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Abstract

Energy consumption has been conspicuously rising. Sri Lanka's dependence on imported fuel for energy means that the need for more economical use of electricity has risen. Nowadays, our dependence on electricity is powerful because power consumption has augmented significantly within the last few years. Therefore, to manage the utility consumption, Today's smart systems are intelligent and versatile to manage a balanced approach to controls and offer operational efficiency. This report explains the development of "SMART U," a user-friendly smart utility monitoring application, with more information about users' utility usage through the use of digital sensors that measure the energy consumption. Armed with this knowledge, users can reduce their electricity wastage simultaneously saving them money. This report concludes the problem, solution and project requirements, the stages of development, the core benefits that the user would obtain, product validation, a prototype of the final product, ultimately a detailed evaluation of the project.

Acknowledgement

Implementing this project would not have been possible without the help and guidance of many individuals. We would like to express our heartfelt gratitude to every one of them.

We would like to express our sincere appreciation to Ms. Jananie Mayooresan, who gave us the wonderful opportunity and the supervision and direction for this project. Moreover, we'd like to express our gratitude for providing the required knowledge and resources to work on this project as a Team. We would like to express our thankfulness to our parents as well as our friends for their kind cooperation and encouragement, which has contributed us in completing this project.

Thank you to everyone who has volunteered to support us with their expertise.

Table of Contents

List of Figures

List of Tables

List of Acronyms or Abbreviations

SDLC- Software Development Life Cycle

IoT – Internet of Things

AI – Artificial Intelligence

UI – User Interface

1. Introduction and Description of the Project

Sri Lanka is transforming at a rapid rate as more people are gaining access to electricity, in addition, the amount of electricity consumed per person has risen. Sri Lanka's primary source of energy comes from non-renewables such as petroleum, biomass, and coal. While it does have renewable sources such as hydro and solar, they are unreliable and unable to generate the necessary capacity of energy.

This increased reliance on imported fuel has put the country in a precarious situation where it is affected massively by the price of oil. As such there's been a growing mindset among the people for more sustainability to save as much money and electricity as possible.

The aim of this project is to provide a more efficient and reliable monitoring system that will help reduce energy wastage. The solution accomplishes this by monitoring user's electricity usage and generating energy saving insights through measurable metrics. This would be achieved by placing a digital energy meter that would detect the rate at which electricity is passing through it and will send that data to a server.

Using this data user's will be able to gain access to a real-time power consumption report allowing them to be more mindful about their electricity consumption.

1.2 Problem Statement

Every day around the world, about 34% of the electricity that is made is wasted when it arrives at the customer's meter, and from there it continues to get wasted by the customer (U.S Energy Information Administration, 2020). In Sri Lanka, people face this problem as well. Individuals and organizations do not save energy as there is a shortage of energy supply. With a shortage of fuel and energy supply, Sri Lanka has become harsher. The below chart shows the percentage of each energy supply that was used in 2017.

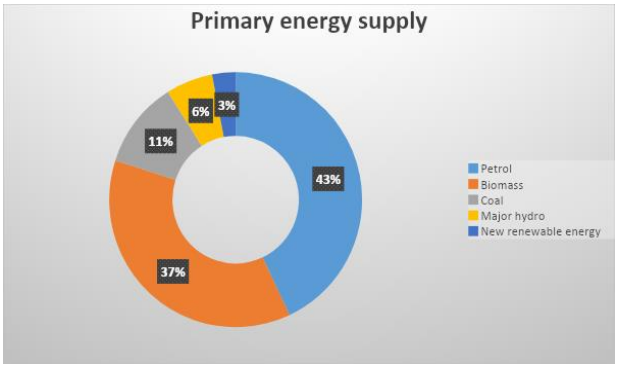

Figure 1 A Pie chart highlighting energy sources in Sri Lanka

(Sri Lanka Sustainable Energy Authority, 2017)

Currently the present method for measuring utility usage is by sending an employee to every household to collect readings from utility meters, while the data is manually entered into a billing software and sent to consumers.

Ideally, there would be a system where you can monitor and control the readings from meters remotely. Thus, reducing labor costs whilst improving the reliability of the readings. With reliable data, users would be able to set up automatic bill payments through banking services to ensure that those bills are paid on time. Furthermore, the utility industry is undergoing a fast transformation. The rising need for sophisticated technology, smart cities, and electric transportation is colliding with the increasing demands for renewable energy and sustainability.

In recent years, with the advancement of technology, the increase of population and change of people's lifestyle has impacted the lives of every individual rapidly. Even though the world is advancing with so many technologies, nowadays people don't have enough time to manage their utilities. Furthermore, the prices of basic utilities like water, electricity and gas have skyrocketed immensely. Therefore, citizens' cost of living has increased over the years. With these essential utilities being too expensive it makes citizens' day to day lives harder.

Same as the average citizen, organizations also depend on utilities heavily, but they tend to waste utilities unnecessarily and do not pay attention to utility bills as well. Many organizations can afford the bills of their utilities but most of them waste a lot of energy before they even consume it. If they manage it properly, they could save a significant number of resources, energy and save their finances.

This is how the project aims to improve the sustainability for both organizations and individuals by providing more accurate readings and bill calculations as well as monitor and identify where electricity is being wasted and automatically turn off devices when they are not in use, improving user's energy efficiency whilst reducing their utility costs.

1.3 Gap Analysis Table

Below is a GAP analysis table highlighting and comparing features with other similar utility management applications.

Features	Local Applications			Global Applications			SMART U
	CEB Care	ePro	Voltas	JadeTrack	Smappee	Neurio	
Real-Time Monitoring							
Cloud - Syncing							
Integration of IoT devices							
Intelligent saving guidance							
Calculating bill Payments							
Force - control							
combinations of service providers							
Personalized Insights on Usage							
Community forum							
Compatibilities of virtual assistants.							
Automated payment with biometrics.							
Energy on demand							
Multi factor authentication, Multi Login and end-end encryption							

YES	NO	INNOVATIVE	ONLY ONE

Table 1: GAP Analysis Table

2. Methodology

This issue is very complex and is of relative importance to the public as such it is critical that each stage of the project goes through numerous amounts of validation and verification. Furthermore, since there are features that are more critical than others it is important that these features are released sooner than others. In addition, this project is using technology that has not been implemented in this country yet and is expected to be developed in the long term. Moreover, the basic requirements of this project are known but are expected to evolve as unexpected challenges may emerge. Moreover, this model is well suited for an inexperienced team . It is due to the above statements that the **Incremental SDLC Model** was chosen for this project.

2.1 Justification

This model is suitable for the project as it is important to get the basic functionality of the project that would-be real-time monitoring of electricity usage. Furthermore, this project has a lengthy development schedule due to the number of features, that wish to implement this model allows us to release features in batches. Moreover, customers are able provide feedback that allows to adjust the user experience accordingly.

