AN INTERACTIVE DESIGN PROCESS OF A SMART HOME

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This Report Presented in Partial Fulfilment of the Requirements for the Degree
of MS in Management Information System

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APPROVAL

This Project titled "**AN INTERACTIVE DESIGN PROCESS OF A SMART HOME**", submitted by **Muhammad Sazib Hossain** to the Department of Computer Information System, Daffodil International University, has been accepted as satisfactory for the partial fulfilment of the requirements for the degree of MS in Management Information Systemand approved as to its style and contents. The presentation has been held on January 2023.

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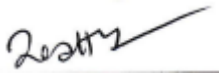Daffodil International University

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DECLARATION

I hereby declare that, this project has been done by me under the supervision of **Md Zahid Hasan, Assistant Professor, Department of CSE,** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.
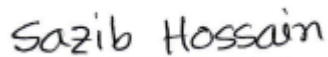
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Finally, I must acknowledge with due respect the constant support and patients of my parents.

ABSTRACT

Design is about people. We live experiences, we engage with them and we hope they are meaningful to us, and deep inside it always been like this. We can no longer think about design decisions without having in mind all the related fields that are required to develop a successful solution. This paper presents the design process of a smart home application that aims to improve the user experience and convenience of managing various household tasks. The application utilizes a user-centered design approach, incorporating feedback and testing throughout the design process to ensure the application is intuitive and easy to use. The application is also designed to be customizable, allowing users to personalize the interface and functionality to fit their individual needs. The evaluation of the application shows that it is effective in improving the efficiency and convenience of managing household tasks.

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CHAPTER 1

Introduction

1.1 Introduction

Design for people. That's what life is for. It is a matter of knowledge. Design is a living person. Designing is an on-going and powerful process. It means trying. Don't be afraid to fail.

Design experience and schooling don't make us professionals, but we do have them. Progress can only be made through research and practice. Creativity means paying attention to situations, people and feelings.

Technological advances and changes in the social sciences have created new ways of thinking about how design works. Design options include network design; it interacts with other areas such as interface design and user interaction. All these places are connected. So, in all these areas; how they interact with each other; it is important to know how to identify obstacles and how they are connected to the process.

This process involves problem-solving and finding solutions. No technical or digital solutions (except essential). The answer to this problem is a solution. This response can be anything that suits the user's needs. As a designer, the goal is to understand the user's problems; It's about explaining and finding solutions.

In a test/research/deployment environment, a network administrator must work with researchers, developers, and other professionals to develop knowledge and interpretive concepts design, simulation and testing.

1.2 Motivation

Academic knowledge makes us active. Working in a real business environment, working in a team and understanding business processes helps us to understand the work of professional designers. Working in this context directs the designer's attention to the original goal.

When working in a group, participants provide feedback. Sharing knowledge improves our skills and helps us understand what we can do and where we can go abroad and work in a

multidisciplinary team around the world. Realize the importance of applying everything you've learned. Therefore, we provide insight into the role of contacts and the methods needed to answer customer research questions. Technology and social relations such as human relations and communication and critical thinking.

The decision to send people abroad is based on the ability to work in a test/research environment where IDX developers test and develop their technologies and expand their knowledge of systems communication and related fields.

1.3 Research Question &Rationale of the Study

How the design processes of a Digital Solution (Smart Home) in perspective of Interaction design? – It is wanted to understand the process, explain, analyze legal decisions, create recommendations and demo solution

The rationale of the study of interaction design research is to understand how users interact with digital products and services, and how to design interfaces that are intuitive, efficient, and satisfying for the user. Interaction design research aims to identify the needs, goals, and behaviors of users, and to develop design solutions that meet those needs and support user's goals.

Interaction design research is important because it helps to create products and services that are user-centered and meet the needs of diverse user groups. By understanding how users interact with digital products, designers and developers can identify pain points and areas for improvement, and create solutions that are more efficient, effective, and satisfying for the user.

Interaction design research also helps to improve the accessibility of digital products and services. By understanding the needs of users with disabilities and older adults, designers can create interfaces that are inclusive and accessible to all users, regardless of their abilities.

Furthermore, interaction design research is important for the development of new technologies and services. As technology evolves and new devices and platforms are introduced, understanding how users interact with these technologies is crucial for the design of effective and efficient interfaces.

Overall, interaction design research plays a crucial role in creating digital products and services that are easy to use, efficient and satisfying for users, and inclusive and accessible to all. It is important for designers and developers to continue to conduct research and gather user feedback to ensure that products are meeting the needs of their users and are being designed in a way that is inclusive and accessible to all.

1.4 Research objective

- Toget a clear understanding of the IxD domain and the role of communication systems.
- To gain insight into the design process by creating digital solutions (Smart Home) in an experimental and innovative environment.
- To clearly understand design theory and generate idea, design, prototyping and testing.

CHAPTER 2

Background Study

The term "smart home" refers to a home that can be monitored and controlled through smart devices connected to the Internet. Basically, a smart device is an electronic device that is connected to another network and functions normally. Smart homes and devices are increasing, and people are looking to improve their homes for various reasons, including convenience, efficiency, productivity, and quality and to make them beautiful. Experts say that luxury homes are becoming more popular every day. According to a report by the Swedish research company Berg, in 2022, 63 million Americans will there is a residence that can be used. Therefore, it is impossible to predict the future of luxury buildings [1].

A literature review of home automation applications reveals that these systems have become increasingly popular in recent years, as they allow for remote control and monitoring of various household devices and systems. Studies have shown that home automation can improve energy efficiency, increase comfort and convenience, and enhance security.

One study from the National Renewable Energy Laboratory found that advanced home automation systems, such as those that allow for remote control of lighting and thermostats can reduce energy consumption in homes by up to 15%. This can lead to significant cost savings for homeowners, as well as a reduction in carbon emissions [2].

Another study, conducted by ABI Research, found that the global market for home automation systems is expected to reach $100 billion by 2020, with a compound annual growth rate of over 20%. This rapid growth is driven in part by the increasing affordability of home automation technology, as well as the growing awareness of the benefits it can provide [3].

A survey conducted by Parks Associates, a market research firm, found that security and remote monitoring were the most popular uses of home automation systems among consumers, with over 60% of survey respondents expressing interest in these features. Meanwhile, energy management and home entertainment automation were also popular among respondents, with around 50% expressing interest in these features [4].

The study also reported that majority of home-automation systems are used to monitor the temperature of home, Lock doors, and control lighting with voice-activated devices, either

through stand-alone device such as Amazon Alexa and Google Home or integrating with Smartphone.

In addition to these studies, many experts have discussed the potential for home automation to revolutionize the way we live. By allowing for greater control and automation of household functions, home automation can help to make our homes more comfortable, energy-efficient, and secure, while also providing convenience and peace of mind.

Overall, home automation systems have been rapidly growing, driven by the increasing affordability of technology and growing awareness of the benefits it provides. The most popular features among users are security, remote monitoring, energy management, and home entertainment automation. Experts believe that home automation will continue to revolutionize the way we live.

2.1 Related Works

There have been several studies and research works related to interaction design for home automation. Some examples include:

"Designing for Home Automation: A Study of User Needs and Interaction Styles" by J. O'Hara, K. Rodden, and T. Rodden, which studied user needs and interaction styles for home automation systems and identified key design requirements for creating effective and efficient home automation interfaces [5]. It also explored the use of natural language interfaces for home automation and found that they can improve the efficiency and ease of use of home automation application design.

Another papers "A Study of User Needs for Home Automation" by L. L. Chiang, which investigated the user needs for home automation systems and identified key design requirements for creating effective and efficient home automation interfaces.

"The Design of Everyday Things" by Donald A. Norman is a classic book on the principles of human-centered design and the importance of making technology easy to use and understand. The book explores the concept of "affordances," which are the physical and perceptible properties of an object that indicate how it can be used. The book argues that good design should make the affordances of an object clear and easy to understand, while bad

design can lead to confusion and frustration for users [6]. It also explores the concept of "mapping," which is the relationship between controls and their effects. The book argues that good design should make the mapping between controls and effects clear and consistent, while bad design can lead to confusion and errors for users.

The book also highlights the importance of "feedback," which is the information that the product provides to the user about the results of their actions. The book argues that good design should provide clear and timely feedback, while bad design can lead to confusion and uncertainty for users. It also covers the concept of "conceptual models," which are the mental models that users have of how a product works. The book argues that good design should align with the users' conceptual models and make the product easy to understand, while bad design can lead to confusion and frustration for users.

These are just a few examples of the many studies and research works that have been conducted in the field of interaction design for home automation. It is an active field of research with many new findings and solutions being proposed as technology continue to advance.

2.2 Frameworks of the Interaction Design

Ii is believed that this plan is just the basis for achieving the right goals. It allows you to write ideas and identify the problems you want to solve [7]. Frameworks help designers create hierarchies of advanced solutions, fast and efficiently.

2.2.1. User Centered Design

User systems are designed according to the needs of users and operators. It is a 5-step process. It used what it did tools, methods and other techniques to help understand customer needs. In the first phase, designers work in groups and try to explain the design to users. Then they turn to business needs. After reading the requirements, the design team develops the solution and finally, the team evaluates the results of the solution situation based on the characteristics of the organization and the needs of the users [8].
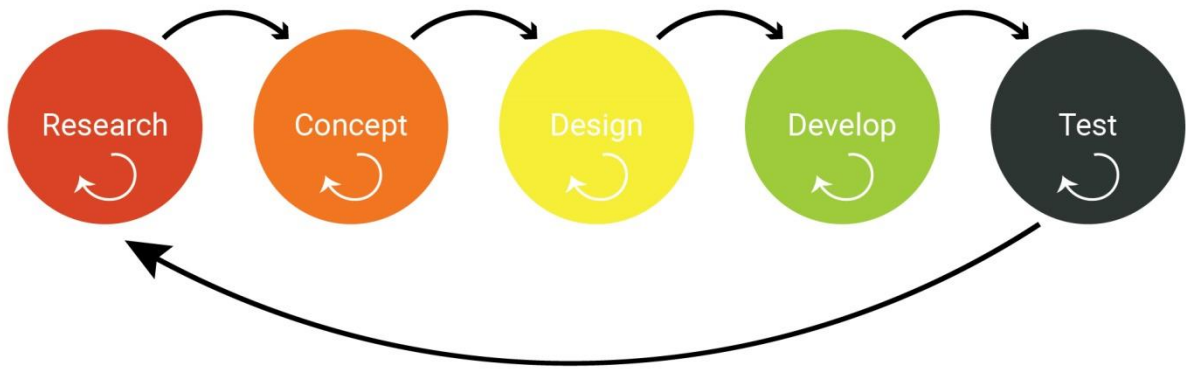
Figure 1 : User Centered Design Process.

