user experience.

According to Figure 23, Glassmorphism is a visual design system of a semi-transparent background with an exquisite shadow and border is the key feature of this. The background blurred in a way that whatever is behind it will beautifully "morphed" into the piece (Szőgyényi, 2021).

Figure 23

Glassmorphism UI design



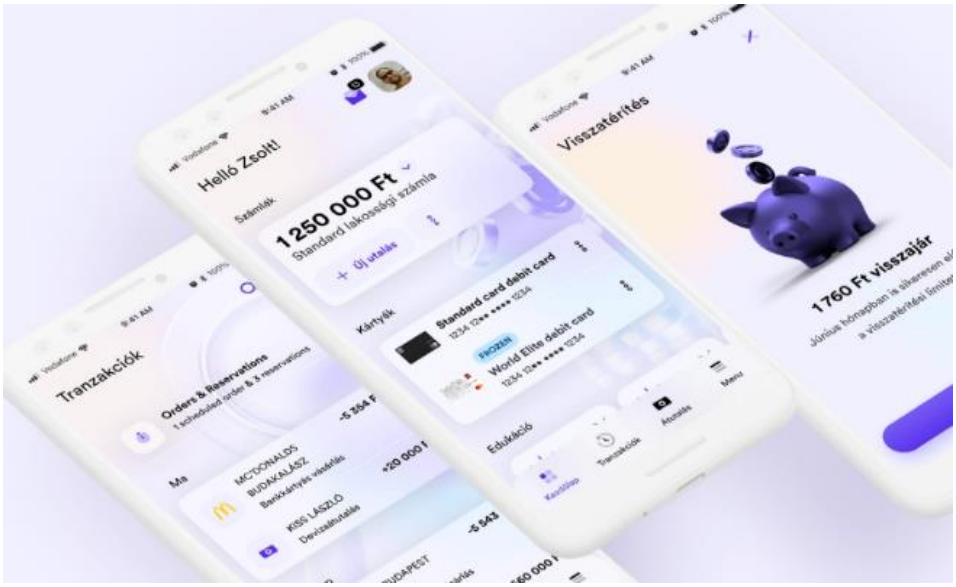
Note. Design from (Dynowska, n.d.)

Micro interactions are tiny interactions between the user and the design. They're made to make the user's experience more enjoyable. Micro-interaction is perfectly illustrated by Instagram's "Like" function and Twitter's "Retweet" feature. Gestures and touchless controls, for example, are advanced micro-interactions that open up new possibilities for generating a more intuitive experience (Jingar et al., 2021).

The holographic/neon trend in Figure 24, appears to be a perfect match for the Metaverse, virtual reality, and hologram futuristic interface. All of the new possibilities that virtual worlds have to offer are inspiring. This trend is characterized by bright, vibrant colors, abstract, circular shapes, and hologram-like textures. It's also widely used in the virtual currency field to demonstrate how futuristic the interfaces are.

Figure 24

Holographic colors UI design



Note. Design from (Ihász, n.d.)

Gamification (see Figure 25) stands for the technique of insert gameplay elements into the non-gaming environment to create effective digital products and secure high level of user engagement by attracting users' motivations and pleasure. It's not about transforming user interfaces into games. Instead, in this method there are fun elements such as leaderboards and badges or even rules that encourage users to achieve goals and help them overcome the negative connection they may have with the system and the tasks they need to perform (Koivisto & Hamari, 2018).

Figure 25

Gamification in UX design

Note. Gamification for health analysis from (Aluna Care, 2019).

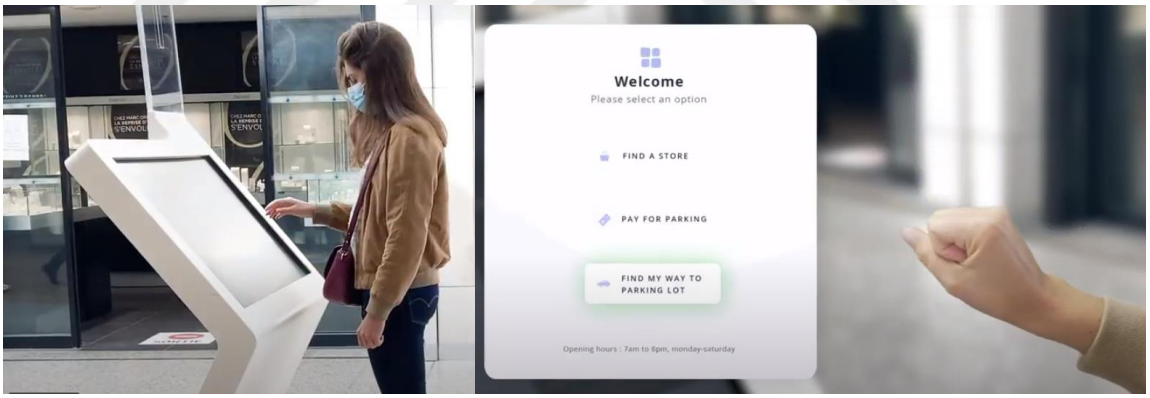
Touchless interaction is another UI and UX trend. Voice control and air gesture control, for example, are becoming increasingly common ways of communicating with devices. Voice user interface (VUI) is a speech recognition technology that allows individuals to use voice commands to communicate with a computer, smartphone, or

other device. Apple's Siri, Amazon's Alexa, Google's Assistant and Microsoft's Cortana are prime examples of VUIs (Klein, 2021; Telner, 2021).

As can be seen in Figure 26, air Gesture is a hand motion technology that removes the need to use a touch panel or other input device to operate electronic gadgets. It allows users to interact with the screen without touching it, for example, by hovering fingers on the screen to navigate through the pages or accepting calls by waving a hand over the phone (Liao et al., 2021).

Figure 26

Air Gesture UX design



Note. Air Gesture from (Clay AIR, 2020).

4.1.2. PACT analysis findings

Human-centered techniques are used methodically and innovatively in PACT analysis approaches to address extraction, training, learning, and application problems. The main question of this analysis is that "Which people, conducting what activities within what context by using which technology". The overall purpose is to create better smart home assistants with health services and experiences. The result of the investigation is illustrated in Figure 27, we studied potential users extensively to develop an understanding of their needs, examined the interactions in the contexts in which they would utilize the system, and finally came up with the required technologies and functionalities.

4.1.2.1. People

What stands out in the Figure 27 is that potential users can be individuals or families with different age so it must be usable even for children. One group of the users can be remote workers that suffered from limited physical movement or don’t have enough time to work out. They can have physical disability like being deaf or blind or may be disabled owing to pain, drug and stress (psychological) that will affect their expectations. Users usually have basic technology knowledge also we to consider old people with memory problem to be able to onboard easily. Users may need special cares within professional help like Diabetes, Asthma or even during pregnancies to have personal assistant.

Figure 27

PACT analysis of the health smart homes

4.1.2.2. Activities

From the Figure 27, it can be seen that activities need non-stop health monitoring with automatic adjustments based on the checkup results of user-defined routines. Complex commands such as routines must be settled within the easy flow. Some activities needed to send notifications to professionals (like doctors) or centers (like hospitals) for treatments or diagnosing problems so they can plan to solve them remotely before happening to avoid major risks. Each activity can have multiple users with different access for editing or viewing, they can be AI calculations, physical movements, or psychological (like socializing), and they must be rearranged by the user's wakeup time automatically. Providing easy access to the most requested functions, giving orders or defining tasks by voice or gesture, and using app space in larger size will enhance the user experience. enhance the user experience.

4.1.2.3. Contexts

From the data in Figure 27, we can see that contexts are in the direct spatial connection with the activities. Contexts are the environmental features of the actions that they could be physical, social or organizational. Some activities may need silent environment, as an example imagine a virtual meeting at home that happen in noisy environment like hearing neighbors' argument across the windows, children's playing in the next room or television's loud music. We have to consider simultaneous activities in the same context too, imagine that you are in that virtual important meeting but suddenly a delivery guy rings the doorbell and you have to receive it without leaving the meeting.

Users must be able to provide enough movements in limited time or space, without disturbing or having conflict with the others. Contexts must provide fearless communication to find friends or to have virtual hangouts with other colleges or staff, it also must be able to detect different objects for applying the UI elements with the ability to balance work time and rest.

4.1.2.4. Technology

As Figure 27 shows, there are a variety of existing technologies that can be employed in the smart house to automate health care. Some of them are used as input solutions, such as smart sensors for tracking health attributes or other daily routines that have the ability to analyze and respond quickly as the output or synchronizes states with professionals like a nurse or a hospital if they were programmed.

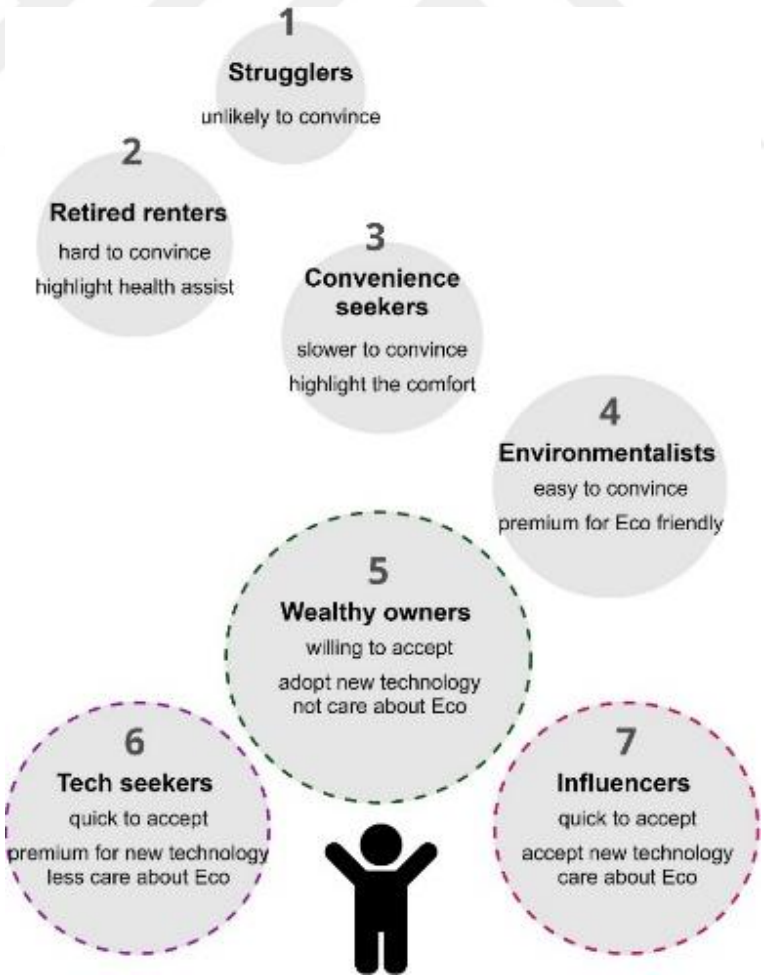
Users can easily talk to the gadget without any expert knowledge or do sophisticated flows for making routines by elders thanks to technical advancements in the user interface design. For people with disabilities, one alternative approach to this problem is to use air gestures. The requirement for a physical interface is rapidly decreasing, and people are actively accepting of virtual experiences such as simulated touchable screens in any size and location.

4.2. User research and interview

As discussed in the previous part, after having a deep understanding of the users and their possible activities in different contexts with the help if the technology of their smart homes, now it is a time to create their persona. A persona is virtual person that presented a whole group of customers that have similar preferences, frustrations, motivations and goals.

Figure 28

seven segments of the HSH target audience



4.2.1. Classify segments of the target society

Knowing which audience to target to, is the first step in developing a strategy. Consistent with the research method, this study found that smart home consumers can be divided into seven segments. As can be seen in Figure 28, the person icon represents the final user; segments 1 to 3 are too far away from the target; segment 4 may be a longer-term goal; however, segments 5 to 7 are the best candidates for the interview.

