IOT based Smart Energy Meter Mobile Application Design

BY

RAYHAN KHAN RAFI
201-40-692

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Multimedia and Creative Technology

Supervised By

Mr. Kazi Jahid Hasan
Assistant professor
Department of MCT
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY
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APPROVAL

This Project titled **"IOT based Smart Energy Meter Mobile Application Design"**, submitted by **RAYHAN KHAN RAFI, ID: 201-40-692** to the Department of Multimedia and Creative Technology, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Multimedia and Creative Technology and approved as to its style and contents. The presentation has been held on 11 January, 2025.

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Consultant (Graphics), SDMGA Project, ICT Division
Adjunct Faculty of Fine Arts
University of Dhaka

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mr. kazi Jahid Hasan, Assistant professor, Department of MCT** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:

Mr. Kazi Jahid Hasan
Assistant Professor
Department of MCT
Daffodil International University

Submitted by:

Rayhan khan Rafi

ID: 201-40-692
Department of MCT
Daffodil International University

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First, I would like to express my sincere gratitude and appreciation to Almighty God, whose blessings enabled us to successfully complete my final year project.

I am sincerely grateful and deeply grateful to Mr. Md. Salah Uddin, Assistant Professor and Head of Department of Multimedia and Creative Technology, Daffodil International University, Savar, Birulia, Dhaka, Bangladesh. The deep knowledge and deep interest of ours in the field of "UI/ UX" for the implementation of this project. His endless patience, scholarly direction, constant encouragement, constant and energetic supervision, constructive criticism, valuable advice, and reading many inferior drafts and revising them at all stages made this project possible.

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I must acknowledge the continued support and patience of our parents with due respect.

ABSTRACT

IoT in smart energy meter mobile application breaks new ground by introducing users to better energy management methods. This calls for increased demand for sustainability. Not only at the residential level but also in commercial areas. Therefore, an application is presented to analyze usage trends. Identify devices that use the most energy and set custom goals for energy saving. All of this is combined with smart energy meters and Internet of Things devices to provide real insights into energy usage... Designed to improve energy behavior, predictive analytics, customized data for unusual usage, help users make informed decisions with a wide range of features. Including supporting renewable energy sources. Our solution automates invoicing. Makes it easy to pay bills and generate detailed consumption reports for users. This will help improve the user experience and contribute to the sustainable development of resources. This application represents an important step towards smarter, energy-efficient living.

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Chapter 1

INTRODUCTION

1.1 Introduction

The development and advancements of technologies and means of communication have drastically changed everyday life and communication. Before technology began to develop, communication was via face-to-face conversations, oral tradition, and handwritten letters. It was just such a system that built close-knit social structures and communities. The panorama of everyday life and communication has changed amazingly with the advent of digital technology. On one hand, digital media, cell phones, and smart devices of the Internet of Things create an unprecedented closeness, encourage creativity; on the other hand, they raise problems of dependency on technologies, issues relating to privacy, and gaps in digital literacy. Digital advances have brought new path-breaking opportunities to the energy management sector. The Internet of Things-powered smart energy meters replace traditional energy monitoring systems riddled with a number of errors and inefficiencies. The functionality of these devices allows collecting data in real time, while increasing user interaction in ways that encourage greener energy consumption. All smart meter-interfaced mobile applications allow consumers to access their energy consumption and thereby understand their usage trends to make prudent decisions towards lessening wastages.

This paper discusses the design and development of a mobile application for Internet of Things-based smart energy meters. An effort will be made to integrate an intuitive interface that, through its features-data visualization, real-time monitoring, and personalized recommendations-will promote the conservation of energy. Targeted at empowering users to help in environmental sustainability by way of design concepts, user research, and industrial standards in overcoming energy problems presently faced, this app is being designed.

1.2 Motivation

The IoT revolutionized the manner of interaction and control with our environment; among its applications, one of the most valued concerns energy managements. It will be very timely and important for the development of a mobile application for IoT-based Smart Energy Meters with an increase in the demand towards sustainable development and efficient energy utilization. The present project aims at providing an ease-of-operation, real-time solution in tracking and managing energy consumptions for both individuals and organizations through a mobile platform. Application of the IoT in this particular application will assuredly lead to a potential decrease in energy waste, affordable utility costs, and therefore a move toward a greener future. Besides its accuracy and usability, the system will be designed to foster long-term goals on energy savings and the conservation of the environment. The paper outlines the design process, the challenges faced, and the likely impact of the system; hence, it contributes to the proliferation of smart energy solutions in a digitally growing world today.

1.3 Objectives:

Main Objective:

Create a mobile application for energy tracking which is IoT-based and enables customers to have real-time tracking, get actionable insights, and receive personalized and aware energy usage giving them efficient and green energy usage.

Enhancing User Experience:

Create an intuitive and scalable UI that suits both technical and non-technical people, and presents them with a myriad of options to tailor. It has to include customized notifications, appliance-based advice, and easy navigation to ensure the best possible user experience.

Leveraging IoT Capabilities:

Figuring out the way to use an Internet of Things technology to achieve a real-time electric monitoring technology, data security through data communication, and combined smart home appliances. For this, the realization of automatic data collection and manual control makes remote environments more convenient.

Promoting Sustainability: Energize eco-friendly behaviors by providing tools for tracking and lowering the energy usage. The software enables the user to choose among renewable energy options and to set sustainability-related goals as well. The feedback they give are the tools.

Boosting Engagement with Gamification:

Integrate fun tools like badges, saving energy through the use of the milestone function and rewarding users for their achievements. Such implementation will bring many rewards; for instance, incentive coupled with knowledge sharing.

Simplifying Energy Management:

Calculate your electricity bills automatically, propose in-app payment and let your customers download sophisticated usage reports while making them simple to read.

Making an Impact Beyond the Fundamentals:

To hack the problems existing in the data comprehension and efficiency of the energy companies, the software features to individuals the savings they would have on their expenses, and at the same time their contribution to efforts to save our planet.

1.4 Features

User Interface (UI):

The energy tracking app comes with a fairly simple and user-friendly interface to ease e-tracking. It's the inclusion of a well-arranged list of appliances, each with an energy bar that is colored with different shades to indicate energy consumption over chosen periods (day, week, month). More vibrant or deeper red tones signal extremely high usage, thus making it easy for consumers to recognize the power-consuming devices. Also, along with each bar, the approximate costs are specified for easier financial calculations. Comparison bars (these are not essential) allow users to see how their appliances relate to the best-case scenarios in their categories, which helps them understand how exactly they are doing energy-wise.

Gamification Elements:

The app with the use of gamification delivers a comparatively more fun and engaging energy management. Users are attested to be emitting less of an excessive amount of gas that causes global warming, through their actions they now become the reason for companies to cut back

on gas burning. This situation leads to production in LED lights much higher leading to a shift to the distribution of the lamps in the market because as the prices of LED lamps decrease, their demand on the market grows. Therefore, government regulations make sure that renewable energy sources can produce more energy and the electric vehicle industry is established. Achievements are powered by the players who play but can be obtained.

User Experience (UX):

Developers made the app as user-friendly as possible, and thus are intended to let it work with smart meters smoothly, without human intervention. Users can set up their experience by adding and/or deleting appliance items, turning on/off notifications, and modifying the dashboards. Handy features such as comprehensive energy insights and direct advice make the discovery of consumption more engaging. The learning of ways to save energy; most of the promotions centered around electricity conservation and the high-demand electricity periods, including the peak periods seem to capture the interest of most users especially during the summertime.

1.5 Problem Statement:

The failure to engage users is a significant problem in current designs. Consequently, adoption rates are low and application engagement.

Multifaceted statistical data: Standard energy consumption information can be challenging for users to comprehend. Why? Based on research, the capacity to make energy-saving decisions is limited.

Excessive customization options: Current apps may not offer any customization features. It also means that users are unable to personalize the program.

UX: Certain applications may have issues with usability, such as poor navigation or limited performance. Why? Consequently, one is left feeling exhausted and...

Unsatisfactory integration with smart devices: Smart meters may not be a sufficient connector to IoT devices. Why? The application's capacity to transmit real-time data and remote-control capabilities is restricted.

Basic functions:

- ☐ Real-time energy monitoring.
- ☐ Presents current energy consumption (kWh) through an innovative and user-friendly meter.
- ☐ Easily display device and category details (lighting, heating, electronic devices) using colored pie or stacked bar charts. •.
- ☐ The study of consumption patterns during peak usage periods is beneficial.
- ☐ Historical and survey information.
- ☐ Users can view energy consumption trends for the day, week, month, and year.
- ☐ By using usage accounts as a basis for cost estimates, the financial impact can be clearly seen.
- ☐ Energy saving tips based on usage patterns with personalized insights.
- ☐ Expense management.
- ☐ Elucidates the projected and actual electricity expenses for straightforward budgeting purposes.
- ☐ Provide a chance to compare bills with those of the past month.

UI Design Principles:

- Clean and modern aesthetics: Simple layout with clear hierarchy of information.
- Intuitive navigation: Easy access to all features with clear labeling and icons.
- Data visualization: Utilize graphs, charts, and colors effectively to present complex data understandably.
- Accessibility: Ensure good color contrast, appropriate font sizes, and text readability for all users.

UX Considerations:

- Onboarding tutorial: Guide new users through the app's functionalities.
- Customization: Allow users to personalize the dashboard layout and information displayed.

- Push notifications: Provide timely alerts for high energy usage events or goal achievements.
- Help and support: Offer in-app FAQs, tutorials, and easy access to customer service.

Chapter 2

BACKGROUND STUDY

2.1 IoT-based mobile application

These mobile applications, based on IoT platform, could provide the strong connection to Ionic devices and manage them using smartphones, so users can make the interaction and control of these intelligent devices fast and easy in real time. However, some applications or software programs could enable users to control and supervise the IoT devices installed on their bodies, at home in terms of smart appliances, or in their workplace's industrial sensors. Alerts have been mostly real-time, while there has also been provision for interactive data visualization. Hence, IoT devices can communicate effectively with other devices across mobile networks and utilize their capabilities more efficiently. In fact, such IoT-based mobile applications permit users to consider optimizing the use they can make of devices, empowered access to informed choice-making, and optimum deployment of the connected ecosystems into their lives through effective, easy-to-use interfaces and good connectivity.

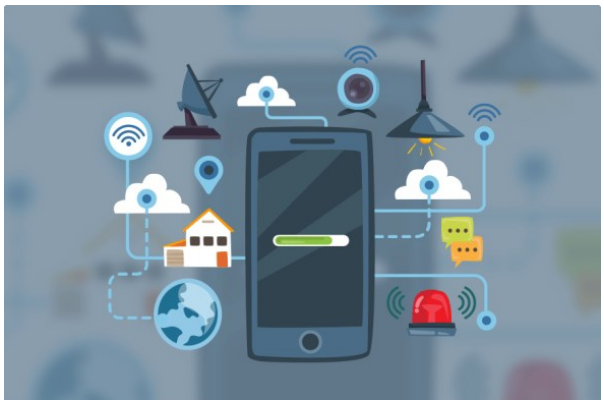


Figure: 2.1: IoT-based mobile application

2.2 Telecommunication Technology

Telecommunication technology can be understood as a system that utilizes various electronic media to transfer or communicate information across long distances. It comprises the various technologies and systems which are involved in transmitting voice, data, or multimedia content over distance. Telecommunications technologies allow communication between persons, companies, and organizations around the globe, with real-time interaction and transfer of

information. The examples include telephone networks; internet protocols; wireless communication systems, and satellite communication. This is a fundamental technology that connects people and devices, or indeed the backbone of modern communication infrastructure, and is powering global interconnectedness and collaboration.

Figure: 2.2: Telecommunication Technology

2.3 Related work and research

This essentially composes research on mobile applications for the internet of things that connects existing ecosystems for improving connectivity, technology solutions, and usability. The scope of these studies could range from resource efficiency to secure data transfer and real-time data processing. It may also include development of very-complex user interfaces for easy control and exhaustive monitoring, the optimization of communication protocol for low latency and high reliability in data transfer. Other studies focus on privacy and security, thereby protecting sensitive user data and ensuring strong authentication. All of these activities jointly contribute to making mobile applications for IoT more effective, usable, and secure.

2.4 Guides

IoT-based mobile application guides are instructional resources designed to help users understand and utilize mobile apps that manage Internet of Things (IoT) devices. These guides typically include step-by-step instructions on setting up and connecting IoT devices, navigating the app interface, utilizing key features like real-time monitoring and alerts, and troubleshooting common issues. They aim to make it easier for users to effectively control and optimize their IoT ecosystems, enhancing the functionality and user experience of their connected devices.

2.5 Proposed Method

This is a state-of-the-art meter mobile application for efficient energy monitoring and management. The application will collect and transmit real-time consumption data using IoT-enabled smart meters via secure communication protocols such as MQTT or HTTP APIs. This will be backed up by an Advanced Metering Infrastructure (AMI) that would allow two-way communication and remote communication control.

The user interface of this application designed by Figma will give priority to simplicity, easy access, and personalization for integration with other smart home devices. It will be an interactive platform engaging users actively while ensuring practices that favor sustainable energy savings through energy-saving milestones and rewards. In this way, the solution is a complete, scalable, and secure energy management solution for availability to the modern user.

2.6 Energy Meter

An electric meter is such a device, by means of which the measurement of the quantity of electrical energy consumed by a dwelling, establishment, or an electrically powered item is carried out as an energy meter.

