International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

RASPBERRY EMPLOYED POWER THEFT CONTROLLER AND IOT BASED LOAD CONTROLLING FOR SMART ENERGY METER SYSTEM

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ABSTRACT: This paper discusses the significance of right monitoring and controlling power consumption, specifically in detecting strength theft. It suggests using an Internet of Things (IoT) and Arduino-based totally clever energy meter to deal with energy waste and theft. The Raspberry Pico is applied in this undertaking to control strength theft via controlling loads connected to a 4xl channel relay and presenting strength intake details to the IoT interface. This statistics may be used by purchasers to make knowledgeable choices about their strength usage.

Keywords: Energy consumption tracking, Power theft detection, Internet of Things (IoT), Arduino- based, smart energy-meter, Raspberry Pico, Load manipulate, Relay, Energy consumption information, Consumer consciousness**.**

INTRODUCTION

The Internet of Things (IoT) is a system The Internet of Things (IoT) is a system where gadgets are related to the internet thru IP addresses, making them effortlessly identifiable on the net. This technology has the ability to alter people's life, as human beings prefer to display matters through automated structures instead of manual ones. In this paper, an IoT-based electricity robbery detection system is introduced the usage of Raspberry Pi and relay, along with circuitry using the gadget. Electricity theft contributes to sluggish financial boom in growing countries, wherein maximum output is for intake. The World Bank's development indicator series shows that 23% of distribution and losses because of transmission in Ghana have been due to transmission losses in 2014. Reducing transmission and distribution losses is a sizeable undertaking for strength software authorities. Losses may be categorized into technical (TL) and non-technical (NTL) losses. Technical losses are in-constructed inside the machine, while NTL losses are due to energy dissipated in gadget and conductions used for distribution and transmission traces. NTL losses arise because of inaccuracy of metering, theft, or theft of strength, in addition to energy consumed however unrecorded by way of the strength meter. Electricity robbery takes place because of meter tampering, bypassing, and service lines tapping into customers' premises. These troubles negatively impact the monetary popularity of energy distribution and software companies, placing strain on destiny funding inside the electricity area. The ripple impact is that losses incurred due to robbery are passed directly to paying purchasers in terrible first-class provider and better price lists. The emergence of smart grid technology has led researchers to use smart grid systems to locate and display energy robbery. This research proposes a generalized IoT-based layout using Raspberry Pi to come across power theft with the aid of comparing recorded values of present day on the application carrier intake to the electricity meter intake. The results are saved on a firebase server, handy in real-time.

RELATED WORK

1. N. Donald, The Internet of Things: Do-It- Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black, London: McGraw-HillTAB Electronics, 2015.

"The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black" by N. Donald, published in 2015 by McGraw-HillTAB Electronics, provides readers with a comprehensive guide to creating IoT projects using popular platforms like Arduino, Raspberry Pi, and BeagleBone Black. The book offers step-by-step instructions and practical insights for building various DIY projects that utilize these platforms, enabling readers to explore the potential of IoT technology in their own homes. With a focus on hands-on experimentation and learning-by-doing, this publication serves as a valuable resource for hobbyists, enthusiasts, and makers interested in delving into the world of IoT.

2. Eseosa and E. Promise, Economic Effects of Technical and Non-Technical Losses in Nigeria Power Transmission System, IOSR Journal of Electrical and Electronics Engineering Ver. I, vol. 10, no. 2, pp. 2278- 1676, 2015.

"Economic Effects of Technical and Non- Technical Losses in Nigeria Power Transmission System" by Eseosa and E. Promise, published in IOSR Journal of Electrical and Electronics Engineering Ver. I, volume 10, issue 2, pages2278-1676 in 2015, delves into the economic implications of both technical and non-technical losses within Nigeria's power transmission system.The authors likely explore the impact of inefficiencies, such as electricity theft and infrastructure problems, on the country's economy. This research could provide valuable insights into the challenges facing Nigeria's energy sector and offer potential solutions for improving efficiency and reducing losses.

3. M. U. Hasmi and J. . G. Priolkar, Anti-theft energy metering for smart electrical distribution system, in 2015 International Conference on Industrial Instrumentation and Control, ICIC 2015, Maharashtra, 2015.