The segments of the target society are listed as below:

1. Strugglers are too far away from the target user, they have lower incomes, little interest in technology, and little care for environmental issues. The majority of smart home goods and services are unlikely to appeal to this demographic.
2. Retired renters are hard to convince, but with emphasizing how smart home features can assist with their health problems may persuade them.
3. Convenience seekers are slower to accept technology, but by highlighting the comfort of smart home products while downplaying the technology may appeal to them.
4. Environmentalists aren't the only people concerned about the environment, but they are the only ones willing to pay a premium for Eco friendly products and services.

5. Wealthy owners are willing to pay for items and services that help manage the home and are willing to adopt new technology, but they are not very worried about the environment.
6. Tech seekers are technology nerds who are willing to pay for new items to manage their homes, but they are less worried with the look of their homes and environmental issues.
7. Influencers are quick to accept new technology and are concerned about the environment, making them an ideal market for smart home products and services.

In this research, the main target of the project are wealthy owners, tech seekers and influencers. A total of fifteen interviewees were questioned; one participant was picked from each segment, and they were then paired with four other people from the same segment.

4.2.2. Persona profiles (interview findings)

To identify the basic needs of designing the application, 5 participants selected from the main target audience segments consist of wealthy owners (5), tech seekers (6), and the influencers (7). Persona profiles were created after determining the target audience segments. Qualitative questions of the interview can be found in Appendix B. All of the information gathered in appendix C and encoded into a single persona layout for the associated segment. The persona profiles created for this project is explained below:

Figure 29, Matthew persona profile displays the results obtained from the interview analysis of the segment 5. Matt is the father of two children. His wife is a teacher, and the two of them recently relocated to a large villa home in order to create a healthy lifestyle for their children. He has to work from home on sometimes, but he is too busy to check on the kids, so he wants some automated services to take care of the family's requirements while he is away.

Figure 29

Matthew persona profile of the wealthy owner's segment

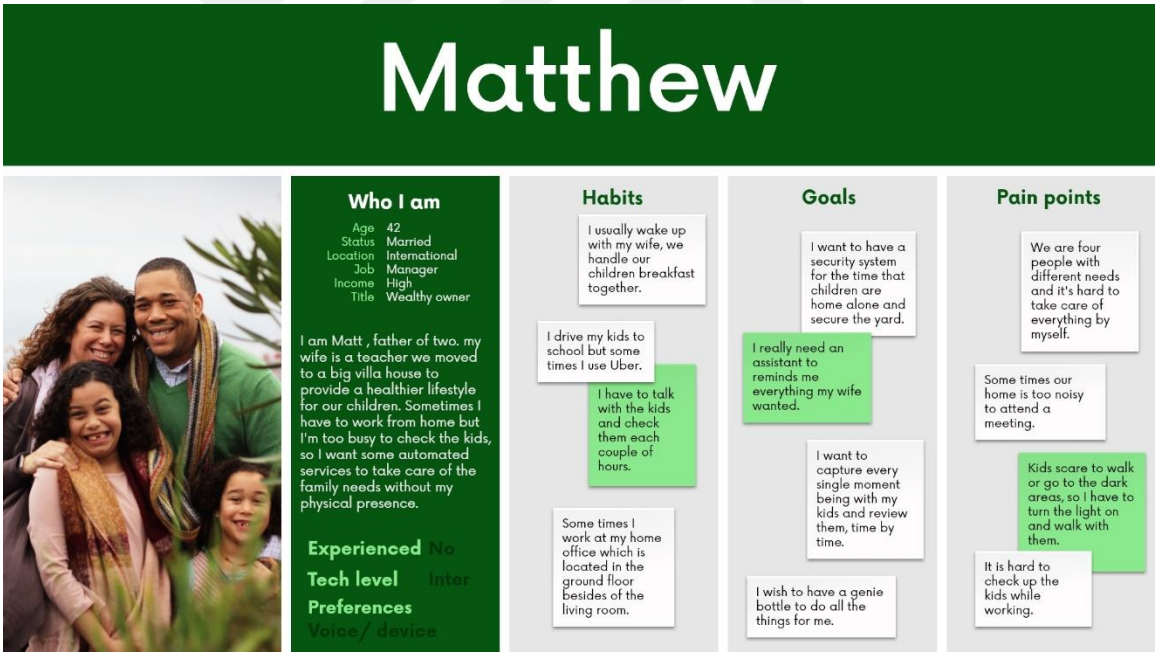


Figure 30, Lizzy, mentions the interrelation among the interviewees of the segment 6. Lizzy is an extremely busy person who studies and works from home. She is single and lives far away from her family. There are many days when she sits in a chair for more

than 9 hours without moving; as a result, she has just begun to hunt for solutions that will help her strike a better balance between work and her personal life, making her both sociologically and physically healthier.

Figure 30

Lizzy persona profile of the tech seekers segment

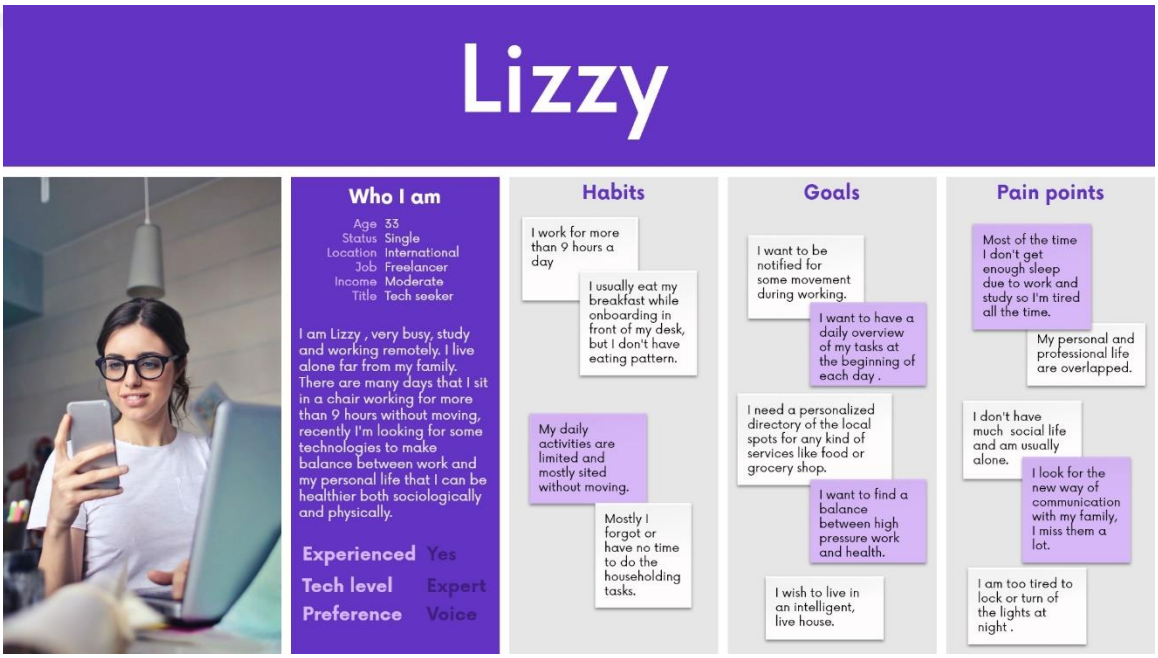
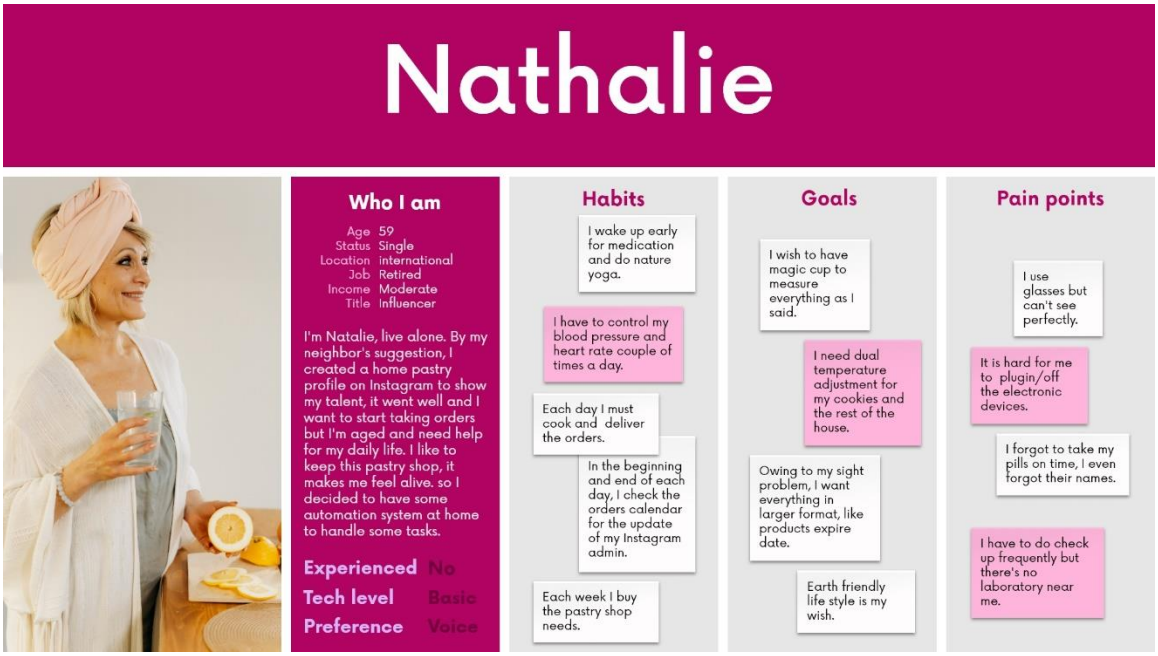


Figure 31, Nathalie, represents the extracted data of the segment 7. She is a senior citizen who lives alone. She made an Instagram page to showcase her talent after a recommendation from a neighbor; it went well, and she now wants to start taking orders, but she is elderly and need assistance in her everyday life. She enjoys maintaining this pastry bakery because it helps her feel alive. As a result, she decided to install an automation system in her home to handle some of the responsibilities.

Figure 31

Nathalie persona profile of the influencers segment



4.3. Planning the UI and UX design

After gaining a comprehensive understanding of the potential users based on the previous section's findings, as well as a complete knowledge of the health smart home assistant concept on the first section's findings, it is time to identify design interface elements and plan their interactions to provide the best desirable experience.

4.3.1. User stories and features

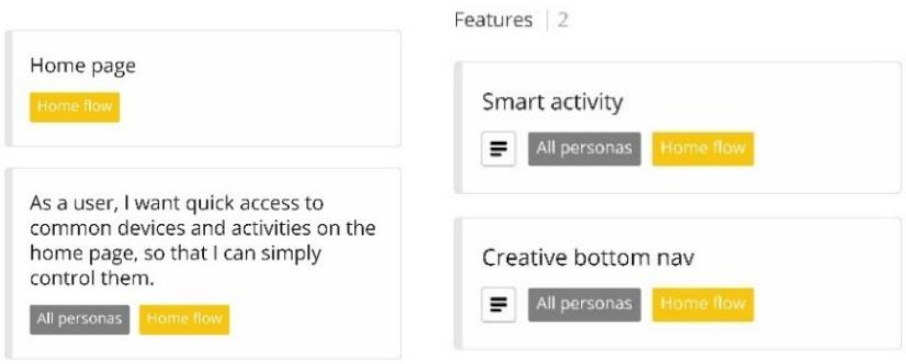
A user story is a general description of a software feature written from a person's perspective. All extracted data is routed to an individual flow that determines the user experience scenario and required features. In this study five user flows have determined.

4.3.1.1. Home flow

The homepage's expectations are described by the home flow presented in Figure 32. The user requires simple access to common devices and activities on the home page so that they may control them. Smart activity is a carousel-shaped indicator of commonly used activities or gadgets that will categorize them intelligently based on their volume of use, time volume, or routine preferences. It must have elements that are appealing to the eye. The creative bottom navigation will take users to all of the home areas that have been submitted, as well as a quick link to the iSurface (projection) feature.