Kilowatt hour is the most widely used billing unit for calibrating electric meters. Billing cycles and the usage of electricity are determined at regular intervals through checking the electric meters.

Solid state electricity meter located on a panel that is linked to a 2 MVA substation. Both locally and remotely, using infrared and a modem, current and voltage sensor information can be read and programmed. Infrared port indicates a circle with two dots.

Figure: 2.6: Digital Calorimeter

2.7 Smart Energy

A smart energy meter is an electronic instrument capable of measuring, recording, and controlling energy consumption in real time. As opposed to pre-paid meters, smart energy meters offer more functionality such as utility consumption control, spending monitoring and increased efficiency. With the IoT features like remote access, automated billing, and instant notifications about the unusual use of energy, these devices send data to the users and the energy providers without relying on physical connections. Smart energy meters have to do with promoting efficiency, saving costs and energy, because they are the first thing supplying updated figures to clients and easily fitting into modern intelligent housing systems.

Figure: 2.7: Smart Energy Meter

CHAPTER 3

RESEARCH METHOD

The research strategy for a smart energy meter mobile application combines qualitative and quantitative methods. User interviews, focus groups, and usability testing are all examples of qualitative approaches for gathering information about user requirements, preferences, and behavior. Surveys and data analytics are examples of quantitative approaches used to examine vast amounts of user data, find patterns, and validate hypotheses. Furthermore, prototyping and iterative design techniques allow for ongoing development based on user feedback. This thorough strategy assures that the application is user-centered, functional, and successful in addressing energy management concerns.

The book outlines five key elements of user experience design:

- Strategy: Setting goals and performance indicators.
- Scope: Determining features and functionality.
- Structure: Organizing features logically.
- Skeleton: Defining layout and navigation.
- Surface: Designing visual elements.
- Following this framework helps create effective and engaging user experiences, meeting user needs and adding value to business

3.1 User research

User research for mobile application on smart energy meter will focus on apprehending user behaviors, wants, preferences, and inhibitions towards energy consumption and management. The goal here would be to know the attitude of users towards energy monitoring system and their expectations from such applications, along with their issues regarding managing energy consumption. Survey, Interview, Usability Testing, and Observation techniques are used to collect qualitative and quantitative data for analysis and improvement in the design and development of the application. This user research aims to make the smart energy meter mobile app usable by the users, keeping in mind a user-friendly system with high user satisfaction.

3.2 User Personas

Mobile app for smart energy meters is backed by research that is both quantitative and qualitative in its nature. Experts argue that qualitative research can be of various kinds such as user interviews, focus groups, and usability testing all of which provide one with information concerning the user requirements, preferences, and behavior. Quantitative techniques also include surveys and data analytics, which can be employed to large-scale user data in more complex patterns to verify hypotheses. Additionally, prototyping and iterative design procedures allow for such revision based on the past user experience. This strategy as a whole ensures that interaction with the app is simple, the app is effective, and the app assists in solving the problem of energy management

- **Interviews**

My moderated user research interviews were more challenging to organize. I needed to find the right candidates and coordinate with their schedules; this took longer than anticipated. I was able to conduct 3 interviews and the interviews went well. I kept the interviews short down to 10 minutes and gained more insight as to how I might consider building my application. Without these interviews, I would be designing my application blindly not solving the true problem of what users actually need. My assumption and the idea of what users need before my survey and interviews were the opposite of what users actually need. This changes my perspective completely and I am learning not to assume anything when it comes to design. Best to research and test always.

3.2.1 Timeframe

The qualitative interviews took 15 days to schedule and conduct.

3.2.2 Interview Script

Today we shall consider really an interesting new development in the field of energy management, IoT based smart energy meter driven, integrated mobile Application. This technology indeed has the user-friendly smart phone interface using the Internet of Things-that is real-time monitoring and control over energy consumption. This will be the use we will explore regarding how the application works with smart meters, what the benefits are both monetary as well as energy-saving, and the privacy protections that are put in place to secure user information. We shall have on our agenda how the user inputs were received, what the technology impediments happened to be during the Developing time, and plans for future developments associated with this inventive product. Hence, let us begin with some keys on smart energy meters and their working mechanism over the Internet of Things technology.

We get into it now.

3.2.3 Interview Questions

1. Are you satisfied with your current electricity bill?
2. Where from your electricity bills comes?
3. What do you know about smart meters?
4. How profitable can you feel if you can monitor the electricity bill?
5. How will people and country benefit if this work is established in modern life?

Interviews
Interview taken with job holders.

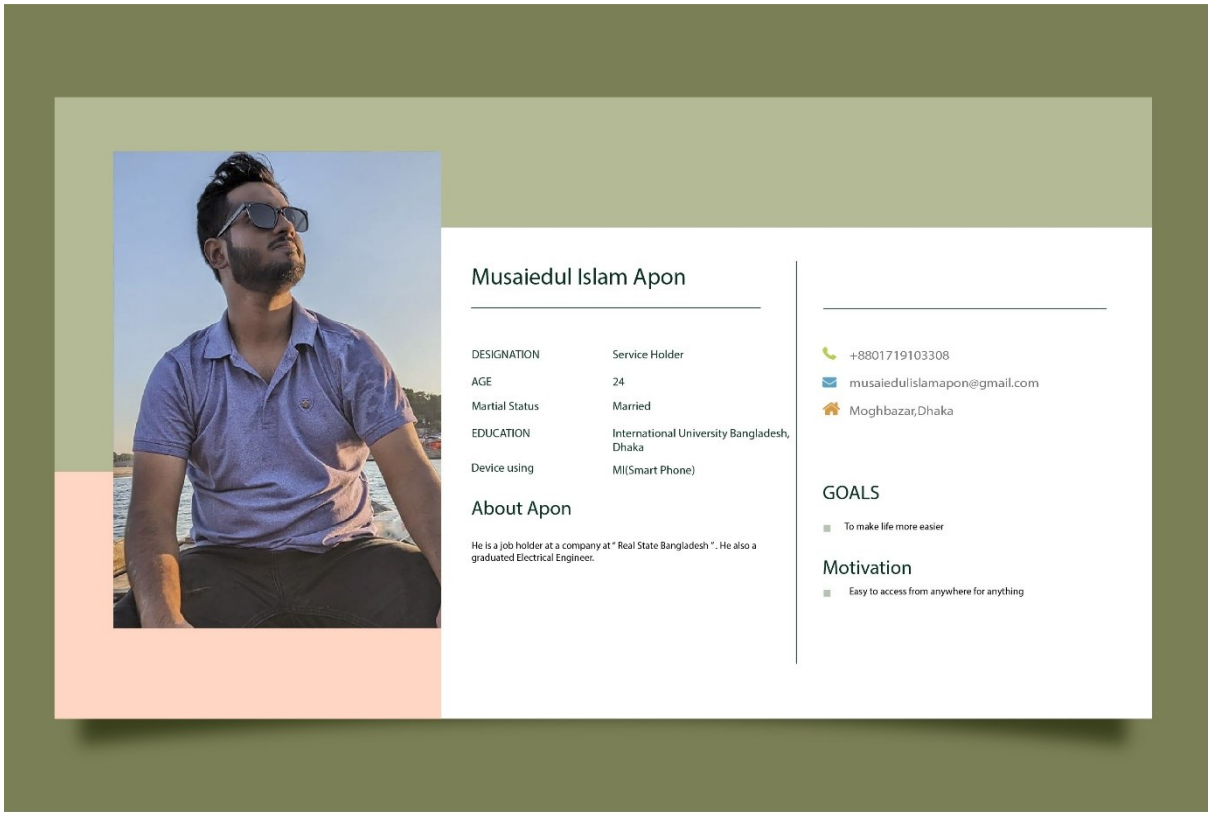


Figure: 3.2.3.1: Interview

Fazle Rabbi Ashique

DESIGNATION	Job Holder
AGE	24
Martial Status	Unmarried
EDUCATION	East West University, Aftabnagar, Dhaka
Device using	IOS (smart phone)

ABOUT ASHIQUE

He is a job holder at a company " Foofpanda ". He also a MIS grade student.

+8801956308930
ashiquef@gmail.com
Khilgaon, Dhaka-1219

GOALS

- To make A great future

Motivation

- To flow with the modern world correctly and perfectly

About Ashique's Smart Meter Energy Iot based Interview Q&A

1. Are you satisfied with your current electricity bill?

answer : No

2. Where from your electricity bills comes?

answer : Dhaka Power Distribution Company Limited (DPDC)

3. What do you know about smart meters?

answer : Smart meters are devices that provide real-time data on electricity usage, allowing for more accurate and detailed monitoring. They can automatically send usage data to the utility company, which helps in creating more accurate bills and identifying issues quickly.

4. How profitable can you feel if you can monitor the electricity bill?

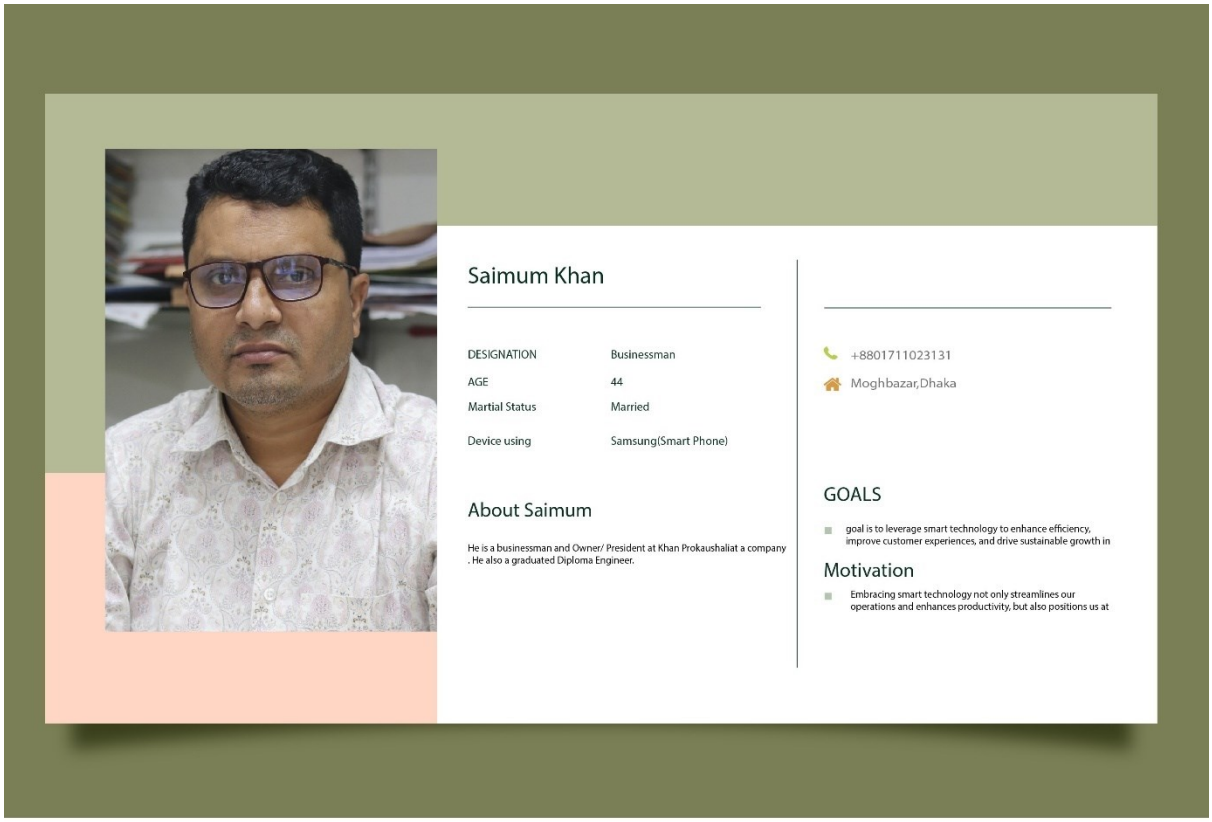
answer : If I could monitor my electricity bill in real-time, it could be quite profitable. I could identify high-usage appliances and make adjustments to reduce consumption, leading to lower bills. This level of monitoring would also help in spotting any irregularities or errors in billing, ensuring I only pay for what I actually use. Over time, these savings could add up significantly.

5. How will people and country benefit if this work is established in modern life?

answer : Widespread implementation of smart meters and real-time monitoring in Bangladesh would have numerous benefits. For people, it means lower electricity bills, more control over energy use, and fewer billing disputes. For the country, it would lead to more efficient energy distribution, reduced losses from power theft, and a more stable power grid. This could also support economic growth by providing reliable electricity to industries and businesses, and contribute to environmental sustainability by promoting energy efficiency.

Figure: 3.2.3.2: Interview

Interview taken with Businessman.



Saimum Khan

DESIGNATION	Businessman
AGE	44
Martial Status	Married
Device using	Samsung(Smart Phone)

About Saimum

He is a businessman and Owner/ President at Khan Prokaushaliat a company . He also a graduated Diploma Engineer.

+8801711023131

Moghbazar,Dhaka

GOALS

- goal is to leverage smart technology to enhance efficiency, improve customer experiences, and drive sustainable growth in

Motivation

- Embracing smart technology not only streamlines our operations and enhances productivity, but also positions us at

About Smart Meter Energy Iot based Interview Q&A

1. Are you satisfied with your current electricity bill?

answer : No

2. Where from your electricity bills comes?

answer : DPDC

3. What do you know about smart meters?

answer : Smart meters are advanced devices that provide real-time data on energy usage, helping businesses optimize consumption, reduce costs, and enhance operational efficiency.