2.2.2 Goal-Directed Design

According to Alan Cooper's book Collaborative Design, the purpose of design refers to different behavior's that reflect the preferences of using different products. The foundation consists of eight steps and the importance of goodness [9].
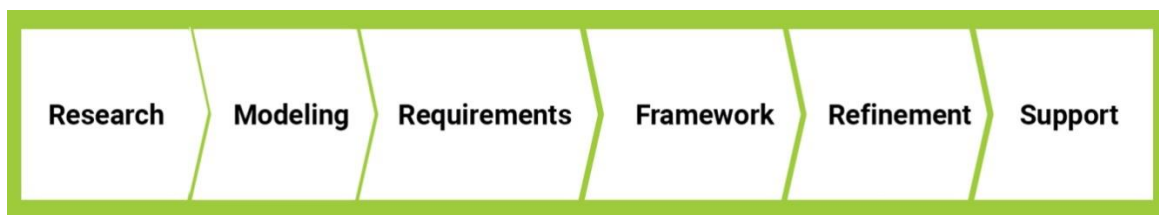

Figure 2: Goal Directed Design Process.

It also works with end users through research and group interviews, literature review, interpretation, research and field studies. Strategy turns ideas into action. The main difference between goals and objectives is that goals define what the user wants to achieve and objectives refer to the objectives achieved by delivery.

2.2.3 Lean UX

Lean UX is based on the Toyota Manufacturing Process, which acts as an agile development platform and creates added value rather than waste. The main difference between this framework and other frameworks is the foundation on which Lean UX is built. In addition, Lean UX strives to be flexible and receive feedback from stakeholders, which helps make decisions and release products faster [10].

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The system divides the entire project into several parts that facilitate the process efficiently and effectively. This method can be used to emphasize key steps and remember concepts. Things need to be fixed. The design was created using the Lean UX design process. Necessary steps:
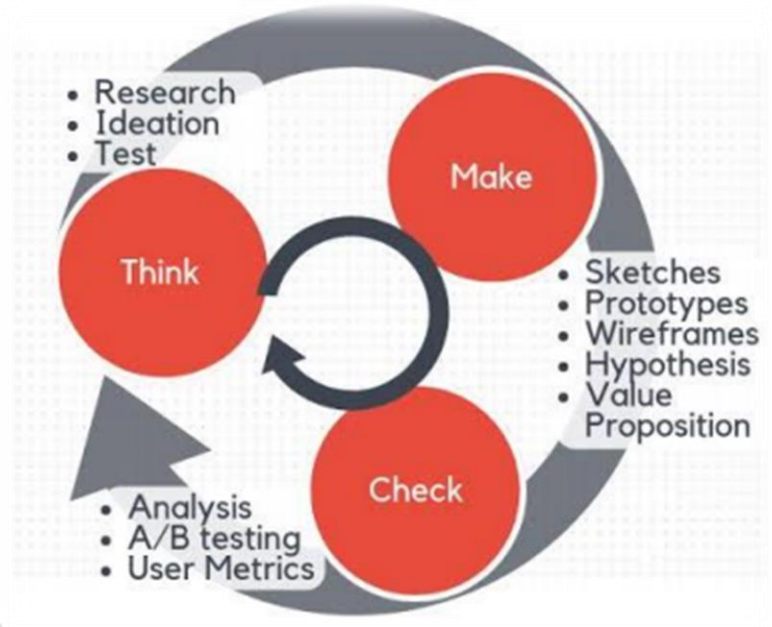
Figure 3: Working flow of Lean UX.

Think: In this process, the model predicts a specific problem based on the analysis. It helps to develop ideas, concepts and plans.

Make: This section describes the minimum product (MVP). Creating prototypes, mockups, hypotheses, and implementation code will help you achieve the goals of this chapter.

Check: MVP is the final stage of Lean UX. The company conducts A/B testing, database research, verification and validation. Then the whole process starts again.

At the end of the research project, I discuss design and design thinking.

2.3 Cognitive Phycology

Thinking understands how information is understood and processed, including reasoning, memory, learning, problem-solving, reading, writing, and speaking.

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Figure 4: Cognitive Psychology Process.

Different users join the UX team based on their expertise. Science helps designers to identify the possibilities, constraints and variables that interact with design to create more efficient, effective and attractive designs.

2.3.1 Cognitive Process

There are many types of cognitive processes. Let's look at some of them.

Attention

From a cognitive perspective, attention refers to how a person receives information to make a choice. Auditory and/or visual perception helps to identify objects.

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Dividing your mind into several things at once is called multitasking. This affects the user's memory. As a designer, you need to be mindful of the time you spend creating images.

One of the most important aspects of design is observation. A good interface creates focus and makes the system easy to use. There should be enough concern for the user colors, fonts, sizes, logical symbols, popup messages and more. They believe in it.

For Example, sinceone system works with a large online store, I want to specify the quantity (price). This allows the user to know the value of the item. Also, pop-ups can be used to ensure that the user is looking for the right product for their needs [11].

Memory

Sternberg (an American psychologist) says that memory is based on what we know beforehand. There are many reminders and wisdom, for example, we don't like to read the first page often because we use the same page over and over again

Less memory is required for better performance. The smart home system should use common symbols so that users can set up and operate the system easily. Following this pattern, I use common symbols and logical groups to create an intelligent system that allows users to make changes.
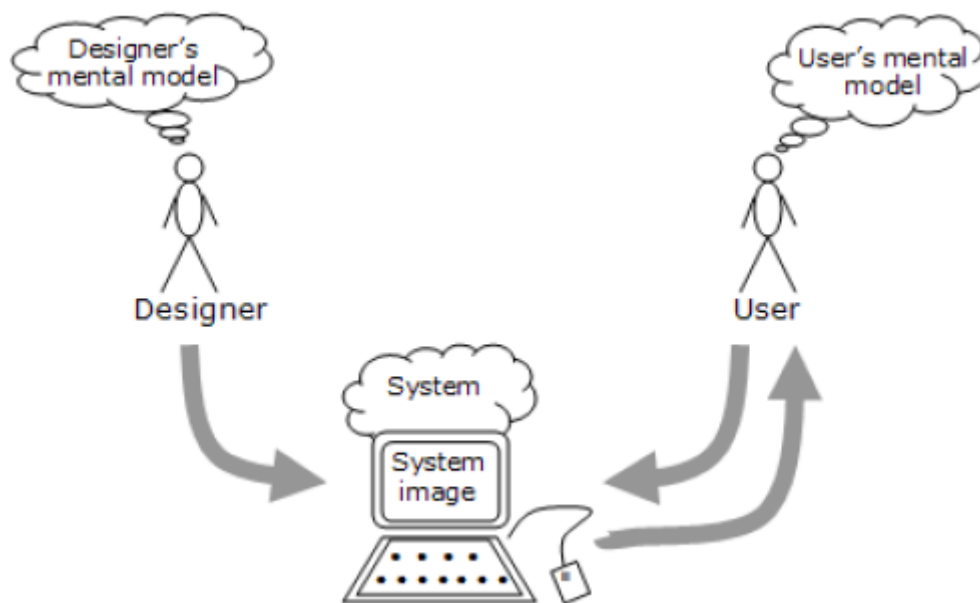
Perception

In terms of cognitive psychology, consciousness, and how people use their ears, eyes, etc. This is a unique and complex process based on the human experience this is terrible.

Organizational details are very important to minimize user confusion. This helps the user to work faster. According to this principle, the agreement can be friendly and beneficial.

For Example, It can use icons, buttons and other elements to create a beautiful home. (For example: Next, OK, Cancel). Using the right color will complement the design.

Mental model

The mental models refer to the knowledge that users add to their conceptual models about how to use a particular system. It is normal to have different roles over time. Don Norman answered the riddle [12].

Figure 5: Mental Model Process.

Knowledge is the foundation of this model. The user creates a mental model that believes that the system works without his knowledge.

External Cognition

In Cognitive psychology, external perception refers to the communication process between internal knowledge and human perceptual processing and external representations. This provides a structured user flow that minimizes user memory usage.

The three ways of external cognition is used:

- ✓ **Externalizing Memory Loading:** Strategies can be developed to reduce memory loss due to external factors. For example, we can set up a system to store a phone number with a date of birth, an email address; Options, etc. to simplify administration. Very low memory usage.

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- ✓ **Computational Offloading:**Explain how to use different tools when working with a computer. It is difficult to work with our brains. Using a calculator instead of a pencil and paper is a good example of doing digital work.

- ✓ **Annotations and Cognitive Tracing:** Changing or manipulating external factors involves interpreting and processing external data to obtain new information based on cognition[13].

2.4   Different Interaction Medium

User can use different medium for interacting with the system.

Voice

Voice communication is very different from any other form of communication. It's no surprise that users want to feel like they're talking to others through voice.

Touch

Touch marks the tool surface and touches the work on the touch surface. This is an important position in the translation chain, which is completely dependent on the user's interaction with the device.

Graphical User Interface (GUI)

A user interface (GUI) is a system for interacting with various forms. These can be icons, buttons, etc. Online shopping apps use voice and touch communication methods.

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2.5 Types of Interaction

There are several types of interaction that can be used in the design of user interfaces and interactions. Some of the most common types of interaction include:

Instructing

The purpose of the instructions is to tell the user what to do after the task is completed. If a person wants to enter the online shopping process, he needs to register.

Conversing

This model is designed when users want to interact with others while using the system. Since users are used to chatting with other people, chat helps them interact with the system in a way they are familiar with. When a command is applied to a smart object, the user receives a response from the application.

Manipulating

These relationships often involve how the user handles and uses things in the world.

Exploring

Exploring user movement, both virtual and physical, can provide valuable insights into how people interact with technology and can inform the design of user interfaces and interactions. Virtual movement refers to the way users navigate and interact with digital environments, such as a website or mobile app. Physical movement refers to the way users move and interact with the physical world, such as how they manipulate objects or use gestures to control technology.