Figure 32

User stories of the home page flow with its features description

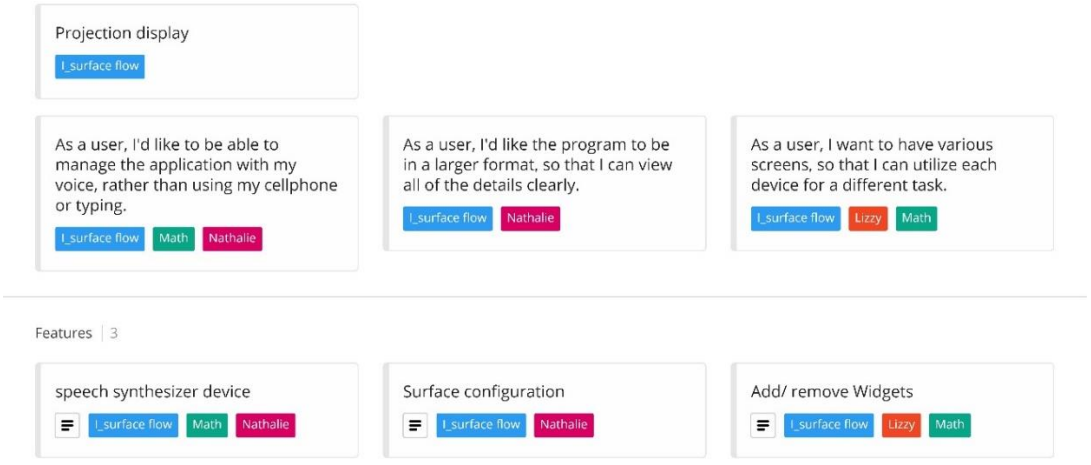


4.3.1.2. iSurface flow

Figure 33 describes the minimum acceptable experiences with the iSurface display, which is a virtual application display that stream directly from the phone via a projection device. Instead of dimming over time, new technology allows it to shine brilliantly all the time. It is environmentally beneficial due to its lamp-free design; no glass bulb is required, which means no mercury, and it is compatible with all of the application's features. With this display, the user may convert any flat surface, such as a desk or a wall, into an application display. Instead of requiring any hardware or typing, the user would like to be able to manage the application using voice. A speech synthesizer device is a smart speaker that uses artificial intelligence (AI) for input and output, similar to Alexa, which allows voice control. The user would like the application to be in a larger format so that all of the details can be seen properly. Also, the customer needs many screens so that each device can be used for a separate job.

Figure 33

User stories of the iSurface flow with its features description

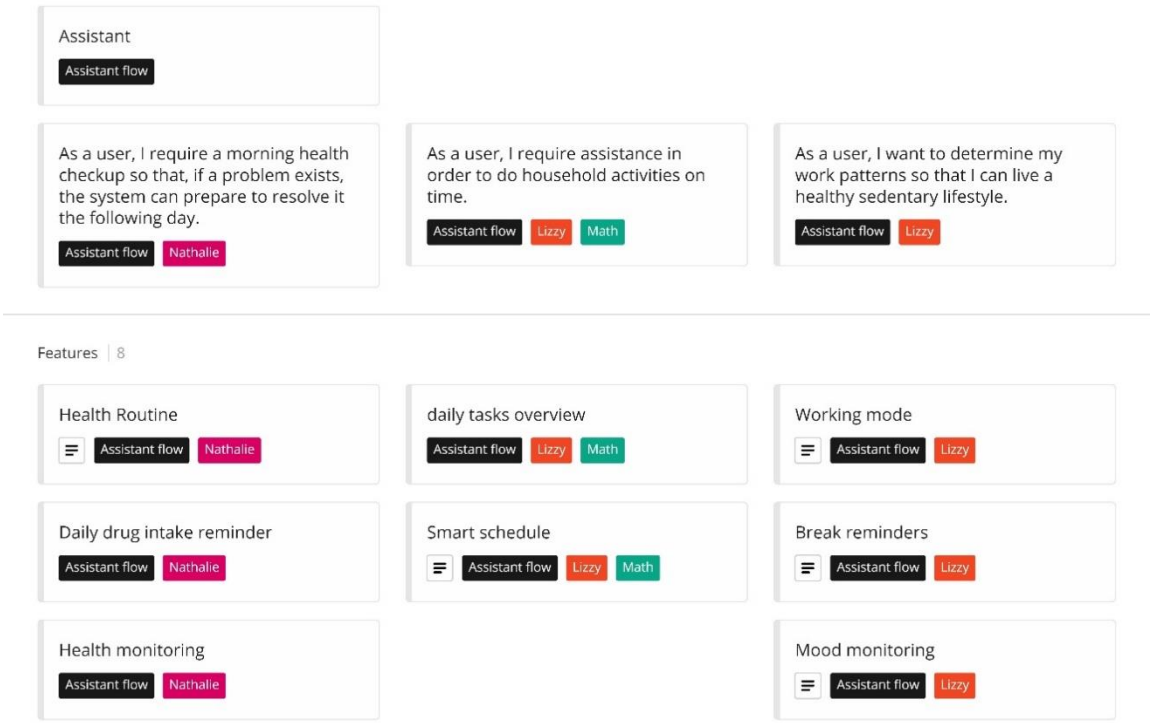


4.3.1.3. Assistant flow

As can be seen in Figure 34, user's assistant flow is a process that delivers expert assistance in daily life. A user may need a morning health evaluation so that, if a problem arises, the system can plan to fix it the same day. Health Routines are pre-programmed health checks that the user or a doctor can do. The system will assess the user at specific periods to ensure the health elements' safety, and if the results are not suitable, it will advise improvements and implementation. If the user accepts them, they will be implemented in daily activities, and the user's health is measured at every moment.

Figure 34

User stories of the assistant flow with its features description



The assistant feature can be used to program reminders or schedules, such as an overview of today's duties, home activities, drug intakes or even reminders for some breaks during work time. A smart schedule will rearrange and manage daily chores while taking into account daily living limits such as various wake-up times or inspection changes.

Another unique feature is the ability to determine work patterns so that the user can maintain a healthy sedentary lifestyle while working efficiently. Workplace mode must be set up separately, with noise control taken into account (Outdoor or indoor). To avoid stress or other psychological side effects of working under pressure, mood monitoring might be implemented.

4.3.1.4. Profile flow

In the profile flow of Figure 35, the user has access to all of the devices' and application's settings. All biometrics must be entered in the profile page for intelligent health adjustments with the possibility to authenticate other users, which is ideal for families, users of any age or characteristics can have their own health modifications.

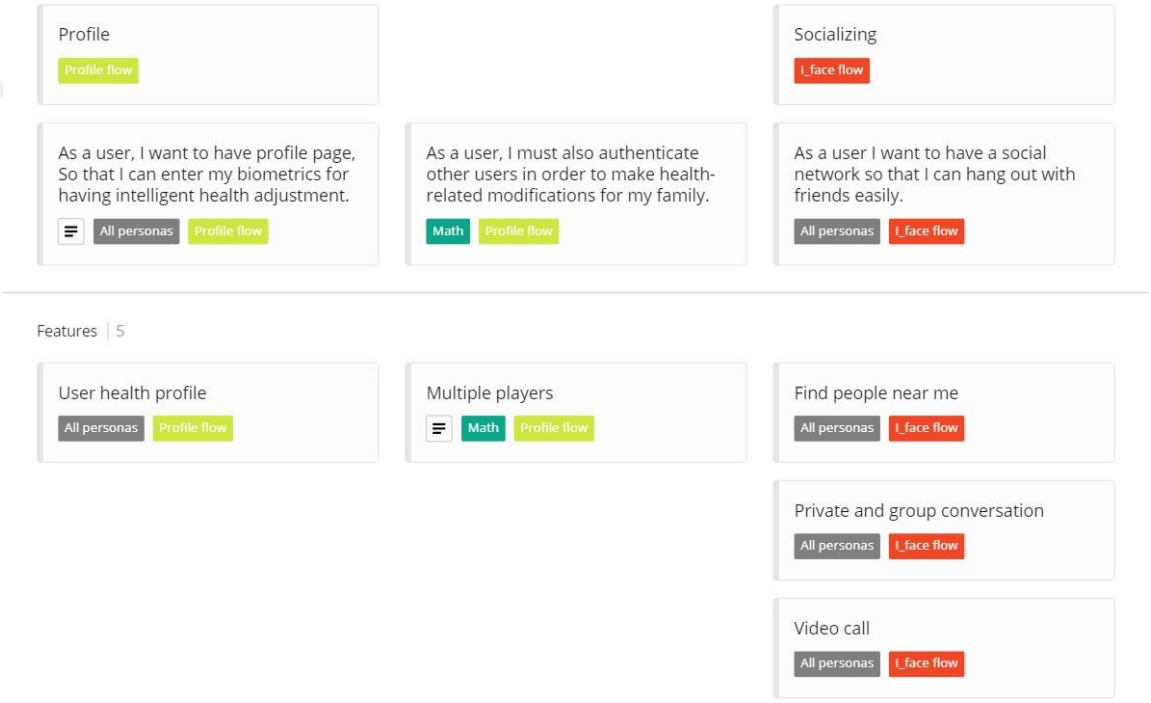
4.3.1.5. Socializing flow

Socializing flow presents iface feature (see Figure 35), that is a social network so that user can make friends easily and hang out with them. iface is compatible with other

famous networks such as What's app, Telegram, Instagram and Snap chat. It can find other subscribers near the user to have private or group video or texting conversation.

Figure 35

Profile and iface user stories with their features description



4.3.2. Information architecture design

Following the modification of the user stories, it's time to create the optimum information architecture for the suggested features, taking into account the specific needs of the target audience. The structure is also dictated by how elements interact inside the system; Such as visual elements, functionality, interactivity, and navigation that will all be designed by using information architecture principles.

Figure 36, presents the design interactions among the three sections of the application's home page; Smart activity is a location for displaying forthcoming tasks or routines. The navigation to the room's devices and iSurface feature is provided by the creative bottom nav. All settings for social accounts, iface, adding a family member and personal health data, setup of the home plan and smart devices in each room, and the heart of the program, the assistant section, are all in the profile.

