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SMART ENERGY MONITORING AND CONTROL SYSTEM USING IOT FOR DOMESTIC ELECTRICITY CONSUMPTION

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ABSTRACT

In the upcoming Internet of Things (IOT), the everyday objects that surround us will become proactive actors of the Internet, generating and consuming information. The elements of the IoT comprise not only those devices that are already deeply rooted in the technological world (such as cars or fridges), but also objects foreign to this environment (garments or perishable food), or even living beings (plantations, woods or livestock). By embedding computational capabilities in all kinds of objects and living beings, it will be possible to provide a qualitative and quantitative leap in several sectors: healthcare, logistics, domestics, entertainment, and so on. Due to the drastic changes in technology in the last decade, so many advancements were introduced in electricity departments. The electricity bill can be paid now through E-Seva centers, Net-banking and even through mobile phones. In this project electricity consumption by the user i.e. Units consumed in that meter will be available in the mobile phone/pc through internet using IOT module and also 16X2 LCD is provided to read units available. Whenever there is a change in count value / units in the meter get changed, these values are displayed on LCD. This system uses 5V regulated power supply for the microcontroller unit and 18V supply for the load. This is provided by the 18V, 2Amp transformer. Recharging unit also requires regulated 5V supply, which is provided by a separate 18V and 750mA transformer. Hence this project provides a best solution for the users to know how much amount of power is consumed in their day- to- day life and also the amount of power consumed is also under the user control.

Keywords: Internet Of Things (Iot), Electricity Consumption, Units Consumed, Iot Module, User Control.

I. INTRODUCTION

The potential for smart meters to offer consumers better information about, and control over, their energy use, leading to both financial savings and control over the energy consumption, has been discussed for a number of years. Advances have been made in developing the design and technology for smart meter systems although, to date, there have been no major pilot schemes to establish the costs and benefits to supply companies, consumers or to quantify any wider benefits in terms of meeting environmental/security of supply objectives. Now a days energy Measurement and electric energy pilferage detection has become prime importance for the state electricity department. All most all state electricity departments in our country, they are facing so many problems because of energy pilferage. In the recent survey conducted by the state electricity departments, it is found that 20 to 30 percent-produced energy is non-accountable due to losses and it become a big subject for discussion, because of huge energy losses. Hence, the need has come to think on this line and a solution has to be emerged out. Thus, this project work has been taken up which serves the purpose of energy monitoring and controlling by implementing IOT based system. The main advantage of this IoT based system, particularly for the state electricity department is, that the consumer has to take total responsibility for his energy consumption.

II. METHODOLOGY

1. Requirement Analysis:

- Define the specific features and functionalities you want to include in the system, such as historical data logging, notifications, or power consumption analysis.

- Determine the communication range and reliability required for the IoT module based on the distance between the electricity meter and the monitoring device (mobile phone or PC).

- Consider any specific constraints or limitations, such as budget, power supply availability, or space requirements.

2. System Design:

- Plan the physical layout of the system, considering factors like the placement of the IoT module, microcontroller, LCD, and transformers. Ensure they are easily accessible and adequately protected.

- Determine the appropriate data transfer protocols to use for communication between the microcontroller, IoT module, and remote server/cloud platform (e.g., MQTT, HTTP, or CoAP).

- Define the data format and structure for transmitting electricity consumption information to the mobile phone or PC application.

- Consider any additional features or user interactions you want to include, such as configuring thresholds for energy consumption alerts or integrating with smart home systems.

3. Hardware Implementation:

- Select and acquire the necessary hardware components based on the system design.

- Design and build the physical circuitry, including soldering connections, wiring, and ensuring proper grounding.

- Ensure compatibility between the chosen microcontroller, IoT module, and LCD, considering factors such as voltage levels, pin configurations, and communication protocols.

- Test the hardware components individually to ensure their proper functioning before integration.

4. Software Development:

- Develop the firmware for the microcontroller to handle data acquisition from the electricity meter, perform calculations, and manage communication with the IoT module.

- Implement error handling and data validation mechanisms to ensure accurate readings and prevent data corruption or loss.

- Design and develop the software for the IoT module to establish a secure connection with the internet, handle data transmission to the remote server/cloud platform, and manage any necessary authentication or encryption.

- Develop the user interface software for the mobile phone or PC application, considering factors like responsiveness, user-friendly design, and real-time data updates.

5. Integration and Testing:

- Integrate the firmware and software components with the respective hardware components.

- Test the system's functionality as a whole, including communication between the microcontroller, IoT module, and mobile phone or PC application.

- Perform both unit testing (testing individual components) and system testing (testing the integrated system) to ensure all functionalities work as intended.

- Conduct various scenarios and stress tests to assess the system's stability, responsiveness, and accuracy.

6. Deployment:

- Install the system at the desired location, following appropriate safety guidelines and electrical regulations.

- Configure the IoT module to connect to the desired internet network securely.

- Set up the mobile phone or PC application, ensuring it can connect to the IoT module and display the electricity consumption information correctly.

- Provide user training and documentation to ensure the users understand how to operate and interpret the data presented by the system.

III. CIRCUIT DIAGRAM

The built-in two ADCS digitize the voltage signals from the current and voltage transducers. For current signal, the current transformers (CTS) are used, two CTS are used for this purpose one is connected in series with the phase and the other one is connected in series with the neutral. For voltage signal, the phase voltage is attenuated with the help of potential divider. For this, four numbers of 100K resistors are connected in series. The built in ADCS are 16 bit and are operated with an external clock fed by the crystal. The power output is derived from the instantaneous power signal, which is the multiplication of the current and voltage signals. To

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obtain the exact real power component, the instantaneous power signal is low pass filtered. Accumulating the real power information generates the frequency output of the device. This is a low frequency signal, which means a long accumulation time between output pulses. The output frequency is therefore proportional to the average real power. This average real power information can in turn be accumulated to generate real energy consumption. The frequency output in this IC is generated as shown in the data sheet collected from Internet.

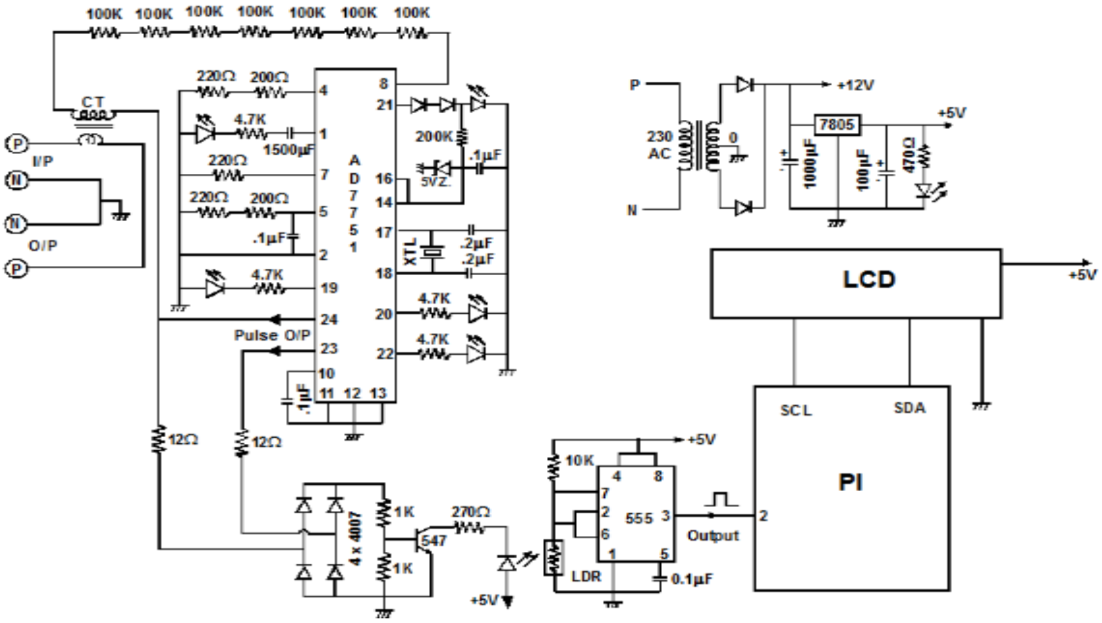

Figure 1: Circuit Diagram.

IV. RESULTS AND DISCUSSION

In this project electricity consumption by the user i.e. Units consumed in that meter will be available in the mobile phone/pc through internet using IOT module and also 16X2 LCD is provided to read units available. Whenever there is a change in count value / units in the meter get changed, these values are displayed on LCD. Hence this project provides a best solution for the users to know how much amount of power is consumed in their day- to- day life and also the amount of power consumed is also under the user control.

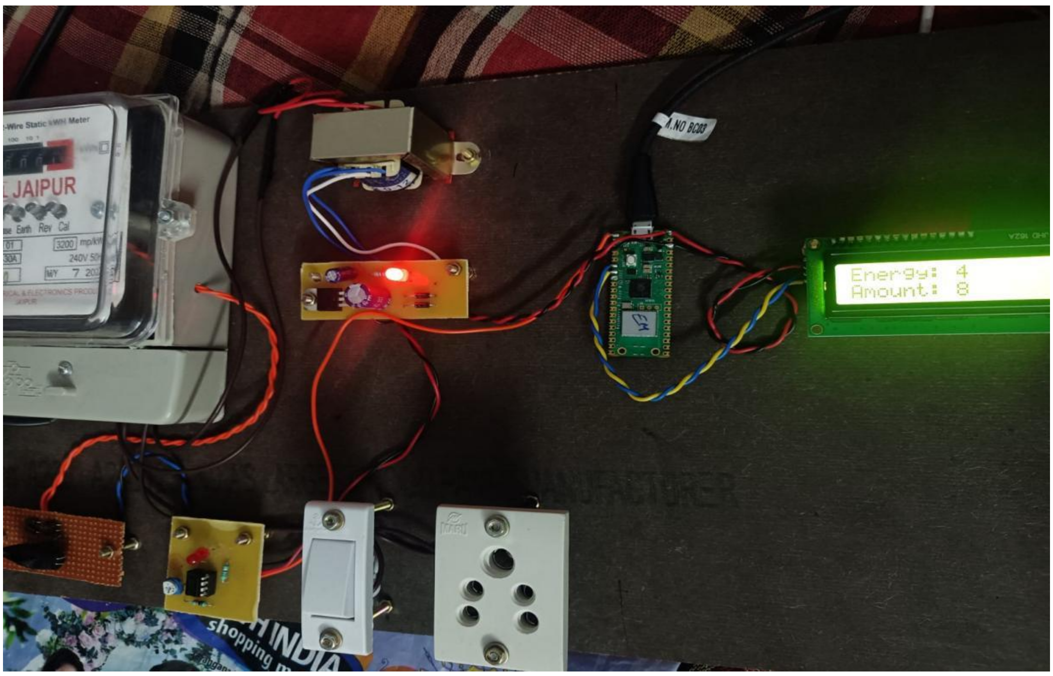

Figure 1: Working Model with Result

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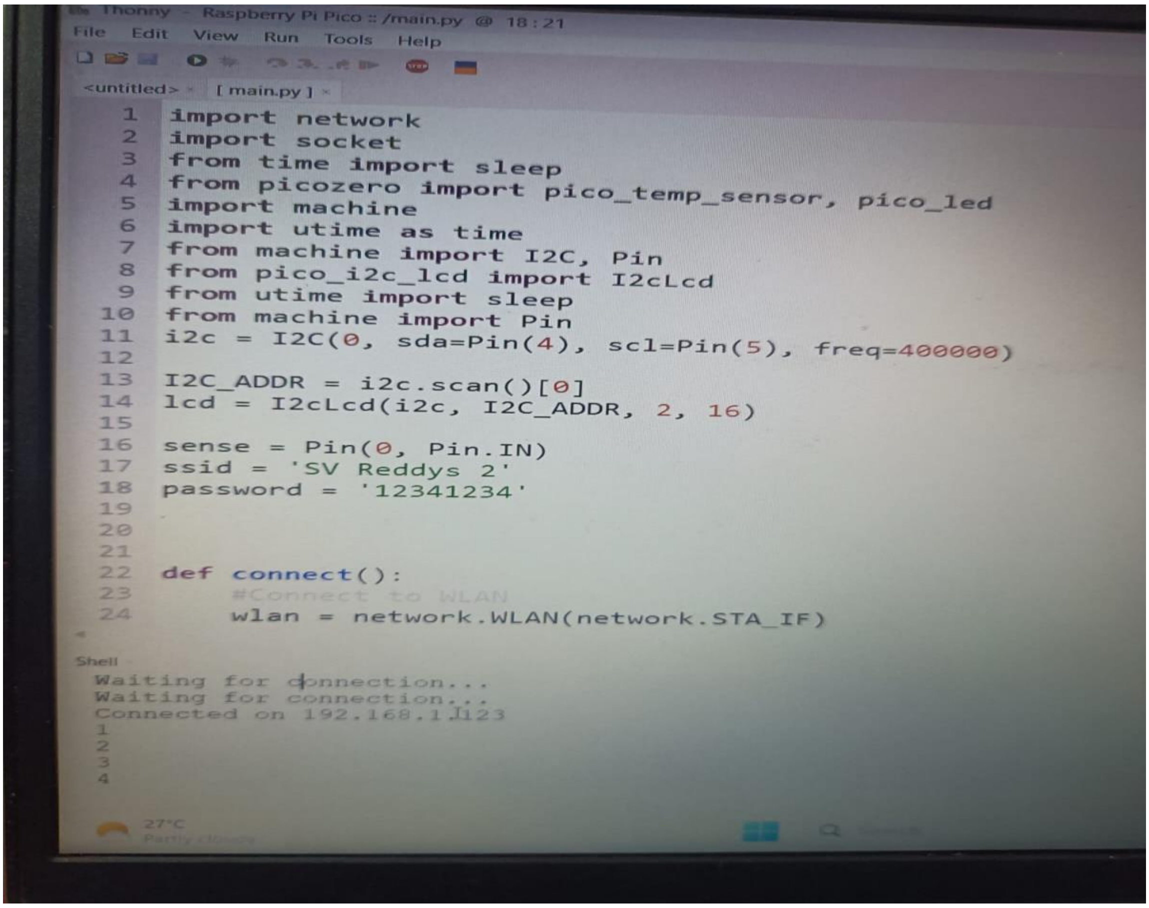

Figure 2: Code Execution

Figure 3: LCD Displaying Result

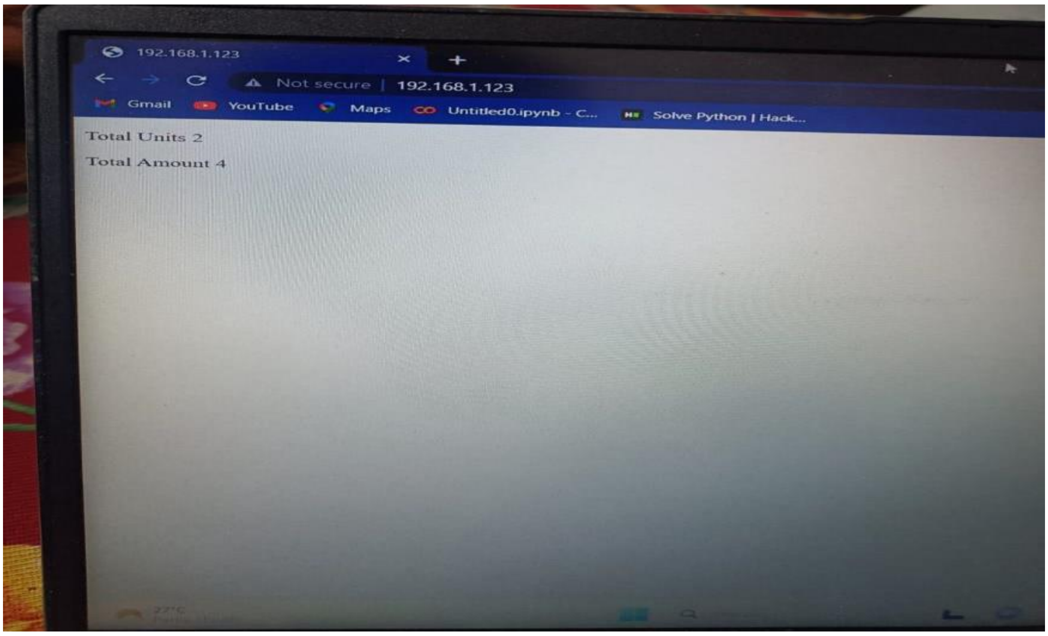

Figure 4: Result on Web Page

V. CONCLUSION

In conclusion, the Internet of Things (IoT) is revolutionizing the way everyday objects interact with the digital world, enabling them to generate and consume information. This transformative paradigm extends beyond traditional technological devices to encompass diverse entities, including garments, perishable food, and even living beings such as plantations, woods, and livestock. By embedding computational capabilities in these objects, the IoT offers unprecedented opportunities for advancement in sectors such as healthcare, logistics, domestics, and entertainment. In the context of the electricity sector, significant technological advancements have emerged in recent years. This project leverages the power of IoT to provide users with real-time access to their electricity consumption data, specifically the units consumed. Through an IoT module, users can conveniently retrieve this information on their mobile phones or PCs. Furthermore, a 16X2 LCD display is implemented to provide local visibility of the units consumed. Any changes in the count value or units in the meter trigger immediate updates on the LCD display. By employing a 5V regulated power supply for the microcontroller unit and an 18V supply for the load, this project ensures reliable operation. The dedicated transformers facilitate a stable power supply, including a separate 18V and 750mA transformer for the recharging unit. This comprehensive solution empowers users to actively monitor their daily power consumption, gaining insights into their energy usage patterns. With access to this information, individuals can make informed decisions and effectively manage their power consumption. The integration of IoT technology and data accessibility presents an opportunity for users to have greater control over their energy usage. By embracing this project's solution, individuals can stay informed about their electricity consumption, leading to improved efficiency, cost savings, and a heightened awareness of their environmental impact. As the IoT continues to evolve, it holds immense potential to shape various aspects of our lives, providing new avenues for innovation and enhancing our everyday experiences.

VI. REFERENCES

While designing and fabrication of this project work, we gathered information from websites and consulted experts in various fields. The information is gathered from google.com search Engine. The following are the references made during design, development and fabrication of the project work.

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