2.5 Synthesis and Critical Analysis

Interaction Design is a destructive concept for many people. From the perspective of human-computer interaction, this group of cognitive processes is called multidimensional science. Basically, this study focuses on how users interact with computers. Research on HCI soon began, learning how to test it.

Productivity is the understanding of how an employee is working. There is a consensus in these studies. It can be defined as how we use and create things for others. People will use it.

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The goal is to create a plan that makes sense. Events such as stories should generate ideas and engage users. Proximity to customers is key to success. Understanding their needs, thoughts and feelings determines the problem we want to solve. We need to answer our questions about who, when and why.

The Research Questions: How the design processes of a Digital Solutions (Smart Home) in perspective of Interaction design? This means learning how to design a solutions with following the interaction design process. Communicating with users means supporting the design and getting user experience. In other words, Applications should be useful and having fun during the use.

Better understanding: users, their thoughts, feelings, actions, thoughts and actions bring us closer to the solution, refer to work in the solution development process, should change and model be the goal of a designer to solve it.

2.6 Scope of the problem

The scope of the problem of interaction design for a home automation research encompasses a wide range of issues related to the design of digital products and services. Some of the key areas of concern include:

1. Understanding how users interact with application, and identifying areas for improvement in terms of usability and user experience.

2. Ensuring that digital products and services are inclusive and accessible to all users, including those with disabilities and older adults.

3. Developing home application solutions designs that are tailored to the needs and preferences of individual users.

4. Keeping up with the rapid pace of technological change and understanding how new devices and platforms impact user interactions.

5. Creating designs that are inclusive and accessible to diverse user groups, including people from different cultures, backgrounds, and abilities.

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6. Understanding how users think, feel and behave when they interact with digital products and services, and how to design interfaces that align with these behaviors and psychology.

7. Ensuring that digital products and services are designed in a way that protects user's privacy and security.

2.7 Challenges

To do this research, several challenges must be faces including:

1. It must keep pace with the rapid changes in technology, including new devices and platforms, to ensure that digital products and services are designed effectively and efficiently for users.

2. Interaction design research must take into account the needs and preferences of diverse user groups, including people from different cultures, backgrounds, and abilities.

3. Interaction design research must balance the need for usability and user experience with the need for security and privacy, which can be difficult to reconcile at times.

4. Measuring the user experience can be challenging as it is a subjective experience, and different methods may produce different results.

5. As Interaction design research relies on user data, but gaining access to this data can be difficult and time-consuming.

6. Interaction design research must keep up with the emerging technologies such as virtual reality, augmented reality, and natural language processing, which may have different interaction design requirements.

7. Interaction design research must take into account the needs and preferences of diverse user groups, including people from different cultures, backgrounds, and abilities.

8. Interaction design research must test and validate the design solutions to ensure that they meet the needs of users and provide an efficient and satisfying user experience.

Despite these challenges, interaction design research is crucial in creating digital products and services that are user-centered, efficient, and satisfying for users, and inclusive and

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accessible to all. It is important for designers and developers to continue to conduct research and gather user feedback to ensure that products are meeting the needs of their users and are being designed in a way that is inclusive and accessible to all.

CHAPTER 3

Methodology

Methodology refers to the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. In simple terms, methodology is the process used to gather and analyze data in order to answer research questions or solve problems.

Methodology is an essential part of any research study. It helps to ensure that the research is conducted in a consistent, reliable and valid manner. It includes the specific procedures and techniques used to collect and analyze data, such as survey design, sampling methods, data collection tools, and statistical analysis techniques. Additionally, it includes the philosophical assumptions that underlie the research, such as the research paradigm (e.g. positivism, constructivism) and the research design.

In this case, it is important to describe how the study was conducted. What method is considered effective and how the law is enforced.

3.1 Data Collection Procedure

Data collection for UI/UX (user interface/user experience) design typically involves gathering information about the target users, their needs, and how they interact with the product. This information can be gathered through a variety of methods, including:

Personas:

Personas are a method used in user experience (UX) and user interface (UI) design to create fictional representations of the target users of a product or service. Personas are based on real data collected through research methods such as surveys, interviews, and ethnographic

studies, and are used to help designers and developers understand the needs, goals, and behavior patterns of their users[14].

The process of creating personas typically begins with data collection. This data can be collected through a variety of methods, including surveys, interviews, and ethnographic studies. Surveys can be used to gather quantitative data from a large number of participants, while interviews and ethnographic studies allow for more in-depth, qualitative data collection from a smaller number of participants.

Surveys

Surveys are one of the most commonly used methods of data collection for UI/UX design. They can be administered online or in-person, and can be used to gather a wide range of information, including user demographics, preferences, and satisfaction levels. Surveys are relatively quick and easy to administer, and can be distributed to a large number of participants. However, they can be biased if the survey questions are not well-crafted, and they may not provide detailed or in-depth information.

Interviews

Interviews are another popular method of data collection for UI/UX design. They can be conducted in-person, over the phone, or online, and are typically used to gather more detailed and in-depth information than surveys. Interviews can be used to explore users' needs and preferences, and to identify potential areas of improvement in a product or service. However, they can be time-consuming and costly to conduct, and may not be feasible for large-scale studies.

Focus Groups

Focus groups are similar to interviews, but involve a group of participants rather than individual users. They are typically conducted in-person, and are used to gather information about users' perceptions, attitudes, and behaviors. Focus groups can provide valuable insights into users' needs and preferences, and can be used to identify potential areas of improvement in a product or service. However, they can be time-consuming and costly to conduct, and may not be feasible for large-scale studies.

Usability Testing

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Usability testing is a method of data collection that involves observing users as they interact with a product or service. It is typically used to identify problems or difficulties that users may experience when using a product or service. Usability testing can provide valuable insights into how users interact with a product or service, and can be used to identify potential areas of improvement. However, it can be time-consuming and costly to conduct, and may not be feasible for large-scale studies.

Analytical Tools

Analytical tools, such as Google Analytics, can be used to collect data on user behavior and interactions with a product or service. They can provide valuable insights into how users interact with a product or service, and can be used to identify potential areas of improvement. However, they may not provide detailed or in-depth information, and may not be able to capture all of the information needed for a thorough analysis.

Social Media Monitoring

Social media monitoring is a method of data collection that involves monitoring social media platforms for mentions of a product or service. It can provide valuable insights into users' perceptions, attitudes, and behaviors, and can be used to identify potential areas of improvement. However, it may not be able to capture all of the information needed for a thorough analysis, and may not be feasible for large-scale studies.

A/B Testing

A/B testing is a method of data collection that involves testing different versions of a product or service with different groups of users. It can provide valuable insights into users' preferences and behaviors, and can be used to identify potential areas of improvement. However, it can be time-consuming and costly to conduct, and may not be feasible for large-scale studies.

According to the Maze report the most used method for the UI/UX researched are provided herewith.

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Figure 6: Representation of Using Method for Designer.

3.2 Statistical Analysis

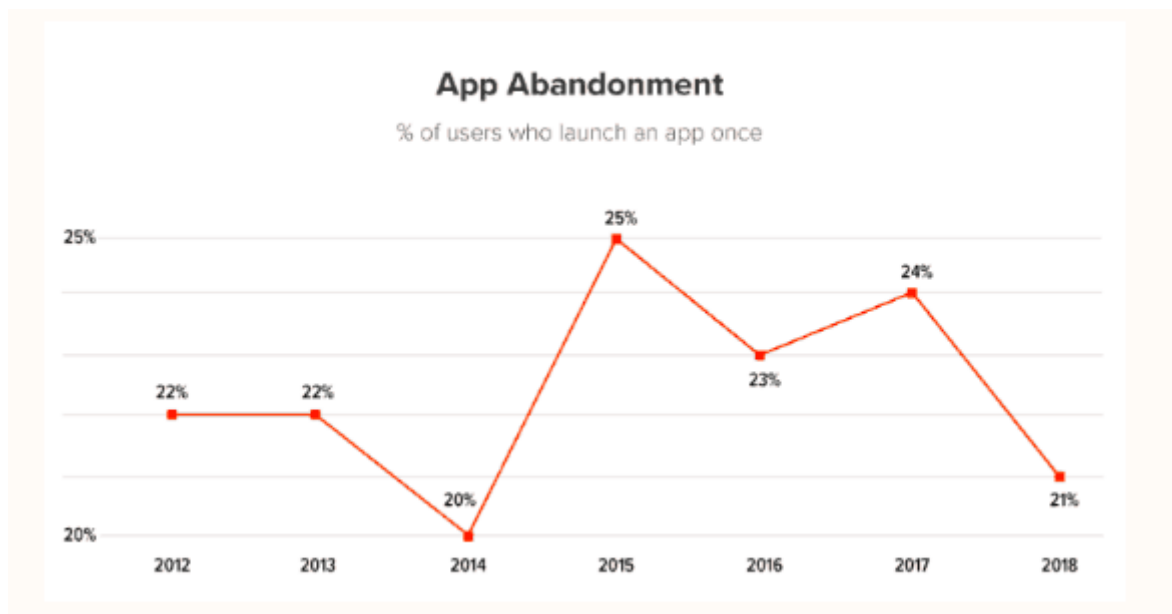Based on the different report common mistake that are made in interaction design are shown below.
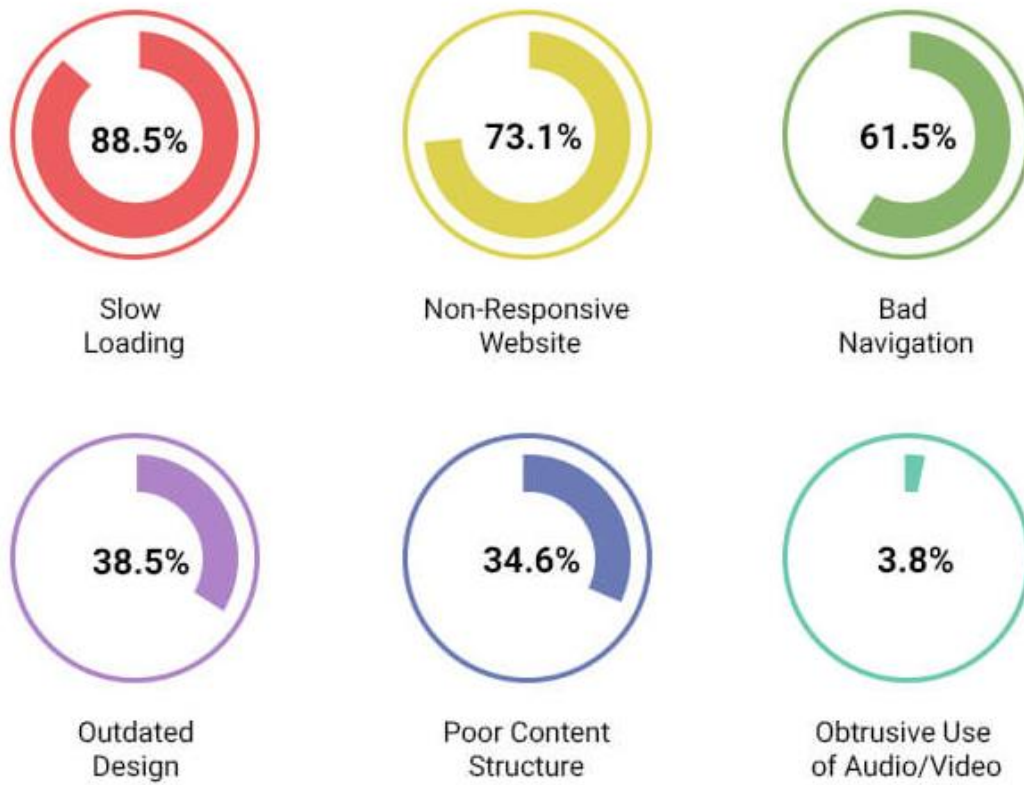
Figure 7: Mistakes of Interaction Design.