Figure 36

Homepage information architecture model

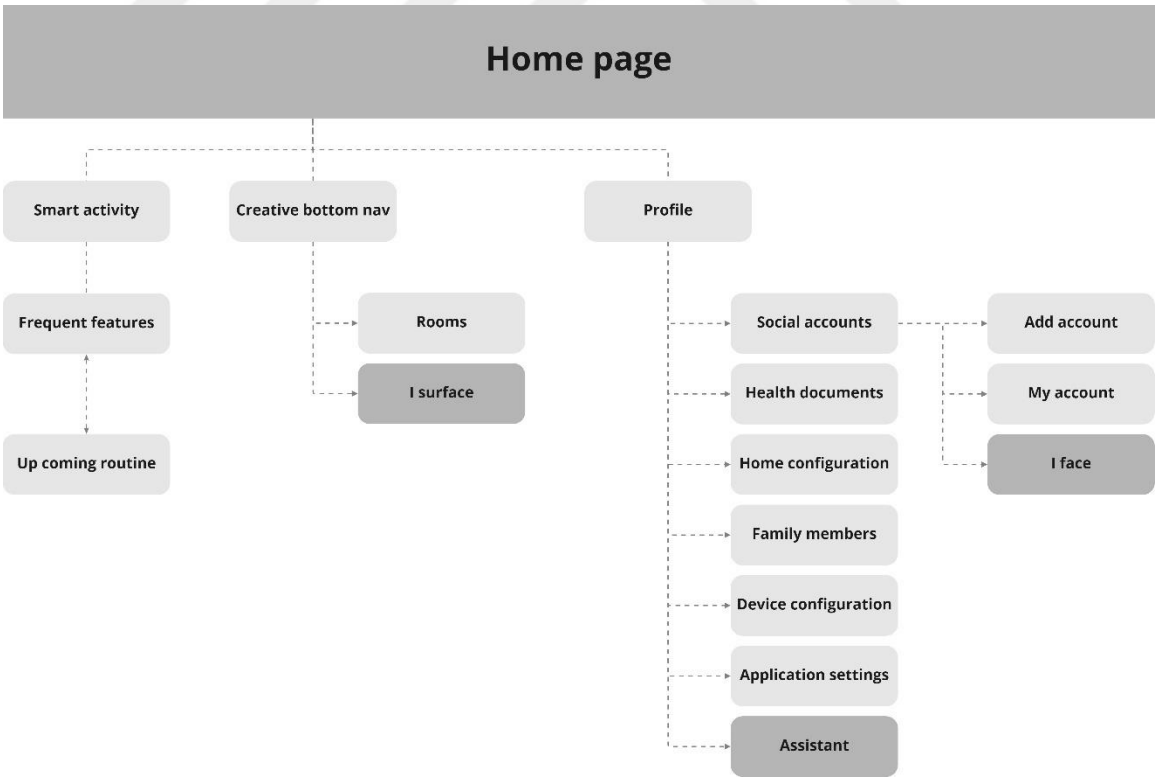
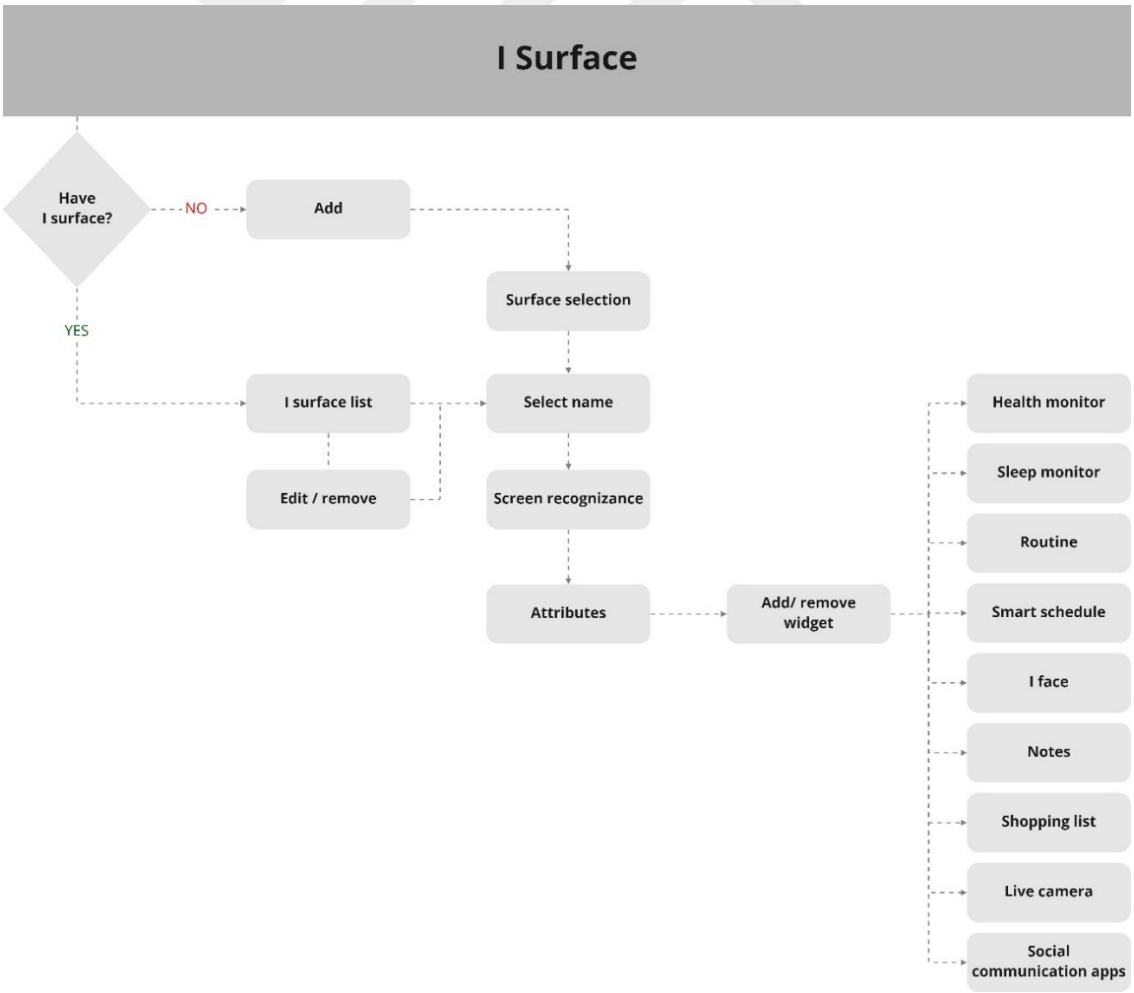


Figure 37, shows the breakdown of the iSurface design structure based on the "Did iSurface implement before?" response. If the answer is yes, the application must guide the user through the process of selecting one of them, editing, or removing. If the answer is no, the user can add one right away by selecting any surface of the home, naming it, and pinning the screen. The app then prompts the user to add one or more widgets, such as a smart schedule or health monitoring data, to that virtual surface.

Figure 37

iSurface information architecture model



According to the design architecture shown in Figure 38, if the user goes through the assistant process for the first time, the application suggests a list of routine categories to create a better experience with using the assistant. Categories such as: healthy body (the foundation of your being), productive working (if you enjoy it, it won't feel like work), preventing care (protect yourself and others), stress relief (release tension and stay calm), morning habits (get the day started with positive vibes), socializing (better communication with others), night time (sleep tight for better health), and household (manage and clean your space).

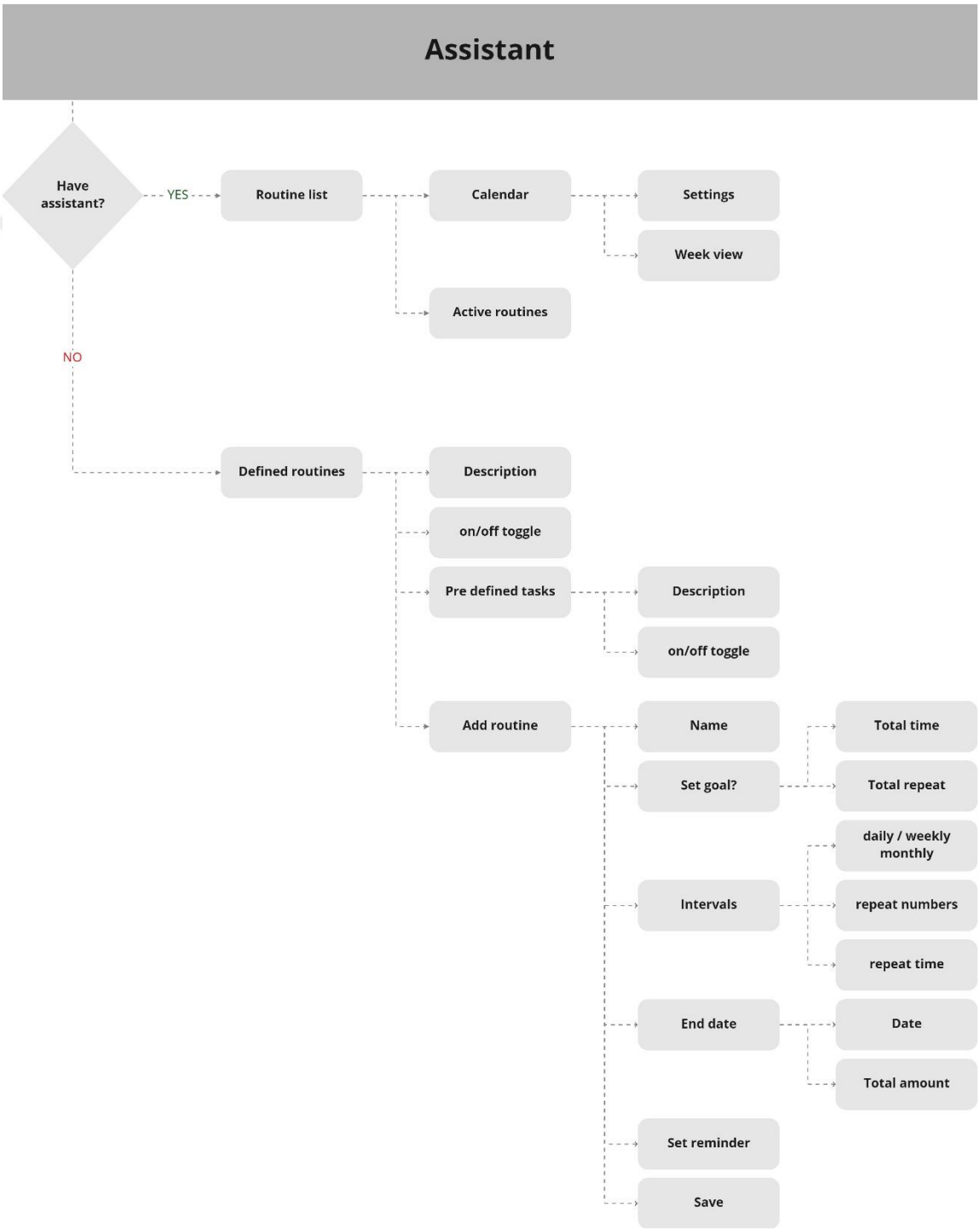
Each category of this enhanced assistant has its own set of tasks or habits, which are adjusted based on the user's health profile and can be manually edited. The user can instruct the system to perform these tasks by turning them on or off.

The other feature is the ability to create a new habit for the selected category by selecting a title and then adjusting its intervals such as the number of times per day, week, month, and year on special days that are expected to be completed. It could be restricted to the start and end times, if the user needs to accomplish it on a specific date, duration, or quantity. Finally, the user can set a reminder.

Alternatively, if the user has previously configured the assistant, a time line will display a list of the selected routines. The user can add habits, edit or remove scheduled routines at any time, and they are always controlled by a smart AI core to avoid conflicts and provide better experiences.

Figure 38

Enhanced assistant information architecture model



4.3.3. Desirability estimation

Desirability is a preference related to experience and appearance. Users are drawn to a product that is desirable, and plays an important role because it attracts users to interact with the product and discover its usability and functionality over time.

4.3.3.1. Physio pleasure (physiological)

This program was designed with futuristic ideas in mind, and it includes "iSurface," which turns any surface into a unique touchable screen. The client prefers this larger and modern interface to the limited mobile display.

4.3.3.2. Socio pleasure (sociological)

The "iFace" feature of the social network allows users to have no limits in their social lives. Simply choose between the product members in the current location or on another common platform, and then relax and enjoy the communication.

4.3.3.3. Psycho pleasure (psychological)

This intelligent assistant simultaneously monitors and analyzes the user's mental and physical health, ensuring that the customer is confident in the accuracy of the results and satisfied with the healthier life.

4.3.3.4. Ideo pleasure (ideological)

The AI core enables applications to perform activities that are beyond human capabilities, such as pre-problem treatment and the generation of less destructive leftovers for the environment.

4.3.4. Usability report

In this study, a usability test was conducted remotely with a supervisor. Five test participants were given two assignments to complete in their own environment while sharing their screen with a moderator, all behavioral patterns and comments were conducted for designing the final experience. The first model, that can be found in Appendix D, is created with four routines (morning, food planning, working, and sleeping), which the user must configure individually. However, the final design has predefined activities with a wide range of topics that will adjust automatically.

Assistant evaluation

1. In the old design, participants were confused about creating routines; in the new design, some tasks have been grouped together with a title and description that suggests a healthy goal.
2. A design gap was discovered for the tasks list. To address this, the timeline design was employed for the assistant view to showcase the ongoing tasks and schedules.
3. Participants were unable to locate the new task details they desired; redesigning this page with more options resolved this problem.

iSurface evaluation

4. During the adjustment, a design gap was discovered for going back or changing the previous selection. The new design covered this problem and repositioned the available buttons to provide the needed emphasize on the main action.