4. How profitable can you feel if you can monitor the electricity bill?

answer : Monitoring the electricity bill can significantly enhance profitability by identifying inefficiencies, optimizing energy usage, and reducing costs.

5. How will people and country benefit if this work is established in modern life?

answer : Establishing modern utility solutions in Bangladesh will enhance infrastructure reliability, attract foreign investment, boost economic growth, and improve quality of life, creating a more prosperous business environment.

Figure: 3.2.3.3: Interview

3.3 User Survey

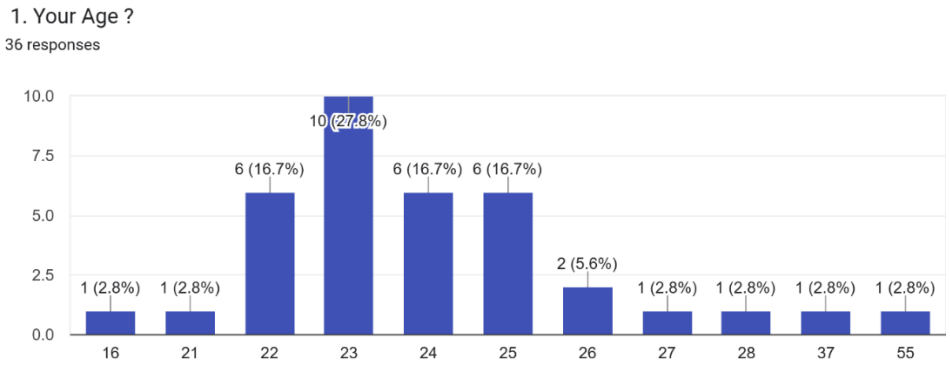


Figure: 3.3.1 Age

Interpretation: The chart shows the age distribution of the 36 respondents. The majority of participants were 23 years old (27.8%, 10 respondents). 22, 24, and 25 years each account for 16.7% (6 respondents). The age at the remainder represents a smaller portion, with ages 16, 21, 26, 27, 28, 37 and 55 years each accounting for 2.8% (1 respondent each).

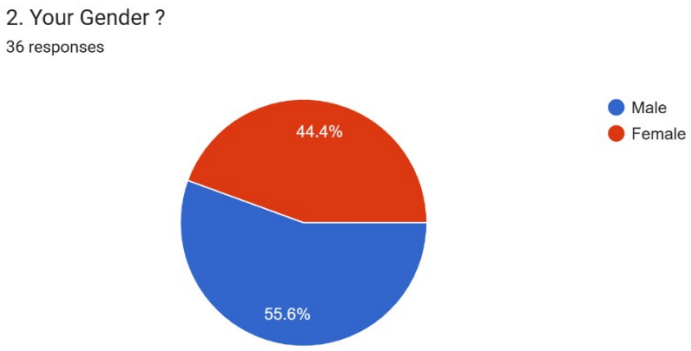


Figure: 3.3.2 Your Gender

Interpretation: The pie chart shows the gender distribution of 36 respondents. A majority, 55.6%, identify as male, while 44.4% identify as female.

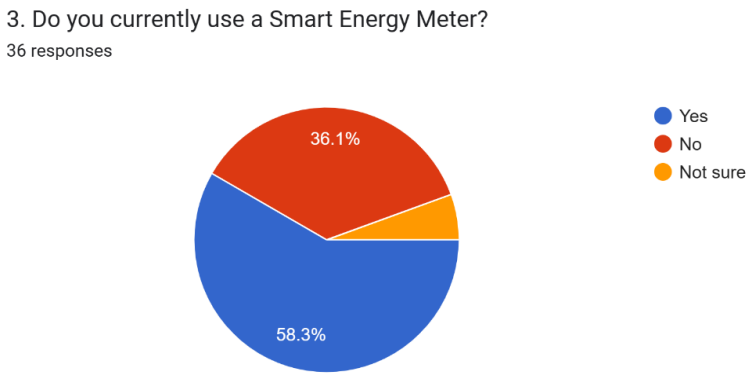


Figure: 3.3.3 Do you currently use a Smart Energy Meter?

Interpretation: Thus, among respondents, those using smart energy meters are 36.1%, while the rest are either not using or are unsure at 63.9%. It can be said that smart energy meters are not yet adopted by all. Awareness, or even use, can still be improved.

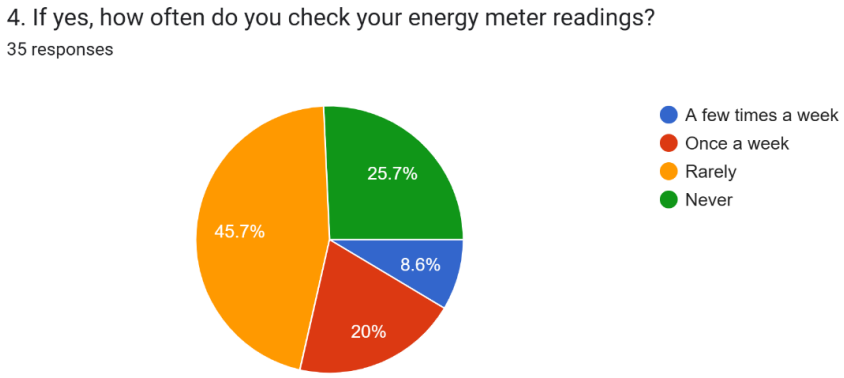


Figure: 3.3.4 How often do you check your energy meter readings?

Interpretation: The survey indicated that the majority of respondents (45.7%) rarely check their energy meter readings, followed by 25.7% who check once a week, about 20% never check their

readings at all, and only 8.6% who check a few times. times per week This shows that a significant proportion of respondents do not closely monitor their energy use.

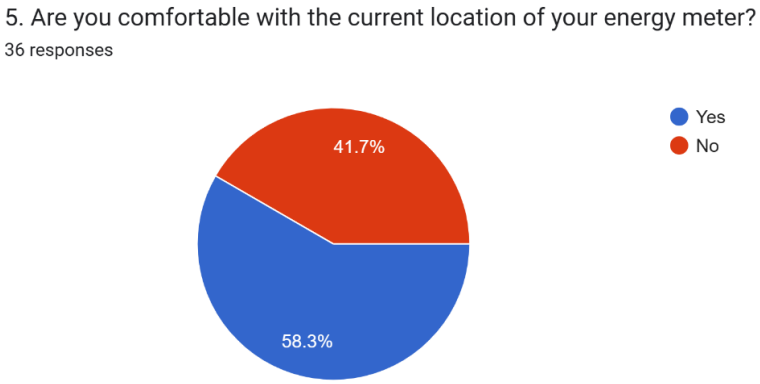


Figure: 3.3.5 Are you comfortable with the current location of your energy meter?

Interpretation: The survey found that 58.3% of respondents were dissatisfied with the current location of their energy meters, while 41.7% were satisfied, indicating the need to address location concerns for better accessibility or convenience.

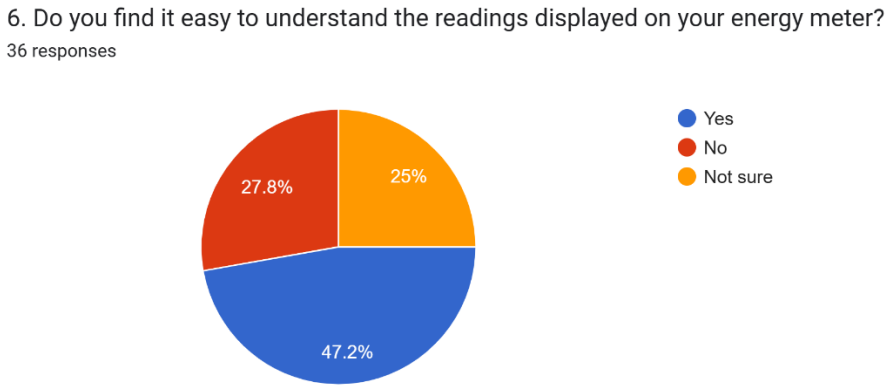


Figure: 3.3.6 Do you find it easy to understand the readings displayed on your energy meter?

Interpretation: The survey found that only 25% felt that energy meter readings were easy to understand, while 27.8% did not and 47.2% felt unsure. This highlights a major gap in people's understanding. Used in relation to the efficiency of the energy meter.

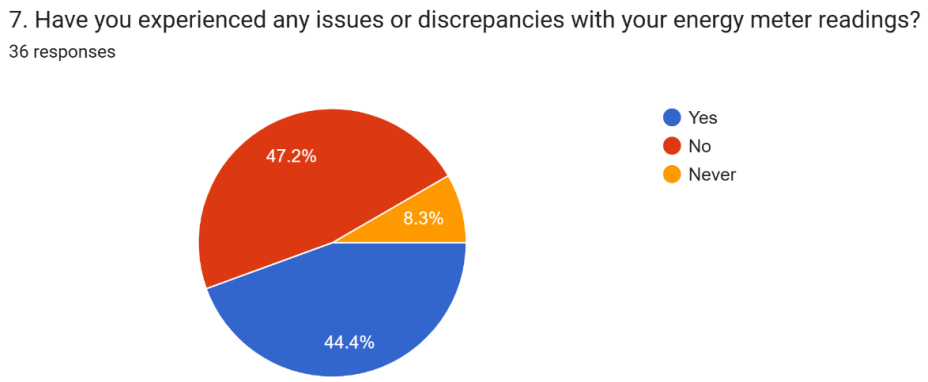


Figure: 3.3.7 Have you experienced any issues or discrepancies with your energy meter readings?

Interpretation: The survey shows that 47.2% of respondents have not experienced issues with their energy meter readings, while 44.4% have never checked for discrepancies, and 8.3% have encountered problems. This suggests that most users either trust the readings or are unaware of potential issues.

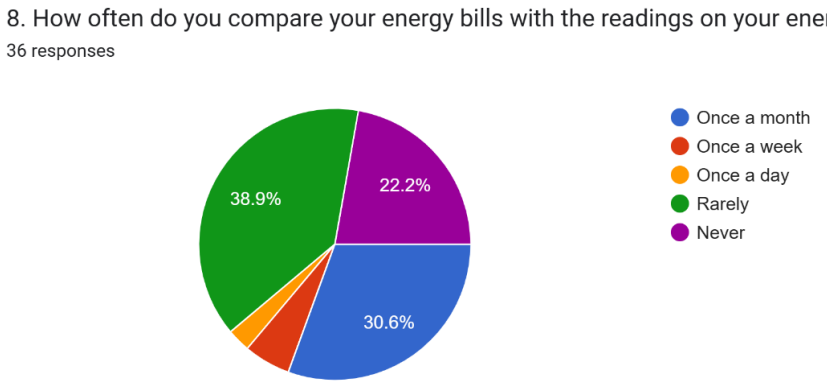


Figure: 3.3.8 How often do you compare your energy bills with the readings on your energy meter?

Interpretation: The survey indicates strong interest in real-time energy usage updates, with 63.9% responding positively. Meanwhile, 19.4% are hesitant but open to the idea ("Why not?"), and 16.7% are not interested. This shows significant demand for real-time energy monitoring features.

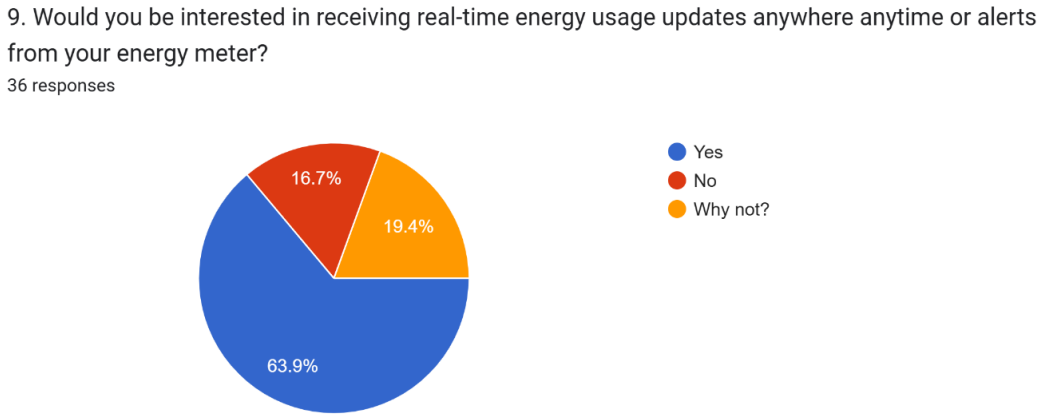


Figure: 3.3.9 Would you be interested in receiving real-time energy usage updates anywhere anytime or alerts from your energy meter?