This paper focuses on anti-theft measures in smart electrical distribution systems. The authors likely propose solutions for detecting and preventing energy theft within such systems. This could involve the development of advanced metering technologies and control mechanisms to monitor and safeguard against unauthorized usage or tampering. The paper likely explores theimportance of addressing energy theft issues in ensuring the integrity and efficiency of smart electrical distribution systems.

4. S. N. Vinay and M. R. Shubham , WSN-POWER THEFT CONTROL, International Research Journal of Engineering and Technology (IRJET), vol. 04, no. 01, p. 1984, 2018.

The focuses on the use of Wireless Sensor Networks (WSNs) for controlling power theft. The authors may discuss the implementation of WSNs as a means to detect and prevent unauthorized or illegal electricity usage. This research likely explores innovative techniques and technologies to monitor power consumption, identify irregularities indicative of theft, and implement measures for enforcement and control. The paper could contribute to addressing the challenges associated with power theft in electrical distribution systems, particularly in the context of utilizing wireless sensor networks for enhanced monitoring and security..

EXISTING SYSTEM

- Smart power meters make use of the Atmega 328 microcontroller as a relevant component for manage and processing.
- Integration of a WiFi module enables Internet of Things (IoT) connectivity in the smart power meter machine.
- A GSM module is included for mobile communication purposes, enhancing the meter's communication skills.
- The smart energy meter capabilities a contemporary detector that continuously video display units actual-time modern readings.

Limitation of the existing system are:

- Limited Connectivity Options.

- SMS-Based Interactions.
- Complexity of Atmega 328 Micro controller.
- Limited Data Accessibility.
- Limited Data Accessibility.

PROPOSED SYSTEM

An Internet of Things (IoT) and Arduino-based totally clever electricity meter is suggested as a solution to those troubles. The Raspberry Pico used in this venture is controlling the strength robbery if all and sundry tries to theft energy. With the implementation of IoT, that's required Raspberry Pico i.e., not handiest controlling the hundreds that are linked to a 4xl channel relay but additionally presenting the details of power intake to IoT interface in order that information can be used by the consumer.

BLOCK DIAGRAM

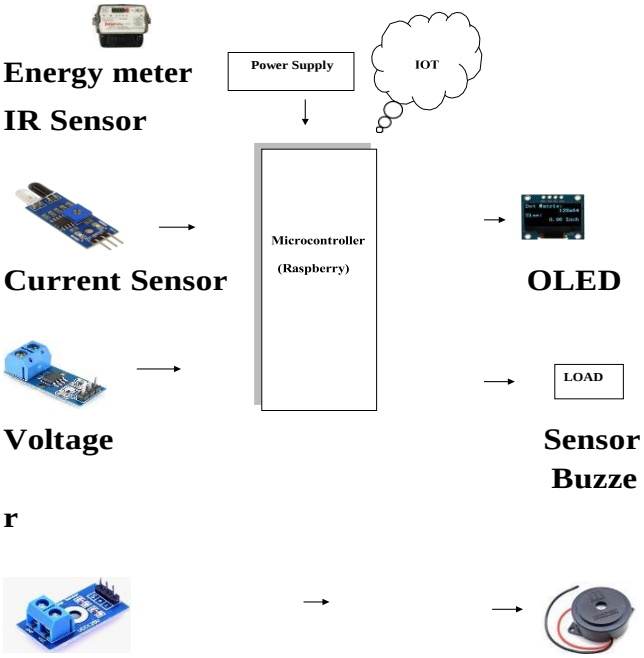

Fig.1 Block Diagram

HARDWARE IMPLEMENTATION OF THE PROPOSED SYSTEM

In this proposed system as a centeral microcontroller we are using raspberry pi pico

- **Raspberry pi pico w (Microcontroller) Raspberry Pi Pico W is Raspberry Pi's first wireless microcontroller board, designed especially for physical computing. It is the successor of the popular Raspberry PiPico board. Similar to the Pico board, which we discussed earlier, the Pico W board is also built around the Raspberry Foundation in-house ARM chip RP2040. The main improvement is the addition .of Wi-Fi and Bluetooth functionality.**

Raspberry Pi Pico W incorporates an Infineon CYW43439 wireless chip that supportsIEEE 802.11 b/g/n wireless LAN, and Bluetooth5.2.