5. A PROPOSAL IMPROVING HEALTH SMART HOME SYSTEM: WISY

The concept of HSH emerged from a combination of three research areas: medicine, domotics (household chores), and informatics (H. J. Kang et al., 2019). Patterns of technology and healthcare developments were derived with the reliable behavior predictions and the acceptable service composition using the SSW's broad range of contextual components (H. J. Kang et al., 2020; H.-J. Kang et al., 2017). As a result, a toolset of modern telemedicine devices with proprietary guidance technology was presented, providing highly efficient and convenient remote patient monitoring (telecare).

The potential of this proposed system in the development of multifunctional assistants is highlighted by the high levels of technology in home health-care gadgets. This assistant uses laser projection technology (iSurface) to expand the user interface concept. After the initial setup, the application will continue to operate, enabling voice commands or smart projection commands by touching the surface. Smart sensors will constantly monitor users, and smart diagnosis technologies will evaluate their data to eliminate ongoing physical or mental issues and maintain health by gradually modifying routines, activities or diets, providing treatment, or prescribing medication.

The findings highlight the significance of the design desirability. Users physiologically drown to the new experience with the assistant interface and functions; they are socially available with no additional effort; they are simply connected to family members or a resource of professionals, doctors, podcasts, and multimedia; thus, with

such intelligent assistant, they have no worries about playing the perfect part in their lives and will be psychologically and ideologically satisfied.

These results, however, may be limited by the assistant program itself. The iSurface must be configured within the primary application; otherwise, the laser projection technology will be left unused. Furthermore, the program can display several screens in multiple rooms; however, each place requires a separate projection.

This chapter displays the proposed application, which is based on the findings reported in Chapter 4 and addresses the design implementation of a health smart home assistant enhanced model. As a result (see Figure 39), an application called Wisy is presented first as a brand sample to demonstrate the UI and UX elements, followed by the proposed assistant model that is supported by isurface technology.

Figure 39

Wisy - Intelligent home

5.1. Implementation of the proposed system

WISY is a smart home application that ensures health quality through its enhanced Ai-based smart assistant (see Figure 40 and 41), and it proudly presents the iSurface technology, which transforms any material into a smart screen (see Figure 42). iFace is yet another feature for Wisy members to socialize and strengthen relationships (see Figure 43).