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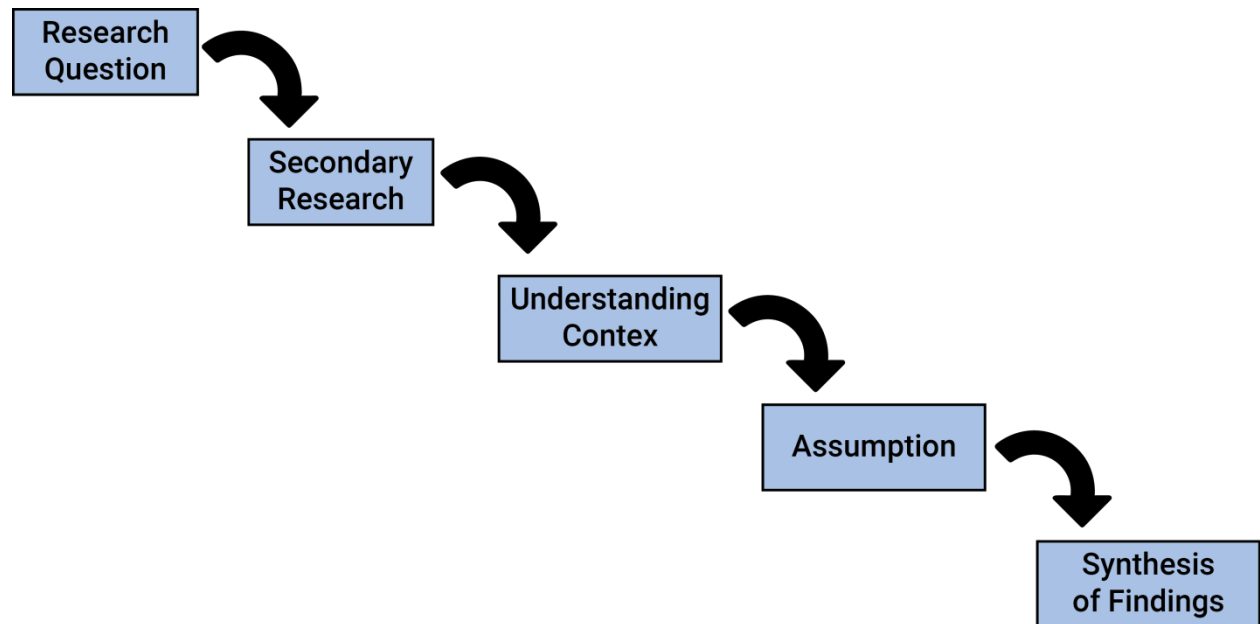
Figure 8: Reason for Apps Failure.

According to the Localytics (the leading mobile engagement platform) from 2012 to 2018, A research that shown the abandon rate of the users.

Figure 9: Apps Abandonment.

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3.3 Proposed Methodology

The research methodology main process is given below:

Figure 10: Applied Mechanism during the Work.

Research Question

In this section a statement that defines the specific topic or issue that a research study will address. It is a clear and concise question that guides the all other process and helps to focus the study. It should be specific, measurable, and answerable through the collection and analysis of data.

Secondary research

This review focuses on current work. But it's not personal. Literature review methods and data from existing companies can be used for this purpose. This study aims to identify a few points in this large study.

Inclusion criteria

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There are a few things to consider before you start your search. How do you find accurate/reliable information. In this case, the source is not scientific. The white paper was adopted as the source of this study as much of the study was work oriented.

Features include:

- International organizations.
- The white paper: Important information or advice to convey to the reader.
- It summarizes complexity and introduces the concept of entrepreneurship.
- Educational activities.
- Market research: the company works or consults.
- general education.
- Articles and videos from experts in the field: can be produced.
- Examples: Give examples of good or bad business practices.
- Content: business research.

Exclusion criteria

Research that does not properly support the founding principles, such as non-commercial research, is avoided. Data older than 5 years should not be considered. Areas other than the above data should not be considered because the technology and economic conditions are unknown. Comparison of the population (by age or gender) is beyond the scope of this article and should not be considered.

User Context

To better understand our problem, we need to understand our users. Therefore, to achieve this goal, I first researched what mental health is and how it affects the lives of individuals and communities. As part of our mission, we tried to understand people with mental illnesses and how we can rehabilitate them. We also heard from a client with dementia who is struggling to understand how he is coping with the illness and how it is affecting his life. Conduct research to identify ideas and concepts that meet employee needs.

In our research and consumer research, we tried to find out how consumers behave in certain situations. We want to share our ideas about human behavior. I wanted to capture action, context, mood and tension. We reflect the goodness of everything, not the mind of a psychopath. Thinking is hard. I want to show you how to see with spiritual eyes.

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Assumption

To making the solution based on the different study and statistics. An assumption need to be made that with be converted into the conceptual design following the sketch and then converted it into the design.

Synthesis and Findings

Synthesis and findings refers the ideas that generated into the previous section fine tune and finalize the design. In this portion, it is very necessary to getting feedback from the user to make the design effective. Different models can use for completing this portion.

3.4 Implementation Requirements

Interaction design implementation requirements vary depending on the project and the specific design decisions made during the design process. However, some common requirements include:

- A clear understanding of user needs and goals
- Accessibility guidelines and best practices
- A consistent design language and visual style
- Responsive design for different screen sizes and devices
- User testing and feedback to ensure the design meets user needs and goals
- Cross-browser and cross-platform compatibility
- Optimization for performance and load times
- Consideration of internationalization and localization for global audiences.

It's important to note that the implementation process is an ongoing effort, and designs may need to be tweaked or updated over time to ensure that they continue to meet user needs and goals, and stay current with design trends and best practices.

CHAPTER 4

Design and Discussion

4.1 Design process

Interaction Design Research

Analysis during the initial design process helps gather accurate, up-to-date and complete data for investigations and inquiries. Various methods can be used to collect data, such as market research, surveys, surveys, and surveys. Let me discuss some of these methods.

Product Researches

Business data collection and analysis methods. This may depend on the target market. An existing product or market is often called market research. This helps in collecting accurate data and making the necessary comparisons. Related products are also available in online stores.

User Researches

The process of understanding consumer needs, experiences, behaviors and motivations are called consumer research. It can be obtained in different ways, such as by asking questions about specific products, surveys, questions about products, etc. This process is done to create online marketing materials to create better results [19].

Age

Statistics shows the age group of the people those who are using smart phone [20].
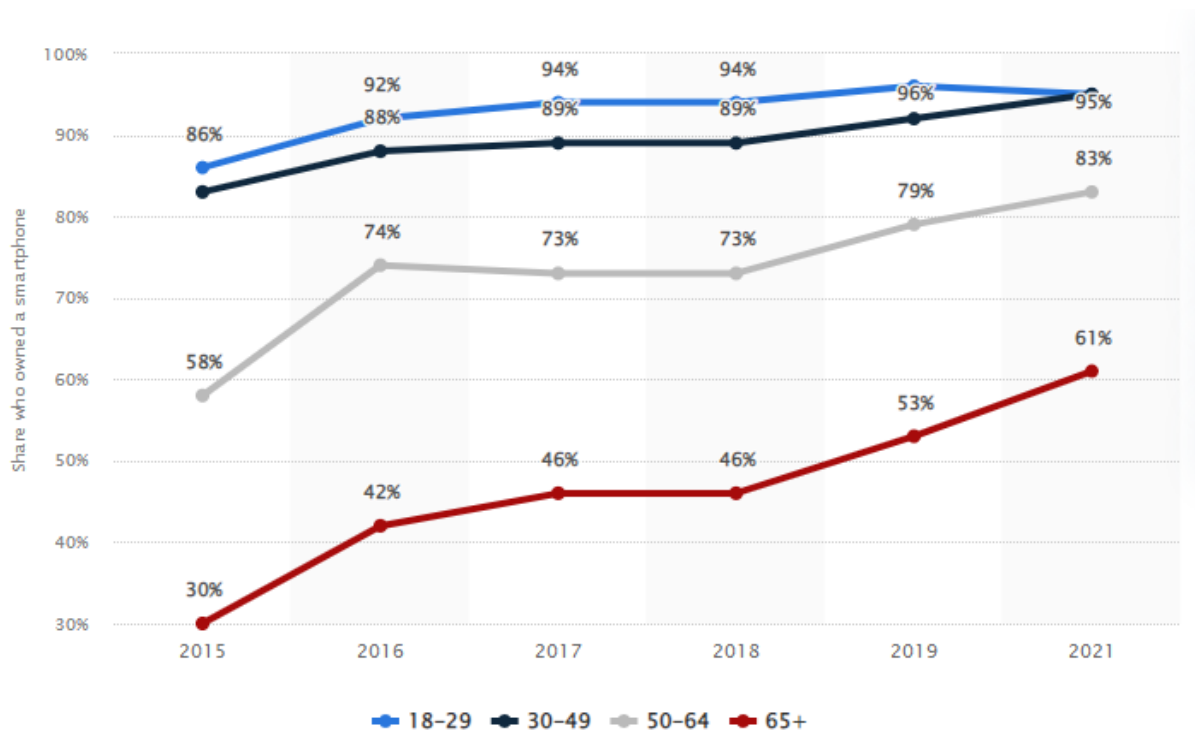
Figure 11: Smart Phone User by age group [20].