Divide and conquer breakdown of tasks allows to work on separate features based on importance and convenient to release it in stages. The model gives the flexibility to adjust to new technologies that may arise in future.

The incremental SDLC model is well suited for this solution since the demand for utilities and the utility industry itself is rapidly changing. This model provides flexibility and is less expensive compared to other models to change the scope of this project. Another benefit is that customers can respond to each stage of the build, providing critical feedback and improvements which can be implemented throughout the development stage of each cycle instead of the finalized build. In addition, this model allows implementation of important features with each subsequent release. Allowing the application to become better and more convenient as time passes. Ultimately due to the important nature of this project it is essential that the project goes through heavy validation and verification so that errors are easily identified and can be swiftly rectified.

3. Solution Outline

To the problem stated above, the solution proposed is “SMART U”. This application aims to tackle this problem by placing digital sensors in user’s homes which measure the number of units consumed. This sensor then sends the data to a server where necessary calculations are performed after which data such as the number of units consumed, cost of bill, predictive charts of future usage and costs, connected smart devices and their status are displayed to the end-user.

3.1 Sensors

The sensor passes the information containing the number of units with time and date to a server that receives this data and calculates the total bill amount before sending that information to the user’s mobile phone or other requested mediums such as e-mail. Allowing users to view their bill amounts and the number of units consumed at any time.

3.2 Smart Switches

If the user has connected any IoT devices, installed sensors will automatically monitor the number of units used as well as detect when the appliance is turned ON and OFF and provide the user with critical information such as the number of units/per hour and display how energy-efficient the appliance. Furthermore, connected appliances give user’s access to force control, which is the ability to turn the appliances ON or OFF through their smartphones.

3.3 Cloud Computing

Cloud computing will be used for this application, as its scalability and its capacity to handle large volumes of data, is essential for smart monitoring. Furthermore, the short delay time in data transfer is crucial to ensure the user gets real-time reports (R. Govindarajan, 2020)

3.4 Artificial Intelligence

A predictive analytic model or algorithms will be used on user’s data to generate trend analysis and predictive reports. As well as study patterns in appliance usage to recommend ways to save energy

3.5 Idea Validation

To ensure that the proposed solution is executed appropriately, idea validation techniques were used to understand consumer needs, wants and reactions to the solution.

The goal was to identify the demand for this solution if this was a problem consumers wanted to be solved and if so, what features would they want to be implemented.

To test this, surveys would be distributed to the public to understand the demand for this solution.

In addition, interviews would be conducted with organizations and other key figures in the energy department sector to gain further insight and understanding of the challenges faced during implementation, as well discover what type of solution users desired.

3.6. Key Benefits

Smart home - Utility technology, also often mentioned as home automation or demotics, provides User security, comfort, convenience, and energy efficiency by allowing them to manage appliances, often by a wise home app on their smartphone or other network devices. A component of the internet of things (IoT), smart home systems and devices often operate together, sharing consumer usage data among themselves and automating actions that support the user's preferences.

3.6.1 Sustainability

SMART U can promote sustainability through features such as:

Real-Time monitoring - which helps users to analyze and display streaming data that will aid in reducing utility waste, recovering revenue, and analyzing your consumption data.

Intelligent saving guidance - Using Artificial Intelligence, will analyze the utility usage patterns of the user’s and provides energy-saving tips and recommendations.

Sharing stats with service providers- By providing consumption rate data of the consumers to utility providers. Utility providers would be in a better position to make informed decisions to increase the supply of energy.

Insights of utility usage - Artificial intelligence will analyze the user’s data gathering insights on the user’s usage whilst also providing trend analysis and predictive charts on utility usage for future months based on previous data.

3.6.2 Accessibility and Accuracy

Multiuser Login - This allows two or more trusted user's access to control and analyze their utility; control can only be given by the primary device.

Cloud–Syncing - By storing data on the cloud, users can access their utility information anywhere at any time from any device.

Integration of IoT devices and appliances - IoT home automation is the ability to control domestic appliances by electronically controlled internet-connected systems, Furthermore, users can manage these appliances remotely through the application allowing them to turn them ON and OFF as well provide notifications when the appliances are turned on as well as gather data about connected appliance's energy consumption.

Calculating bill payment amounts- Through the gathered data, the application automatically calculates and charts the user's utility usage, allowing the user to make comparisons to the previous month's bill amounts. In addition, artificial intelligence would analyze and display future monthly or annual bill amounts based on previous data.

Multiple platforms Support – SMART U will be supported on IOS and Android.

Community Forum – Users can create a community forum inside the application where users can receive important utility-based news such as power cut or water cut from the forum.

Online customer support - This allows users to contact the developers for any problem they're facing in the app or instruction-based help to use the application.

3.6.3 Security & Privacy

Multi-Factor authentication- Users must provide two or more pieces of evidence to verify their identity to gain access to the application, OTP, or digital resource. Multi-factor authentication is used to protect users' data from hackers.

End-to-end encryption - End-to-end encryption will prevent third parties from accessing the collected user's data while it's transferred from one end system or device to another. In end-to-end encryption, the data is encrypted on the sender's system or device, which protects the user's data

Biometrics and Face ID unlocking - This allows the user's biometrics or face ID to access and use the application and is also used for confirmation of payments.

4. Innovative features incorporated in the project

In relation to a utility application with many innovative features, “SMART U” takes a lead in the utility application sector as explained in the “Key Benefits” section. Competing with local and global applications like “CEB Care, ePro, Voltas, JadeTrack, Smappee, Neurio”, “SMART U” is more reliable and convenient than the rest. This application contains every feature from every other software and makes it more user friendly and reliable, and it also has its own unique or innovative features like automated payments with biometric systems, multiple security system controls, force saving modes with AI, variety of service providers and a unique and fluid community forum to help users. With these innovative features it is guaranteed that “SMART U” is more reliable than its competitors.

4.1 Multi factor authentication, Multi Login, and end to end encryption.

Multi-factor authentication is used to protect against hackers by ensuring that user’s access and databases are safe, users must provide two or more pieces of evidence to verify their identity to gain access to an app, OTP, or digital resource. End-to-end encryption will prevent unauthorized third parties from accessing the collected user’s data while it's transferred from one end system or device to another. In end-to-end encryption, the data is encrypted on the sender's device and only ever decrypts it on the recipient's device which protects the user’s data. Multi login gives the advantage of letting many users to login at the same time which makes the app more convenient.

