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IoT Based Smart Energy Meter

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Abstract: *In Modern day smart grid technology relies heavily on communication networks for two way communication between load, generation, transmission, and control centre. As a part of the smart grid, smart meters use advanced metering infrastructures (AMI) that are widely distributed and interconnected to the communication network. In modern Technology the smart grid plays very important role for two way communication between Supplier and consumer. Smart meter is main component of smart grid. Currently we are paying electricity bill like one person came to home to read the electricity board and handover the bills to the owner of that house. The drawback of this it requires more man power, time, and many times it has error in bill amount. To eliminate this error smart energy meter is introduced. This system also helps in detecting and control over power theft. this smart energy meter helps us in home automation using IoT and enabling wireless communication which is a great step towards Digital India .Efficient energy utilization plays a very vital role for the development of smart grid in power system By providing real-time monitoring and control of energy consumption, it can help users to reduce their energy usage, save money, and promote sustainable energy consumption. As a first step towards such cyber-attack related researches and searching for possible mitigation techniques, it is necessary that a smart meter be developed that has the feature of network integration. The present contribution reports the design, fabrication, and operation of an Internet of Things (IoT) based smart meter using Arduino to serve as an integral part of a smart grid system.*

Keywords: smart grid technology

I. INTRODUCTION

In this paper we are discussing about the project “IOT Based Smart Energy meter” addresses the problems faced by both the consumers and the supplier with the current technology you need to go to the meter reading place and take down the readings. To automate this, we can use the Internet of things which saves time, money and manpower by automating remote data collection. This system enables the electricity department to read the meter reading monthly without a person going at each homes. In traditional power grids, the load and control centres are isolated from each other both physically as well as in terms of visibility[1-10].

In recent days, Smart Grid uses the real-time measuring data from Advanced Metering Infrastructure (AMI) for Distribution System Operator (DSO). Therefore, to protect this critical power system infrastructure and to ensure a reliable and an uninterrupted power supply to the end users, smart grid security issues is gaining substantial importance in recent times. In addition to recording energy readings, these meters are also capable of recording other related information such a power factor, active, reactive, and apparent power, harmonics, power outages etc. The present contribution reports the design, fabrication and implementation of a smart energy meter, which utilizes the features of embedded systems[11-21].

Arduino microcontroller with Wi-Fi modem have been used to introduce ‘Smart’ feature in a traditional domestic energy meter. In the present billing system the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The paper discusses

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comparison of Arduino and other controllers, and the application of GSM and WiFi modems to introduce Smart concept[22-34].

With the use of GSM modem the consumer as well as service provider will get the used energy reading with the respective amount, Consumers will even get notification in the form text through GSM when they are about to reach their threshold value, that they have set. Also with the help of Wi-Fi modem the consumer can monitor his consumed reading and can set the threshold value through webpage. The IOT based Smart Meter continuously monitor and records the energy meter reading and in its permanent memory location. There are various researches that are going on and various techniques that are available for measuring the energy use of loads and report this data to the network[34-46].