- **Power Supply Unit**

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

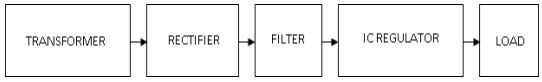

Fig .2 Convertion of supply voltage

- **Voltage Sensor**

The Voltage Sensor is a device that converts voltage measured between two points of an electrical circuit into a physical signal proportional to the voltage. Voltage sensor circuit is a combination of various electronic component by using which the accurate voltage value can be achieved. The major component utilize in voltage sensor are potentiometer & ADC.

Power is calculated by: Power=Vrms*Irms

- **Energy Meter**

The circuit consists of a basic LDR and LED connection, separated by a barrier. When the meter is opened, the connection becomes closed as the LED sends a signal to the LDR, which generates a signal as resistance changes. The LDR is connected to the Raspberry Pi's GPIO
pin and sends a message to the EB.

- **Alarm**

A buzzer or beeper is an electronic signalling device used in automobiles, household appliances, and game shows. It consists of switches or sensors connected to a control unit that determines if a button was pushed or a preset time has lapsed. The device illuminates a light on the appropriate button or control panel and sounds a continuous or intermittent buzzing or beeping sound. Initially, the device was based on an electromechanical system similar to an electric bell, often anchored to a wall or ceiling. Nowadays, ceramic-based piezoelectric sounders like Sonalert are more popular, with driver circuits varying the pitch or pulsed on and off.

- **OLED**

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight). OLED displays are not just thin and efficient -they provide the best image quality ever and they can also be made transparent, flexible, foldable and even rollable and stretchable in the future. OLEDs represent the future of display technology!

- **Relay**

A relay is a switch used to control high power devices, such as Raspberry Pi. It can only control 230V loads with a 12V relay, which is connected to the GPIO pin. A relay is in open contact when it is normally open (NO) and connected when INT1 is high, and closed contact when it is normally closed (NC) and disconnected when INT1 is high. The Raspberry Pi's 5V operating voltage cannot directly control higher voltage devices.

- **Software is required**

Micropython

SYSTEM ARCHITECTURE

Schematic and design of circuit

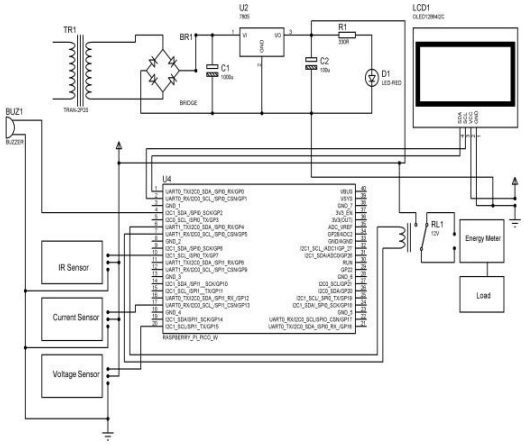

Fig.3 schematic and design of circuitWorking

The 230V power supply and AC load is given to the current measurement unit and voltage measurement unit, through the relay. The input of 5V for arduino is given by rectifier circuit and a voltage regulator LM7805 from the 230V supply. The analog output pin from the current measurement unit is given to analogue A0 pin and the output pin of voltage measurement unit is given to A1 pin of Arduino. From Arduino serial connection is established with help of serial port and given USB port in Raspberry pi. The interfacing of socket programming and 12V relay module is made across the load from the Raspberry pi GPIO pins. The values from the sensors can be displayed through IoT sites like thinkspeak and the load current being consumed can be seen and if repeated theft is coming across a particular load the EB can switch off using the relay.For the working of the proposed model, three different loads like 40 W, 60 W, and 100 W bulbs are used.

IMPLEMENTATION

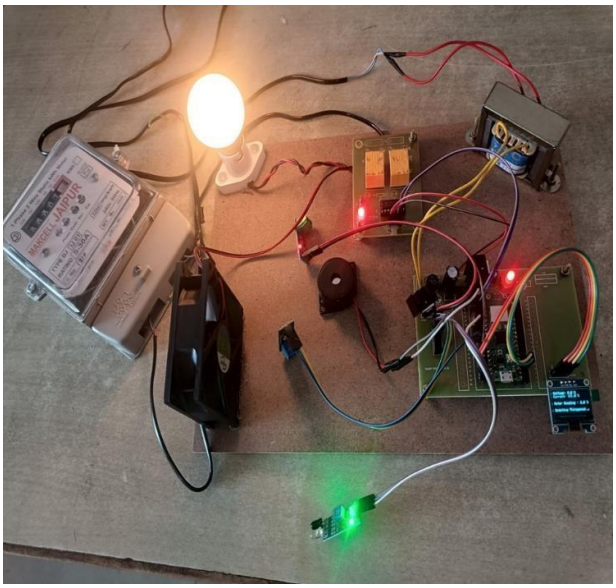

Fig.4 Implementation of circuit

The current and voltage measurement units are used to measure the load current and voltage. With the help of microcontroller, the ADC values are decoded . The decoded value has been send serially to Raspberry Pi. In this work, it checks the predefined ADC values already written in the Python3 code.eg for 60 W the ADC value from current unit will be 400 and if it goes above this value, the theft will be detected. From here signal is sent to IOT cloud module which sends Message to app using socket programming and if meter is opened it sends signal to raspberry pi and send Message.

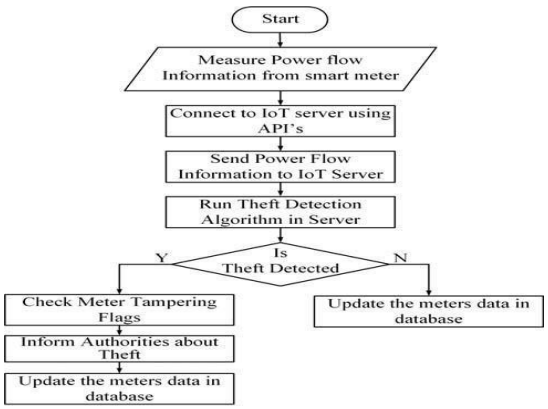

Fig.5 Work Flow of Theft Detection and Smart Meter monitoring

The flowchart given in Fig.5. Initially, all the smart meters at individual consumer premises and the smart meter equipped near the distribution transformer reads the power flow parameters and sends to the server. In server, the algorithm compares the power flow information of transformer with cumulative power flow of all consumer meters to arrive at theft happening. If there was any theft happened then the server checks for any meter tampering/bypass to identify the theft due to tampering/bypass. If there is any tampering/bypass, that corresponding consumer information will be passed to the authorities. If all the meters are not tampered/bypassed, then the theft occurred will be due to direct line hooking. Hence server sends this information to authorities to check the illegal direct access.

Apart from this, the consumer utilization data will be stored in the database for billing. Consumer can access his utilization and billing information at any time using the android application.

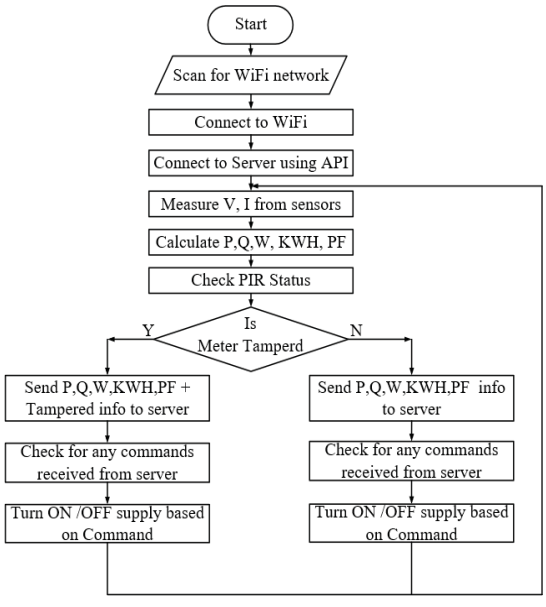

Fig.6. Flowchart of the Smart Meter Working

The breaker is connected in NC (Normally Closed) manner and whenever server sends the command to turn OFF then the input of the breaker is made HIGH, in turn breaking the circuit. Fig.6. shows the overall working of the presented smart meter.

CONCLUSION

Internet of things based electricity theft detection using Raspberry Pi has been designed. The architecture deployed the use of a 4- channel relay interface circuit boards, incorporated with current sensors for measuring and recording current imbalance. The Raspberry Pi gives the utility authority the flexibility to monitor any theft between the energy meter and the USB in real-time. The design also incorporated controller that allows access to data stored on GCloud of the firebase server. It is envisaged that future works look at the construction of the system to establish this designs practicality.

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