6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

25 - 27 SEPTEMBER 2023

E-PROCEEDING

USBET 2023

e-Proceeding

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Editors-in-Chief

6th Undergraduate Seminar on Built Environment and Technology 2023

- E- Proceedings-

Organized by,

College of Built Environment (KAB) UiTM Perak Branch

MYHOMEMETERAPP

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ABSTRACT

One of the most pressing issues confronting civilization in recent decades has been the use of energy. Electricity accounts for an important portion of annual energy use. Several techniques have been implemented to minimise energyconsumption, such as encouraging the use of renewable energy sources or boosting energy efficiency. However, as people's usage of electronic devices for entertainment and online meetings or lessons increased, electricity and waterexpenditures rose day by day, including laptops, smartphones, lamps, fans, air conditioners, and daily activities. As a result, this research will create MyhomemeterApp concepts and explain how to use the apps to monitor electricity and water usage among residences. The research was conducted by identifying the current issues, recommending, and developing innovative approaches to the problems, and evaluating the product's marketability. All of this was done to improve and correct every issue with the current smart metre. As a result, this research will generate MyhomemeterApp design options and explain how to use the apps to monitor electricity and water usage in residences.

INTRODUCTION

People intuitively know almost every day that the entire world is surrounded by two of the most crucial components of all time: water and electricity. Energy usage is one of the greatest challenges facing society over the past few decades (Nguyen & Duong, 2019). A significant portion of annual energy usage is made up of electric energy. Day by day, electricity costs grew as a result of people's growing use of electronic devices for amusement and online meetings or classes, including laptops, smartphones, lamps, fans, andair conditioners (Maslan et al., 2022). Maslan et al. (2022) stated that people have begun integrating technology into their homes and mixing it with various mechanical and electronic household appliances tocreate a "smart home" that will simplify and secure every aspect of societal living. By being aware of the home's electricity usage and bill at any time and from any location, users of home automation can manageremotely.

However, there are several problems that this study may address, which is the rise in carbon emissions in Malaysia as a result of residential and commercial energy consumption (Fong et al., 2008). When excessive electricity is used in residential and commercial buildings for lighting, heating, cooling, appliances, and other activities, it uses energy and indirectly contributes to more carbon dioxide (CO_2 emissions) if the electricityis derived from fossil fuels. The use of fossil fuels to create electricity, such as coal, oil, and natural gas, isa major source of CO_2 emissions from the power sector (US EPA, 2021). Other than that, water is one of the most valuable resources on the planet because it is essential for environmental sustainability, agricultural production, and human health. However, excessive use of water in residential areas can indeedcontribute to the depletion of water resources and lead to a range of environmental and socio-economic challenges (meenakshi, 2018).

The aim of this study is to develop an application that can help consumers calculate and observe electric and water usage in house or building. This innovation project is essential for the building as the electricity and water can be monitored and calculated to reduce the water and electricity usage. There are also several objectives of this study which are to identify the current issues with the smart home metre, to determine what can be improved from the previous home metre invention, to demonstrate the performance and use of MyHomeMeter application and to evaluate the marketability of MyHomeMeterApp innovation for potential consumers.

LITERATURE REVIEW

This chapter includes literature research on the current issue of excessive water and power usage, issues with current smart meters, concerns and problems related to the topic, and the development of the innovation proposal. This chapter also covers research on previous breakthroughs, such as current smart meter applications, which helped form the innovation concept. The advancement of the Internet of Things (IoT) is significant for visualising the future using household objects because it allows for easier access to and interaction with a wide range of devices, which may apply to various industries such as industrial automation, home automation, medical aids, traffic management, and automotive, to name a few (Alejandrino et al., 2022). This chapter will also go over how water and electricity are used in homes and construction.

Electricity And Water Usage

Every nation needs electricity because it is one of the primary drivers of national development, which is why consumption is constantly rising. The need for a more accurate, effective, and environmentally friendly method of measuring energy consumption has forced service providers to respond to the rate at which industrial, commercial, and residential electricity users are growing around the world that makes sure that invoices and bills are generated accurately (Nile University of Nigeria, Department of Computer Engineering, Abuja Nigeria et al., 2021). Electric energy meter is an instrument or device that measures the quantity of electricity consumed by consumers over a specified period of time in residential, commercial and industrial buildings (Nile University of Nigeria, Department of Computer Engineering, Abuja Nigeria et al., 2021). Ordinarily, kilowatt-hours are used as the billing unit for calibrating electric energy metres. Households are diverse customers who use varying amounts of electricity for various purposes at various times of the day so, by Understanding how the level and timing of electricity consumption are related to household characteristics is critical in planning production and grid capacity, as well as in developing policies (Andersen et al., 2021). Figure 1 below shows the electric meter that is frequently used in households.