4.2 Automated payment with biometrics.

Automated payment with biometrics makes the “SMART U” Application more secure because it heavily depends on the user’s unique physical features like their fingerprints, iris and face. Using this method is faster, easy, and effortless because the user may sometimes forget their passwords, pin codes etc. This method also helps banks with their financial services because they do not need to send pin codes or verify the user each time when they make a purchase (Thales, 2020).

4.3 Smart saving modes.

Smart saving modes contain an Artificial Intelligence that provides accurate data to the user, and it also takes a further step to help the user with their utility managements and make the application more convenient.

4.3.1. Intelligent saving guidance.

Using Artificial Intelligence, it will analyze the utility usage patterns of the user's and provide best energy-saving tips and recommendations for the user.

4.3.2. Force control.

With the help of the Artificial Intelligence of the app, Force control feature enables the user to turn off or turn on any appliance with a single tap.

4.3.3. Advance stats manager.

The Advanced stats manager feature uses an AI to sort information as desired and it can make its own decisions to help the user with the app.

4.3.4. Sharing stats with service providers.

By providing consumption rate data of the consumers to utility providers. Utility providers would be in a better position to make informed decisions to increase the supply of energy.

4.3.5. Insights of utility usage.

Artificial intelligence will analyze the user's data gathering insights on the user's usage whilst also providing trend analysis and predictive charts on utility usage for future months based on previous data.

4.5 Community forum

Users can create a community forum inside the application where users can receive important utility-based news such as power cuts or water cuts from the forum and it also provides features to interact with developers to discuss about problems with the app and get direct help from them or post their own opinions on the app so developers can make the user's experience better. It also contains a section dedicated to informing the user about updates and future updates of the app. Community forum of the "SMART U" app also contains a quality user interface. Therefore, users do not face any issues with the community forum while they are interacting with it.

4.6 Combinations of service providers

"SMART U" app contains a section that is dedicated for helping the user with their utility purchases. This feature gives the freedom to the user to make any utility purchases through the application, like they can purchase gas from a variety of suppliers, or purchase bottled water etc.

5. Requirements and Analysis

For this project, these chosen elicitation techniques will be used in order to understand stakeholder's needs and wants Interviewing, Observations, Prototyping, Brainstorming, Questionnaires, Background Reading, and Workshops

5.1 Techniques Used

Interviews – This will allow the project to gain an in-depth understanding of user's requirements, objectives, and concerns related to the application.

Observations - This Will provide an opportunity to understand the user's day-to-day lives, giving key insights to target their needs.

Prototyping - Will be used to test the product to receive user feedback on the implementation of the solution and other quality of life suggestions.

Brainstorming – Will be used in generating innovative ideas for the project.

Questionnaires – The project may be used by the general public; questionnaires will aid in gathering a large amount of data about users as well as gather feedback on the implementation of the solution.

Background reading - To gain knowledge on already existing systems and to understand the policies, rules, and regulations in the industry.

Workshop - Serves as a space for conversation and problem-solving. And the objective is based on is, to give training to participants by presenting speakers who are related to the project. With the help of having workshops, stakeholders could gain some feedback for them requirements.

Furthermore, applying different techniques to different stakeholders, provides a greater chance of extracting more meaningful and impactful data from these stakeholders which will aid in improving the quality of gathered data from these users causing a snowball effect where the stakeholder's views are better understood.

These techniques will be applied to the appropriate stakeholder

General public – Questionnaires

Organizations – Interviews, Observations, and Background Reading

Utility providers – Brainstorming, Prototyping

Government – Background Reading, Observations, and Interviews

End – Users – Questionnaires, Prototypes, Workshops, and Interviews

Bank – Prototyping, Interviewing

Employees - Interviews, Observations, Workshops

Developers & Testers -Workshops, Brainstorms

Owners/Managers – Prototyping, Interviewing

The goal of applying these techniques to stakeholders is to gain and understand exactly the extent to which stakeholders are affected by utilities.

What are the logistical challenges they face and to ascertain how open they are to implementing drastic changes and if they are not willing, what incentive would they need to make the switch?

In addition, it is also important to gauge the knowledge and the amount of information that is available to the public on the current utility systems and what challenges they face. This will help us determine how user-friendly the application needs to be.

5.2 Context Diagram

A context diagram is a tool used for system analysis it is used to provide stakeholders with a general overview of the system below is the context diagram for "SMART U"

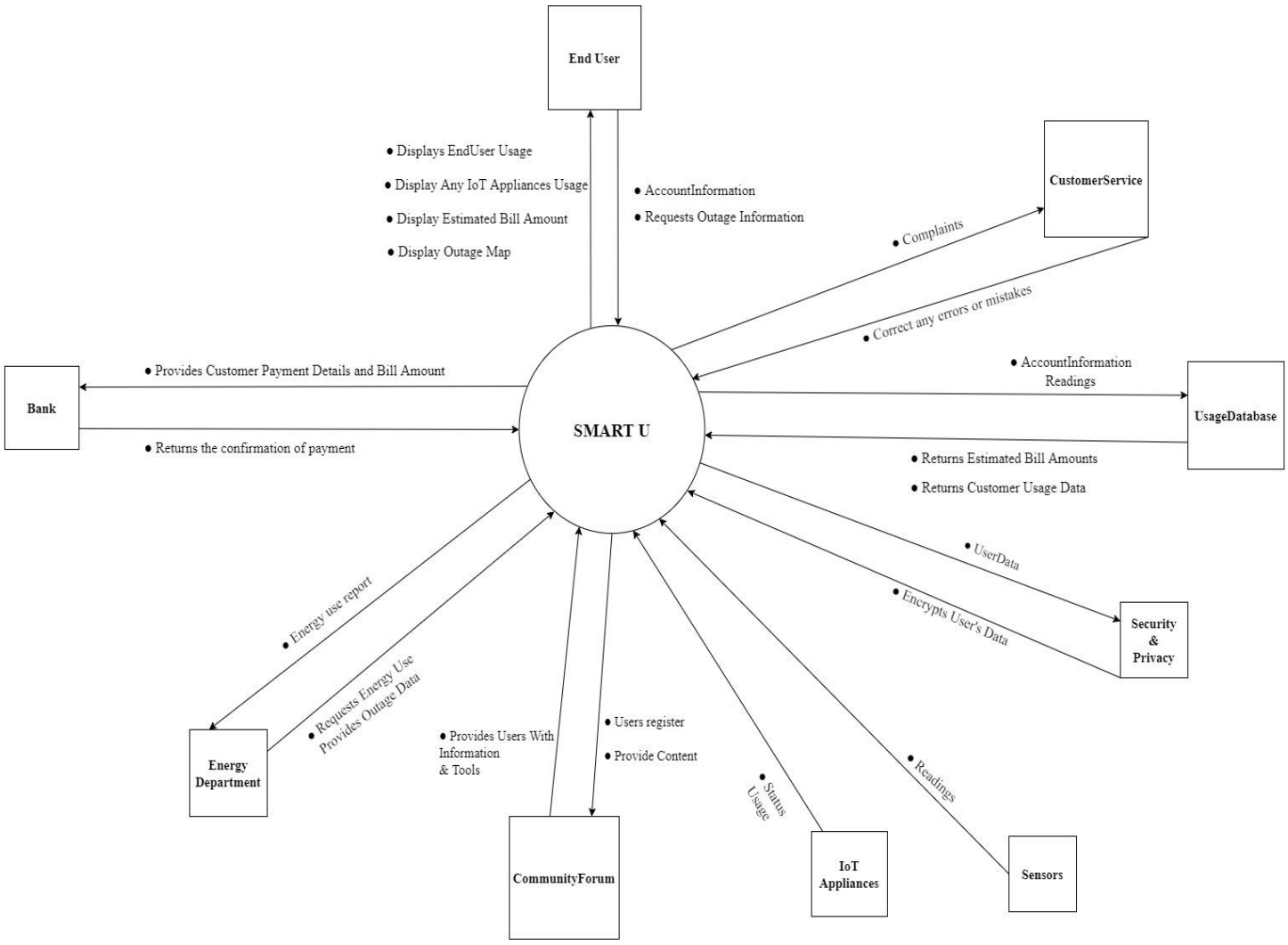

Figure 2 Context Diagram for SMART U

This diagram allows stakeholders to identify and the behavior and interaction of data without having much technical knowledge.

In addition to that due to how easy it is to understand and draw analysts and developers can easily add or remove components and test various different structures of the system to ensure it is functional in theory and is meeting all the requirements of the project

6. Screenshots of the prototype

"SMART U" would be a mobile application. Therefore, the prototype is based on a mobile framework design that will work according to user input, install sensors, and interpret data. The prototype design includes the following results:

Figure 3 Smart U splash screen

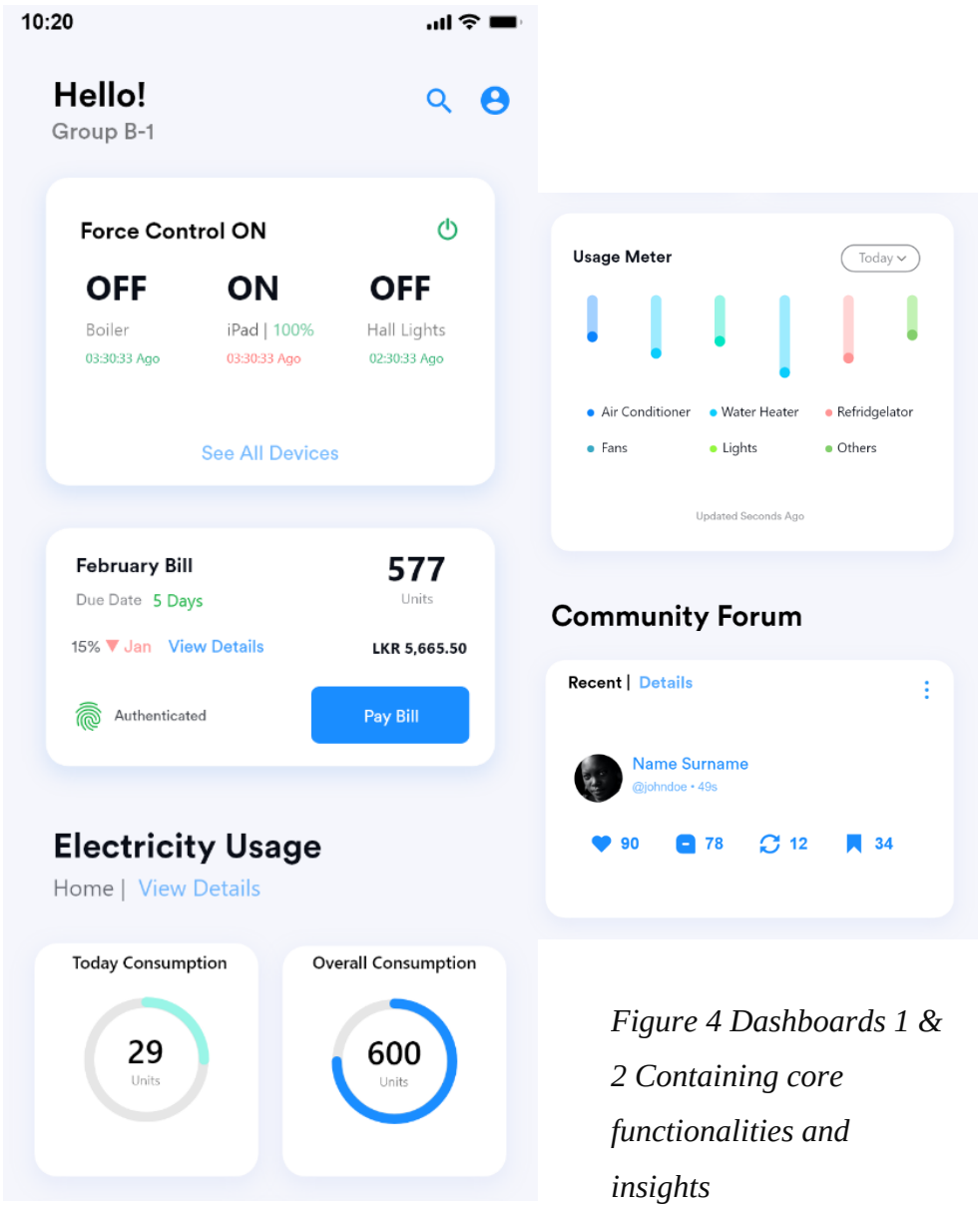

Figure 4 Dashboards 1 & 2 Containing core functionalities and insights

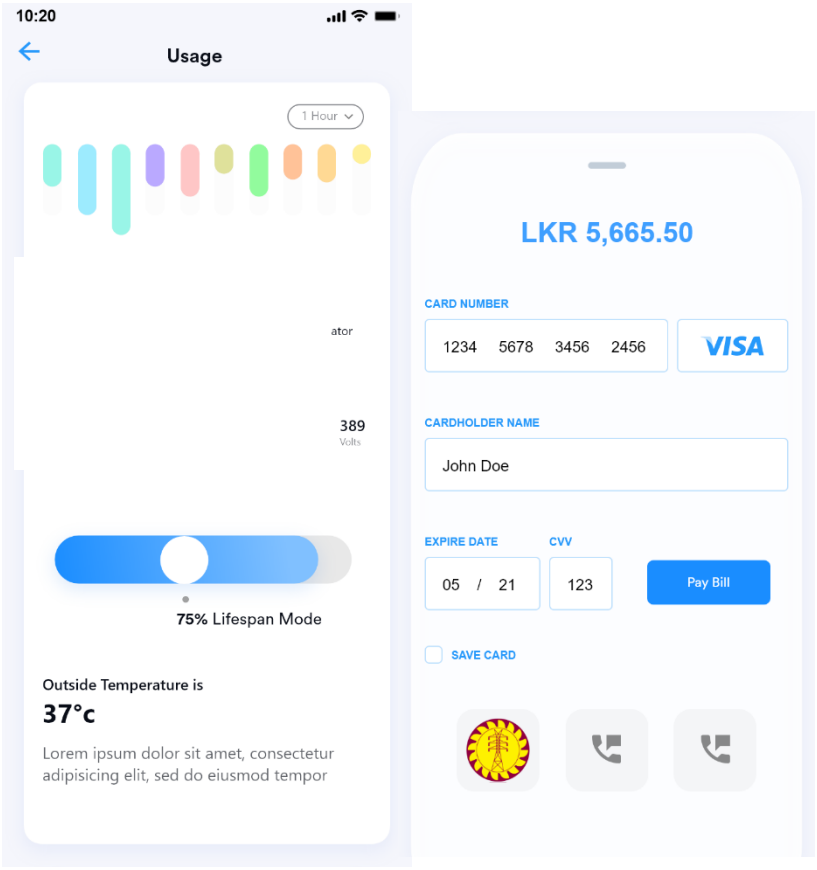

Figure 6 Usage Page 1 and 2 containing analysis, insight, and payment options

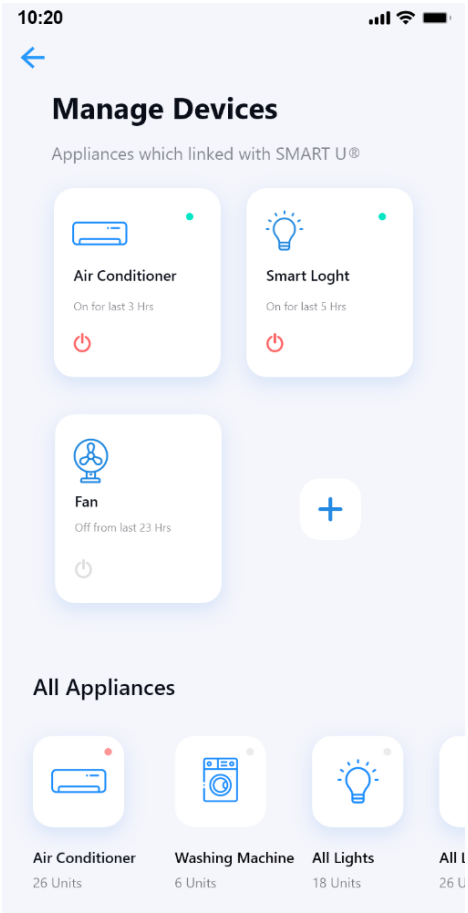

Figure 5 Connected Appliances Page

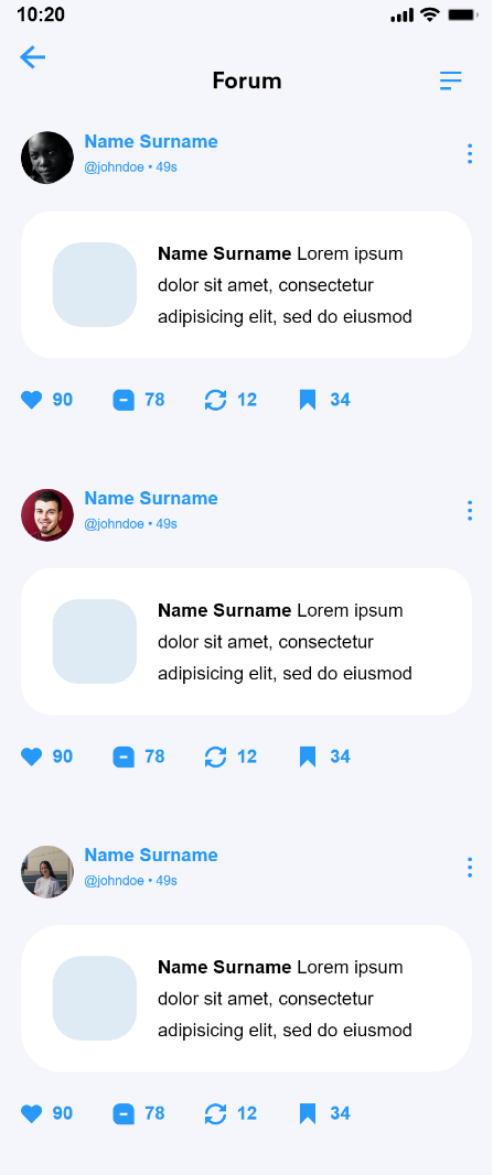

Figure 7 Community Forum Page

7. Evaluation

For this project, both Test cases and user validation questionnaires were used to receive varied feedback. Test cases will help the project to validate in an internal aspect. The main advantage of using test cases in this solution is that it allows us to understand the interaction the users will have with the system, letting us discover and solve any errors that show up. Furthermore, conducting test cases allows us to understand and push the system to see if it can meet the necessary requirements.

7.1 Test Cases

By using test cases the team was able to develop a better understanding of the user's perspective when they are interacting with the system. In addition, by creating these test cases members of the team were able to refer to it to understand the functionality of the features the users interact with. Furthermore, creating test cases allowed the team to check if the product was meeting the necessary requirements. Through the assistance of tests cases the quality of the product is improved.

However, the creation and the implementation of the test cases was a time consuming and arduous process. As if there were any changes in the requirements of the project or if a feature was removed team members had to check test cases and remove them.

But it though it is time consuming creating test cases proved to be vital as it helps to improve the product's quality and effectiveness ensuring that it can meet the requirements.

7.2 User Testing and Questionnaires

User testing and questionnaires were employed to identify if there was a demand for this type of solution and how keen users are to implement it as well as receive feedback from the targeted user base. In addition, testers outside the in-house team may be able to provide different insight and solutions as well find bugs that the team may have missed. Furthermore, by using user validation questionnaires, it will help to discover any cultural issues or barriers allowing us to design a more user-friendly solution.

Users were given a prototype of the application and were asked to use it afterwards they were asked 22 questions about their experience and knowledge with technology as well as their opinion about "SMART U", some of the questions users were asked are:

Do you struggle with managing your utilities?

Would you use an application that would aid in reducing your electricity bill?

How would you describe your overall user experience with the “SMART U” product?

When do you think that “Community forum feature” would be helpful?

What is your opinion about the overall design of this Application?

Like test cases, user testing allows for a greater understanding of the users flow and thought process when they interact with the system providing invaluable feedback that may expose vulnerabilities in this solution. Compared to test cases user testing removes any bias since the test cases are conducted by the team, they may contain assumptions that are not obvious to the user. In addition, any problems discovered through user testing will be problems that genuinely affect the user experience whereas in test cases some scenarios may not be experienced by the user letting the team focus on fixing important problems that affect the user. All of this accumulates into improving the quality and effectiveness of “SMART U”

7.3 Lessons Learned

What can be inferred from these techniques was that this problem affected all the users, but some were not opened to change due to not understanding the technology used and some were content with the current system employed, but in general all the participants were excited about the proposed solution.

Moving forwards this means that the application needs to be more user friendly and should be more direct and clearer about what it does and how it will achieve it.

7.4 Recommendations

For future questionnaires, it would improve the quality of the feedback if a larger sample size was used. As well as add more variety to the types of questions by adding multiple-choice questions and adding more open-ended questions so that users are encouraged to share their thoughts as well as ask questions to identify the application’s shortcomings. In addition, the user testing needs to be improved by giving users specific tasks and actions to conduct as well as ensure there is unbiased moderator so users do not feel pressured and cannot get assistances from a team member

8. Conclusion

This project's primary objective is to reduce electricity wastage for both organizations and individuals as well as provide benefits to users such as lower costs, increased accuracy and improving sustainability.

It sets out to achieve these tasks through a digital sensor that will be placed in the organizations or household's main fuse line.

The sensor can detect when electricity is passing through it, which it will then send this data along with date and time to a server where the real-time usage amount is calculated as well based on the amount of usage data available would be able to generate a predictive chart on future usage amounts and billing costs.

However, this will only allow for more accurate total consumption readings by adding more sensors to various appliances and would allow for more analysis on usage patterns letting the application generate insights on how much energy connected appliances are using and allowing the user to remotely turn them off letting them save energy.

This technique or technology could be further expanded into other utilities such as water or gas. In turn it may be improved upon, to be able to detect the amount of heat generated by connected appliances and calculate how much energy is wasted trying to cool them down, providing users with another insight on how to use their appliances more effectively while also improving their shelf life.

8.1 Limitations

The current limitation of this technique is that it heavily relies on installing and maintaining several sensors which means it is paramount for the sensors to be durable and have a long shelf life. Otherwise, it runs the risks costs ballooning out of proportion as maintenance and installation costs may stack up if users have to keep reinstalling new sensors to combat these sensors should go through various durability and accuracy tests as well remain vigilant and open to implementing new technologies or materials which may tackle this issue or at least provide users with free bi-annual checks of their sensors.

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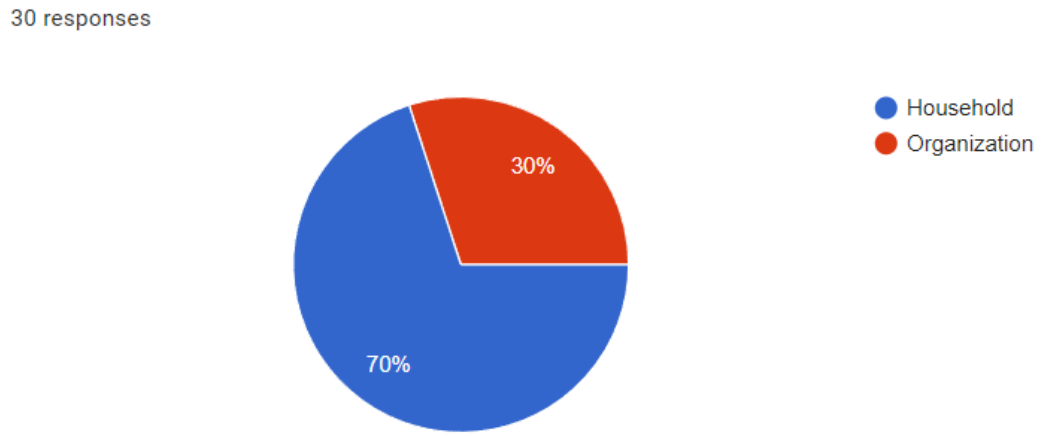
9.Appendices

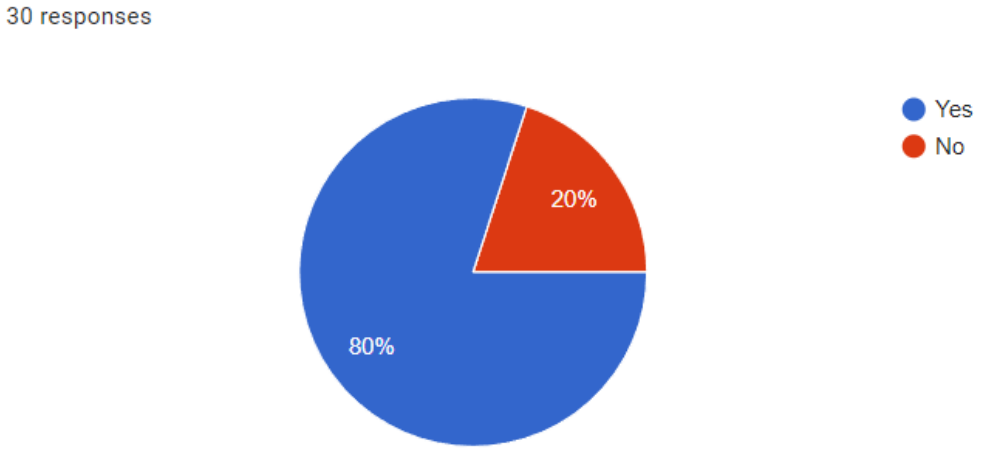
9.1 Idea Validation Survey Summary

The Group B-1 have conducted a survey regarding the "SMART U" Application via google form. Respondents were asked 16 different questions in the survey. Below are responses to some of the questions.