II. METHODOLOGY

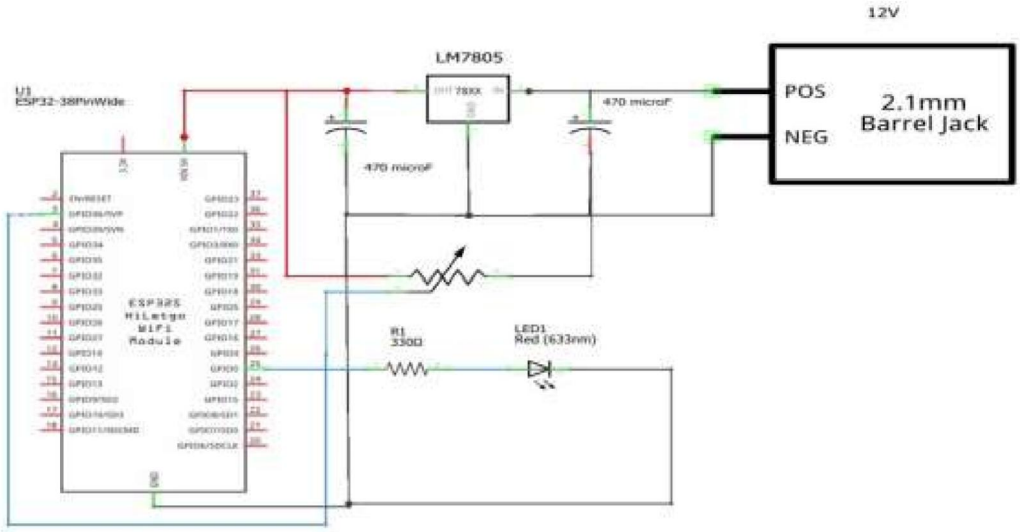

Fig. 1. Circuit Diagram

Figure 1 shows the circuit diagram for our proposed system. Energy meter or watt-hour meter is an electrical instrument that measures the amount of electrical energy used by the consumers. Utilities is one of the electrical departments, which install these instruments at every place like homes, industries, organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerators and other home appliances. Energy meter measures the rapid voltage and currents, calculate their product and give instantaneous power. This power is integrated over a time interval, which gives the energy utilized over that time period.

SCT-013 Current Sensor

The SCT-013 is a non-invasive split-core type clamp meter sensor designed to measure AC current up to 100 amperes. This type of current sensor is commonly known as a current transformer (CT) and is used for measuring alternating current in a building. The SCT-013(Figure 2) is convenient to use, as it can be easily attached to either the live or neutral wire without any electrical work involving high voltage.

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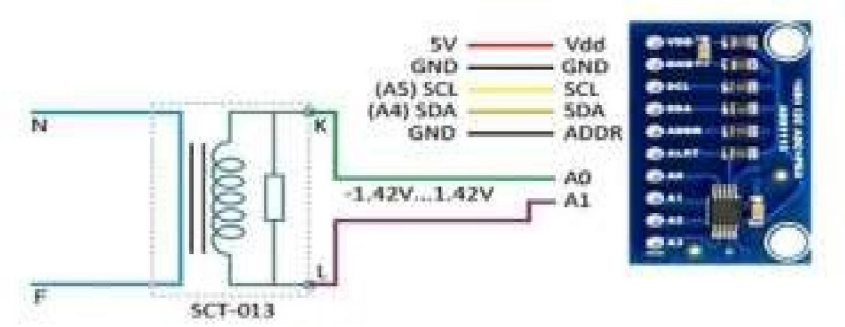

Fig.2. SCT-013 Current Sensor

ZMPT101B AC Single Phase Voltage Sensor

The ZMPT101B AC Single Phase Voltage Sensor Module(Figure 3) is a high-precision device built on the ZMPT101B voltage transformer. This makes it an ideal choice for measuring accurate AC voltage with an Arduino or ESP32.The module is capable of measuring AC voltage within a range of 250V and offers adjustable analog output. It is easy to use, featuring a multi-turn trim potentiometer for adjusting and calibrating the ADC output.

Fig. 3. ZMPT101B AC Single Phase Voltage Sensor

Wi-Fi MODULE (ESP8266)

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which acts as heart for IoT. Through Wi-Fi the consumer can set changes in threshold value, he can ON and OFF the energy meter. Time to time the readings of units and cost are displayed on webpage. Consumer can access the Arduino board and meter with help of Wi-Fi. Figure 4 shows the WiFi Module, we utilized ESP 8266 model for our proposed system implementation. Which is further connected to the controller(Arduino) for sending the information thru IoT system.

Fig. 4. Wi-Fi MODULE (ESP8266)

The VCC & GND pins of both the SCT-013 Current Sensor and ZMPT101B Voltage Sensor are connected to the Vin& GND of ESP32, which is a 5V supply. The output analog pin of the ZMPT101B Voltage Sensor is connected to the GPIO35 of ESP32 and the output analog pin of the SCT-013 Current Sensor is connected to the GPIO34 of ESP32. Additionally, two 10K resistors and a single 100-ohm resistor, along with a 10uF capacitor, are required to complete the circuit.

To measure the current and voltage, the AC wires must be connected to the input AC Terminal of the Voltage Sensor.