Chosen device for Application

It can be seen from the statistics that most users use smartphones to control smart home devices. I am also developing a mobile application for Smart Home.
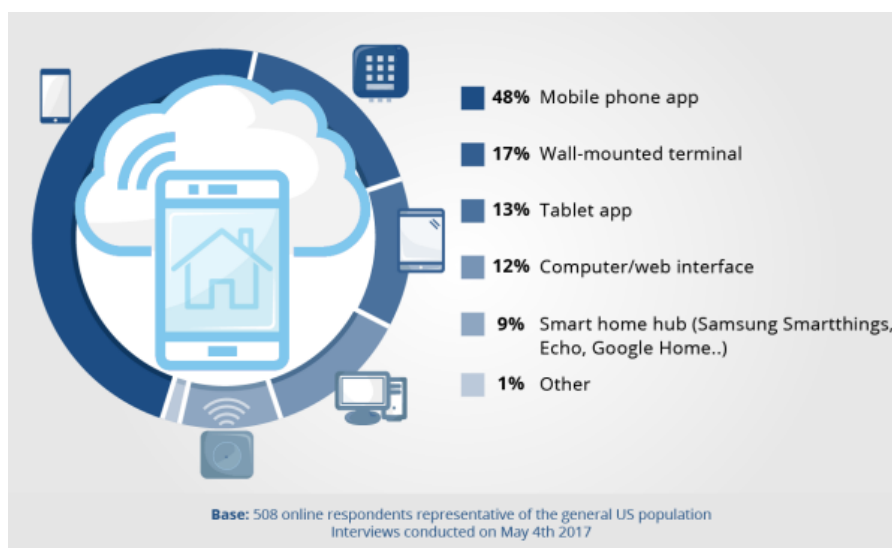
Figure 12: Chosen Device for the application

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Chosen OS for mobile application:

The choice of structure is one of the most important parts of the decision. I am installing an app on Android [21].
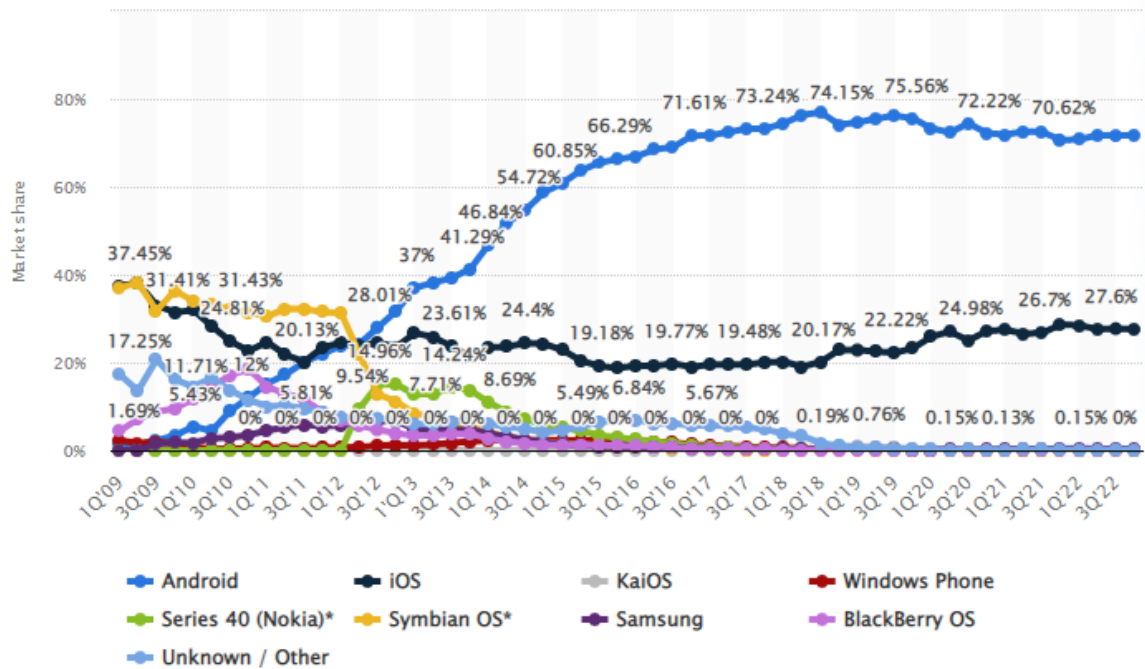
Figure 13: Chosen OS for the application.

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Primary Persona:

Figure 14: Primary Persona

Primary User Scenario

Mrs. X is a 36-year-old married woman living in London who currently works for a non-profit organization as the Vice President of Marketing. He is busy all day and has no money for the family's daily needs. Therefore, internet marketing is the best solution. So, she can finish her work quickly and shop.

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HTA (Hierarchical Task Analysis)
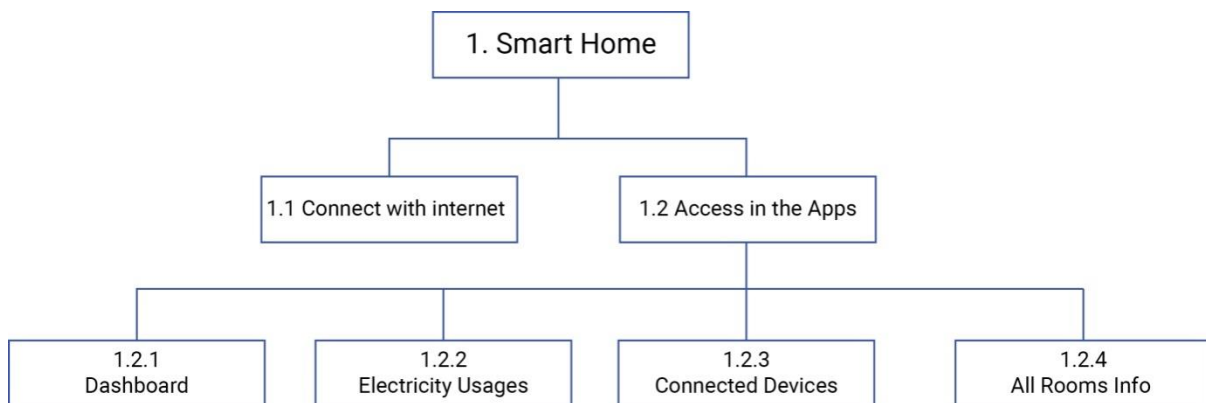
Figure 15: HTA of the Apps.

4.2 Conceptual Design

The interaction Design Research section discusses devices, circuits, and operating systems for optimal commercial use. Here will talk about the tool and how it is used in the process.
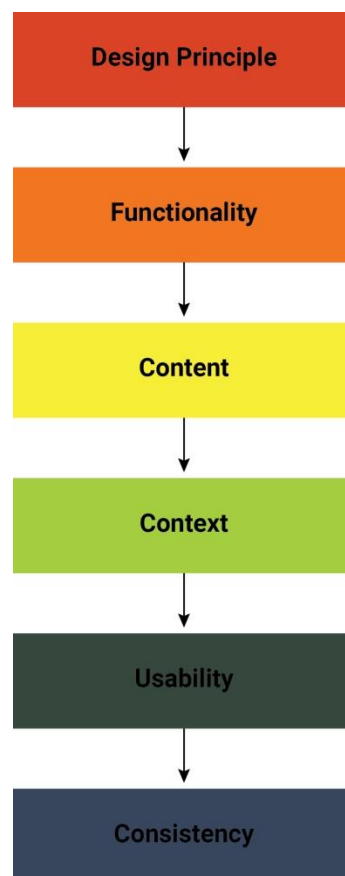
Figure 16: Conceptual Design Process

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Design Principle:

To create a complete, responsive and simple user interface. It must strictly adhere to the principles of online shopping app design, Ben Schneiderman's 8 Golden Rules and Jacob Nielsen's 10 User Behavior Analysis for interface design. As with the design of the Super Shopping Online app, there are a few things to keep in mind when following the rules;

Functionality:

Features refer to what the user can do with the system. The system and the functions required by the system are analyzed.

Apps Specification Guide:

- ➢ Smart objects receive data from users.
- ➢ Online shopping tools decide what is reasonable and keep order.

Content:

The content should be everything we see on the application screen. It can be in different formats such as images, text, images, text, and others.

Apps Specification Guide:

- ➢ Use pictures to identify objects.
- ➢ Messages must be sent to receive comments.
- ➢ Use Bluetooth and WiFi tags.

Context:

Content includes product terms and conditions. This helps developers find services and applications.

Apps Specification guideline:

- ➢ The user returns to the previous state.
- ➢ Allows users to bookmark an application, allowing them to move from one page to another.

Usability:

Usability refers to the ease with which users are able to use an application. This allows users to use the system without any problem. Adding things like icons, symbols, and colors expands the app's functionality.

<u>Apps Specification guideline:</u>

- ➢ Smart Home applications that select individual services and events require appropriate icons and buttons.
- ➢ Send messages to users for immediate action.
- ➢ It is better to use smart devices for online shopping.

Consistency:

Lack of agreement refers to the overall level of the project management process. You don't have to have the same style to be the same, it can be different, but it is important to understand that the interface does not confuse the user.

Apps Specification guideline:

- ➢ Try to keep all pages in one place.
- ➢ Try to write down important information in order

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4.3 Low Fidelity Design

Low-fidelity designs are typically created using simple tools such as pen and paper, wireframing software, or basic design software. They often lack many of the visual details that are found in high-fidelity designs, such as color, images, and typography. This is intentional, as the focus is on functionality and usability rather than aesthetics at this stage.