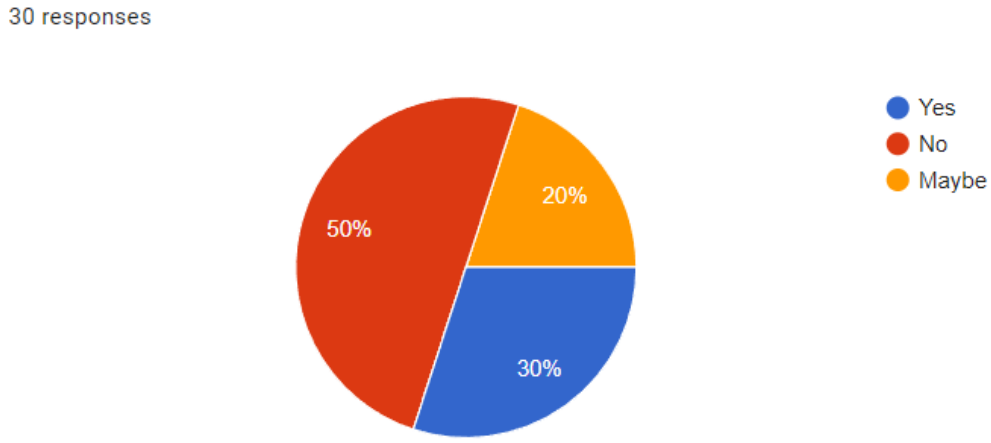
1. Do you used to manage the utility bills of a household or are you representing an organization?



2. Do you think your electricity bill is too expensive?



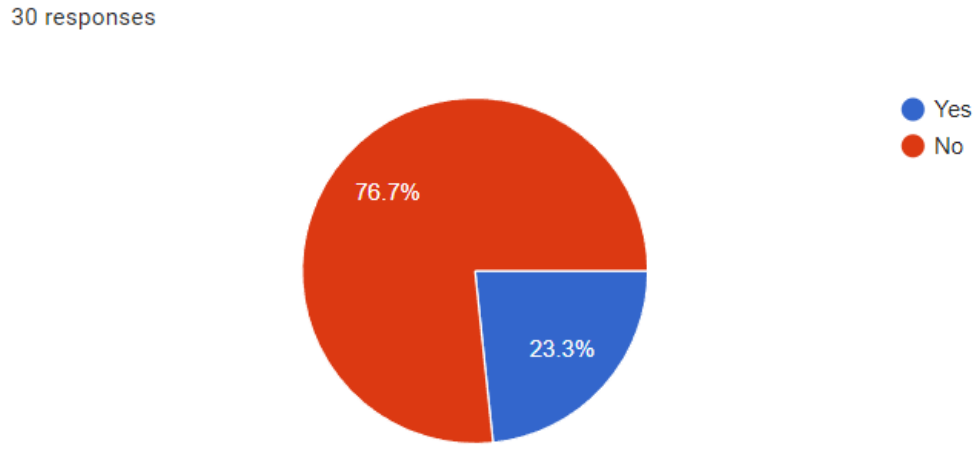
3. Do you have enough time manage your utility bills?



4. What's the reason for the above (3) answer?

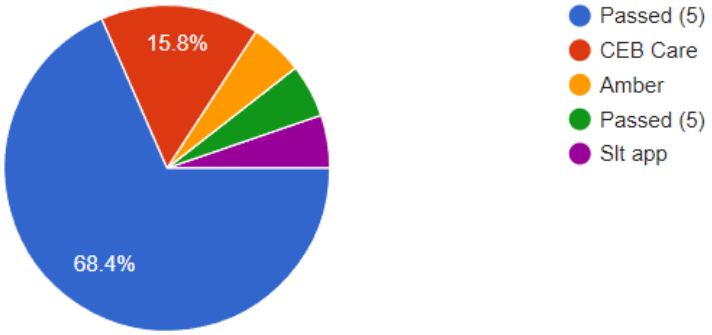
Majority of the respondents have answered as they don't get enough time look after their utilities.

5. Have you used any applications to manage and monitor your utilities?



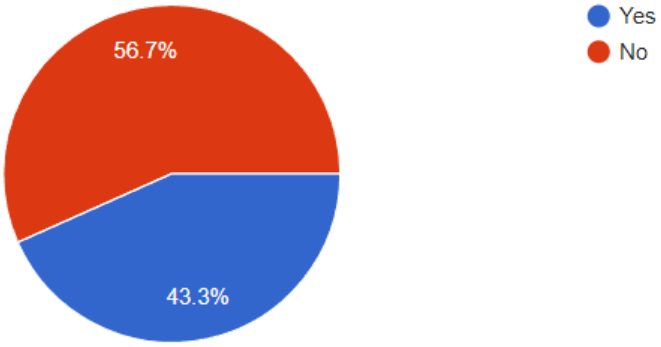
6. If you answered "Yes" to Question 5: Write down the name of the application

19 responses



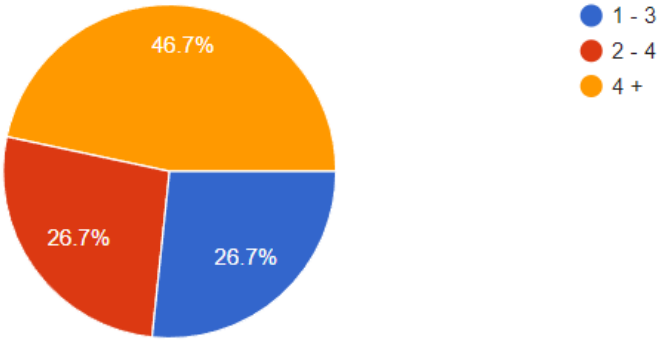
7. Do you use the Application now?

30 responses



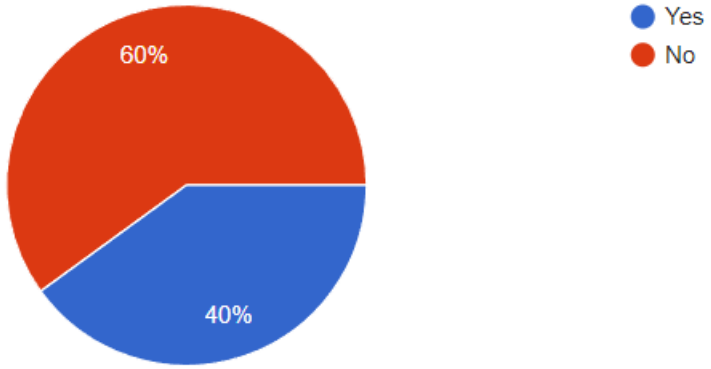
8. How many people in your household?

30 responses



9. Have your organization use such applications to manage their utilities?

30 responses



10. Which of these features would you most enjoy in a utility management application.

29 responses

9.2 Interview questions for Requirements Elicitation

9.2.1 Government

1) What is your experience with managing and paying utilities.

2) What has been your experience with setting up infrastructure for utilities.

3) What are some of the structural challenges you faced with utilities

4) Were there any unexpected challenges that arose that weren't accounted for?

5) How open are you to implement new changes?

`6) Are there any future plans to update or overhaul existing systems?

7)What is your opinion on current systems?

8) What ways have you identified to improve the system?

9) Is there any interest in improving sustainability.

10) How much are you willing to spend on implementing smarter solutions.

9.2.2 Organizations

1) What is your experience with managing and paying utilities?

2) What are some challenges you faced with your utilities?

3) Are you satisfied with the current system you employ? If so, why?

4) Which part of the current system are you dissatisfied with and why?

5) Would you be open to more innovative, smarter solutions?

6) What type of changes to the current system would you implement?

7) What would prevent you from swapping to newer systems?

8) What do you think is the most important objective of a utility solution?

9) Would you be willing to pay more up-front costs in order to save more money in the long run?

10) What key features are most important to you?

9.2.3 End User

1) What is your experience with managing and paying utilities?

2) What are some challenges you faced with your utilities?

3) Are you satisfied with the current system you employ if so why?

4) Which feature of the current system has left you dissatisfied

5) If newer, smarter solutions were to arise would you use it?

6) What would prevent you from swapping to newer technologies

7) What key features are most important to you and why?

8) What type of customer support do you expect and why?

9.2.4 Owner/Manager

1) What is your experience with managing and paying utilities?

2) What are some challenges you faced with your utilities?

3) Which feature of the current system has left you dissatisfied?

4) What are the key structural issues you have identified and how to plan on addressing it?

5) Why do you wish to implement a smarter solution?

6) Why did you decide to develop this application?

7) Do you plan on working with the government or other private entities in the industry?

9.2.5 Utility providers

1) What is your opinion on current systems?

2) What are the ways have you identified to improve the utility system?

3) Is there any interest in improving your sustainability?

4) How much are you willing to spend on implementing smarter solutions?

9.3 Test Cases

Test Case ID	Test Scenario	Test Steps	Test Data	Expected Results	Actual Results	Pass/ Fail
01	Creating an account in Smart U	1.Open the app 2.Enter registration details. 3.Click the Create account button	First Name Last Name Email Password Mobile Number City	Success! You may now log in with this account	As expected,	Pass
02	Logging into Smart U	1.Open the app 2.Enter login details 3.Press log in	Email address, password, Face ID, fingerprint	Goes to the user's dashboard	As expected,	Pass
03	Accessing Usage chart	1.Open the app 2.Enter login details 3.Press log in 4.Tap the usage chart	Usage data on connected appliances	Displays the usage amount on the users connected appliances	As expected,	Pass
04	Accessing Community Forum	1.Open the app 2.Enter login details 3.Press log in 4.Tap the community forum	User's posts	Displays the users post and other related information	As expected,	Pass
05	Accessing Force Control	1.Open the app 2.Enter login details 3.Press log in 4.Tap force control	Sensor data on connected appliances	Displays the usage data on connected appliances as well as if they are ON/OFF	As expected,	Pass

06	Accessing Payments	1.Open the app 2.Enter login details 3.Press log in 4.Tap Payments 5.Enter payment details	Payment details Card Number Expiry Date CVC User bill amount	You have successfully paid {Bill Amount}	As expected,	Pass
07	Accessing Connected Devices	1.Open the app 2.Enter login details 3.Press log in 4.Tap connected device	Appliances which are connected	Displays the names of connected appliances and how long they have been ON	As expected,	Pass
08	Accessing Customer service	1.Open the app 2.Enter login details 3.Press log in 4.Tap support 5.Choose either to email or call	Complaint ID Content of the compliant	Thank you for submitting your compliant we value your feedback	As expected,	Pass
09	Creating a discussion	1.Open the app 2. Navigate to community forum tab 3. Press the “Plus” icon 4. Start the discussion	Name User details Profile photo	New discussion	As expected,	Pass
10	Controlling Power Mode	1.Open the App 2.Navigate to usage in the dashboard tab 3.toggle the power mode	Number of Units Wastage Usage Cost	“Power Save Mode” Or “Life span Mode”	As expected,	Pass

9.4 Workload Matrix

Topics		Members' Contributed	Contribution
Title Page		Aamil 20211096	Making of the cover Page
Abstract & Acknowledgement		Aamil 20211096, Sabath 20210836	Making for the Report
Table of Contents, List of Figures etc.		Akshith 20210589, Aamil 20211096	Creating the table of contents
Body of the Report	Introduction and Description of the Project	Akshith 20210589, Manuga 20210970, Sabath 20210836	Contents for Introduction, Updated version of Gap Analysis respectively
	Methodology	Aamil 20211096, Akshith 20210589	Contents, editing respectively
	Solution Outline	Ajey 20210994, Akshith 20210589, Aamil 20211096	Contents for solution, key benefits, etc.
	Innovative features incorporated in the project	Manuga 20210970, Ajey 20210994	Contents and editing respectively
	Requirements and Analysis	Akshith 20210589, Sabath 20210836 Aamil 20211096	Ideas, Contents, editing respectively
	Screenshots of the prototype	Aamil 20211096, Ajey 20210994	Prototype with Adobe XD - 20211096
	Evaluation	Aamil 20211096, Akshith 20210589	Contents - 20210589
	Conclusion	Akshith 20210589, Sabath 20210836	Contents, editing for the project conclusion

References	Aamil 20211096 , Manuga 20210970, Akshith 20210589, Sabath 20210836, Ajey 20210994	Citation – each member to the relevant contents they provided. References List
Appendices	Aamil 20211096	Annexed the Survey Questions and responses Table filling, Editing

9.5 Meeting Agenda Table

Meeting Agenda	Note
Meeting 1: Topics Discussed • Brainstorming on the project ideas • Delegated task to members	Start and End Time: 8:30PM-9:15PM Location: WhatsApp Date: 07/03/2022
Meeting 2: Topics Discussed • Review of information gathered by members • Creation of cover page and Requirements outline	Start and End Time: 6:00PM-7.25PM Location: Zoom Date: 12/03/2022
Meeting 3: Topics Discussed • Correction in the project idea • Corrected content errors related to Evaluation	Start and End Time: 4.00PM - 6.00PM Location: Zoom Date: 16/03/2022
Meeting 4: Topics Discussed • Review and corrections of Methodology Statement	Start and End Time: 6.30PM - 7.30PM Location: Zoom Date: 17/03/2022
Meeting 5: Topics Discussed • Review and correction of report • Delegated tasks	Start and End Time: 8.30PM - 9.00PM Location: Zoom Date: 19/03/2022
Meeting 6: Topics Discussed • Designed the Prototype • Proofreading and editing of report	Start and End Time: 7.30PM - 8.00PM Location: Zoom Date: 21/03/2022
Meeting 7: Topics Discussed • Final review and correction of report • Allocating final tasks • Proofreading and editing of report	Start and End Time: 4.00PM - 5.00PM Location: WhatsApp Date: 25/03/2022
Meeting 8: Topics Discussed • Finalizing the IPR and Starting Presentation Slides	Start and End Time: 6.00PM - 6.30PM Location: WhatsApp Date: 29/03/2022