Figure 40

Wisy home page, profile and routine categories

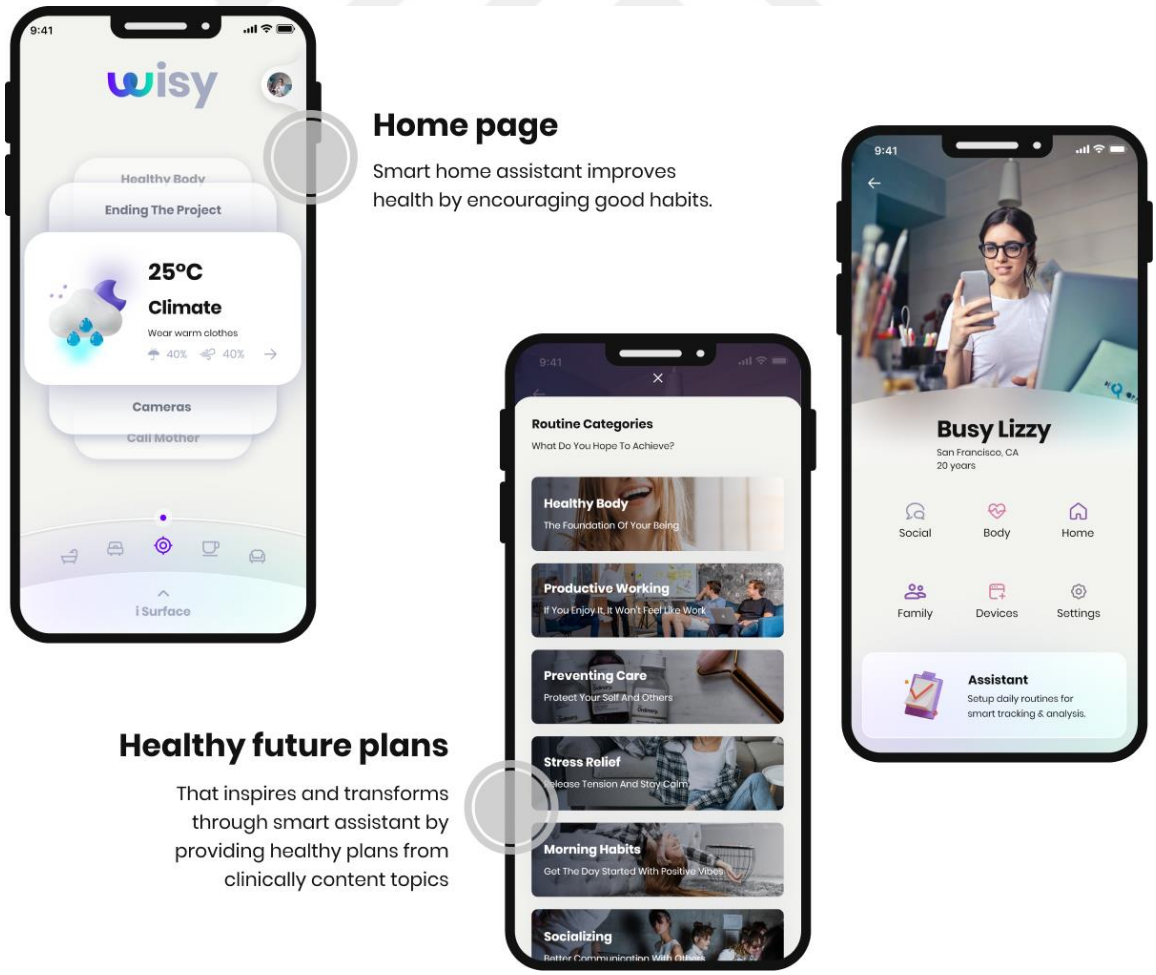


Figure 41

Wisy assistant and programming

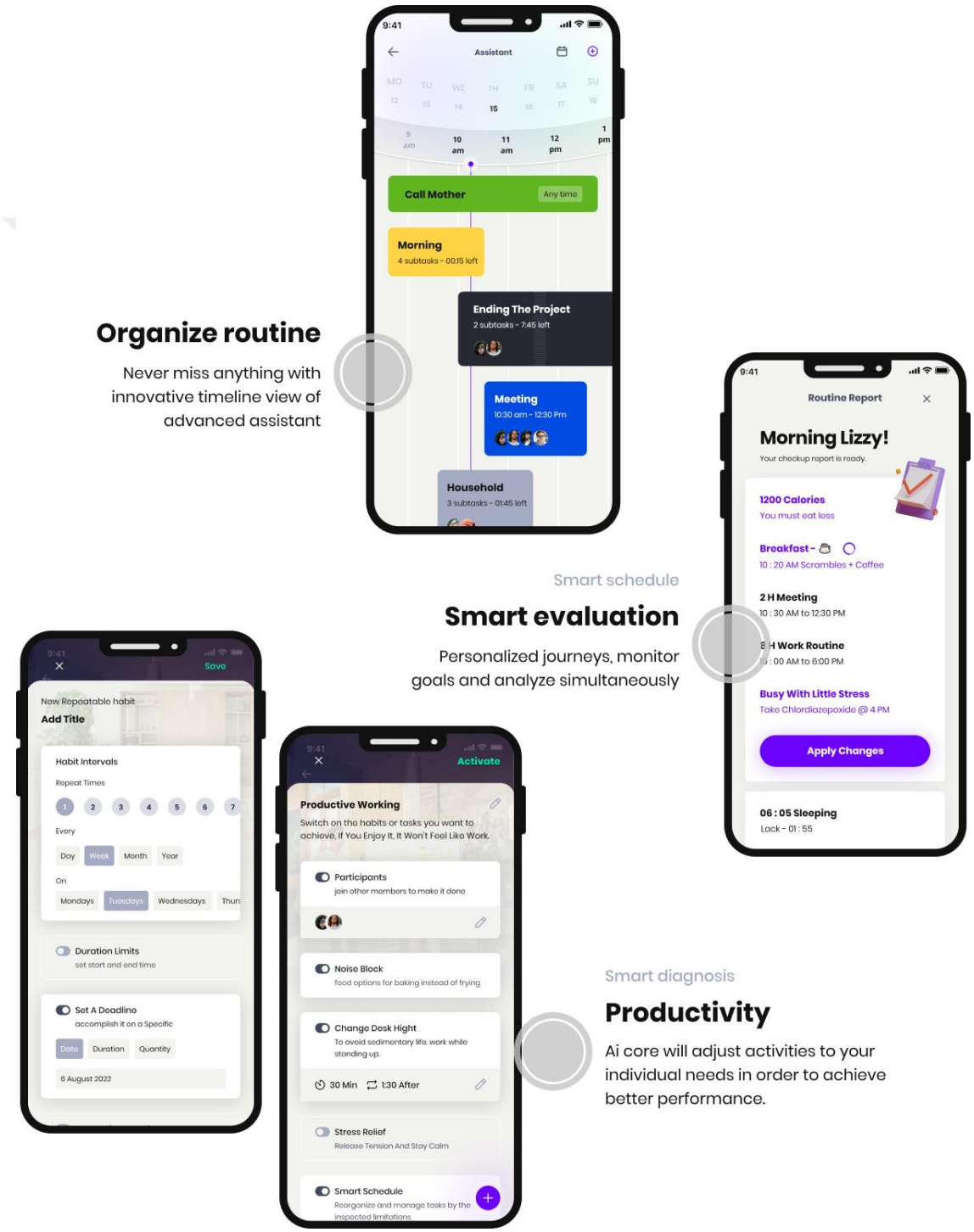


Figure 42

Wisy iSurface set up

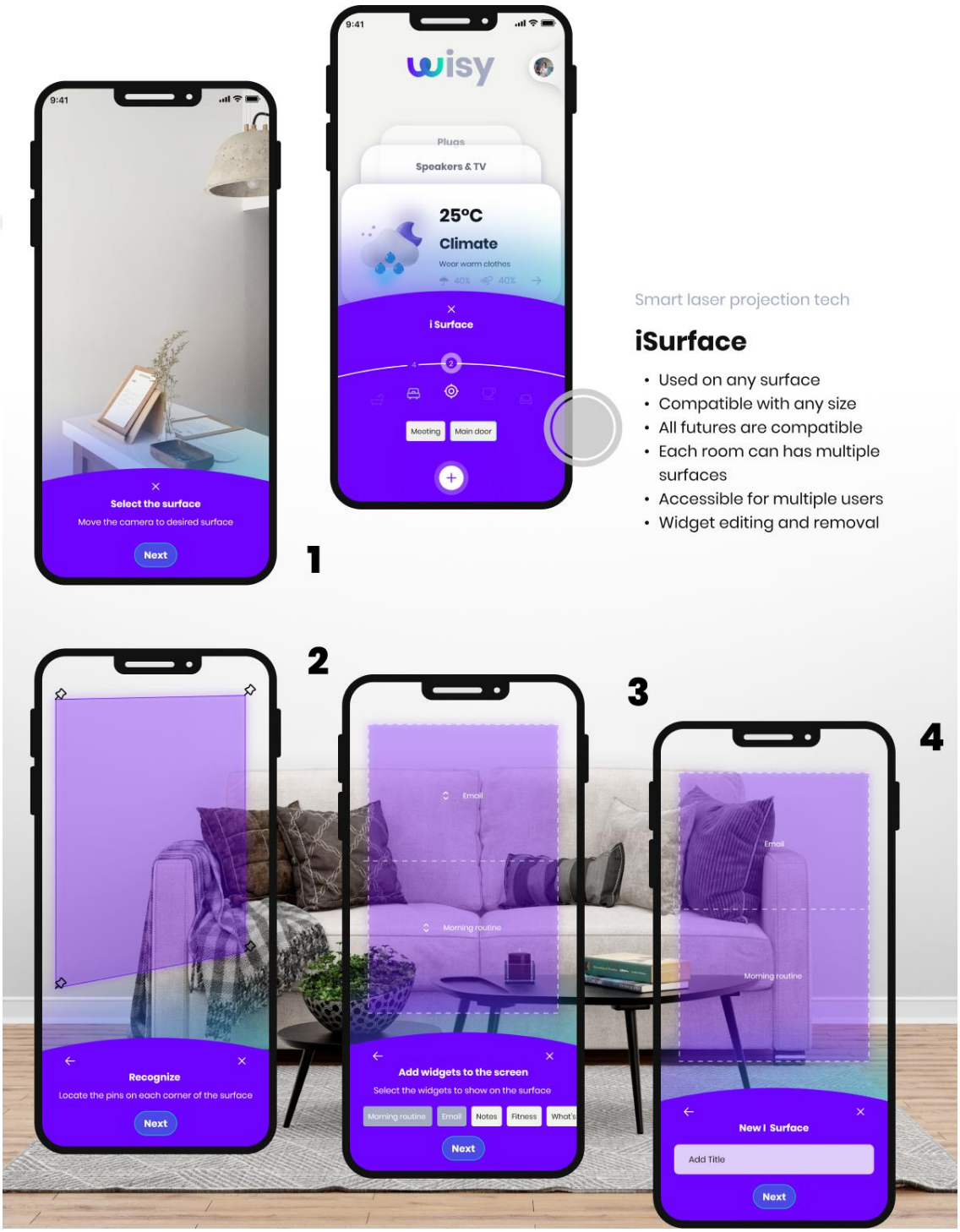
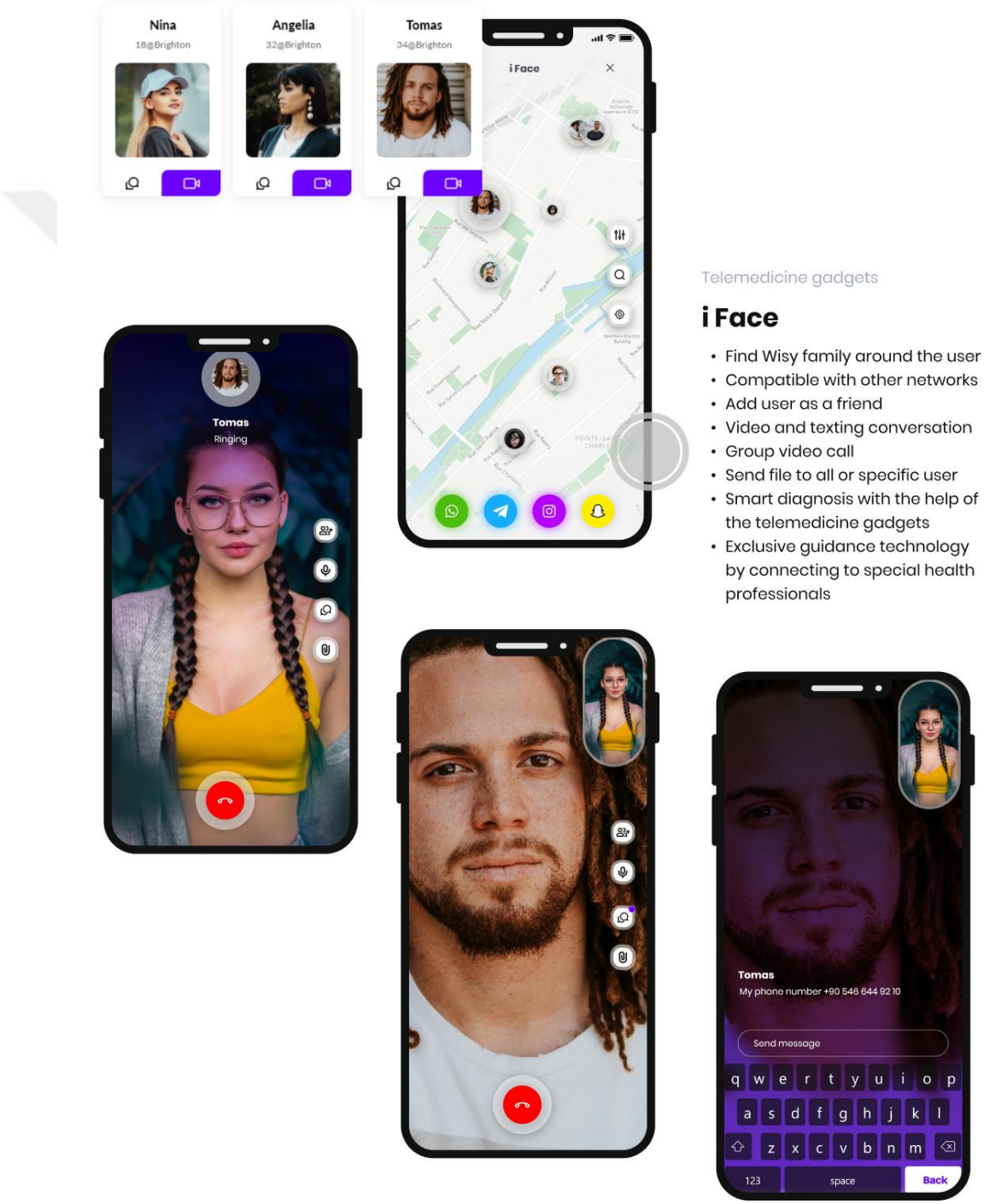


Figure 43

Wisy iFace process

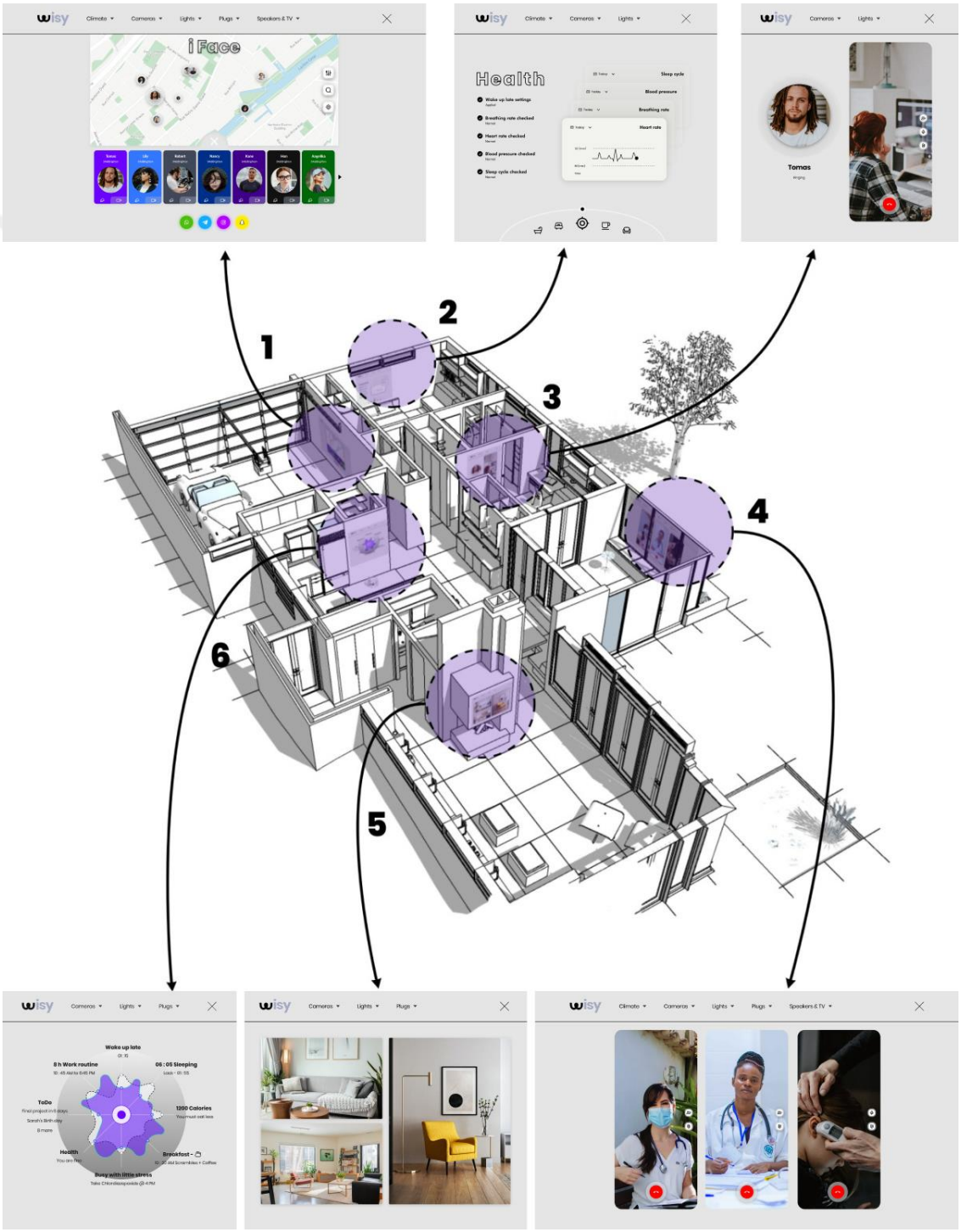


iSurface functions as a bridge between hardware and software to make the home smart for health requirements. The following are the hypothesized interactions, as shown in Figure 44:

1. The iFace feature allows users to locate other members (No 1).
2. Wearable technology and bed sensors to analyze users' health while sleeping are among the smart devices available in the tool kit for health monitoring and analysis (No 2).
3. The iFace feature provide communicating as a social networking app (No 3).
4. With iFace's proprietary guidance system and telemedicine gadgets, users can benefit from immediate health care through smart and accurate diagnosis while maintaining exclusive communication with specialists (No 4).
5. A smart security system can be presented with iSurface (No 5).
6. The pack includes overall health and food analyzing equipment to monitor ingredients and vitamin intake (No 6).

Figure 44

Approach of iSurface through smart house design



6. CONCLUSION

The usability of the Health Smart Home advanced assistant design was evaluated in this study. To identify gaps and build a hypothetical framework for project possibilities, we contrasted existing smart home apps with modern healthcare appliance technology. Our qualitative investigation concluded the real data on user expectations by generating persona profiles based on the summary of those elements after interviewing 15 people from the target segments. Regardless of the fact that previous providers indicated that they did not offer health services in particular, our study covered a broader range of health demands than those developed in this work by transforming qualitative findings into design language in order to create an advanced health smart home assistant. This thesis proposed a system that integrates advanced health gadgets with smart home technology.

As a consequence, a hardware and software combination are presented that makes the home smarter to assure health quality through its enhanced Ai-based intelligent assistant named WISY. Wearable technologies and bed sensors monitor and evaluate users' health parameters in real time, even while they are sleeping or eating using food technology. Additionally, the assistant can motivate users and automatically adapt their routes based on Ai evaluations in order to promote health by proposing alternative healthy routines based on clinically relevant topics.

Wisy proudly presents the iSurface technology, which turns any material into a smart screen. The user can set up this function in a few simple steps on any surface with any

material using the laser projection device included in the toolkit. The technology supports two types of projection: smart projection and non-smart projection. The smart model is touch sensitive and responds to user inputs; it will be installed in each room. A speech recognition device is required to issue commands via speech, which is the most preferred method of engagement with smart assistants like Alexa or Apple Home. However, these results may be affected by the iSurface configuration, it must be configured at least once otherwise, the laser projection technology will be left unused. The other limitation is the projection area, which requires at least one device in each room.

iFace is also another tool that allows Wisy members to socialize and enhance their social connections. The unique concept of this function is to provide a distinctive guidance system for immediate health treatment while keeping exclusive communication with doctors using a toolkit of telemedicine gadgets and sensors to deliver real-time remote laboratory testing, diagnosis and treatment.