In conceptual design a clear indication need to be made for the design product. As the product will be related to the smart hope or home automation, the low fidelity design can be as below.
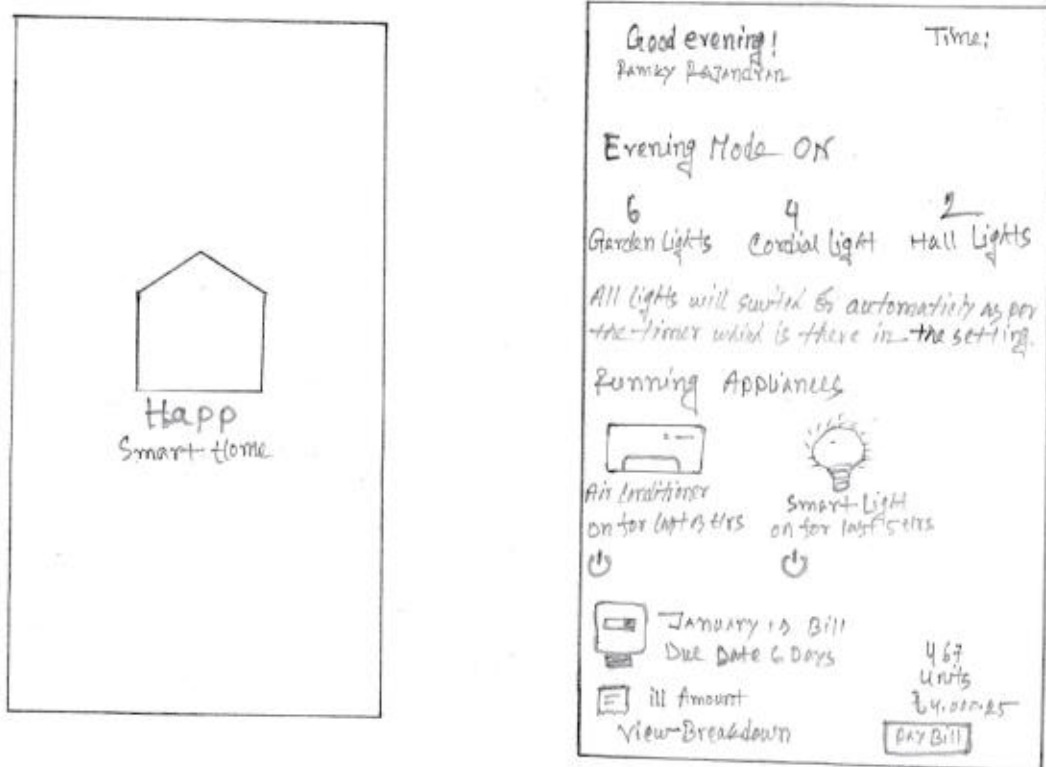
Figure 17: Low Fidelity Design for the Apps 01.

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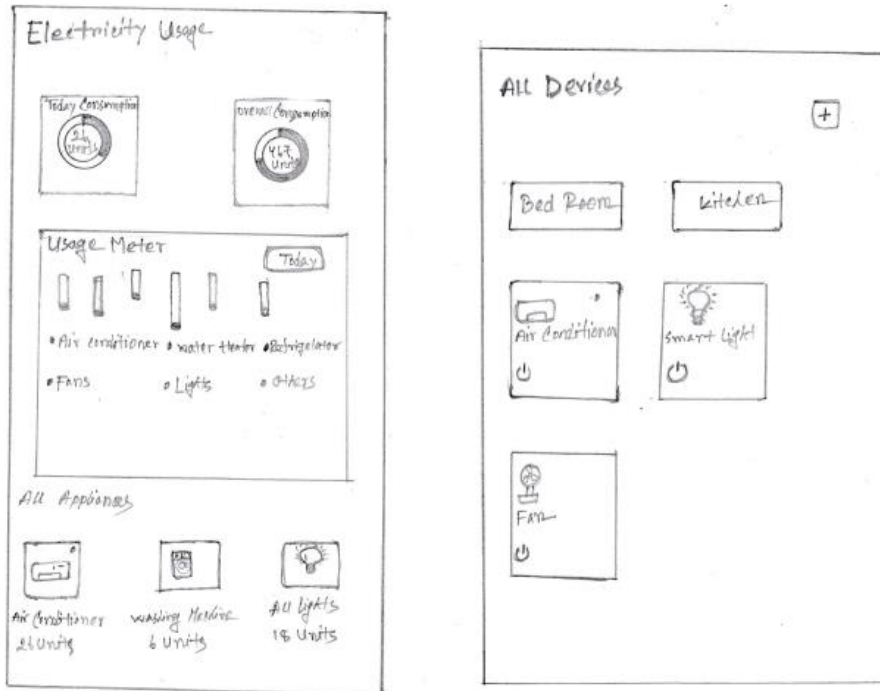
Figure 18 : Low Fidelity Design for the Apps 02.
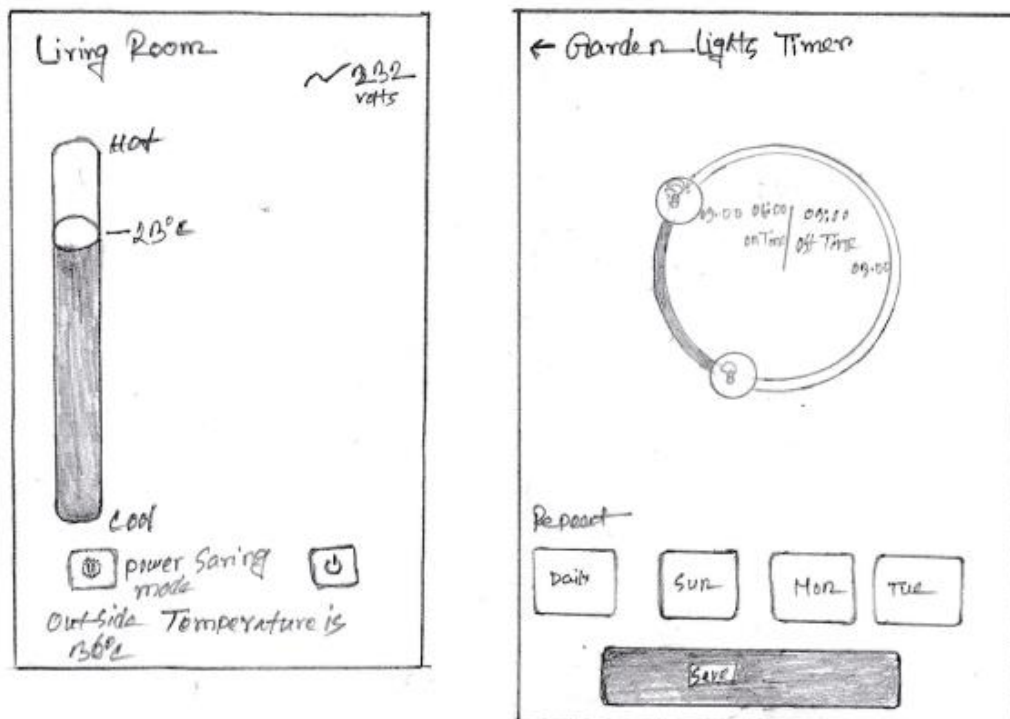
Figure 19: Low Fidelity Design for the Apps 03.
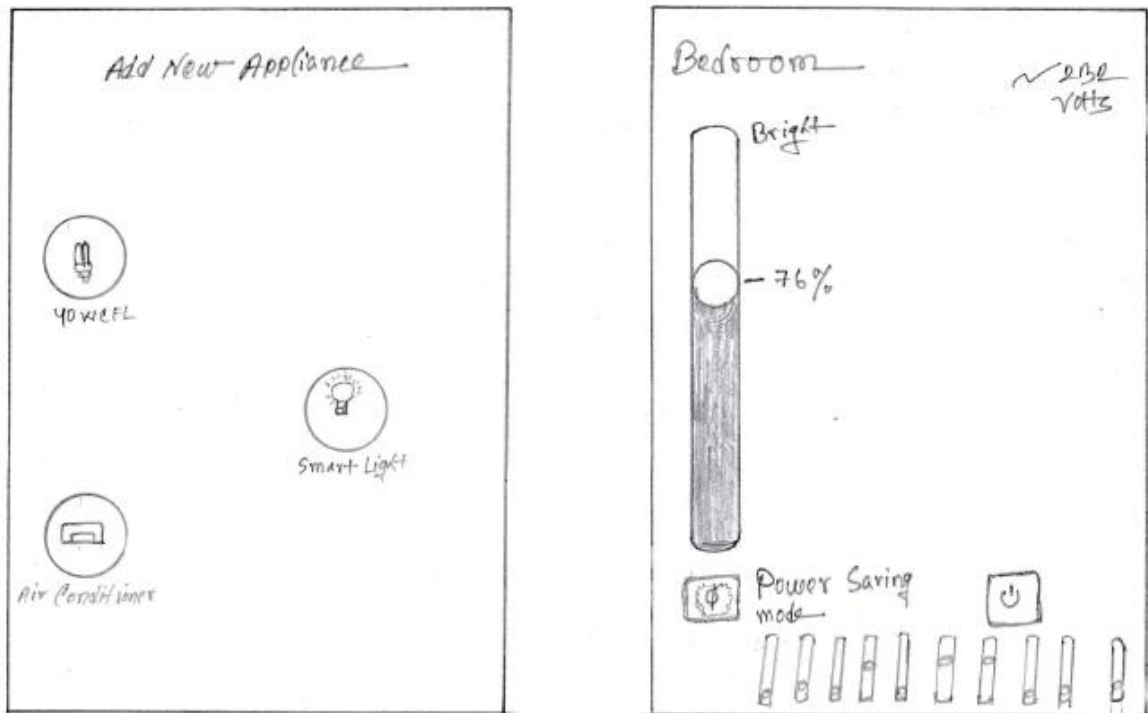
Figure 20: Low Fidelity Design for the Apps 04.

