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An IOT Based Smart Metering Development for Energy Management System

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ABSTRACT: The worldwide energy demand is adding and hence necessity measures need to be taken to reduce the energy destruction with proper metering structure in the structures. A Smart cadence can be used to cover electricity consumption of guests in the smart grid technology. For allocating the available coffers proper energy demand operation is needed. During the once times, colourful styles are being employed for energy demand operation to precisely calculate the conditions of energy that's yet to come. A large system presents a implicit regard to execute energy conservation as well as fresh services linked to energy services, extended as a competent with end stoner is executed. The supervising system at the serviceability determines the interface of bias with significant advantages, while the communication with the ménage is constantly proposing particular structures for applicable buyer- acquainted perpetration of a smart cadence network.

KEYWORDS: Smart meter, IOT based monitoring, power usage monitoring, smart controlling

I. INTRODUCTION

Electricity is an important invention without which life on earth is insolvable. So obviously there's a need for measuring the consumed electricity. It's fulfilled by the energy cadence, but a person from the electricity board has to visit each house for taking the readings about energy consumption which is used for farther operation. The billing process of electricity consumption which we're using at present is veritably long process and requires a lot of force and consumes time. currently electricity cost is also high and thus, it becomes a necessity for the consumer to know how important electricity is being used by them in order to control the electricity bill that should come within their budget. To attack all these issues, we've intended to construct completely automated billing system i.e. “IOT Based Energy Meter Billing System”. The proposed energy cadence measures the quantum of electricity consumed and uploads it to the pall, from which the concerned person can be given cautions. So it automates the process of measuring the energy consumption at homes using IoT and thereby enabling remote access and digitalization. The main ideal of the design is to develop an IoT grounded system which replaces traditional cadence reading styles and enables remote access of being energy cadence by the energy provider and monitoring of energy measures at lower cost is made possible. diurnal consumption reports are generated which can be covered through the web gate. The current system of electrical energy billing is incorrect and also time consuming. crimes get introduced at every stage of energy billing like crimes with electro-mechanical measures, mortal crimes while noting down the cadence readings and crimes while recycling the paid bills and the due bills. This paper reduces the deployment of force for taking cadence readings and distribution of bills. It has numerous advantages from both suppliers as well as consumer’s point

II. RELATED WORK

1. "IoT-Based Smart Meter for Advanced Metering Infrastructure in Smart Grid" by S. S. Rautaray et al. (2016): This paper presents an IoT-based smart metering system that utilizes wireless communication to collect and transmit energy consumption data. It discusses the architecture, components, and communication protocols used in the system.

2. "Smart Meter Data Analytics: Systems, Algorithms, and Comparative Analysis" by S. Goswami et al. (2017): This research paper focuses on the data analytics aspect of smart meters. It explores various data processing and analysis techniques to extract meaningful insights from the large volumes of data generated by smart meters.

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3. "An IoT-Based Smart Meter Architecture for Energy Management in Smart Homes" by A. T. Chronopoulos et al. (2018): This paper proposes an IoT-based smart metering architecture specifically designed for energy management in smart homes. It discusses the system's architecture, communication protocols, and the integration of renewable energy sources.

4. "IoT-Based Smart Metering System for Energy Efficiency in Buildings" by S. D. Nguyen et al. (2019): This research paper presents an IoT-based smart metering system for energy efficiency in buildings. It explores the integration of various IoT devices, such as smart plugs and smart thermostats, to enable real-time monitoring and control of energy consumption.

5. "Secure and Scalable IoT-Based Architecture for Smart Metering in Smart Grid" by S. Zeadally et al. (2020): This paper focuses on the security and scalability aspects of smart metering systems. It discusses the challenges associated with securing IoT-based smart metering infrastructure and proposes a secure architecture to protect against various cyber threats.