Interpretation: The survey found that 63.9% of respondents are interested in receiving real-time energy usage updates or notifications from energy meters. This shows that there is a strong demand for this feature. 19.4% are open to it but have some reservations. (“Why not?”) and 16.7% were not interested, indicating strong interest in more active verification options

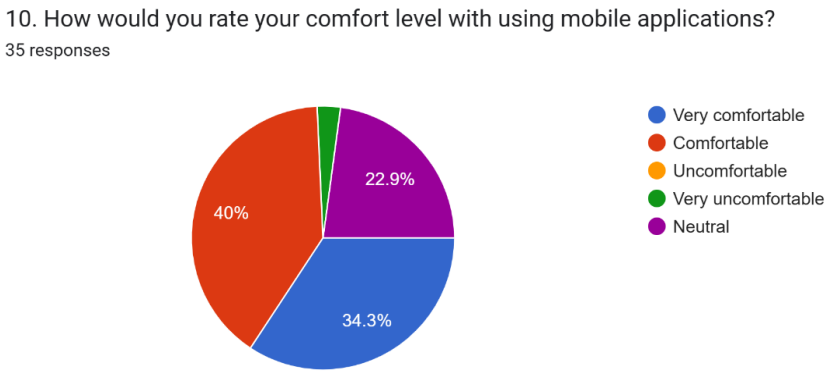


Figure :3.3.10 How would you rate your comfort level with using mobile applications?

Interpretation: Loosely articulated survey interrogatories indicate that, out of the total, most respondents tend toward the opinion that mobile applications are relatively usable, for 40 percent considered themselves "comfortably adapting to it," whereas 22.9 percent were observed to go beyond the "much smoother." The number saying that use is "very uncomfortable" did not form much of a percentage at 2.9, while the remaining 34.3 percent remain neutral, suggesting the ease overall in the use of mobile app applications.

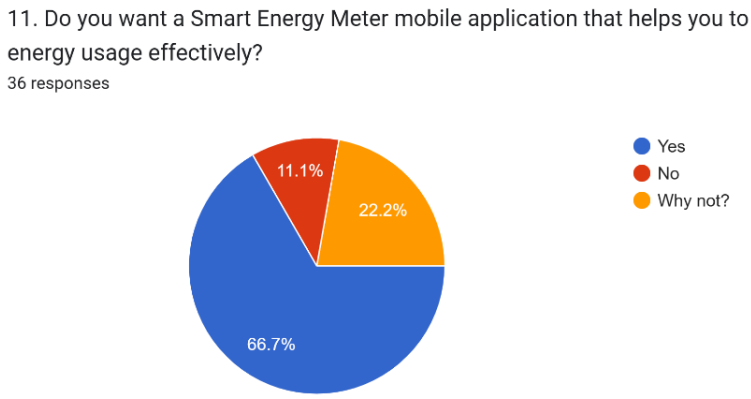


Figure :3.3.11 Do you want a Smart Energy Meter mobile application that helps you to manage and track your energy usage effectively?

Interpretation: Strong response for a mobile application comprising Smart Energy Meter was revealed through the survey; 66.7% of respondents wished for such an application. The proportion of 22.2% showed interest in the idea, while 11.1% were not, thus indicating that demand is very strong for tools that can co-ordinate and monitor energy usage.

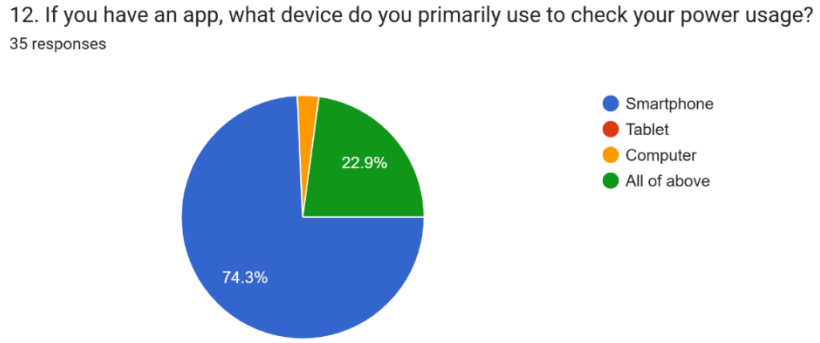


Figure :3.3.12 If you have an app, what device do you primarily use to check your power usage?

Interpretation: The survey found that 74.3% of respondents primarily use their smartphones to monitor energy usage, while 22.9% use multiple devices together. (All of the above) Very few respondents use tablets (0%) or computers (1%), indicating a strong demand for smartphones for energy monitoring.

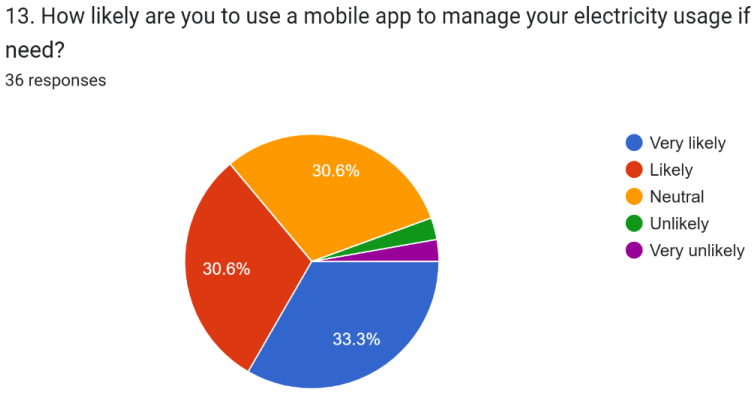


Figure :3.3.13 How likely are you to use a mobile app to manage your electricity usage if it had the features you need?

Interpretation: The survey found that 61.2% of respondents would probably use a mobile app to manage their electricity usage if it had the necessary features, with 30.6% "very likely" and 30.6% "likely", while a smaller percentage (33.3%) considered it "very likely". neutral remain, while only 2.8% are unlikely to use the app.

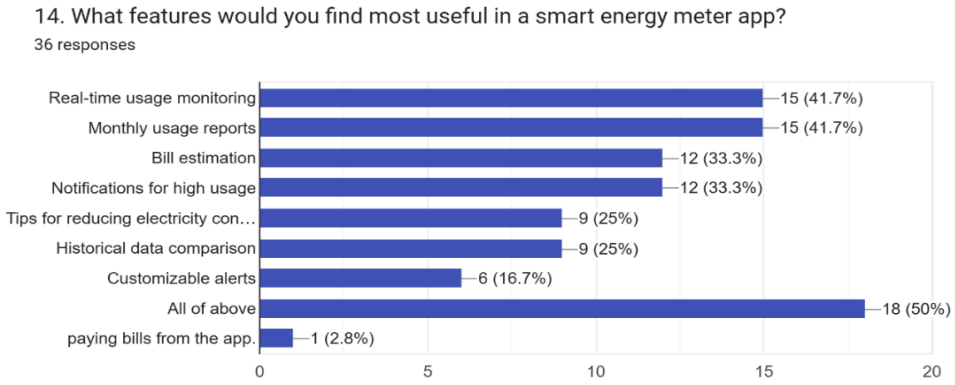


Figure :3.3.14 What features would you find most useful in a smart energy meter app?

Interpretation: The survey found that the most desired features for smart energy meter apps are: "Real-time usage monitoring" and "monthly usage report," which 41.7% of respondents liked, each expressed interest in them. "All of the above" is the most comprehensive option. This was preferred by 50% of respondents, while "pay bills from the app" was the least preferred feature, with only 2.8% interested.

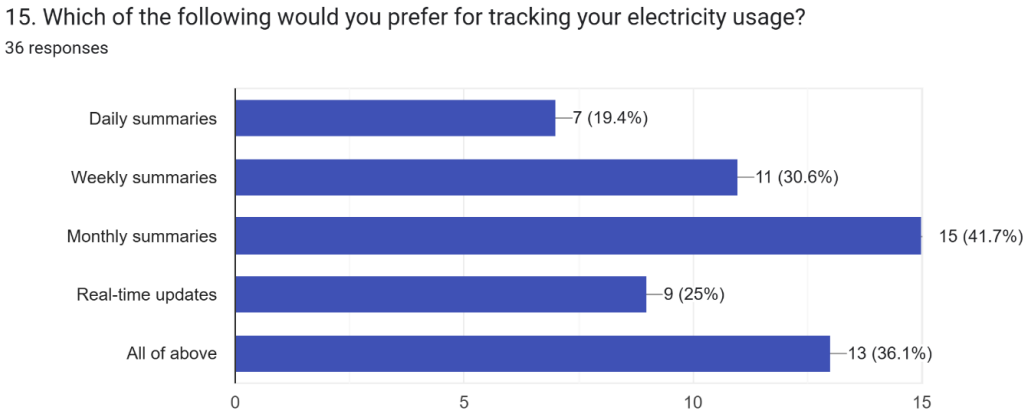


Figure :3.3.15 Which of the following would you prefer for tracking your electricity usage?

Interpretation: The survey found that "monthly summary" was the most popular way to track electricity use, with 41.7 percent choosing "all of the above" as the second most popular option. This was preferred by 36.1% of respondents, indicating interest in a combination of tracking options. "Real-time updates" and "Weekly summaries" were popular at 30.6% and 25%, respectively, while "Daily summaries" were the least popular at only 19.4%.

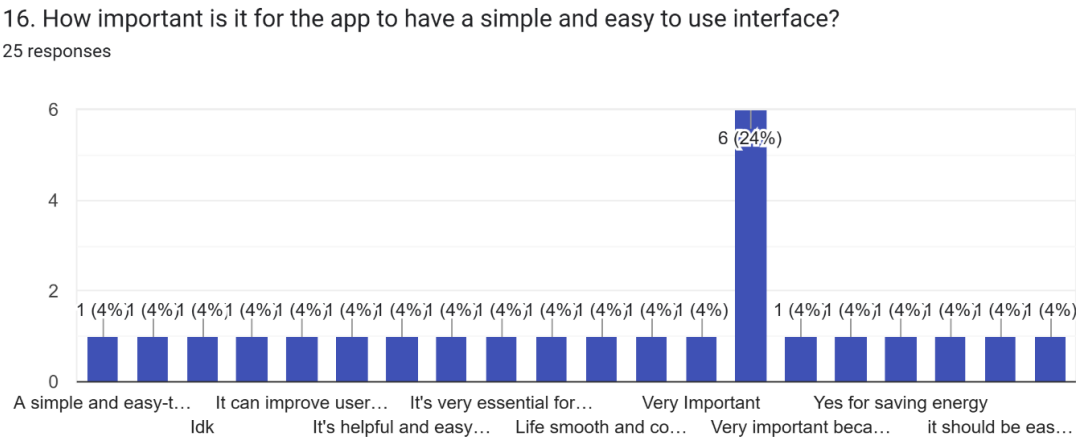


Figure :3.3.16 How important is it for the app to have a simple and easy to use interface?

Interpretation: The survey shows strong agreement on the importance of having a simple, intuitive interface for apps, with 24% of respondents describing it as "very important". It is also emphasized that the user-friendly interface improves the user experience. Participation and accessibility so that everyone, especially non-tech-savvy users It's easy to navigate and track their energy usage effectively. This highlights that simplicity and clarity in design are crucial for the app's success.

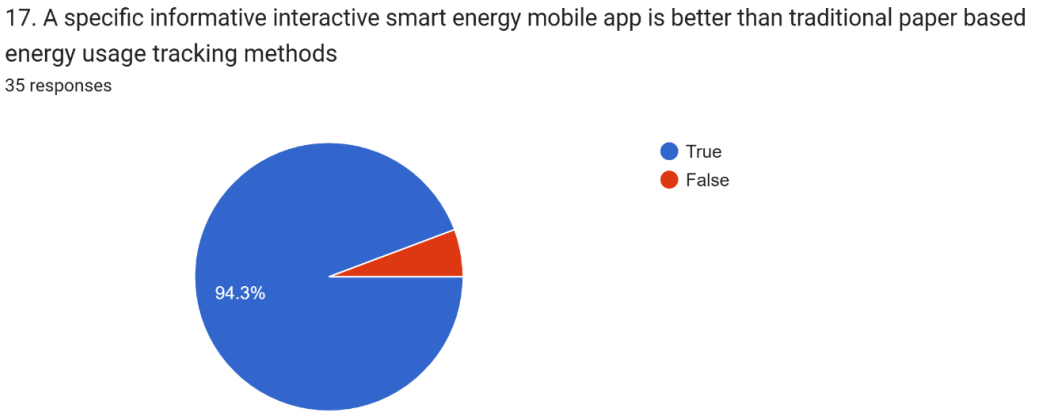


Figure :3.3.17 A specific informative interactive smart energy mobile app is better than traditional paper-based energy usage tracking methods

Interpretation : The survey supports the idea that smart energy mobile apps are more specific, informative and interactive than traditional paper-based monitoring methods. 94.3% of respondents agreed ("True") and only 5.7% disagreed ("False"), and this makes digital solutions more robust than manual tracking. Priority is specified.

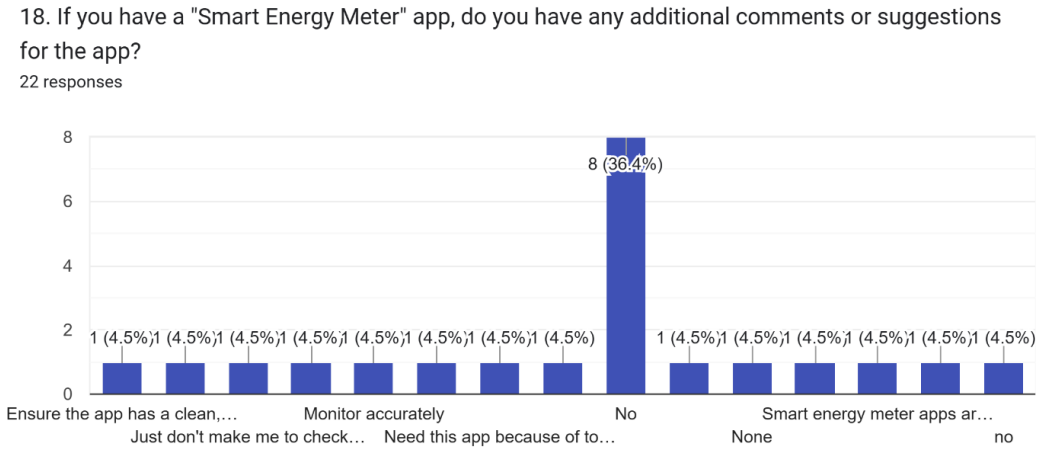


Figure :3.3.18 If you have a "Smart Energy Meter" app, do you have any additional comments or suggestions for the app?