4.4 High Fidelity Design

High-fidelity design for UI/UX refers to the process of creating detailed, visually-accurate representations of a user interface for a product or website. This can include wireframes, mockups, and prototypes that closely resemble the final product in terms of layout, typography, and visual design. High-fidelity designs are usually created after low-fidelity designs have been validated and are used to test and iterate on specific interactions, navigation, and user flows. They help to communicate the design vision to stakeholders and developers, and to gather feedback from users to improve the overall usability and user experience. Adobe XD has been used to design the application.
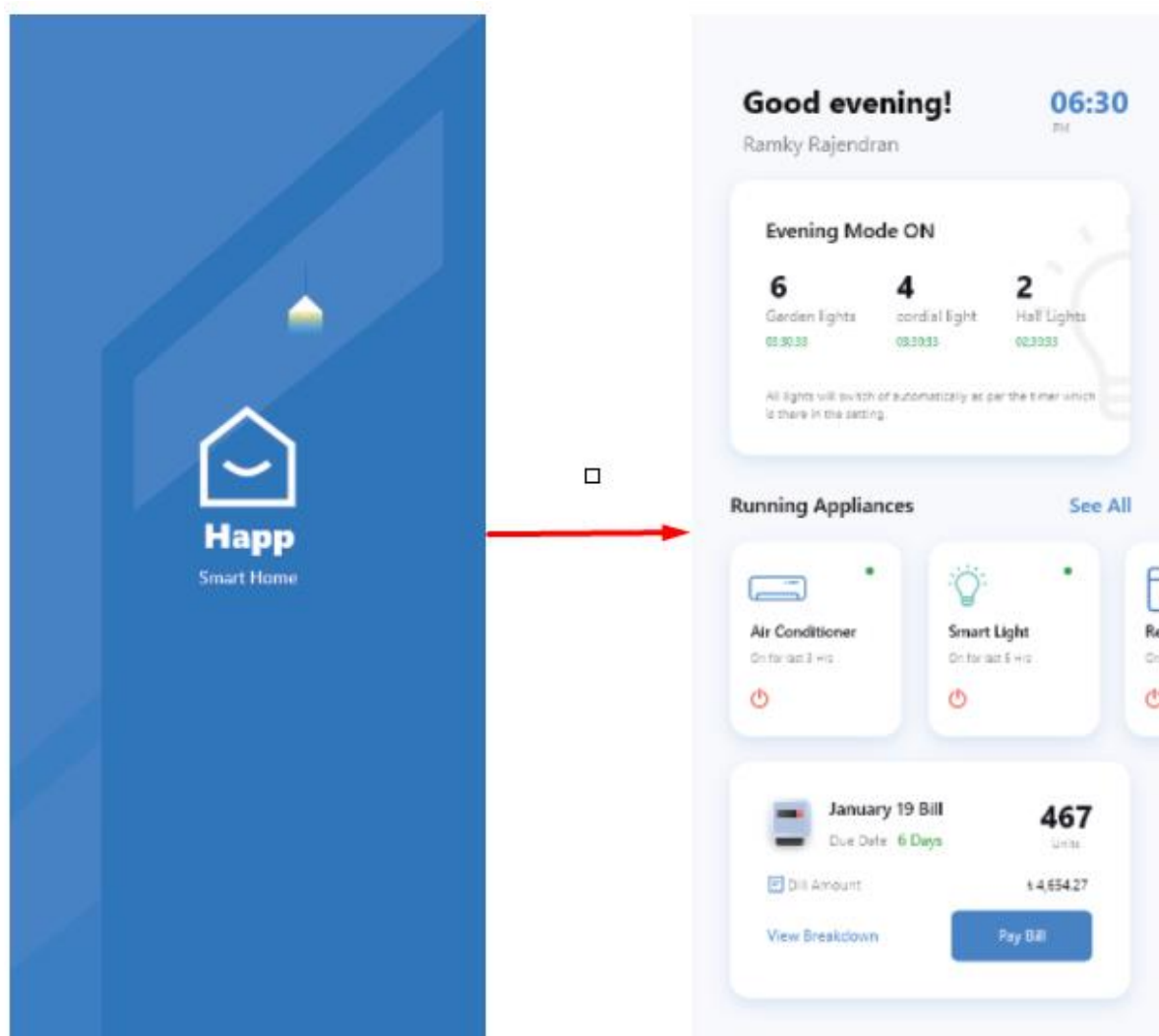
Figure 21: High Fidelity Design for the Apps 01.
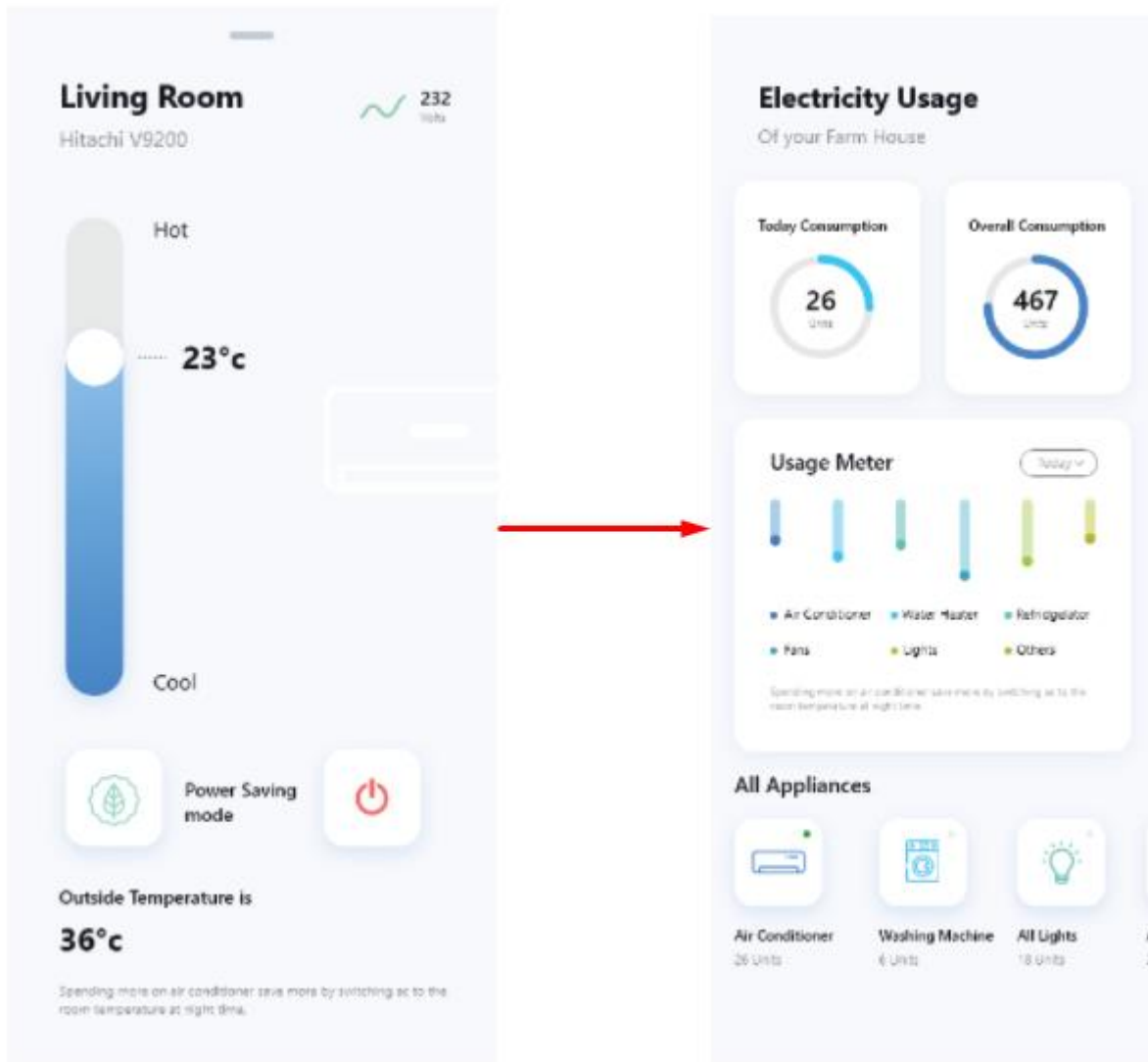
Figure 22: High Fidelity Design for the Apps 02.
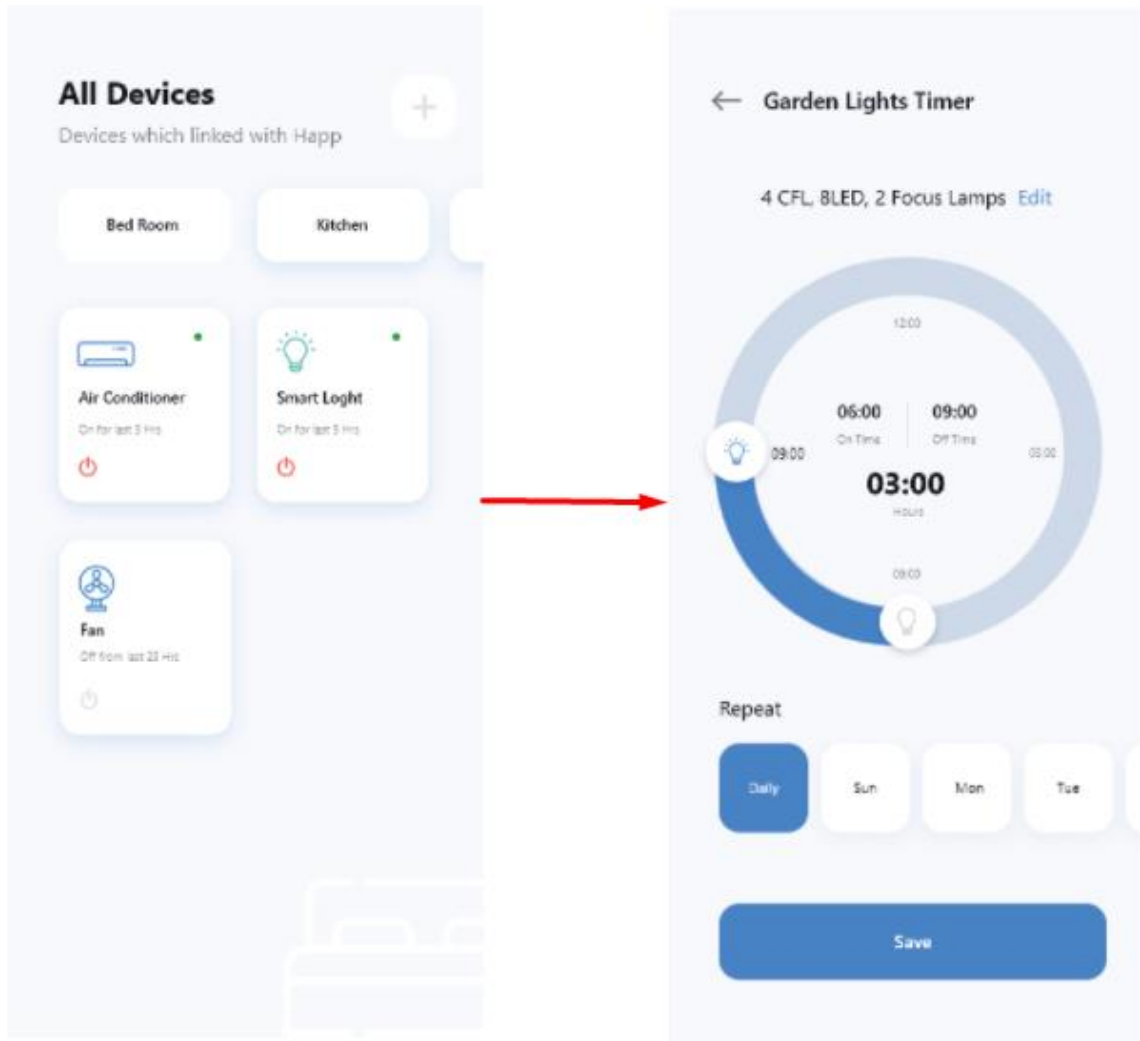
Figure 23: High Fidelity Design for the Apps 03.