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III. RESULT& DISCUSSION

IoT based smart energy metering refers to the use of internet-connected devices to measure and monitor energy consumption in homes, buildings, or entire communities. These IoT-based smart meters are equipped with sensors that can collect data on energy usage and transmit that data over the internet to a cloud database for advanced data analytics.
IoT technology allows for real-time monitoring of energy consumption, which can be used to optimize energy usage and identify areas for improvement. Smart energy metering systems can provide insights into energy usage patterns and allow users to make informed decisions about how to reduce their energy consumption and save money.
An IoT-based Smart Energy Metering works by collecting data from the smart meter and sending it to a cloud-based database for analysis(Figure 5). The data is then processed using advanced analytics to provide useful insights into energy consumption.
Setting UpBlynk 2.0 Web and Mobile Dashboard Blynk is an application that runs over Android and IOS devices to control any IoT based application using Smartphones. It allows you to create your Graphical user interface for IoT application. Here we will display the IoT Energy Meter Data on Blynk Web Dashboard and also in mobile Application.
The IoT-based smart energy meter eliminates manual meter readings, saving time and money.
With the use of the best current and voltage sensors, accurate readings of voltage, current, power, and total energy consumed can be obtained.
This is an opportunity to automate electricity consumption monitoring and make it a more streamlined experience.

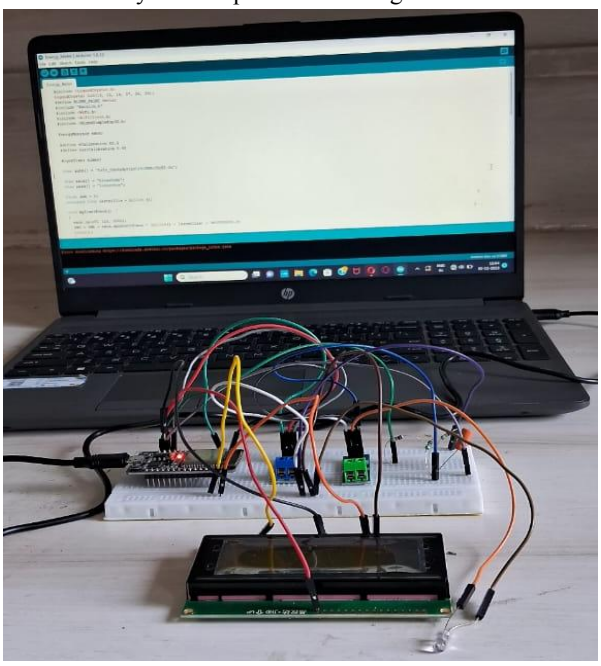

Fig. 5. IOT base smart energy meter

IV. CONCLUSION

The development of a IoT Based Smart Electricity Energy Meter using ESP32 and Blynk 2.0 will bring about a revolution in the monitoring and measurement of electricity consumption. The IoT-based solution eliminates manual meter readings, saving time and money. With the use of the best current and voltage sensors, accurate readings of voltage, current, power, and total energy consumed can be obtained. This is an opportunity to automate electricity consumption monitoring and make it a more streamlined experience.

REFERENCES

[1]. K. Kazi, "Smart Grid energy saving technique using Machine Learning" Journal of Instrumentation Technology and Innovations, 2022, Vol 12, Issue 3, pp. 1 – 10.

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[2]. G. N. Sorebo and M. C. Echols, "Smart Grid Security: An End-to End View of Security in the New Electrical Grid", Boca Raton, FL, USA:CRC Press, 2011.

[3]. A. J. Wood and B. F. Wollenberg, "Power Generation, Operation, and Control. Hoboken", NJ, USA:Wiley, 2012.

[4]. S. Sridhar, A. Hahn, and M. Govindarasu, "Cyber–physical system security for the electric power grid", Proc. IEEE, Vol. 100, No. 1, 2012, pp. 210–224.

[5]. imshekhar Das, L. C. Saikia, GSM Enabled Smart Energy Meter and Automation of (ome Appliances, PP-978-14678-6503-1, 2015 IEEE.

[6]. Yingying Cheng, Huaxiao Yang, Ji Xiao, XingzheHou, Running State Evaluation Of Electric Energy Meter, PP978-1-4799-4565-, Workshop on Electronics, Computer and Applications,) IEEE

[7]. Luigi Martirano, Matteo Manganelli, DaniloSbordone, Design and classification of smart metering systems for the energy diagnosis of buildings) IEEE 2015.

[8]. Anitha. k, prathik, "Smart Energy Meter surveillance Using IoT", Institute of Electrical and Electronics Engineers (IEEE), 2019.

[9]. Devadhanishini, et.al" "Smart Power Monitoring Using IoT"5th International Conference on Advanced Computing & Communication Systems (ICACCS) 2019.

[10]. Kapse, Mrunal M., Nilofar R. Patel, Shruti K. Narayankar, Sachin A. Malvekar,. "Smart Grid Technology." International Journal of Information Technology & Computer Engineering (IJITC) ISSN: 2455-5290 2, no. 06 (2022): 10-17.

[11]. Mohammad HosseinYaghmaee Design and Implementation of an Internet of Things Based Smart Energy Metering" 6th IEEE International Conference on Smart Energy Grid Engineering 2018.

[12]. Himanshukpatel "arduino based smart energy meter" 2nd Int'l Conf. on Electrical Engineering and Information &Communication Technology (ICEEICT) 2018.

[13]. "BibekKanti Barman, et.al" proposed paper "smart meter using IoT" department of international electronics and electrical engineering (IEEE) 2017.

[14]. Garrab. A, Bouallegue. A, Ben Abdullah, A new AMR approach for energy savings in Smart Grids using Smart meter and partial power line communication", IEEE First International Conference on ICICS, vol 3, pp. March 2012.

[15]. Landi, c.: Dipt. Di Ing. dell" Inf, Second a Univ di Napoli, Aversa, Italy; Merola p." ARM-based energy management system using smart meter and Web server", IEEE instrumentation and measurement technology conference binjing, pp.1-5 may 2011.

[16]. Malvekar Sachin A., C. L. Bhattar, and Viraj B. Savakhande. "Non-Isolated High Voltage Gain DC-DC Converters using Inductors for DC Microgrid." In 2018 International Conference on Control, Power, Communication and Computing Technologies (ICCPCCT), pp. 455-459. IEEE, 2018.

[17]. B. S. Koay, S. S. Cheah, Y. H. Sng, P. H. Chong, P. Shum, Y. C. Tong, X. Y. Wang, Y. X. Zuo and H. W. Kuek, "Design and implementation of Bluetooth energy meter", IEEE Proceedings of the 4th International Joint Conference of the ICICS, vol. 3, pp. 1474-1477, Dec,2003.

[18]. N. Fathima, A. Ahammed, R. Banu, B.D. Parameshachari, and N.M. Naik, "Optimized neighbor discovery in Internet of Things (IoT)," In Proc. of International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT), pp. 1-5, 2017.

[19]. Kazi K S, " Detection of Malicious Nodes in IoT Networks based on Throughput and ML", Journal of Electrical and Power System Engineering, 2023, Volume-9, Issue 1, pp. 22- 29.

[20]. Liyakat, K.K.S. (2024). Machine Learning Approach Using Artificial Neural Networks to Detect Malicious Nodes in IoT Networks. In: Udgata, S.K., Sethi, S., Gao, XZ. (eds) Intelligent Systems. ICMIB 2023. Lecture Notes in Networks and Systems, vol 728. Springer, Singapore. https://doi.org/10.1007/978-981-99-3932-9_12 available at: https://link.springer.com/chapter/10.1007/978-981-99-3932-9_12

[21]. Liyakat, K.K.S. (2023). Machine Learning Approach Using Artificial Neural Networks to Detect Malicious Nodes in IoT Networks. In: Shukla, P.K., Mittal, H., Engelbrecht, A. (eds) Computer Vision and Robotics.

CVR 2023. Algorithms for Intelligent Systems. Springer, Singapore. https://doi.org/10.1007/978-981-99-4577-1_3

[22]. K.K S Liyakat (2022), "A novel Design of IoT based 'Love Representation and Remembrance' System to Loved One's", Gradiva Review Journal, 2022, Vol 8, Issue 12, pp. 377 - 383.

[23]. Kazi K S L, "Significance of Projection and Rotation of Image in Color Matching for High-Quality Panoramic Images used for Aquatic study", International Journal of Aquatic Science, 2018, Vol 09, Issue 02, pp. 130 – 145.

[24]. Halli U M, "Nanotechnology in IoT Security", Journal of Nanoscience, Nanoengineering& Applications, 2022, Vol 12, issue 3, pp. 11 – 16

[25]. K. K. Sayyad Liyakat, "Nanotechnology Application in Neural Growth Support System", Nano Trends: A Journal of Nanotechnology and Its Applications, 2022, Vol 24, issue 2, pp. 47 - 55

[26]. Kazi Kutubuddin S. L., "Business Mode and Product Life Cycle to Improve Marketing in Healthcare Units", E-Commerce for future & Trends, 2022, vol 9, issue 3, pp. 1-9.

[27]. Kazi K S L, "IoT-based weather Prototype using WeMos", Journal of Control and Instrumentation Engineering, 2023, Vol 9, Issue 1, pp. 10 – 22

[28]. Kazi Kutubuddin, "Detection of Malicious Nodes in IoT Networks based on packet loss using ML", Journal of Mobile Computing, Communication & mobile Networks, 2022, Vol 9, Issue 3, pp. 9 -16

[29]. Kazi Kutubuddin, "Big data and HR Analytics in Talent Management: A Study", Recent Trends in Parallel Computing, 2022, Vol 9, Issue 3, pp. 16-26.

[30]. Kazi K S, "IoT-Based Healthcare Monitoring for COVID-19 Home Quarantined Patients", Recent Trends in Sensor Research & Technology, 2022, Vol 9, Issue 3. pp. 26 – 32

[31]. Kazi Kutubuddin, "Blockchain-Enabled IoT Environment to Embedded System a Self-Secure Firmware Model", Journal of Telecommunication study, 2023, Vol 8, Issue 1

[32]. Kazi Kutubuddin, "A Study HR Analytics Big Data in Talent Management", Research and Review: Human Resource and Labour Management, 2023, Volume-4, Issue-1, pp. 16-28

[33]. K. K. S. Liyakat, "Detecting Malicious Nodes in IoT Networks Using Machine Learning and Artificial Neural Networks," 2023 International Conference on Emerging Smart Computing and Informatics (ESCI), Pune, India, 2023, pp. 1-5, doi: 10.1109/ESCI56872.2023.10099544

[34]. Kazi Kutubuddin Sayyad Liyakat, "Analysis for Field distribution in Optical Waveguide using Linear Fem method", Journal of Optical communication Electronics, 2023, Vol 9, Issue 1, pp. 23- 28

[35]. Kazi Kutubuddin Sayyad Liyakat, "IoT based Smart HealthCare Monitoring", In: RhiturajSaikia (eds), Liberation of Creativity: Navigating New Frontiers in Multidisciplinary Research, Vol. 2, July 2023, pp. 456- 477, ISBN: 979-8852143600

[36]. Kazi Kutubuddin Sayyad Liyakat, "IoT based Substation Health Monitoring", In: RhiturajSaikia (eds), Magnification of Research: Advanced Research in Social Sciences and Humanities, Volume 2, October 2023, pp. 160 – 171, ISBN: 979-8864297803

[37]. Kazi Sultanabanu Sayyad Liyakat (2023). IoT Changing the Electronics Manufacturing Industry, Journal of Analog and Digital Communications, 8(3), 13-17.

[38]. Kazi Sultanabanu Sayyad Liyakat (2023). IoT in the Electric Power Industry, Journal of Controller and Converters, 8(3), 1-7.

[39]. Kazi Sultanabanu Sayyad Liyakat (2023). Review of Integrated Battery Charger (IBC) for Electric Vehicles (EV), Journal of Advances in Electrical Devices, 8(3), 1-11.

[40]. Kazi Sultanabanu Sayyad Liyakat (2023). IoT in Electrical Vehicle: A Study, Journal of Control and Instrumentation Engineering, 9(3), 15-21.

[41]. Kazi Sultanabanu Sayyad Liyakat (2023). PV Power Control for DC Microgrid Energy Storage Utilisation, Journal of Digital Integrated Circuits in Electrical Devices, 8(3), 1-8.

[42]. Kazi Sultanabanu Sayyad Liyakat (2023). Electronics with Artificial Intelligence Creating a Smarter Future: A Review, Journal of Communication Engineering and Its Innovations, 9(3), 38-42.

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[43]. Kazi Sultanabanu Sayyad Liyakat (2023). Dispersion Compensation in Optical Fiber: A Review, Journal of Telecommunication Study, 8(3), 14-19.

[44]. Kazi Sultanabanu Sayyad Liyakat (2023). IoT Based Arduino-Powered Weather Monitoring System, Journal of Telecommunication Study, 8(3), 25-31.

[45]. Kazi Sultanabanu Sayyad Liyakat (2023). Arduino Based Weather Monitoring System, Journal of Switching Hub, 8(3), 24-29.

[46]. V D Gund, et al. (2023). PIR Sensor-Based Arduino Home Security System, Journal of Instrumentation and Innovation Sciences, 8(3), 33-37

[47]. Kazi Kutubuddin Sayyad Liyakat (2023), System for Love Healthcare for Loved Ones based on IoT. Research Exploration: Transcendence of Research Methods and Methodology, Volume 2, ISBN: 979-8873806584, ASIN : B0CRF52FSX