6.1. RECOMMENDATIONS

A more in-depth investigation into the assistant's established interface shapes is consequently recommended. By displaying Metaverse space, users' home is no longer restricted to physical structures; virtual living environments must be considered in the future, in accordance with new methods of interaction.

This information can be used to develop current features with the new technology:

- iHologram, with 3D hologram technology users can have the hologram communication.
- iBeta, user may use professional software like Adobe with the assistant.
- iSkin, On the next generation users could use virtual gadgets on their skin.

To protect the environment and save lives, the assistant might calculate meet consumption and substitute artificial meat. The same thing may happen with the remaining groceries.

Further research could also focus on data privacy issues, as this advanced assistant collects a large amount of personal data that requires a perfect protection system.

REFERENCES

Sleep Number. (2022, June 3). *The Future of Health and Wellness at CES*. YouTube. https://www.youtube.com/embed/zK5bWY5UZik

Adams, R. (2007). User modeling for intelligent interfaces in e-Learning. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 4556 LNCS*(PART 3), 473–480. https://doi.org/10.1007/978-3-540-73283-9_53

Aluna Care. (2019, July 4). *Breathe Easier with Aluna*. YouTube. https://www.youtube.com/watch?v=uxQG1LBw5pY

AMZN Mobile LLC. (2022). *Amazon Alexa*. App Store. https://apps.apple.com/us/app/amazon-alexa/id944011620

Arnowitz, E. H. (2017). Evaluating the impact of display medium on perceived user experience and aesthetic value within virtual hotel environments [Unpublished master's thesis]. In *Cornell University*. https://doi.org/10.7298/X4JH3J5D

Becerrak, L. (2017). Trend-based design research. *Universidad Nacional de Colombia, Bogotá*, *27*(4), 55–60. https://doi.org/10.15446/bitacora.v27n4Esp.63543

Benis, A., Tamburis, O., Chronaki, C., & Moen, A. (2021). One digital health: A unified framework for future health ecosystems. In *Journal of Medical Internet Research* (Vol. 23, Issue 2). https://doi.org/10.2196/22189

Science Museum. (n.d.). *Booth's original red trolley vacuum cleaner*. Science and Society Picture Library. Retrieved December 31, 2021, from https://www.ssplprints.com/image/81823/booths-original-red-trolley-vacuum-cleaner

Bouma, H. (1998). Gerontechnology: Emerging technologies and their impact on aging in society. *Studies in Health Technology and Informatics*, *48*. https://doi.org/10.3233/978-1-60750-892-2-93

Davies, E. I., & Anireh, V. E. I. (2019). Design and Implementation of Smart Home System Using Internet of Things. *Advances in Multidisciplinary & Scientific Research Journal Publication*, *7*(1), 33–42. https://doi.org/10.22624/AIMS/DIGITAL/V7N1P4

Demiris, G., & Hensel, B. K. (2008). Technologies for an aging society: a systematic review of "smart home" applications. In *Yearbook of medical informatics*. https://doi.org/10.1055/s-0038-1638580

ECHO IV article - cortesi. (n.d.). SmugMug. Retrieved December 31, 2021, from https://cortesi.smugmug.com/Other/ECHO-IV-article/i-zmmbwZJ

Fan, X. (2017). Scalable Teaching and Learning via Intelligent User Interfaces. In *ProQuest Dissertations and Theses*.

Ferreira, J. J., Fernandes, C. I., Rammal, H. G., & Veiga, P. M. (2021). Wearable technology and consumer interaction: A systematic review and research agenda. *Computers in Human Behavior*, *118*. https://doi.org/10.1016/j.chb.2021.106710

FoodMarble. (2020, September 11). *FoodMarble AIRE*. YouTube. https://www.youtube.com/watch?v=fEcUYfy0xYo

Fozard, J. L., Rietsema, J., Bouma, H., & Graafmans, J. A. M. (2000). Gerontechnology: Creating enabling environments for the challenges and opportunities of aging. *Educational Gerontology, 26*(4). https://doi.org/10.1080/036012700407820

Ihász, Z. (n.d.). *Futuristic financial app*. Dribbble. Retrieved March 17, 2022, from https://dribbble.com/shots/15803837-Futuristic-financial-app-concept

Szőgyényi, Z. (2021). *Glassmorphism tutorial*. Themes Berg. https://themesberg.com/blog/glassmorphism/tutorial?ref=glass-ui-generator

Google LLC. (2022). *Google Home, Your home in your hands*. App Store. https://apps.apple.com/us/app/google-home/id680819774

Haje, U. (2018). *Automated multi-functional smart home system using arduino* [Hasan Kalyoncu Üniversitesi]. http://openaccess.hku.edu.tr/xmlui/handle/20.500.11782/1826

Hasinoff, A., & Bivens, R. (2021). Feature Analysis. *Journal of Digital Social Research*, *3*(2). https://doi.org/10.33621/jdsr.v3i2.56

Apple. (2022). *Home*. App Store. https://apps.apple.com/us/app/home/id1110145103

Huh, J., Kwon, B. C., Kim, S. H., Lee, S., Choo, J., Kim, J., Choi, M. J., & Yi, J. S. (2016). Personas in online health communities. *Journal of Biomedical Informatics*, *63*. https://doi.org/10.1016/j.jbi.2016.08.019

Hui, S. L. T., & See, S. L. (2015). Enhancing User Experience Through Customisation of UI Design. *Procedia Manufacturing*, *3*. https://doi.org/10.1016/j.promfg.2015.07.237

Jingar, M., Lindgren, H., & Blusi, M. (2021). Exploring Limitations of User Interface Design to Understanding the Gap Between Technology and Seniors. *Studies in Health Technology and Informatics*, *281*. https://doi.org/10.3233/SHTI210315

Joo, H. (2017). A study on understanding of UI and UX, and understanding of design according to user interface change. *International Journal of Applied Engineering Research*, *12*(20), 9931–9935.

Kang, H. J., Han, J., & Kwon, G. H. (2019). An ecological approach to smart homes for health care services: conceptual framework of a smart servicescape wheel. *JMIR MHealth and UHealth*, *7*(2). https://doi.org/10.2196/12425

Kang, H. J., Han, J., Yun, B., & Kwon, G. H. (2020). Validating and improving the smart servicescape wheel: A qualitative video analysis. *Advances in Intelligent Systems and Computing*, *1208 AISC*, 220–227. https://doi.org/10.1007/978-3-030-51057-2_31

Kang, H.-J., Kwon, G. H., & Kim, B. (2017). A Framework for Smart Servicescape: A Case of Smart Home Service Experience. *International Association of Societies of Design Research*, 1665–1677. https://doi.org/10.7945/C2RH6N

AliveCor, Inc. (2021, October 30). *KardiaMobile*. YouTube. https://www.youtube.com/watch?v=QzN2Qb5OsYU

Klein, A. M. (2021). Toward a user experience tool selector for voice user interfaces. *Proceedings of the 18th International Web for All Conference, W4A 2021*. https://doi.org/10.1145/3430263.3456728

Koivisto, J., & Hamari, J. (2018). *The rise of motivational information systems: A review of gamification research*. https://doi.org/10.1016/j.ijinfomgt.2018.10.013

Lacerda, F., Lima-Marques, M., & Resmini, A. (2019). An Information Architecture Framework for the Internet of Things. *Philosophy & Technology*, *32*, 727–744. https://doi.org/10.1007/s13347-018-0332-4

Lanius, C., Weber, R., & Robinson, J. (2021). User Experience Methods in Research and Practice. *Journal of Technical Writing and Communication*, *51*(4), 350–379. https://doi.org/10.1177/00472816211044499

Liao, Z., Luo, Z., Huang, Q., Zhang, L., Wu, F., Zhang, Q., & Wang, Y. (2021). SMART: screen-based gesture recognition on commodity mobile devices. *ACM MobiCom*.

Lucassen, G., Fabiano Dalpiaz, •, Martijn, J., van der Werf, E. M., & Sjaak Brinkkemper, •. (2015). *Improving agile requirements: the Quality User Story framework and tool*. https://doi.org/10.1007/s00766-016-0250-x

Malaka, R. (2008). Intelligent User Interfaces for Ubiquitous Computing. In *Handbook of Research on Ubiquitous Computing Technology for Real Time Enterprises: Vol. Chapter xx* (pp. 470–487). IGI Global. https://doi.org/10.4018/978-1-59904-832-1.ch026

Malhotra, S., Das, L. K., & Chariar, V. M. (2014). Design Research Methods for Future Mapping. *International Conferences on Educational Technologies 2014 and Sustainability, Technology and Education 2014*, 121–130. http://files.eric.ed.gov/fulltext/ED557342.pdf

Miraz, M. H., Ali, M., & Excell, P. S. (2021). Adaptive user interfaces and universal usability through plasticity of user interface design. In *Computer Science Review* (Vol. 40). https://doi.org/10.1016/j.cosrev.2021.100363

Molich, R., Wilson, C., Barnum, C. M., Cooley, D., Krug, S., la Roche, C., Martin, B. A., Patrowicz, J., & Traynor, B. (2020). How professionals moderate usability tests. *Journal of Usability Studies, 15*(4).

Mshali, H., Lemlouma, T., Moloney, M., & Magoni, D. (2018). A survey on health monitoring systems for health smart homes. In *International Journal of Industrial Ergonomics* (Vol. 66). https://doi.org/10.1016/j.ergon.2018.02.002

Muse. (2019, May 15). *Muse: Technology Enhanced Meditation*. YouTube. https://www.youtube.com/watch?v=FESbJNma3f4

Nakano, N., Oliveira, J. A. D. B. e., & Jorente, M. J. V. (2018). Design thinking as a dynamic methodology for information science. *Information and Learning Science*, *119*(12). https://doi.org/10.1108/ILS-07-2018-0061

Norman, D. (2003). Emotional Design: Why We Love (or Hate) Everyday Things. In *Basic Books; 1st edition*.

Ollenburg, S. A. (2019). A Futures-Design-Process Model for Participatory Futures. *Journal of Futures Studies*, *23*(4), 51–62. https://doi.org/10.6531/JFS.201906_23(4).0006

Pattison Tuohy, J. (2021). *Amazon Glow projector review: an innovative, interactive video calling device*. The Verge. https://www.theverge.com/22765217/amazon-glow-review-video-calling-projector

Rachdi, C., Karaduman, I., & Rachdi, N. (2019). Consumer Expectations from the Internet of Things: A study on Smart Home Products. *International Journal of Recent Research in Commerce Economics and Management (IJRRCEM)*, *6*(2), 222–231. www.paperpublications.org

Raharjana, I. K., Siahaan, D., & Fatichah, C. (n.d.). *User Stories and Natural Language Processing: A Systematic Literature Review*. https://doi.org/10.1109/ACCESS.2021.3070606

Reducept. (2019, December 21). *Reducept Trailer (En)*. YouTube. https://www.youtube.com/watch?v=GicoZha-1wA

Rehman, O. U., & Ryan, M. J. (2018). A framework for design for sustainable future-proofing. *Journal of Cleaner Production, 170*, 715–726. https://doi.org/10.1016/j.jclepro.2017.09.177

Rettinger, J. (2018). *This Projector Turns Any Desk Into a Touchscreen*. YouTube. https://www.youtube.com/watch?v=uuucvsuBpX8

Rialle, V., Duchene, F., Noury, N., Bajolle, L., & Demongeot, J. (2002). Health "Smart" home: Information technology for patients at home. *Telemedicine Journal and E-Health, 8*(4), 395–409. https://doi.org/10.1089/15305620260507530

Samrgandi, N. (2021). User Interface Design & Evaluation of Mobile Applications. *IJCSNS International Journal of Computer Science and Network Security, 21*(1), 55–63. https://doi.org/10.22937/IJCSNS.2021.21.1.9

Shaikh, A. (2020). An interactive design using human computer interaction for autonomous vehicles. *International Journal of Engineering Trends and Technology, 1*. https://doi.org/10.14445/22315381/CATI3P226