© Daffodil International University
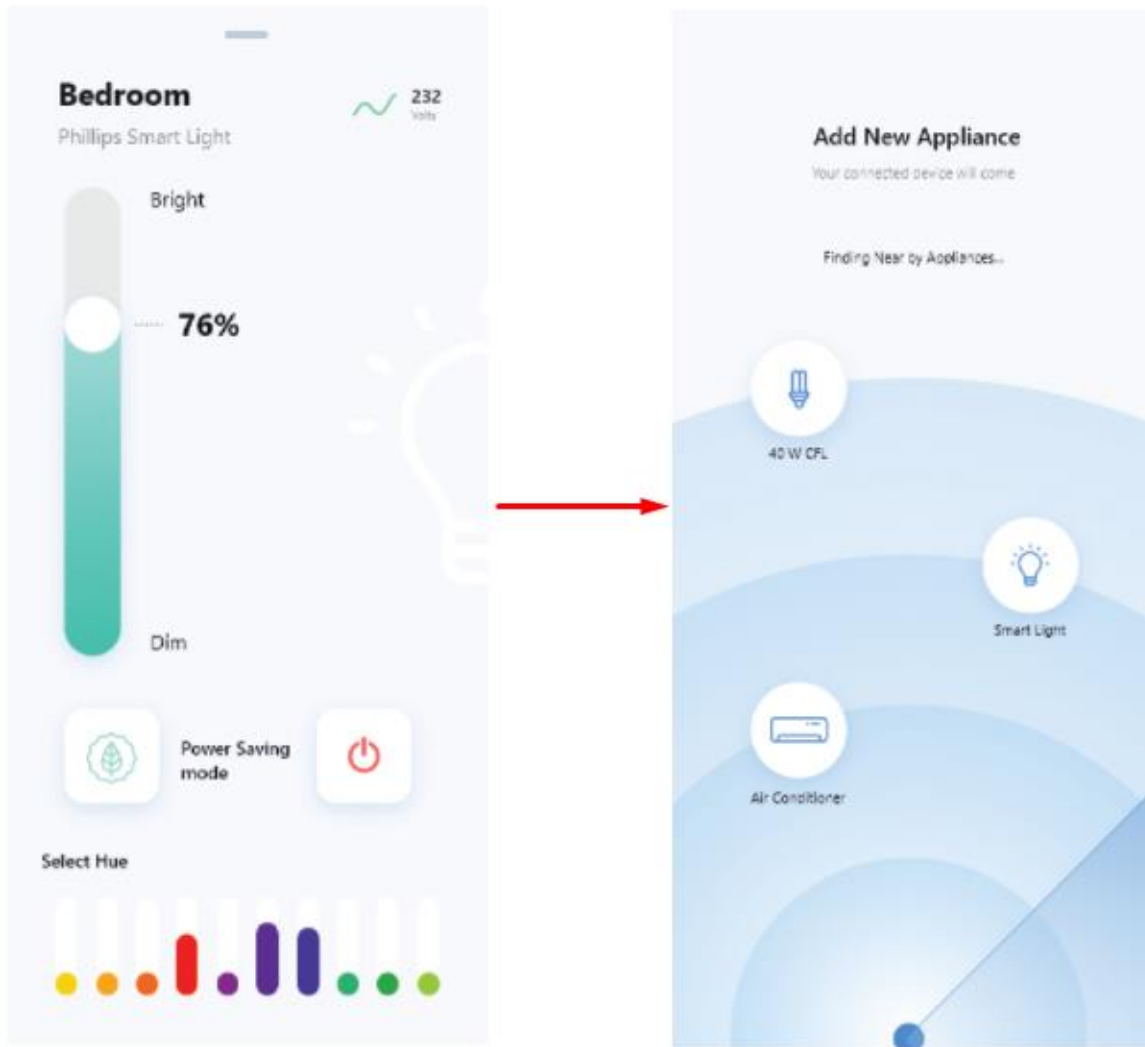
Figure 24: High Fidelity Design for the Apps 04.

4.5 Discussion

System Usability Scale (SUS) and HEART are the two most common and useful method for checking the measure of the usability and user experiences.

System Usability Scale (SUS)

The System Usability Scale (SUS) is a widely-used, 10-item questionnaire used to measure the perceived usability of a system. It is a simple and efficient way to obtain an overall score that reflects the usability of a system. Participants are asked to rate their agreement with each statement on a 5-point Liker scale, with higher scores indicating better usability [22].

The questions are as follow as:

	Strongly Disagree				Strongly Agree
1. I think that I would like to use this product frequently.	1	2	3	4	5
2. I found the product unnecessarily complex.	1	2	3	4	5
3. I thought the product was easy to use.	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this product.	1	2	3	4	5
5. I found the various functions in the product were well integrated.	1	2	3	4	5
6. I thought there was too much inconsistency in this product.	1	2	3	4	5
7. I imagine that most people would learn to use this product very quickly.	1	2	3	4	5
8. I found the product very awkward to use.	1	2	3	4	5
9. I felt very confident using the product.	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this product.	1	2	3	4	5

The formula to calculate:

((Q1-1)+(Q3-1)+(Q5-1)+(Q7-1)+(Q9-1)+(5-Q2)+(5-Q4)+(5-Q6)+(5-Q8)+(5-Q10)) x 2.5

SUS Score	Grade	Adjectival rating
>80.3	A	Excellent
68-80	B	Good
58	C	Okay
51-68	D	Awful
<51	F	Poor

Heart Framework

The HEART framework is a user-centered design framework used to evaluate and improve the user experience (UX) of a system. HEART stands for the five key elements of a successful UX such as Happiness, Engagement, Adoption,Retention, Task success.

Each of these elements is associated with a set of metrics that can be used to quantify the performance of a system. The HEART framework can be used to identify areas where a system is performing well and areas that need improvement, and to prioritize design changes based on the needs of users. It is widely used in the field of User Interface and User Experience Design [23].

GOALS		SIGNALS	METRICS
Happiness	Users find the app helpful, fun, and easy to use	• Responding to surveys • Leaving 5-star ratings • Leaving user feedback	• Net Promoter Score • Customer satisfaction rating • Number of 5-star reviews
Engagement	Users enjoy app content and keep engaging with it	• Spending more time in the app	• Average session length • Average session frequency • Number of conversions *(consuming content, uploading files, purchases, etc.)*
Adoption	New users see the value in the product or new feature	• Downloading, launching app • Signing up for an account • Using a new feature	• Download rate • Registration rate • Feature adoption rate
Retention	Users keep coming back to the app to complete a key action	• Staying active in the app • Renewing a subscription • Making repeat purchases	• Churn rate • Subscription renewal rate
Task **Success**	Users complete their goal quickly and easily	• Finding and viewing content quickly • Completing tasks efficiently	• Search exit rate • Crash rate

Figure 25: HEART Framework.

CHAPTER-5

Conclusion and Future Work

5.1 Conclusion

In conclusion, the research on UI/UX has shown that a well-designed user interface and user experience can greatly enhance the overall performance and satisfaction of a product. The main goal of UI/UX design is to create a seamless and intuitive user experience that allows users to accomplish their tasks with ease and efficiency. This can be achieved through various design principles such as simplicity, consistency, and accessibility.

The research has shown that simple and intuitive design can greatly improve the user's ability to complete tasks and achieve their goals. For example, clear navigation and consistent layout can help users to quickly find the information they need and understand the structure of the product. Moreover, personalization and customization options can make the experience more tailored to the user's needs and preferences.

Additionally, accessibility features are an essential aspect of UI/UX design. Ensuring that products are inclusive and accessible to all users, including those with disabilities, can greatly improve their overall experience and satisfaction. This can be achieved through features such as high contrast mode, text-to-speech, and keyboard navigation.

User testing and feedback are crucial in the development of a successful UI/UX design. By gathering user feedback, designers and developers can understand how users interact with the product, identify any pain points, and make necessary improvements. Furthermore, user testing can help to validate design decisions and ensure that the product meets the needs of its target audience.

In summary, UI/UX design is a complex and multi-disciplinary field that requires a deep understanding of user behavior, psychology, and technology. It is important for designers and developers to conduct research and gather user feedback to ensure that products are meeting the needs of their users and are being designed in a way that is inclusive and accessible to all. With the ongoing advancement in technology, it is essential that the field of UI/UX design continues to evolve and adapt in order to provide the best possible experience for users.

5.2 Future Work

Possible areas of future work for an interaction design thesis paper on a smart home application include:

➢ Conducting user testing and gathering feedback to improve the usability and user experience of the application.

➢ Adding new features and functionality to the application, such as integration with other smart home devices or support for additional languages.

➢ Investigating new interaction methods, such as voice or gesture control, to enhance the user's interaction with the application.

➢ Exploring methods for ensuring the security and privacy of users' data and controlling access to the smart home system.

➢ Evaluating the effectiveness of the application in terms of energy efficiency and cost savings.

➢ Investigating how to design for accessibility, by considering users with special needs, disabilities and age.

➢ Investigating how to design for multi-user households, by considering different user profiles and permissions.

➢ Investigating how to design for different cultures, by considering cultural differences in the way people interact with technology.

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