The vast majority of residential water metres used by water supply utilities today are analogue, magnetically driven, positive displacement metres. These metres measure water flow using the positive displacement principle and employ an annotating disc or a similar mechanism(A Low-Cost, Open Source Monitoring System for Collecting High Temporal Resolution Water Use Data on Magnetically Driven Residential Water Meters. - EBSCO, n.d.). Water metres Water metres as we know them have been in use for more than a century to measure how much water is used and to determine flow through a specific portion of a public water supply system and to measure the volume of water used by residential and commercial building units that are supplied with water by a public water supply system (Arregui et al., 2007).

The Issue with Smart Meter Applications

According to Alwaisi & Opoku Agyeman (2018), in general, replacing a regular metre with a smartmeter has greater benefits. However, the smart meter's design, deployment, and maintenance raise a number of concerns and challenges. (Alwaisi & Opoku Agyeman, 2018). Smart home metres, or smart metres, are devices that monitor and record energy consumption in a more advanced and automated manner than standard metres. While smart metres have many advantages, they might also have some drawbacks. Some of the most typical concerns with smart house metres are as follows: -

Data security risks

According to unauthorised access, privacy can be affected. To send data, smart metres rely on wireless communication standards and internet connectivity. This opens the door for unauthorised access by hackers or malicious individuals. Smart metres might be subject to attacks if their security measures are inadequate or incorrectly designed. Furthermore, consumers' data privacy may be threatened too. Smart meters capture extensive data on energy consumption, which might reveal sensitive information about people's daily routines, occupancy patterns, and lifestyle choices. If this data is not securely protected,it can be used for a variety of purposes, including targeted advertising, identity fraud, and even determining whether a home is vacant. Smart metres rely on a continuous network connection for data transfer, which might lead to denial-of-service attacks. Malicious actors may use denial of service (DoS) attacks to disrupt connectivity between smart metres and energy company computers. This might result in data loss, operational disruptions, and incorrect billing. Other than that, tampering and metre fraud are possibilities. Smart metres can be physically tampered with to alter energy consumption readings or gain unauthorised access to the metering system. Such interference can result in financial losses for utility providers as well as incorrect billing for customers.

Installation and compatibility issues

This issue may be related to infrastructure readiness. It can be a considerable undertaking to upgrade current infrastructure to handle smart meters. This includes making sure that dependable communication networks, such as cellular or Wi-Fi, are available for data transmission from meters to utility companies. Infrastructure changes may be required in some circumstances to establish a robust and stable communication network. Aside from that, meter placement and accessibility can be a problem for consumers. Installing smart meters necessitates physical access to the meters, which can be difficult in some cases. Meters in isolated places, high-rise structures, or gated communities, for example, may necessitate additional planning and cooperation to ensure proper installation. Metre compatibility can also be an issue. Utility companies frequently install a wide range of metering devices across their client base. It might be difficult to ensure interoperability between existing metering infrastructure and new smart metres. Differences in communication protocols, data formats, or metering standards may cause compatibility concerns. Next, in terms of installation and compatibility, there is integration with existing systems: Smart metres are often connected with current systems used by utilities, such as metre data management systems, billing systems, or client portals. It can be difficult to ensure seamless integration and data flow between these systems and the new smart metres, which necessitates careful planning and coordination.

Cost and affordability

Smart metre costs and affordability can vary based on a number of factors, including the volume of implementation, the location or country, the specific technology employed, and the accompanying infrastructure requirements. The first is the expense of purchasing the metre. Smart metre procurement costs include the hardware, software, connectivity modules, and other components required for metre functioning. The cost varies according to the type and capabilities of the smart metre technology chosen. When compared to simple smart metre devices, advanced features such as two-way communication or real-time data monitoring may increase the cost. The issue could be smart metre infrastructure upgrades. Smart metre deployment frequently necessitates infrastructure changes such as communication networks, data management systems, and backend infrastructure. These changes, which include hardware, software, and labour, might increase the overall cost of deploying smart metering systems. Installation costs are likewise high. The cost of installing smart metres might vary based on factors such as metre position, accessibility, and installation complexity. Remote or difficult-to-reach places may necessitate more resources and result in higher installation costs. In some circumstances, utility providers may be required to hire outside contractors for installation, which might raise overall expenses.

SCOPE OF STUDY

The scope of the innovation will be concentrated on the issues with the current application and meters that calculate electricity and water in the residence. The concept of calculating electricity data will be implemented to address issues such as excessive energy consumption, but with the addition of calculating water usage. The advancement of application innovation in terms of easy and useful data as well as potential evaluation around household and on the construction site. During construction, the client can monitor daily usage of water and electricity, not just once a month.

LIMITATION TO STUDY

This innovation study was founded on the feasibility study about the electricity and water consumption among users along with the application of Internet of things (IoT) on latest technology. The study includes a detailed analysis of what is required to complete the innovation from various articles. The study included a description of a new product of technology that has not yet been released onto the market. Aside from that, there have been very few studies on the topic of avoiding unethical behavior on e-commerce platforms. When there is a scarcity of research, it can be difficult to discover specific studies that address this topic explicitly.

SIGNIFICANT OF THE STUDY

The study of calculating electric and water usage technology can be a valuable guideline tool in the household as well as on the construction site to improve the reduction of excessive water and electricity usage. The project's goal is to develop an application that will assist citizens in improving their lifestyle. This application will implement new strategies or establish effective ideas to generate new energy-saving patterns for users. These would allow users to identify and address water and electricity usage issues before they became a concern. Furthermore, on a construction site, the client can monitor and control the usage, which can be used as a strategy to reduce the bill amount because prevention is better than treatment. The findings will also shed light on the problem-solving strategies. Based on the Sustainable Development Goal (SDG) 7, affordable and clean energy, between 2000 and 2018, the number of people with access to electricity increased from 78 to 90 percent, while the number of people without access decreased to 789 million. However, as the population grows, so will the demand for cheap energy, and an economy based on fossil fuels is causing drastic changes in our climate. This statement shows that the excessive usage of the internet can have negative impact to the country.

Various Existing Product

Malaysia, as a developing country, demonstrates an interest in technology adaptation. Adopting and changing with changing technologies is a healthy approach to keeping the country up to date (Fakharuddin, n.d.). There are several existing smart metre apps and smart metre equipment available on the market. Each product in Table 1 has its own unique selling point. The specifics of each are listed below:

MyTNB

Typically, manual entry is used to record electricity usage on the bill. Human proficiency is impacted by this approach, which results in the delivery of bills being delayed during the Covid-19 pandemic (Chai Ri & ChuaKing, 2021). The more elegant controls on Malaysia's smart metres enable the smart metre to communicate data with myTNB application and the portal for tracking and adjusting energy use in order to save money and the environment (Chai Ri & ChuaKing, 2021). The user can utilise the myTNB applicationto pay the smart metre bill anytime, anywhere, and the smart metre will continuously read the energy usedto provide an accurate bill. Figure 3 below shows the TNB application that can be downloaded from GooglePlay Store or App Store.

Sub Meter Water Bill Calculato

Other than that, there are also application that can calculate water consumption which called Sub Meter Water Bill Calculato. Sub Meter Water Bill Calculato is an app that calculates each tenant's total submeter water consumption. The recorded data can be easily calculated, saved, and used for the next month's bill by apartment owners. Essentially, this app is intended for apartment owners who have multiple sub metersfor tenants. Essentially, this app is intended for apartment owners who have multiple sub meters for tenants.Figure 4 below shows the Sub Meter Water Bill Calculator.

MyLAPApps

Next, there are also an apps that called MyLAPApps that is launched by Lembaga Air Perak. On April 1, 2022, the launch of Mobile Apps (Mobile Apps) MyLapApps Lembaga Air Perak was begun. Payment canbe made through online banking. The app can calculate the usage of water for every month. User can monitor their water consumption and total bill for the month through the application.

Loop Homes

Other than that, there is also an application called Loop Homes that calculates the gas and electricity consumption and bills. The Loop app evaluates data from smart meters and provides simple suggestions for cutting energy use, saving money, and lowering carbon footprint. The average power and gas bill reduction for Loop homes is 16% and 10%, respectively. If the residence has a smart meter, the Loop smart meter app is recommended to save money on electricity. It was a fantastic app that operates withouta hitch, provides accurate real-time meter readings, and aids in bill reduction. The app's data is eye-opening.The app allows users to view the gas and electricity usage at any depth or level they choose. For instance, the user can be notified of the expense of each shower.

AEW100 Wireless IOT Power Meter

Finally, is an electrical equipment that can calculate electricity used in residence which is AEW100 Wireless IOT Power Meter. AEW 100 is a multifunction power meter. There are functions like RS485 communication and Lora communication on 470MHz. With built-in MODBUS-RTU protocol, AEW100 can match most of the system integration requirements. AEW100 has the advantage of higher accuracy, more compact and easy installation.

Table 1: AEW100 Wireless IOT Power Meter

|					
 Loop Homes		/	/	Device	Accurate
 AEW100 Wireless IOT Power Meter			/	Equipment	Accurate
MyHomeMeterApp	/	/	/	Device	Accurate

METHODOLOGY

This chapter will cover and explain several subjects, including the data gathering and analytic methodologies utilised in the research. The methodology chapter will assist readers to assess the trustworthiness and validity of the research and dissertation topic (Goddard & Mellville, 2004). A research technique is a systematic approach to solve a research topic (Kothari, 2004). The research method is more than just collecting data; it is a process that develops on an unanswered topic (Goddard & Mellville, 2004). This part is crucial because it discusses how the research was carried out and why the methods used were chosen. It is also to show that the research was rigorously carried out and that it can be reproduced.

RESEARCH PROCESS

The research process consists of a series of systematic procedures that a researcher must follow in order to give knowledge that will be valued by the project and focus on the relevant issue (Singh, 2021). The research process consists of several steps or actions required for successful research, such as formulation of the research problem, extensive literature review, development of hypotheses, preparation of the research design, selection of the sample design, data collection, project execution, data analysis, testing of hypotheses, generalisation and interpretation, and preparation of the report or presentation of the results (Singh, 2021).

Innovation Framework

Innovation frameworks are strategic structures that allow businesses to access ideas, evaluate their strengths and limitations, make intelligent decisions, and establish plans to translate concepts into opportunities that may bring value to the organisation. Design thinking is commonly defined as a creative and analytical process that allows for experimentation, model building and prototyping, feedback collection, and redesign (Razzouk & Shute, 2012).
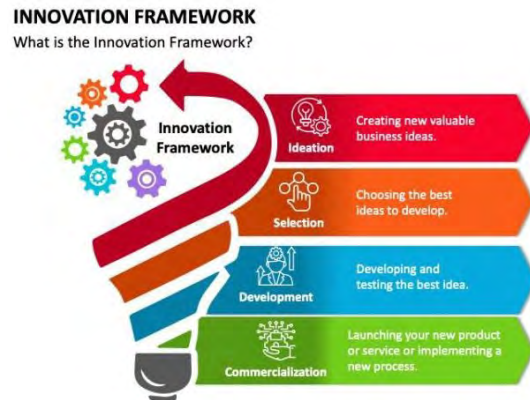
Figure 1: Innovation Framework (Source: SketchBubble.com)

RESULT AND DISCUSSION

After comparing prior innovations, MyHomeMeterApp was chosen for some improvement and innovation. In this section of the ideation process, improvements are made in terms of convenience and by combiningthe usage of water and electricity in one application. This section analyses the usage of the e-commerce platform. The current problems were utilised to improve equipment and mobile software applications. As a result, in some approaches, the improvement will be displayed in the simulation process for the exact simulation performed for the current features and functions with the new upgrade for the performance, idea, and component by component of the mobile software program.

The Development of Proposed Product

MyHomeMeterApp

It's wise to be energy efficient, not only to save money on the electricity bill, but also to reduce the carbon footprint. All of this is possible with the MyHomeMeterApp, which displays the most recent Smart Meter readings every day. Meanwhile, the MyHomeMeterApp will show data on daily energy consumption. Convenient monitoring allows users to identify instances of excessive electricity and water consumption and adjust to more energy-efficient habits. The app will assist the user in monitoring the amount of water and power used in the home so that they are informed of their daily energy usage. MyHomeMeterApp will make it easier to ascertain how much energy is used by various home equipment. Customers must enter the needed information into this app to compute the water usage, appliance's energy consumption, including power usage, Kwh pricing, and the number of hours utilised. Therefore, after including this data, calculations may now be performed to calculate specifics like Kwh/day, cost/day, cost/month, and cost/year.

Figure 2: MyHomeMeterApp

Elements and Features of MyHomeMeterApp for Residence.

The study that enabled the development of this application determined that several components and features must be used in order to improve workflow. The main components of the MyHomeMeterApp are the registration or sign-up process for the users and the approach to product marketing.

a)   Home Page of the Apps

Figure 3: Home Page

b)   Sign Up for New Users

The sign-up or registration step is required for every application that requires personal information. Users generally require a higher level of trust before they are willing to divulge their personal information to programs with little brand awareness or ones where the benefit proposition is unclear. As a result, establishing reputation and gaining consumers' trust are significantly reliant on the sign-up or registration process. A well-designed and transparent registration method should encourage users to provide personal information and interact with the application. If an error occurs, easy error handling and validation should be provided. Using effective error handling and validation should assist users smoothly through the registration process. Indicating any inaccuracies or missing information clearly and providing useful

suggestions for correcting the users. Aside from that, integration with third-party services such as Google, Facebook, Apple ID, or Instagram might be beneficial in terms of saving time and making the registration process more user-friendly. As a result, Figures 13 and Figure14 show how to register as a new user.
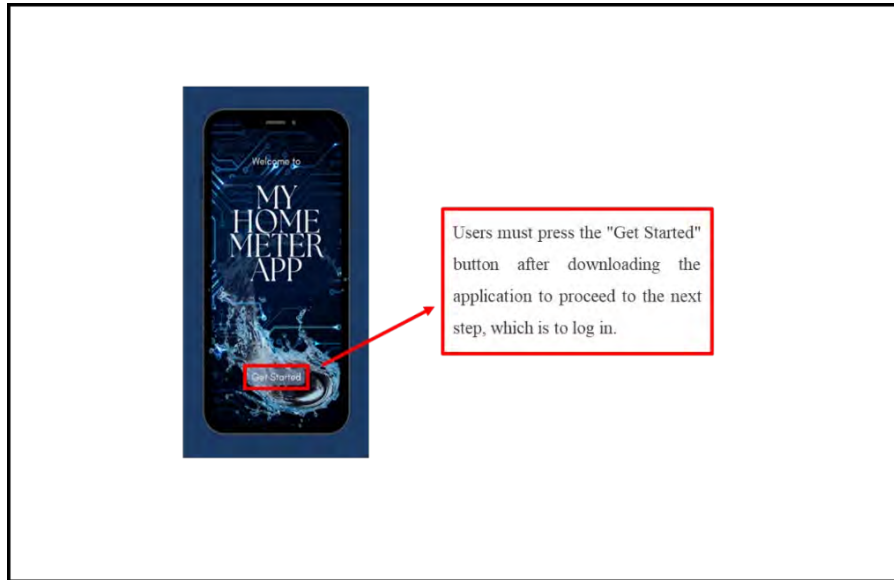

**Figure 3: Step 1 of MyHomeMeterApp**
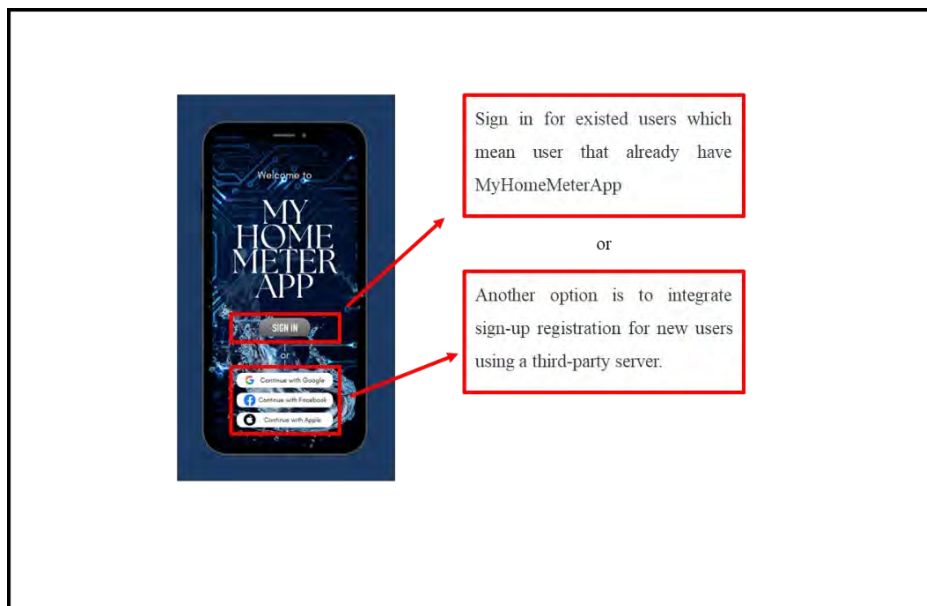
Figure 4: Step 2 of MyHomeMeterApp

The registration was not directly associated with a Google, Facebook, or Apple ID account. Social media integration will be facilitated by security and personal data. Creating a distinct sign-up or log-in process only allows users to get to where they need to go quickly. This page only contains form fields that are necessary for collecting information, such as a username, email address, and password.
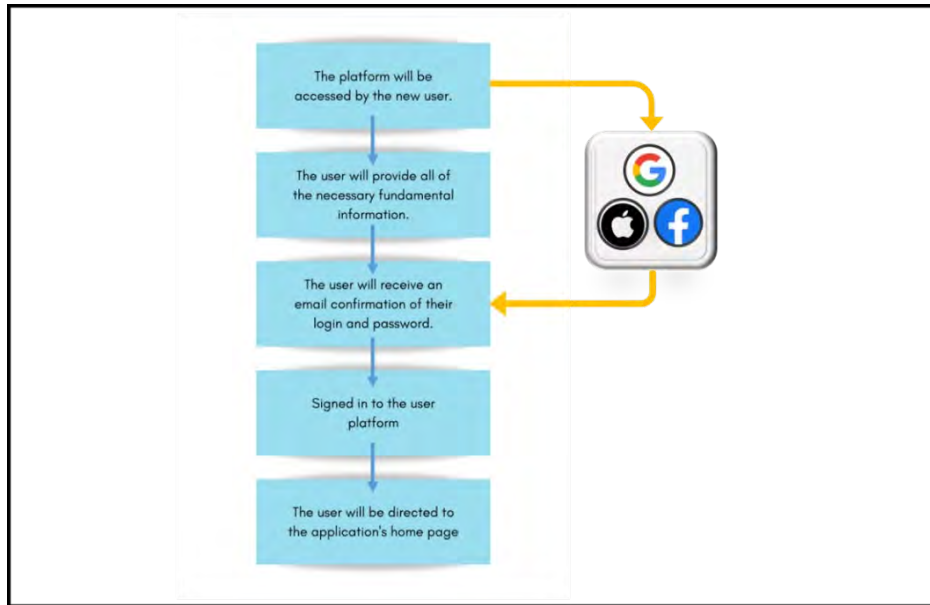
Figure 5: Registration for integration with a third-party server

Furthermore, to avoid inappropriate behavior when using the e-commerce platform, the user will be required to input more information in the security and information settings or fill out all specific facts in My Profile. By introducing a progress indicator or giving incentives for completing their profiles, users are encouraged to fill out all of the essential fields in their profiles. In order to increase trust and improve their entire experience on the site, emphasise the necessity of truthful information. It is necessary to do so in order to prevent any information from jeopardizing the platform's security. Figure 4.6 illustrates a more in-depth look into the application's prologue, acquired from reliable sources and suitable for inclusion in this application.
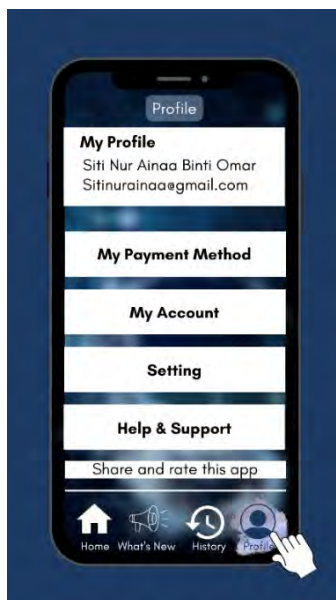
Figure 6: Feature descriptions for registering new users