III. PROPOSED WORK

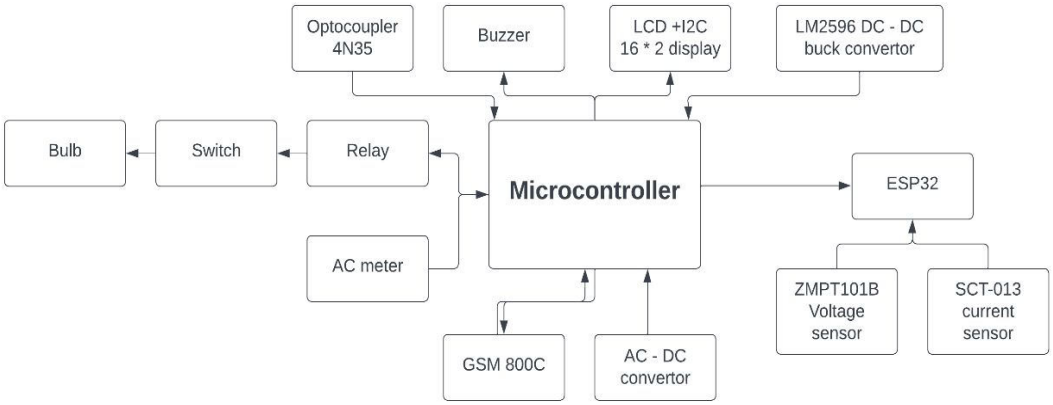

Fig. 1. Block diagram of proposed work

HARDWARE PART:

ARDUINO UNO: We choose the Arduino UNO as the main hardware component of the project due to its low cost, small size, and compatibility with various operating system.

GSM Modem: GSM is a “Global System for Mobile Communication”. GSM modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number.

POWER SUPPLY: A 5V/12V power supply was used to power the Arduino UNO and GSM module.

DISPLAY SCREEN: A display screen was used to show the energy used and pulse rate

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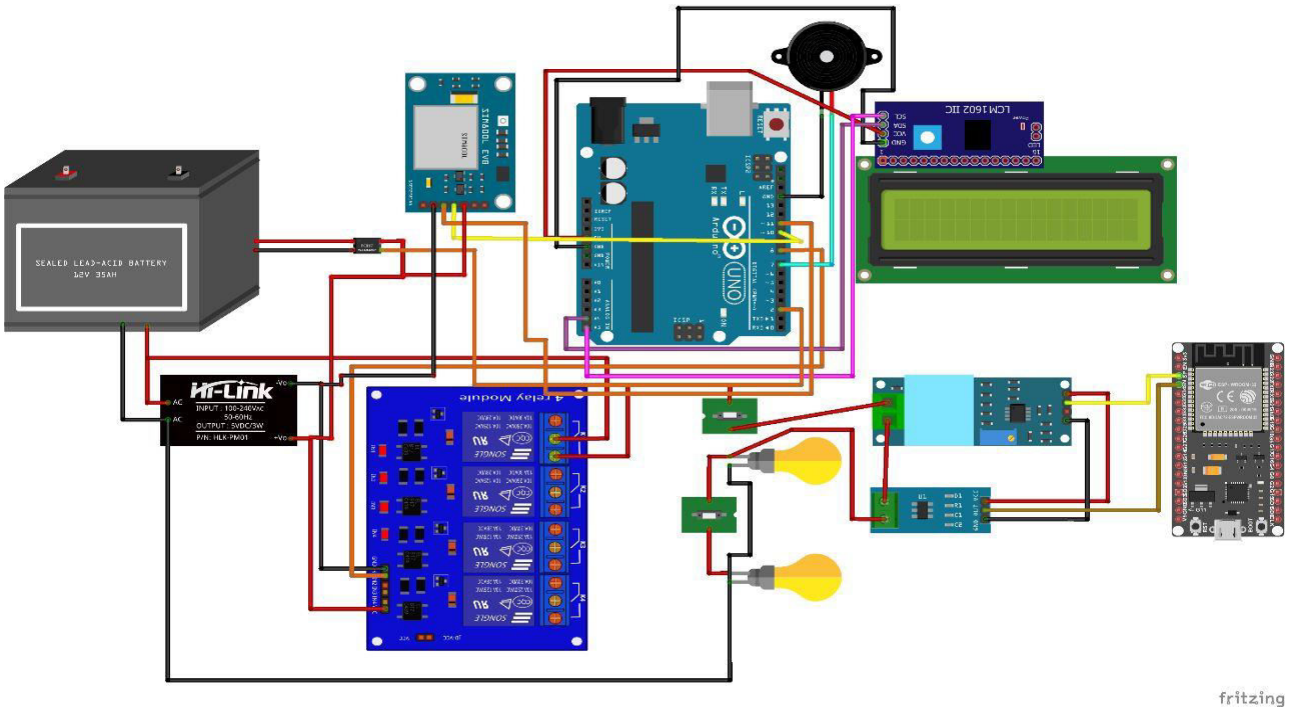