Interpretation : Users recommend that smart energy meter apps should have a clean and easy-to-use interface. With easy navigation and clear instructions. Optional features include real-time energy monitoring. Precise inspection Data exports, notifications, and online bill payments iOS compatibility and an ad-free experience have been requested. The app should focus on energy efficiency. Especially in a country like Bangladesh. and provide customer support. Overall, users are looking for a simple app. effective and user-friendly to help manage energy use

3.4 User Stories & user psychology

In the later stages of this project, the application of an Internet of Things (IoT) technology metering device was created with a user-driven design focus. These applications aim to meet practical problems as well as comprehension needs simultaneously. User-stories were deployed to parallel self-evident problems with everyday goals and objectives rendering the user-to-story interaction.

For instance, one user story highlights the need to check the current consumption of their energy resulting in the challenge to real time energy consumption monitoring software users being unable to identify any issues in their energy management and amending their behavior accordingly. Such an approach satisfies the need for control and immediate feedback and encourages the user in the same time. The second story is about the wanted You user story creates the energy-saving goal and also tracks the energy goal to be achieved. It puts different motivation at its core which is the sense of achievement as the user will get when advancing towards a particular goal.

Last but not the least other reason is custom notifications about events when the energy consumption is abnormal or when the expected expenditures are above the user's pre-set estimate enabling in this way users to be notified on time. This simple notification may serve just as a reminder to the users assuring them to be alert and act against such instances without having to spell out everything. Also, the application has other functions that enable users to review their bills, therefore, assist users in confirming their energetic financials.

3.5 Scope

Real-time tracking of the smart energy meter mobile applications based on IoT can greatly enhance energy management and efficiency by giving extensive usage information in an instant and allowing remote control features. It aims at empowering users to keep track of their energy expenditure, identify some patterns in it, and make informed decisions to save costs and wastage. Therefore, this program also provides an effortless connection to smart home systems, very robust security provision to secure user data, and user-friendliness. Energy environment may also be achieved by saving energy and providing space for the integration of renewable sources of energy. Thus, this innovation has the potential to lead to a future that

would be more efficient as well as environment friendly, by entirely altering the mechanism with which energy management is handled for commercial and residential consumers.

3.6 Functional Requirement

This application is intended to be an IoT based smart energy metering mobile application which users can use as a tool to monitor, manage, and optimize their energy usage. The main feature of this app is that it provides real-time feedback about the energy consumed, displayed in a very user-friendly manner using graphs and dashboards to help them find ways to minimize wastage.

Customization is another key area in which the application is going to be tested: energy-saving targets and personalized alerts for abnormal consumption patterns or achievements will be set. IoT-enabled includes the support for integration with smart energy meters and other devices-an exceptional entry into the whole thing of energy management. The app will have gamified components like badges and rewards to strengthen energy-efficient habits among users. It also promises users their Most Important Thing (MIT)-data security since the application is to have encryption and privacy standards.

This was done using by Figma: a cloud-based design tool-for prototyping and designing the application's user interface. Figma provided a collaborative space to develop intuitive and appealing layouts for usability and accessibility. Design, simulation, and refinement within Figma were also the processes to rely upon in developing the app's interactive capabilities-from real-time graphs to interfaces for payments and notifications. The flexibility of the tool allowed for improvements-even iterative ones-based on the feedback from users, giving everyone at the end a great experience that matched the app's functional goals.

Figure :3.6: Figma

Application Reference Images:

Bkash App Design:

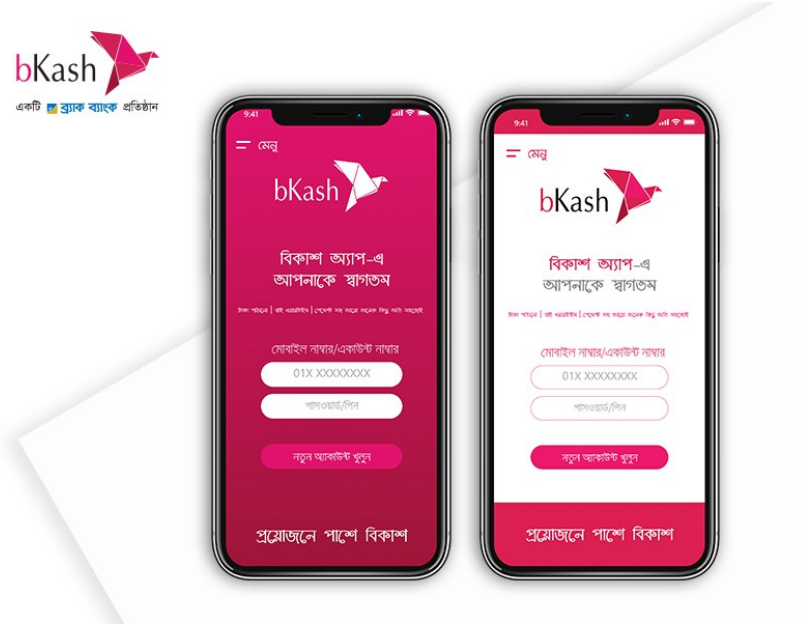


Figure :3.6.1: Bkash App

Bkash App User Homepage:

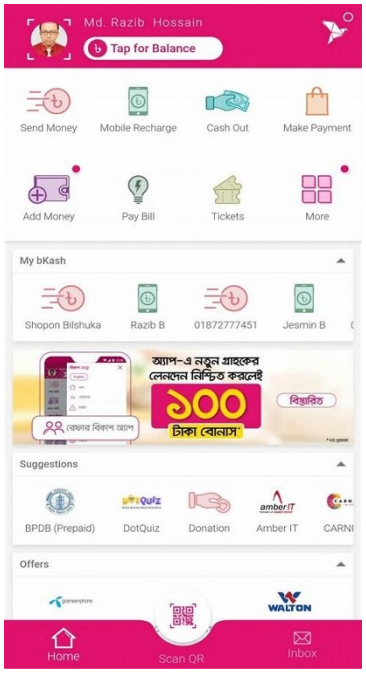


Figure :3.6.2: Bkash App User Homepage

Collected References:

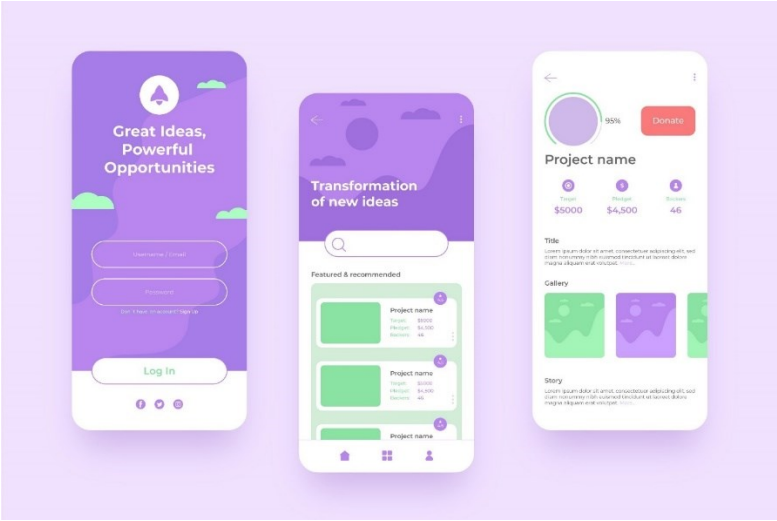


Figure :3.6.3: Reference Designs

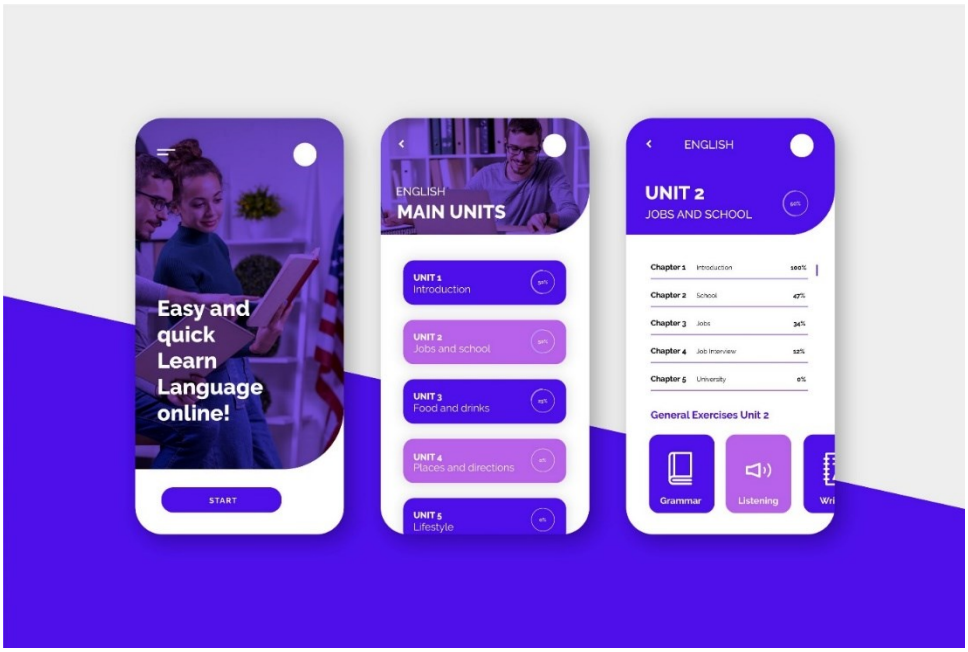


Figure :3.6.4: Reference Designs

Mobile Banking References:

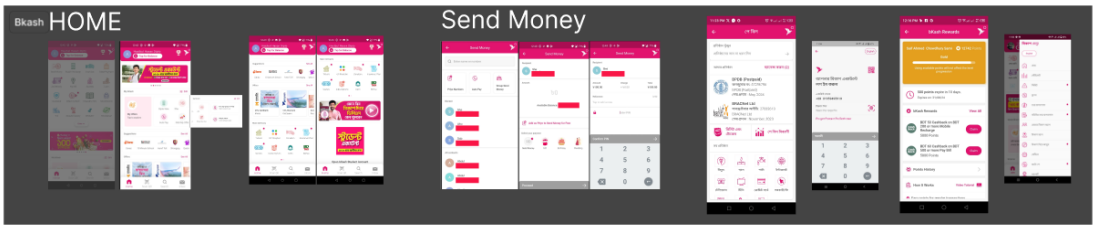


Figure :3.6.5: Bkash

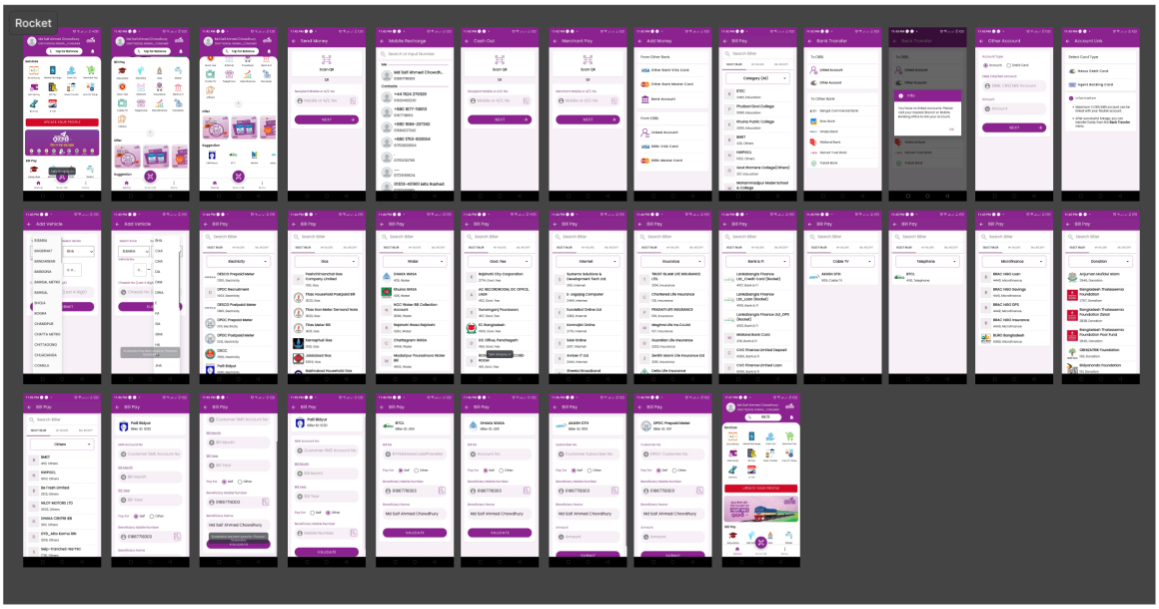


Figure :3.6.6: Rocket

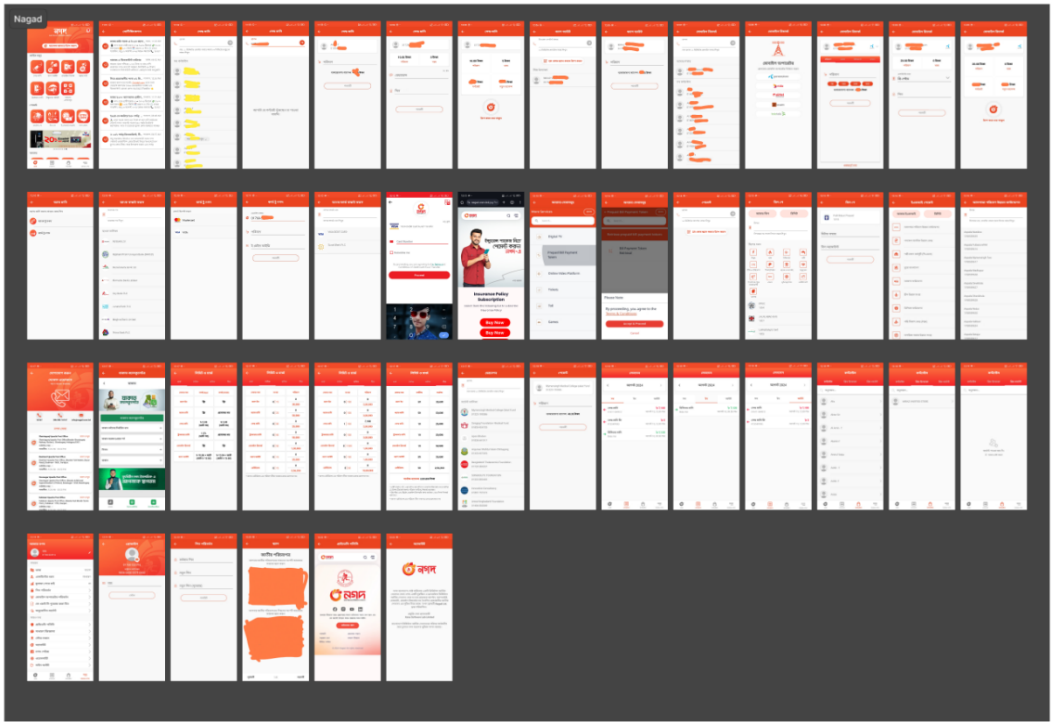


Figure :3.6.7: NAGAD

3.7 Empathy Map

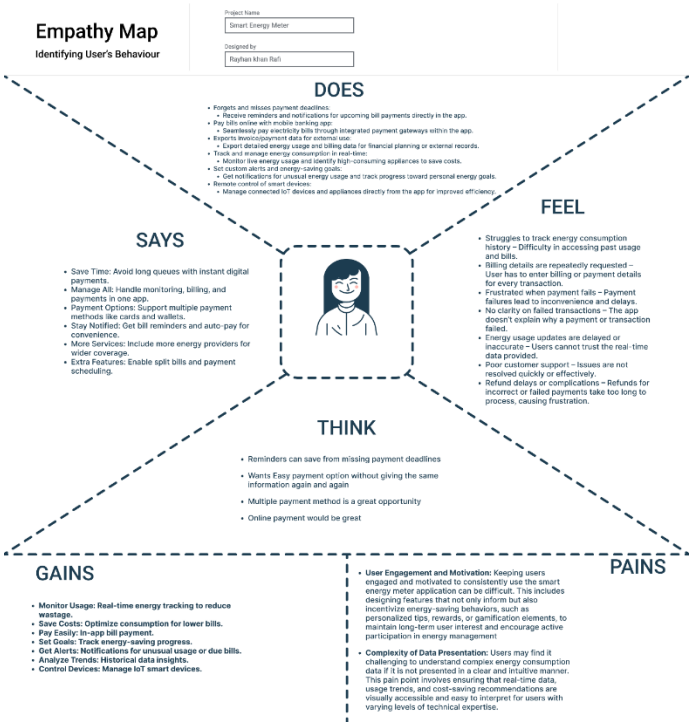


Figure :3.7: Empathy Map

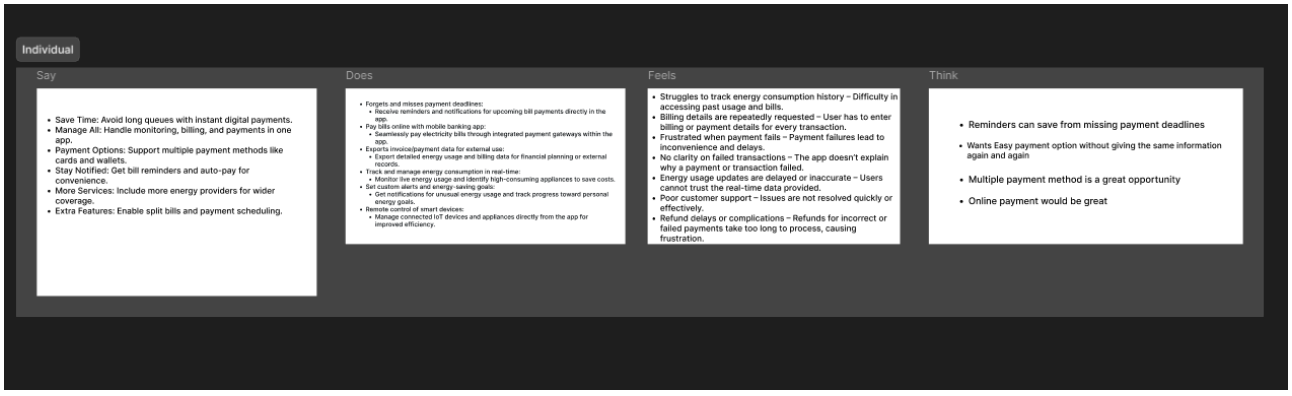


Figure :3.7.1: Individual

3.8 User Flows

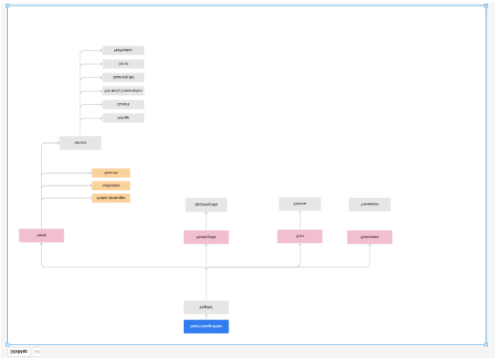


Figure :3.8: User Flow 1

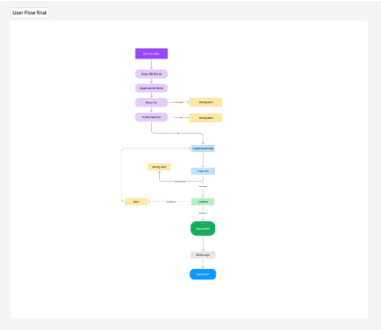


Figure :3.8.1: User flow 2

3.9 Competitive Analysis

It is competitive analysis of smart energy meter mobile applications on parameters like functionalities, usability, and efficiency.

o Hugo Energy:

Reduction in the energy bills by 12. This platform facilitates synchronization with meter data to be represented through interactive graphs.

Tracks daily electric and gas consumption. It includes energy-saving tips as well as bill calculators in its offerings.

o Octopus Energy:

Account balance, bill tracking, and smart meter usage are tracked. Features phone camera assistance for data submission, tips for saving energy, and web version.

o OVO Energy:

The app has all features boast a bulky app: Simple interface with simple controls, visual representation of usage data, and an average level of reliability minus anything groundbreaking.

3.10 Hypothesis of My Solution

The smart energy meter mobile application proposes a solution for the problems associated with energy consumption monitoring and billing. Its application includes the wireless use of IoT technology for real-time monitoring and control of home appliances with automatic electricity bill generation on consumption data. The consumers are given remote access to power usage information in real time, thus promoting awareness that may lead to reduced consumption. Other works have looked at the same issues, such as smart energy meter surveillance through IoT and ZigBee-Wireless Sensor Network, as well as user-centered designs for mobile apps for smart metering.

3.11 Information Architecture

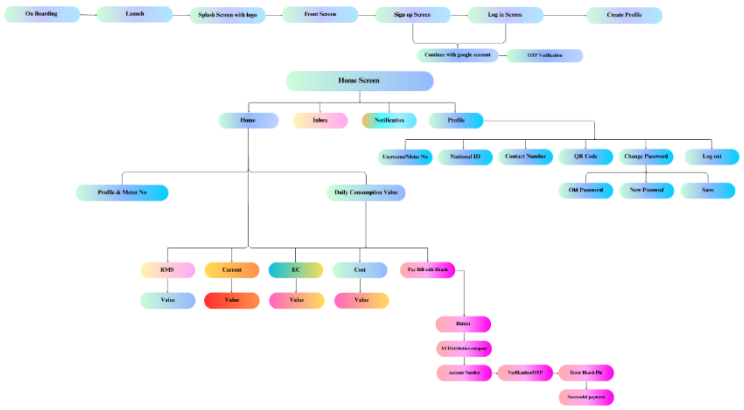


Figure :3.11: Information Architecture

Chapter 4

RESULTS

4.1 Low Fidelity

Figure :4.1: Low Fidelity

4.2 Usability Test Methods

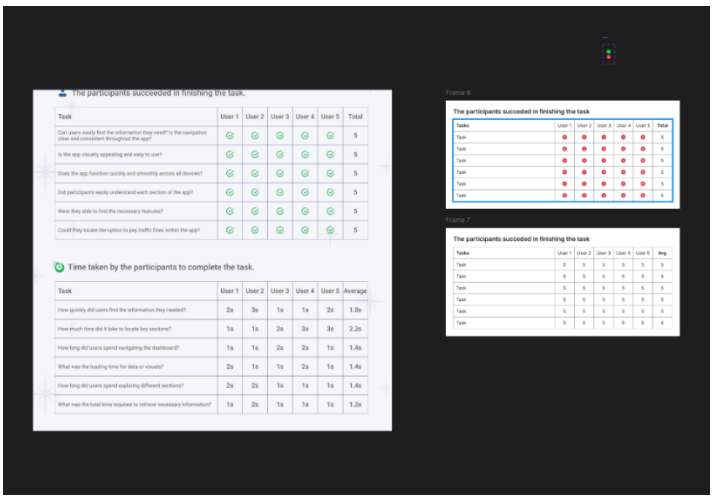


Figure :4.2: Usability Testing

4.3 Wireframe

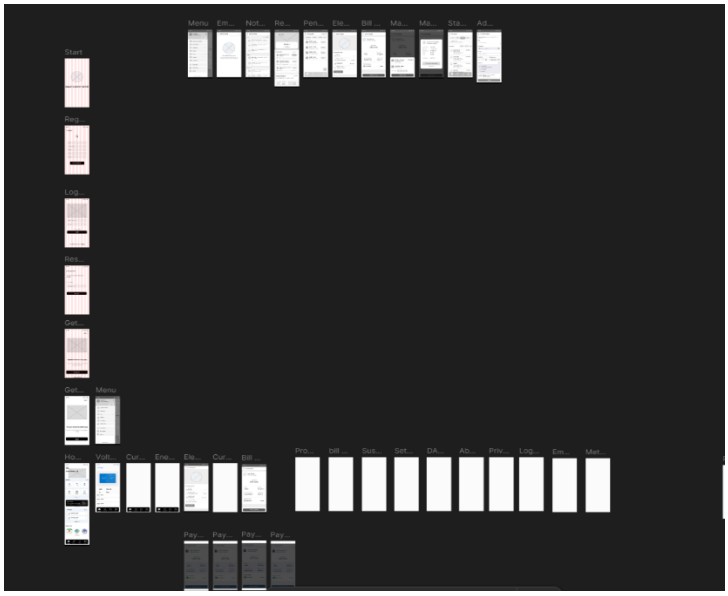


Figure :4.3: Wireframe

4.4 Design System

Typography:

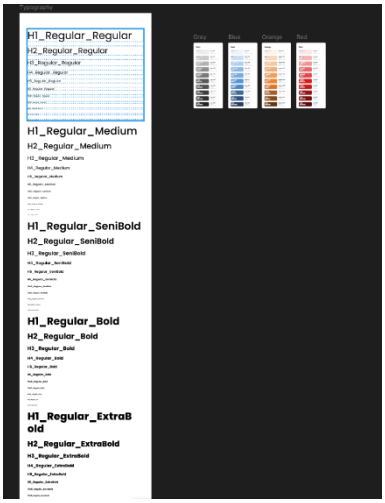


Figure :4.4.1: Typography

Components:

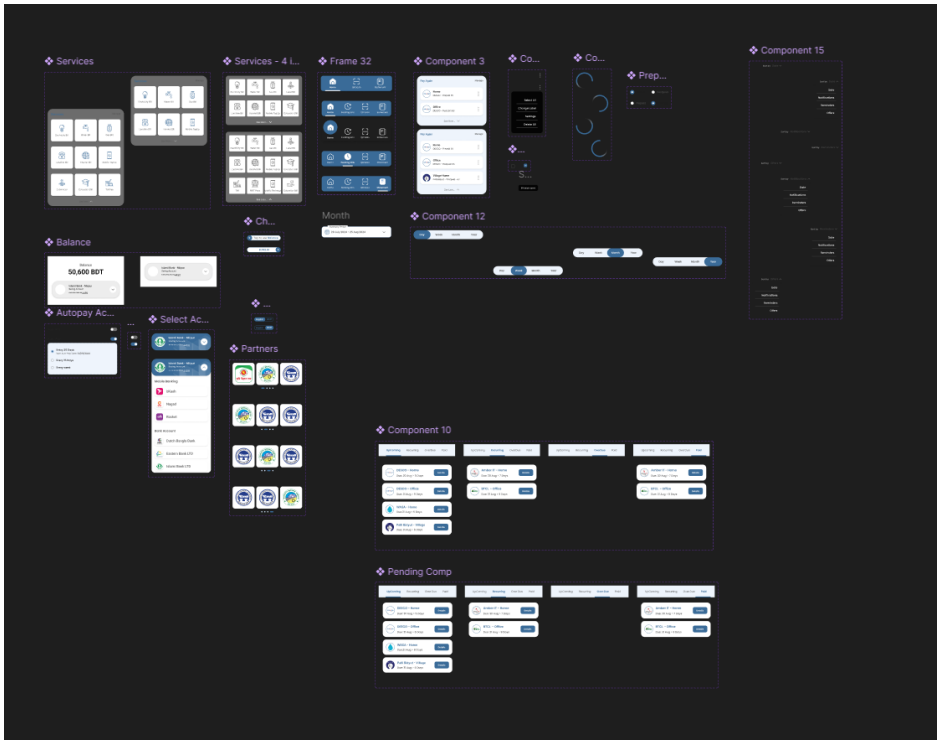


Figure :4.4.2: Components

Icons:

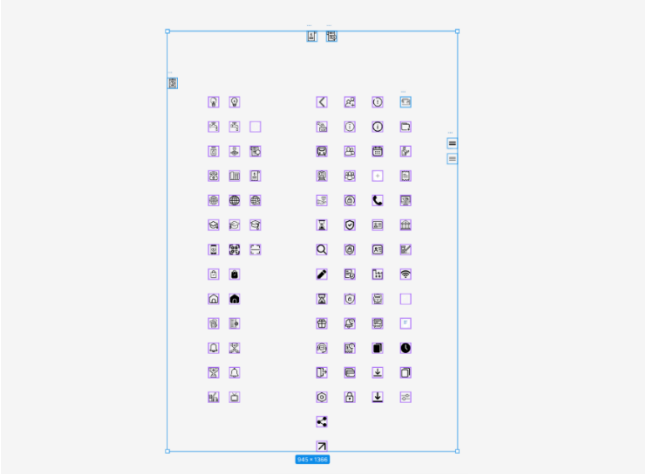


Figure :4.4.3: Icon

4.5 Prototype:

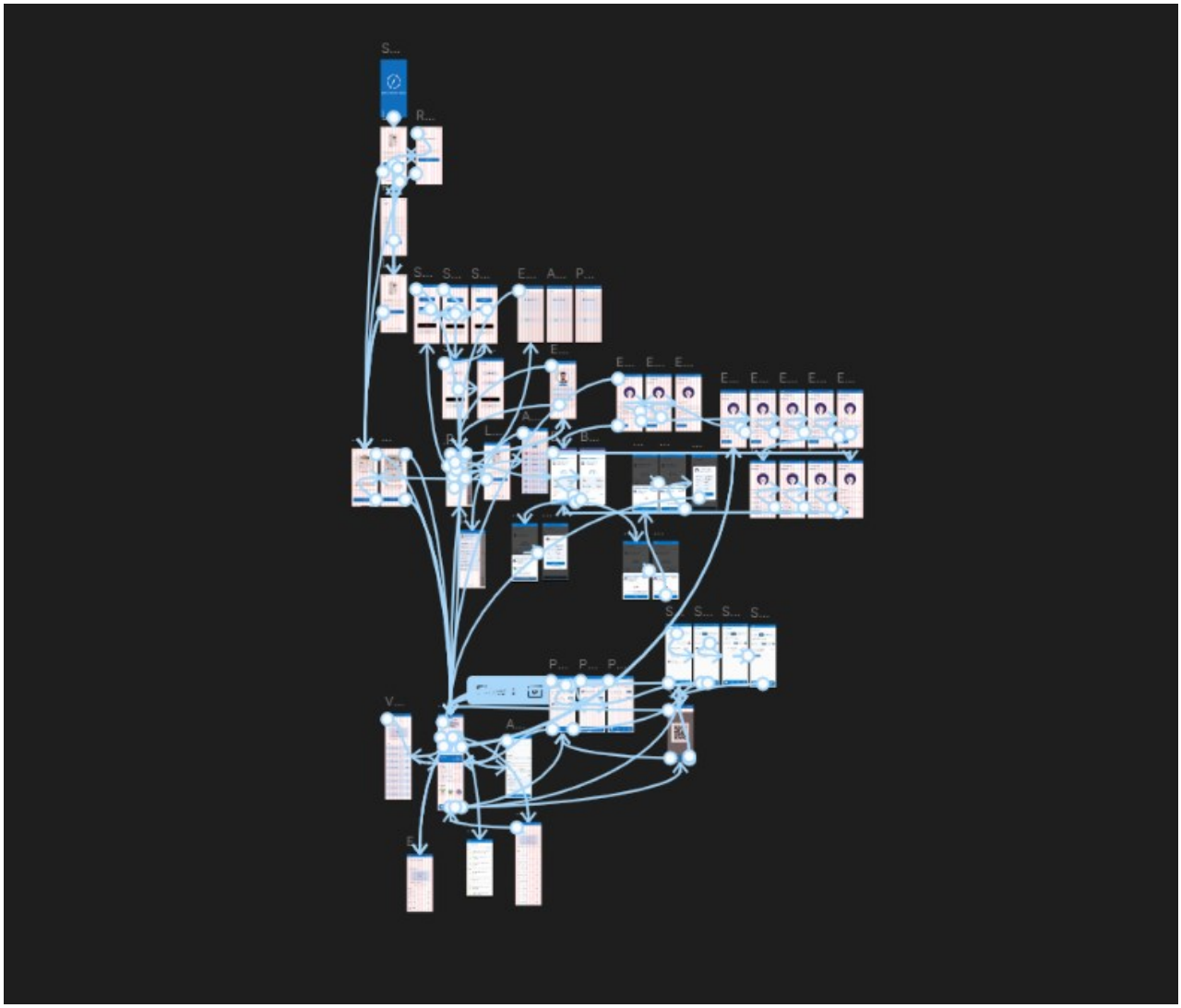


Figure :4.5: Prototypes

4.6 UI design for the app:

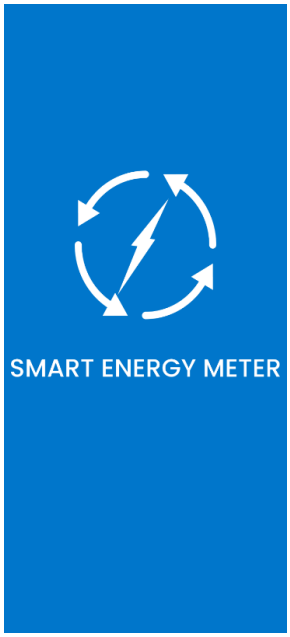


Figure:4.6: Start

Figure:4.6.1:log in

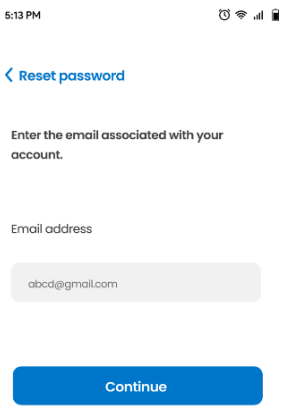


Figure:4.6.2: Reset Password

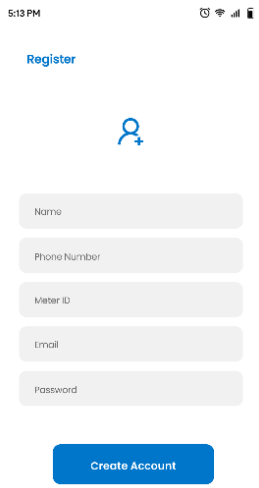


Figure:4.6.3: Register

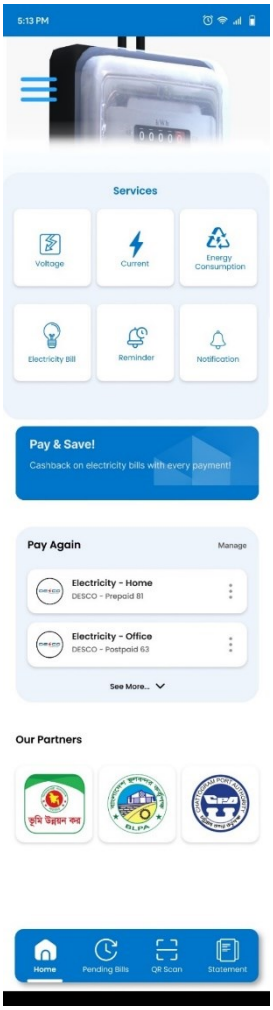


Figure:4.6.4: Homepage

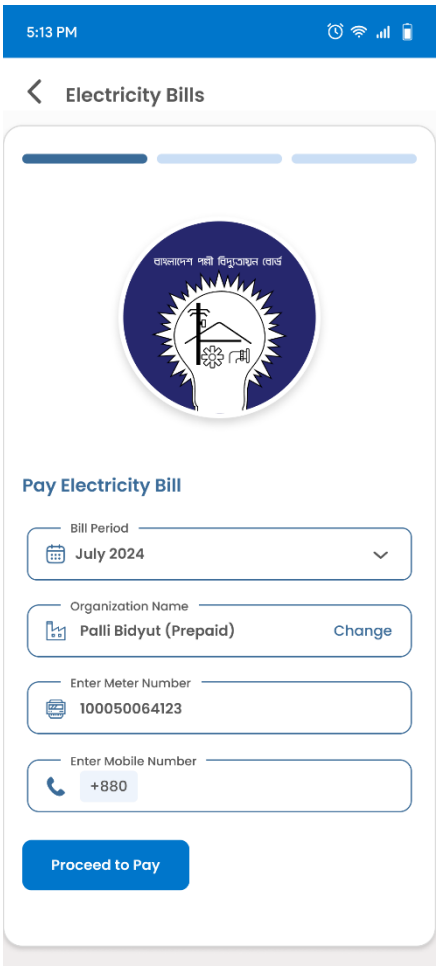


Figure:4.6.5: Electricity Bill

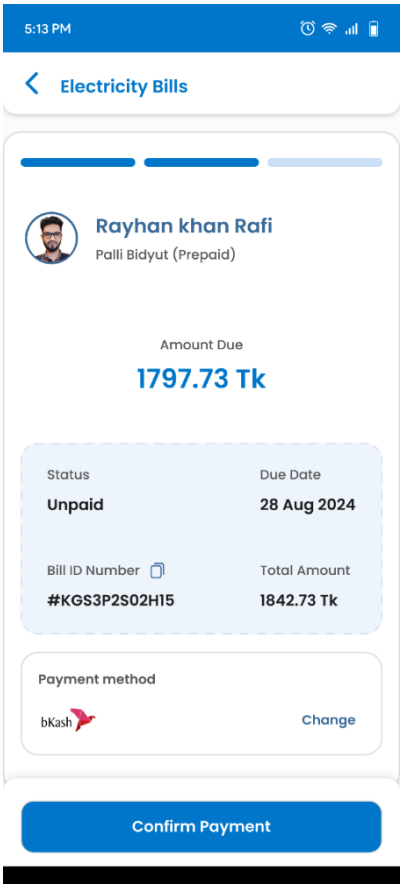


Figure:4.6.6: Electricity Bill

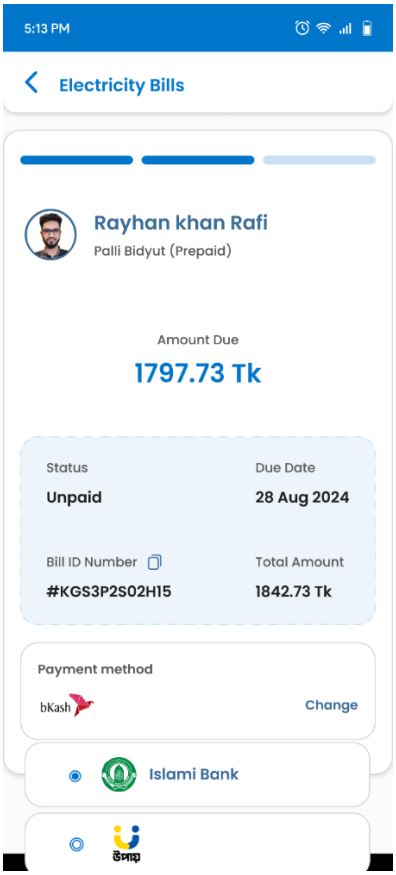


Figure:4.6.7: Electricity Bill

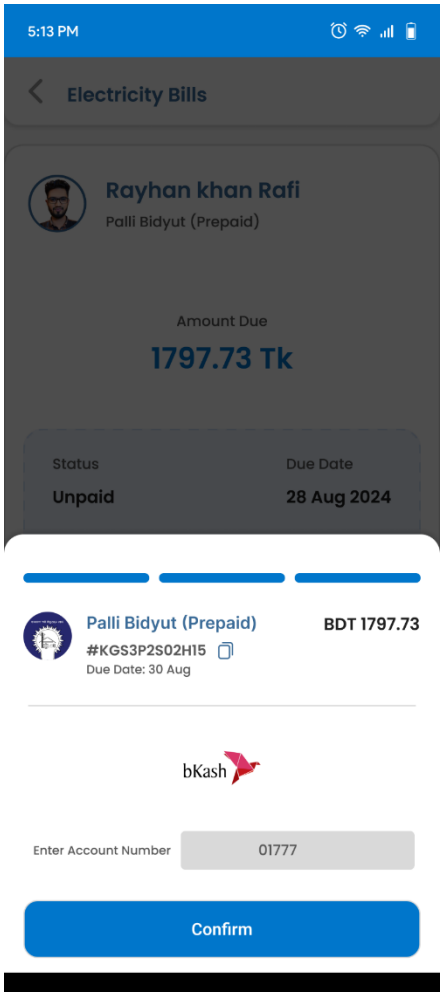


Figure:4.6.8: Bkash Payment

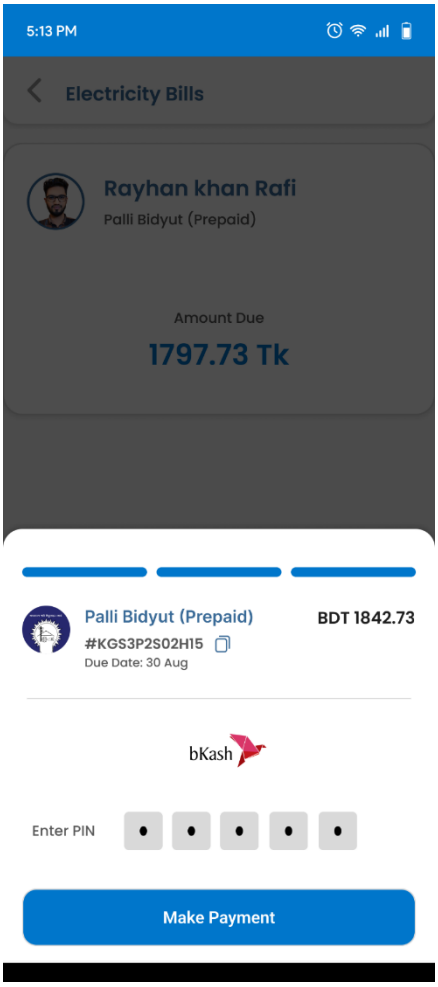


Figure:4.6.9: Bkash Payment

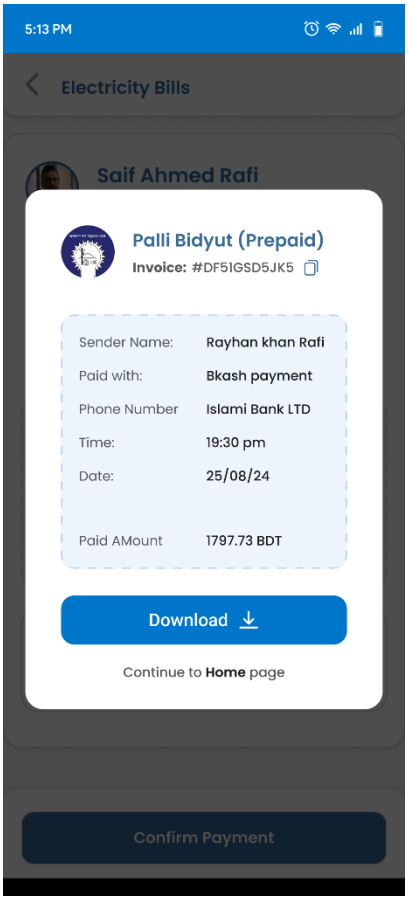


Figure:4.6.10: Payment Receipt

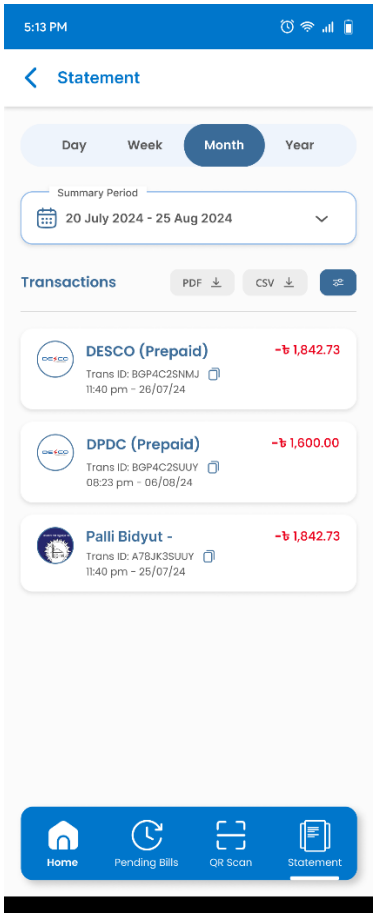


Figure:4.6.11: Statement

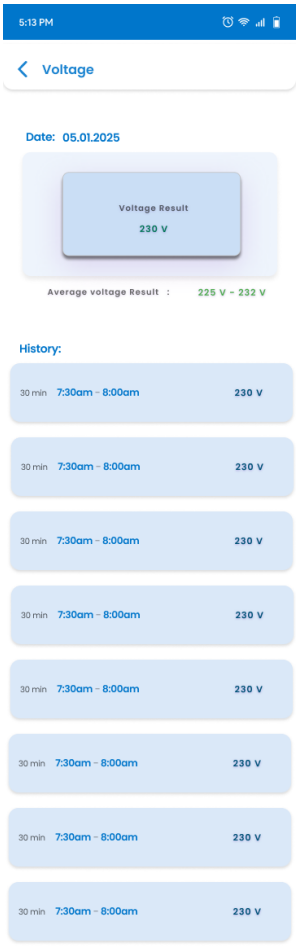


Figure:4.6.12: Voltage

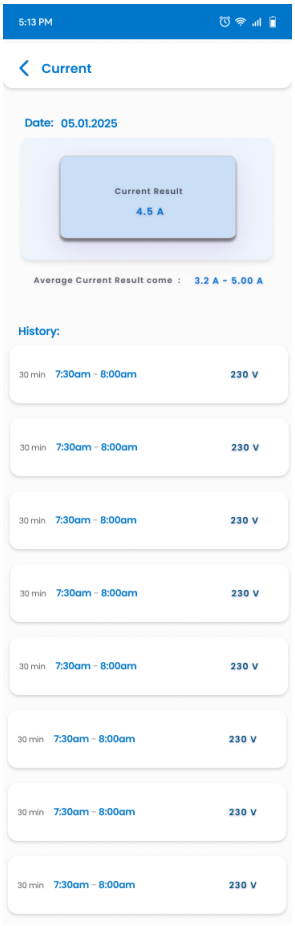


Figure:4.6.13: Current

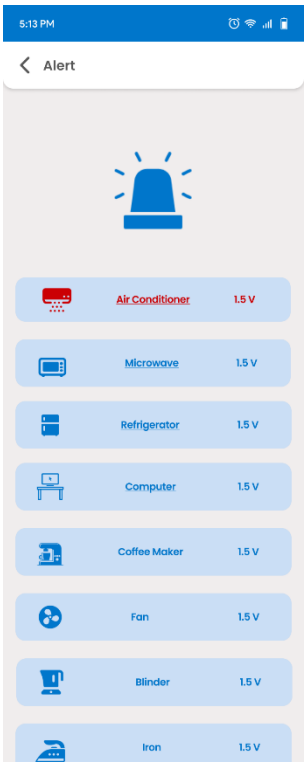


Figure:4.6.14: Alert

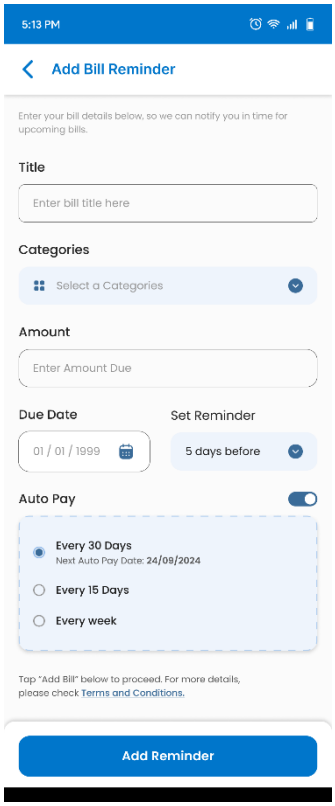


Figure:4.6.15: Reminder

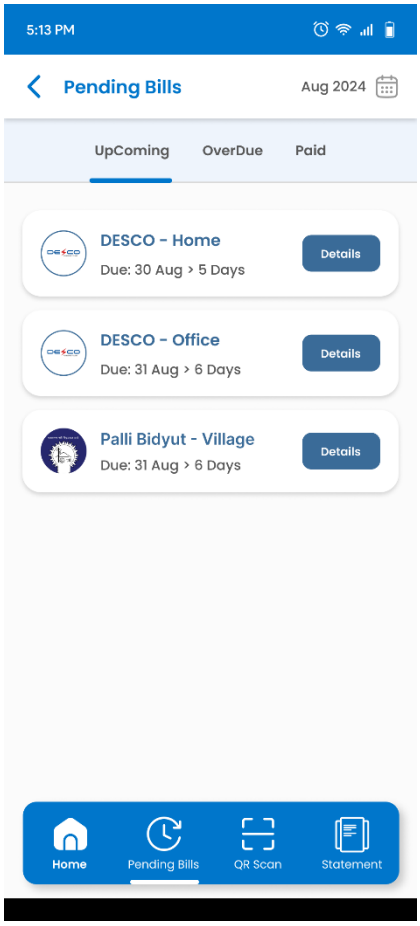


Figure:4.6.16: Pending Bills

Figure:4.6.17: Scan

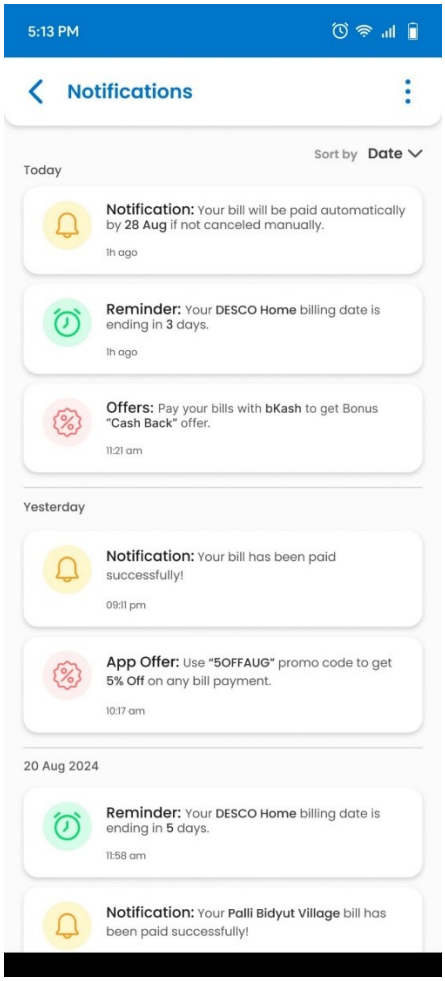


Figure:4.6.18: Notification

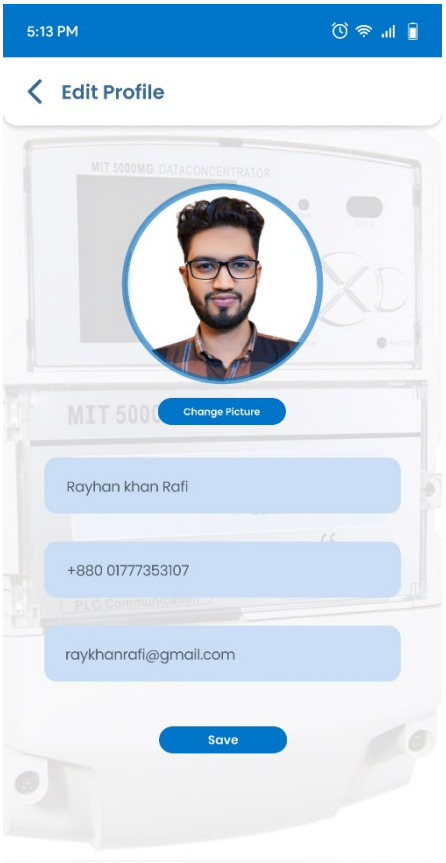


Figure:4.6.19: Edit Profile

Chapter 5

CONCLUSION

This step-in energy management is to die for. This is done by giving the user a real-time visualization of their energy billing, fully automated payments, and personalized advice. Such an application encourages the user to master the practice and adopt energy through a sustainable approach.

This technology fits all as the app will have a simple interface designed for both users with technical knowledge and ones without. Therefore, the app has a user base large enough to have a good market. The service that the company provides is not a pain in the neck for both owners and tenants since they can save the energy either in their home or building by implementing smart control units, identifying, and solving problems.

This application is the way to unite the development of both high-tech systems and the practical needs of daily life by then setting a course for energy use to more efficient and sustainable one by adopting it. Consequently, the software should be implemented as a priority matter of the world agenda, as it may serve as a marker for saving energy in the long run not only by increasing energy efficiency and smart home appliances but also by achieving customer satisfaction.

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