CONCLUSION

According to this study, the MyHomeMeterApp Mobile Software Application innovation concept can improveon the previously identified e-commerce platform in the most recent server-based study. The innovative concept of combining water and energy usage can help consumers monitor their daily usage and promotechanges in excessive usage, making the planet a better place. Consumers can track their consumption, purchases, or any other pertinent information using a "meter mobile" app that tracks usage in real time. This transparency can assist users in making informed purchasing decisions and effectively managing theirbudget. It can also make tailored suggestions.

It is advised that this software works with TNB and water supply companies to reach a wider number of clients and deal with a bigger number of upgrades to decrease excessive electricity use. MyHomeMeterAppis keen to add features such as the ability for consumers to control their home's water and power production remotely. Aside from that, it is also beneficial to do additional research on smart house meters and smart meter applications to determine what is lacking to invent more innovation that may entice more consumersto use energy efficiently.

ACKNOWLEDGEMENT

REFERENCES

Alwaisi, Z., & Opoku Agyeman, M. (2018). On the Challenges and Opportunities of Smart Meters in Smart Homes and Smart Grids. 1–6. https://doi.org/10.1145/3284557.3284561

Fong, W., Matsumot, H., & Ho, C. (2008). Energy consumption and carbon dioxide emission considerations in the urban planning process in Malaysia. Journal of the Malaysian Institute of Planners, 6, 101–130. https://doi.org/10.21837/pmjournal.v6.i1.68

Goddard, W., & Mellville, S. (2004). Research Methodology—An Introduction (Second edition). Software Publications Pty, Limited. https://books.google.com.my/books?hl=en&lr=&id=bJQJpsU2a10C&oi=fnd&pg=PA1&dq=research+meth odology&ots=Xuu4UcyT7l&sig=LxqitxlKsi_2785l6eCQfwGUdkQ#v=onepage&q=research%20met hodolog y&f=false

Kothari, C. R. (2004). Research Methodology—Methods and Techniques by C.R Kothari (Second Edition). New Age International. http://lms.aambc.edu.et:8080/xmlui/bitstream/handle/123456789/212/Research%20Methodology %20Met hods%20and%20Techniques%20(%20PDFDrive%20).pdf?sequence=1

Maslan, M. N., Abdullah, L., Chairat, A. S. N., Zamri, R., Syed, M. S., Ali, M. M., Zainon, M., & Samsuddin, N. M. (2022). Application of simple smart home devices for energy efficiency in Malaysia.

Meenakshi. (2018, February 23). What is water depletion, causes and effects and what is effective water management. *Natural Energy Hub*. https://naturalenergyhub.com/environmental-hazards/water-depletion-causes-effects-effective-water-management/

Razzouk, R., & Shute, V. (2012). What Is Design Thinking and Why Is It Important? *Review of Educational Research*, *82*(3), 330–348. https://doi.org/10.3102/0034654312457429

Singh, A. (2021). *Significance of Research Process in Research Work*. https://doi.org/10.13140/RG.2.2.32664.93445/1

US EPA, O. (2021, January 24). *Power Plants and Neighboring Communities* [Data and Tools]. https://www.epa.gov/power-sector/power-plants-and-neighboring-communities

Abu-Taieh, E., Hadid, I. H. A., & Mouatasim, A. E. (2020). *Cyberspace*. BoD – Books on Demand.

Alwaisi, Z., & Opoku Agyeman, M. (2018). *On the Challenges and Opportunities of Smart Meters in Smart Homes and Smart Grids*. 1–6. https://doi.org/10.1145/3284557.3284561

Ambarwati, D. R. S. (2019). *The Design Thinking Method in the Learning of Store Interior Design*. *2*. Björk,

J., Boccardelli, P., & Magnusson, M. (2010). Ideation Capabilities for Continuous Innovation. *Creativity and Innovation Management*, *19*(4), 385–396. https://doi.org/10.1111/j.1467-8691.2010.00581.x

Boslaugh, 2007.pdf. (n.d.). Retrieved January 5, 2023, from https://cyfar.org/sites/default/files/Boslaugh,%202007.pdf

Cote, C. (2021, December 2). *7 Data Collection Methods in Business Analytics*. Business Insights Blog. https://online.hbs.edu/blog/post/data-collection-methods

Dam, R. F., & Siang, T. Y. (2022, June 27). *What is Design Thinking and Why Is It So Popular?* The Interaction Design Foundation. https://www.interaction-design.org/literature/article/what-is-design-thinking- and-why-is-it-so-popular

Desmar. (2022, May 10). *Document Review: Meaning, Purpose, and More*. ECLIPSE Suite. https://www.eclipsesuite.com/document-review/

Gasparini, A. A. (2015). *Perspective and Use of Empathy in Design Thinking*.

Gilbert, D. T., Fiske, S. T., & Lindzey, G. (1998). *The Handbook of Social Psychology*. McGraw-Hill.

Goddard, W., & Mellville, S. (2004). *Research Methodology—An Introduction* (Second edition). Software Publications Pty, Limited. https://books.google.com.my/books?hl=en&lr=&id=bJQJpsU2a10C&oi=fnd&pg=PA1&dq=research+meth odology&ots=Xuu4UcyT7l&sig=LxqitxlKsi_2785l6eCQfwGUdkQ#v=onepage&q=research%20met hodology&f=false

Hesse-Biber, S. N., & Leavy, P. (2010). *Handbook of Emergent Methods*. Guilford Press.
Innovation development framework. (n.d.). Retrieved December 19, 2022, from https://www.linkedin.com/pulse/innovation-development-framework-daniel-david

Jaiswal, S. (2022, July 28). 5 Types of Research Design—Elements and Characteristics | Emeritus India. *Emeritus - Online Certificate Courses | Diploma Programs*. https://emeritus.org/in/learn/types-of-research-design/

Johnston, M. P. (2014). Secondary Data Analysis: A Method of which the Time Has Come. *Qualitative and Quantitative Methods in Libraries*, *3*(3), Article 3.

Kelley, K. (2020, May 27). *What is Data Analysis? Process, Types, Methods and Techniques*. Simplilearn.Com. https://www.simplilearn.com/data-analysis-methods-process-types-article

Kortekaas, B. F. (2009). *Internet-based electronic payment systems*. https://uir.unisa.ac.za/handle/10500/858

Kothari, C. R. (2004). *Research Methodology—Methods and Techniques by C.R Kothari* (Second Edition). New Age Ihttp://lms.aambc.edu.et:8080/xmlui/bitstream/handle/123456789/212/Research%20Methodology %20Met hods%20and%20Techniques%20(%20PDFDrive%20).pdf?sequence=1

Leavy, P. (2022). *Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches*. Guilford Publications.
Lever, A. (2022, July 26). *The design thinking process for novice*. Medium.https://bootcamp.uxdesign.cc/the-design-thinking-process-for-novice-a6ce53878e83

Liébana-Cabanillas, F., Muñoz-Leiva, F., & Sánchez-Fernández, J. (2018). A global approach to the analysis of user behavior in mobile payment systems in the new electronic environment. *Service Business*,*12*(1), 25–64. https://doi.org/10.1007/s11628-017-0336-7

Maslan, M. N., Abdullah, L., Chairat, A. S. N., Zamri, R., Syed, M. S., Ali, M. M., Zainon, M., & Samsuddin, N. M. (2022). *Application of simple smart home devices for energy efficiency in Malaysia*.

Methods of Data Collection-Primary and secondary sources. (2018, February 27). Theintactone. https://theintactone.com/2018/02/27/br-u2-topic-6-methods-of-data-collection-primary-and-secondary- sources/

Paradis, E., O'Brien, B., Nimmon, L., Bandiera, G., & Martimianakis, M. A. (Tina). (2016). Design: Selection

Razzouk, R., & Shute, V. (2012). What Is Design Thinking and Why Is It Important? *Review of Educational Research*, *82*(3), 330–348. https://doi.org/10.3102/0034654312457429

Research Process Steps: What they are + How To Follow. (2022, July 21). *QuestionPro*. https://www.questionpro.com/blog/research-process-steps/

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PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2.   Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3.   Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

setuju.

27·1·2023

Saya yang menjalankan amanah,

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
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KAMPUS SERI ISKANDAR

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

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