Fig. 2 Hardware Requirement

Android Application: Blynk is used for IOT (Internet of Things). It is used to monitor data on the made system through dashboard, save data and memorize it. Components of the application areInterface – Shows data to be executed in forms that we customize according to our vision and need. Blynk Server – It establishes connection between the hardware and the device used for dashboard. Blynk Libraries – It stores all data required for hardware execution on the IOT dashboard

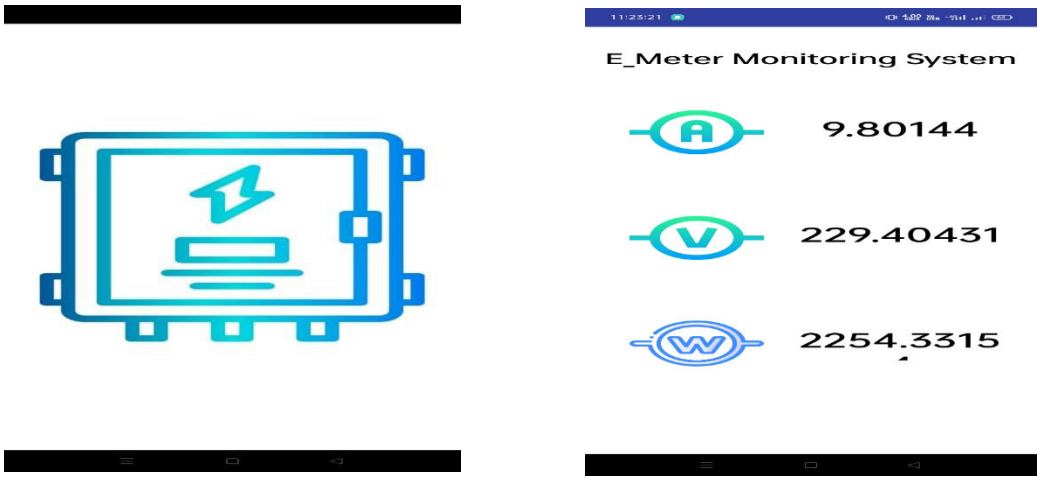

Fig.3. Overview of Application

Steps of Application: To create an Android application for E-meter monitoring using Kodular and Firebase, you can follow these general steps:

1. Set up Firebase:
 - Create a new Firebase project on the Firebase console (https://console.firebase.google.com/).
- Enable the Firebase Realtime Database service.

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2. Set up Kodular:
- Visit the Kodular website (https://www.kodular.io/) and create a new account if you haven't already.
- Create a new project in Kodular and give it a suitable name.
3. Design the user interface:
- Use the Kodular Drag and Drop interface to design the layout of your application.
- Add appropriate components such as labels, buttons, text boxes, etc., as per your requirements.
4. Connect to Firebase:
- In Kodular, add the Firebase component to your project from the Palette.
- Import the `google-services.json` file you downloaded earlier into your Kodular project.
5. Collect E-meter data:
- Use relevant components (e.g., sensors, Bluetooth, etc.) to collect data from the E-meter in your Android device.
- Implement the necessary logic to retrieve the E-meter data and store it in variables within your Kodular project.
6. Send data to Firebase:
- Use the Firebase component's blocks to send the collected E-meter data to the Firebase Realtime Database.
- Set the appropriate Firebase database path and specify the data you want to send.
7. Monitor and retrieve data from Firebase:
- Use the Firebase component's blocks to monitor the E-meter data stored in the Firebase Realtime Database.
- Set up event listeners or periodic checks to retrieve the data from the Firebase database.
8. Display and analyze data:
- Use Kodular's blocks to display the retrieved E-meter data in your application's user interface.
- Implement any necessary data analysis or visualization logic to make the data meaningful and useful.
9. Test and debug:
- Test your application on different devices and scenarios to ensure it functions as expected.
- Use debugging tools provided by Kodular to identify and fix any issues or errors.
10. Build and distribute the app:
- Once you are satisfied with the application, build the APK file in Kodular.
- Distribute the APK file through app stores or other appropriate distribution channels.

IV. SIMULATION RESULTS

A typical IoT-based smart meter project aims to monitor and manage energy consumption in a more efficient and automated manner. Here's an example of what the final result of such a project might entail:

1. Smart Meter Device: The project would involve the development and deployment of smart meters equipped with IoT capabilities. These devices would replace traditional energy meters and collect real-time energy consumption data.
2. Data Collection and Transmission: The smart meters would be designed to collect energy consumption data at regular intervals, such as every hour or every minute. This data would then be transmitted wirelessly to a central data repository.
3. Data Management System: A robust data management system would be implemented to store, process, and analyze the collected energy consumption data. This system could include cloud-based infrastructure to handle large volumes of data efficiently.
4. Data Analytics and Visualization: The collected data would be analyzed to extract meaningful insights and patterns. Various analytical techniques and algorithms could be applied to identify energy consumption trends, peak usage periods, and potential areas for optimization. These insights would be visualized through intuitive dashboards and reports for easy interpretation.
5. Energy Monitoring and Control: With the smart meter system in place, users (such as homeowners or businesses) would be able to monitor their real-time energy consumption through web or mobile applications. They could view their energy usage patterns, set consumption targets, and receive notifications/alerts for abnormal usage or potential energy-saving opportunities.
6. Security and Privacy: The project would prioritize the implementation of robust security measures to protect the data and ensure user privacy. Measures such as encryption, access control, and data anonymization would be implemented to safeguard sensitive information.

It's important to note that the specific features and functionality of a smart meter project can vary depending on the goals, scope, and requirements of the project. The above description provides a general outline of what a final result might encompass, but the actual implementation and details would depend on the specific project context.

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A. Implementation

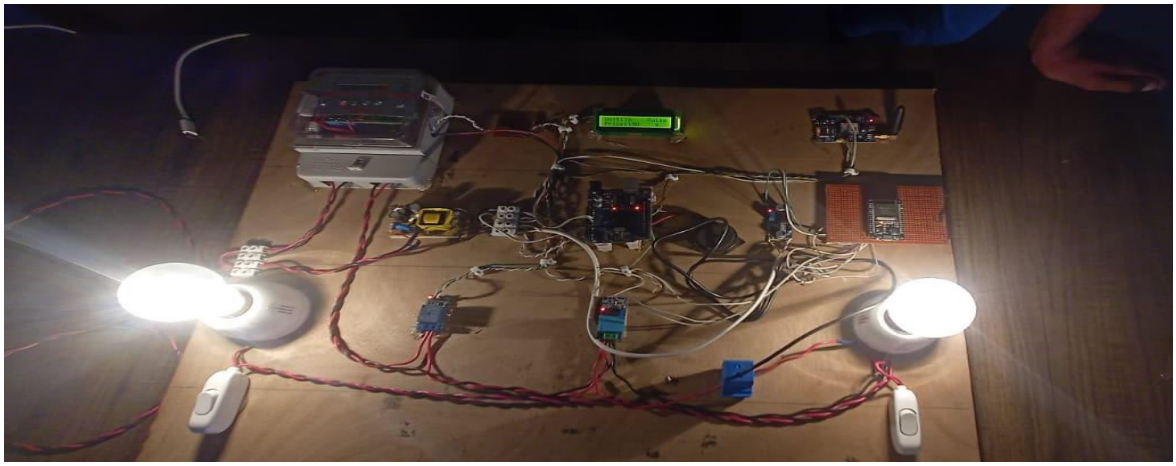

Fig.4 Hardware Implementation

B. Output

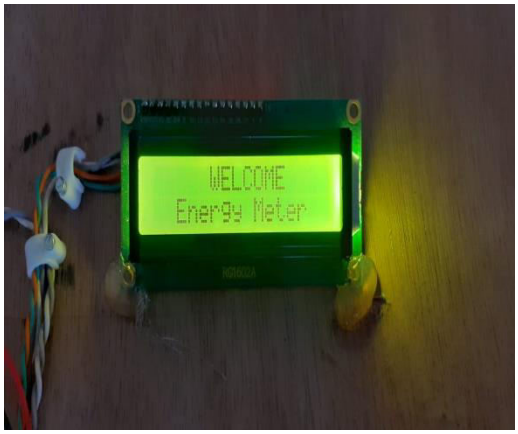

Fig. 5. Start the Project

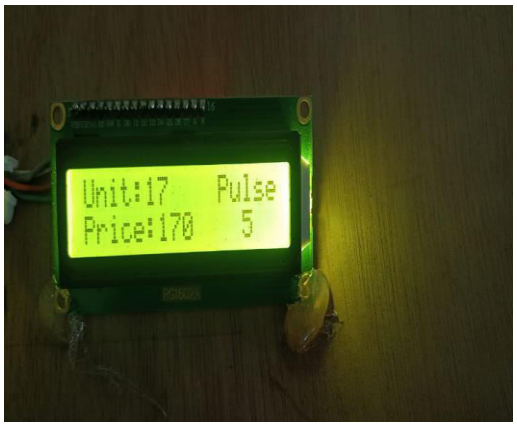

Fig. 6. Unit and Price

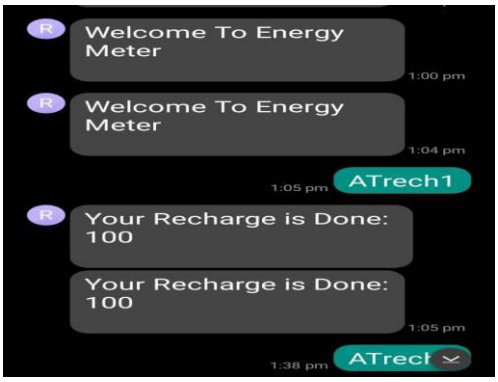

Fig. 7. Mobile SMS

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C. FUTURE SCOPE AND CONCLUSION

The energy usage per hour collected from the energy source is the subject of this thesis function. These ad hoc values assist energy resources and users in determining their hourly reported energy usage. In reality, customer behaviour may be tracked and the information can be used to enhance customer experience, particularly when it is linked to a fluctuating price. This role bridges the gap between customers and electrical services, allowing them to interact successfully through cost-cutting techniques. To rectify misunderstandings, consumers must be informed about the measures. Standard data from sixteen groups of households were used in the sample research. The many alterations to usage have been clearly known and defined. Research can also assist consumers in thinking more critically about how they utilise their power. In addition, everyday patterns for an entire day are evaluated hour by hour. Future savings can be achieved by employing speculative models and mitigation approaches to choose when and what material to utilise. All of the following features are available through an IoT application on their mobile phone. From a distant location, a Blynk user may simply monitor the entire process of power consumption by diverse load. The present work is concentrated on the development of smart energy Candence to avoid the electricity theft. The proposed system is able to alleviate the suffering of the customer and make users worry about the excessive use of electricity and faulty home appliances. With this program, customers can easily view a pulse rate, total units and total electrical costs. The program is easy to read and reliable. The data stored in the cloud is of great value in the extraction of energy meter data in the future. In a big sense, a power distribution company like MSEB is able to identify the pattern of local use.

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