Skiin. (2021, May 12). *Skiin - How it Works*. YouTube. https://www.youtube.com/watch?v=CHRfD_lvLvw

Eight Sleep. (2021). *Dr.Heller_Dr.Louisa_video.mp4*. Vimeo. https://player.vimeo.com/video/644487762?h=72d104c75f

Smart Doorbell Cameras to Monitor Your Door. (n.d.). Ring. Retrieved March 15, 2022, from https://ring.com/doorbell-cameras

Dynowska, U. (n.d.). *Smart Home - mobile app design*. Dribbble. Retrieved March 17, 2022, from https://dribbble.com/shots/15607438-Smart-Home-mobile-app-design

Samsung Electronics Co. Ltd. (2022). *SmartThings*. Google Play Store. https://play.google.com/store/apps/details?id=com.samsung.android.oneconnect&hl=en&gl=US

TellSpec Inc. (2015, February 11). *Tellspec: The Portable Nutrition Scanner*. YouTube. https://www.youtube.com/watch?v=cBKhYWmN4C4

Telner, J. (2021). Future Trends in Voice User Interfaces. *Advances in Intelligent Systems and Computing*, *1213 AISC*. https://doi.org/10.1007/978-3-030-51328-3_26

MIRROR. (2021). *Meet MIRROR*. Vimeo. https://player.vimeo.com/video/460706241?h=55ef294a52

Tomkayo, J. E. (1994). Anecdotes: Electronic Computer for Home Operation (ECHO), The First Home Computer. *IEEE Annals of the History of Computing*, *16*(03), 59–61. https://doi.org/10.1109/MAHC.1994.10011

Clay AIR. (2020, October 23). *Touchless Technology For Public Spaces*. YouTube. https://www.youtube.com/watch?v=S1RK42FgY6s

Tyto Care. (2021, April 21). *Corbin Adam Scott - TytoCare Review*. YouTube. https://www.youtube.com/watch?v=u5hU77iQWrM

Weiser, M. (1993). Some computer science issues in ubiquitous computing. *Communications of the ACM*, *36*(7), 75–84. https://doi.org/10.1145/159544.159617

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2017). Benefits and risks of smart home technologies. *Energy Policy*, *103*, 72–83. https://doi.org/10.1016/J.ENPOL.2016.12.047

Xenxo. (2018, June 17). *Xenxo S-Ring: The World's Smartest Smart Wearable.* YouTube. https://www.youtube.com/watch?v=d6sPlo0Es3Y

Yang, X., Wang, R., Tang, C., Luo, L., & Mo, X. (2021). Emotional design for smart product-service system: A case study on smart beds. *Journal of Cleaner Production*, *298*. https://doi.org/10.1016/j.jclepro.2021.126823

APPENDIX A

smart service wheel for health smart homes(H. J. Kang et al., 2019)

SSWcategories	SSW elements health smart home
Perceptible servicescape	
Physical scape	
Hardware components	
Sensors	Physiological, environmental, multimedia and binary sensors.
Actuators	Actuators for device control.
Environmental cues	
Ambience cues	Light, sound, noise, scent, odor, temperature, humidity, ventilation and radiation.
Object-state cues	Equipment status (e.g., home appliances), space status (e.g., home security).
Human states	
Physiological	Body temperature, weight, blood pressure, pulse rate, blood glucose, respiration, and sweating.
Locational cues	Resident's location, movements, and another person's location.
Behavioral	Habitual or regular activities, and abnormal behaviors.
Social scape	
Service relations	Professional caregivers, clinicians at health care centers, doctors and nurses at hospitals, staff at security or emergency centers, staff at local welfare or community service center.
Social relations	Informal caregivers (e.g., family members and neighbors).
Imperceptible servicescape	
Data scape	
Computing intelligence	
Data collecting	Resident health or activity monitoring, home environment (safety and security) monitoring, and data patterning.
Data reasoning	Activity recognition, behavior prediction, and emergency detection.
Service curating	Home environment assistance, alert and emergency management, and telemedicine services.
Database	
Primary	Environmental, and physiological data.
Secondary	Situation or context data, activity data, and behavioral patterns.
External	Clinical database and cloud service.
Communication network	
In-home network	Body area, personal area, wireless sensor, and local area network.
Bridging platform	Internet and mobile communication.
Secured channel	Security-related technology.

APPENDIX B

Provided questionnaire for in-depth interview regarding the persona layout:

Demographic

1. What is your name and how old are you?
2. Are you single or married? how many children do you have?
3. Where are you located? do you work remotely?
4. If you want to categorize your income which one, is it belong? low/ moderate / high
5. What is your education?

Preferences

6. Do you have the experience of using smart device before? (Like robot or lamp, except smart phone)
7. Do you have smart services at home?
8. What kind of services do you interested in, affordable or premium?
9. Are you curious about the new technology or prefer to use it without knowing the details?
10. Do you want personalized features or want general plan for your family?

11. Which platform do you mostly use, Desktop or Mobile?

12. What is your preferred method of communication with your smart home? (Voice, gesture or physical interface)

Habits

If the participant works in the office,

13. What does a typical day look like for you?

If the participant works at home,

14. What does a typical day look like for you?

15. How often do you work at home and how much time does it take?

16. What's your process for working remotely? Was anyone else involved in this process? If so, who? And why?

17. How do you prefer to interact with your colleagues?

All participants

18. Which publications, blogs or social media do you use personally? How often?

19. What is your health routine? Was anyone else involved in this routine? If so, who? And why?

20. How do you prefer to interact with your doctor, nurse or health center?

21. How is your mood or mental model? Was anyone else involved in keeping it? If so, who? And why?

22. How do you prefer to interact with your spiritual supporters?

Goals

23. What do you want to achieve long term and short term, and why?

24. How do you prioritize your goals?

25. How are you currently trying to achieve them? courses or ..

Pain points

26. what stands in the way of your goals and frustrate you?

27. What problems do they create for you?

28. If you managed to find a solution, did it work and would you do it again, or would you prefer a better solution?

APPENDIX C

The following is the description of the persona interviews:

Demographic

1. The participants ranged in age from 33 to 59 years old. Named Caleb, Bahar, Amir, Adib, Farid, Nakisa, Arezzo, Masha, Michael, Vesna, Nasrin, Igor, Murat, Ebru.
2. Nine of the participants were single and six were married with two children at most.
3. They were located in America (1) Australia (1) Austria (3) Belgium (1) Canada (2) Germany (3) Iran (1) Norway (1) Turkey (2).
4. Seven of them worked entirely from home; two of them worked from home and in the office; two of them were retired; and four of them worked entirely in the office.
5. Four interviewees had a high income, six had a moderate-to-high income, and five considered as modest income. One of the participants has a bachelor's degree, while the others have master's degrees.

Preferences

6. One participant had not any experience but the rest had at least two smart devices (lamp and vacuum cleaner).

7. One had no smart services, one had a smart house, and the others had virtual assistant technology such as Alexa in their homes.
8. 3. All participants were interested in low-cost services, but if they found them useful, they agreed to pay for continued access.
9. For six candidates, technological advantages were the most essential reason for acquiring the product; nevertheless, five of them were more interested in the new design or technology than the specifics, while the rest just wish to acquire out-of-date items.
10. They all said they desire individualized services if they don't have to put in a lot of work, and a few said they didn't know how to achieve it.
11. They all mentioned that they prefer to work on a mobile app, but that they occasionally require a desktop version for a better view.
12. One candidate was skeptical of voice technology, whereas the other applicants preferred voice connection with their smart home.

Habits

13. Wake up between 7 and 11 a.m., then eat breakfast within 10-20 minutes, then get ready for work (or go out) within 10-30 minutes. While some families must prepare breakfast for their children and drop or pick them up from school, the majority of children bike to school or use school bus services. Shopping for groceries on the way home took 5-10 minutes,

changing clothes took 10-30 minutes, showering took 10-30 minutes, and doing household chores (cooking, cleaning) and eating dinner took 1-3 hours while helping children with their homework took 1-3 hours. Sit back and relax by watching television at night (with family). Around 10 p.m. got the kids ready for bed and ended the day by going to bed between 11 and 1 a.m.

14. Get up between 7 and 11 a.m.; some families must prepare breakfast for their children and drop or pick them up from school; the number of kids walk, cycle or use school buses to school, then they are ready for work. However, during work onboarding, the other participants eat breakfast in front of their desktop computer and start their day. Most participants use food delivery services for lunch, but a few prepare their own. When work is completed, it is a good time to go grocery shopping for about 30 minutes, followed by doing household chores for 1-3 hours and helping children with their homework and eating dinner for 1-3 hours. Showering took 10-30 minutes at night, followed by relaxing by watching television (with family). Participant finished the day by going to bed, planning tomorrow's tasks and watching tv between 12 and 3 a.m. after getting the kids ready for bed around 10 p.m. Participants may eat lunch very late or skip eating or resting during work time due to heavy workload.

15. Seven of them worked entirely from home for 8-12 hours per day; sometimes participants work more than 12 hours due to heavy workload.

Two worked from home at least three days a week for 8-12 hours; and two were retired but one did bakery each day for at most 6 hours and the other one did neighbor gardening for at least four days a week for 2-4 hours.

16. Got started by reviewing today's tasks while eating breakfast. Participant had an online daily meeting between 11 a.m. to 2 p.m. to stay up to date on each other's duties and states. They continued to work for the rest of the day to finish the tasks. During work hours, they may require a formal online meeting with stakeholders or supervisors.
17. Participants preferred online voice connections with their colleagues, but formal meetings required video connections.
18. The most popular among participants were email, Whatsapp, and Instagram, including some activities also taking place on Twitter, Facebook, and LinkedIn.
19. Two of the subjects were suffering from heart and kidney problems, while the others were in good condition. As a result of the Covid situation, interviewees did not engage in as much healthy activity as they had previously, but their routine included some physical movements that took at most 10 minutes individually. Two of them, however, did group fitness three times a week for at least 30 minutes with their gym Instagram account live program because they found it much more motivating with a mentor.

20. Instead of going to the hospital, all participants preferred to use health and laboratory services at home. But people with serious disease must visit hospitals.

21. Participants' office jobs were stressful and unsocial, despite the fact that they went out and saw people, but they tried to improve their mental health by talking with other colleagues or listen to music. Those who work from home, on the other hand, felt lonely, and some of them mentioned that they had forgotten how to talk or impress someone face to face, so they tried to have more video chats with their friends or bike in their spare time.

22. Participants preferred face-to-face communication with loved ones, but if they were separated, a video call could be a viable option.

Goals

23. The majority of the respondents suffered from long sitting and desired to move more during work hours in order to strike a balance between high-pressure work and good health. Another popular request was for an application similar to Google Calendar that schedules everything using voice commands, allowing users to be informed of all work and domestic needs. Families with children also needed someone to help them with

various tasks so that they could have more time for themselves. Having an earth friendly life style was mentioned as well.

24. Participants had difficulty arranging and setting priorities so order to see the bigger picture.

25. Participants had various plans for achieving their goals: some planned to use a fitness app, others planned to save money for new smart devices to automate some tasks at home, such as security systems and cameras, and still others wanted to update their working systems and devices to boost productivity.

Pain points

26. Due to employment, several of the participants did not get enough sleep and were constantly tired, making it difficult for them to engage in healthful activities. Families complained about their children's disturbance at home, and they stated that being a parent entails making significant sacrifices in order to be available to the children at all times. Some participants need frequent health checks, but transportation was difficult.

27. They struggled with a lack of physical engagement, loneliness, eye and age issues, as well as stress.

28. 3. Some of them had made arrangements with a health center for home checkups. Some people wore glasses and made the mobile app font larger. Families used kindergarten or other centers to care for their children when they were unavailable, whereas other families relied on smart security systems and left their children at home alone. For some people, adjusting the height of their working desk was a good way to avoid sitting for long periods of time. Some intended to generate electricity using Solar cell technology to be more earth friendly.

APPENDIX D

The following is the first design of the assistant and iSurface setup prior to the usability test: