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SMART ENERGY METER WITH LOAD CONTROL USING IOT

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Abstract: *The Smart Energy Meter with Load Control Using IoT is an intelligent energy monitoring and management system designed to measure, analyze, and control electrical power consumption in real time. The system integrates an embedded controller with IoT connectivity to provide accurate energy tracking and automated load regulation. An energy meter with an LDR-based pulse detection mechanism measures energy consumption without altering the internal meter circuitry. Voltage and current sensors continuously monitor electrical parameters, while an Arduino processes the data and displays real-time values such as voltage, current, energy usage, and load status on an LCD. An ESP32 module uploads the collected data to an IoT platform, enabling remote monitoring and analysis. When consumption exceeds a predefined threshold, the system automatically disconnects high-power loads through a relay, ensuring safe and efficient energy utilization. In abnormal conditions such as overload, a buzzer provides local alerts and a GSM module sends SMS notifications to the user. Powered by a regulated 12V supply, the prototype offers a cost-effective, reliable, and scalable solution for smart homes and industries, promoting energy conservation, remote accessibility, and electrical safety.*

Keywords: IoT, Arduino, GSM, LDR

1. INTRODUCTION

The rapid growth in electricity demand due to industrialization, urbanization, and the expansion of smart homes has increased the need for intelligent energy monitoring systems. Conventional energy meters primarily focus on billing and lack real-time monitoring, automated control, and remote accessibility. With the advancement of Internet of Things (IoT) technology, energy management systems can now provide continuous monitoring, data analysis, and automated control mechanisms.Smart energy meters integrate embedded systems and IoT platforms to monitor electrical parameters such as voltage, current, and energy consumption in real time. Microcontrollers such as Arduino and wireless modules like ESP32 enable remote data transmission and cloud-based monitoring. Intelligent load control mechanisms help in preventing overload conditions and improving energy efficiency.In this project, the system utilizes an LDR-based pulse detection method to measure energy consumption without modifying the internal circuitry of the existing energy meter. The measured data is processed and displayed locally while also being uploaded to an IoT platform. The system includes automated relay-based load control, buzzer alerts, and GSM-based SMS notifications during abnormal conditions. This approach enhances safety, reduces energy wastage, and promotes smart energy management in residential and industrial environments. Internet of Things (IoT) technology, energy management systems can now provide continuous monitoring, data analysis, and automated control mechanisms.Smart energy meters

integrate embedded systems and IoT platforms to monitor electrical parameters such as voltage, current, and energy consumption in real time. Microcontrollers such as Arduino and wireless modules like ESP32 enable remote data transmission and cloud-based monitoring. Intelligent load control mechanisms help in preventing overload conditions and improving energy efficiency.In this project, the system utilizes an LDR-based pulse detection method to measure energy consumption without modifying the internal circuitry of the existing energy meter. The measured data is processed and displayed locally while also being uploaded to an IoT platform. The system includes automated relay-based load control, buzzer alerts, and GSM-based SMS notifications during abnormal conditions. This approach enhances safety, reduces energy wastage, and promotes smart energy management in residential and industrial environments.

A. Existing Methods

The traditional energy metering system is mainly designed for measuring and recording electricity consumption for billing purposes. Conventional meters require manual reading, which can lead to human errors, delayed updates, and lack of real-time monitoring. These systems do not provide remote access to consumption data, load control mechanisms, or instant alerts during overload conditions. In most cases, consumers are unaware of their real-time power usage, which may result in excessive energy consumption and electrical hazards. Load disconnection during abnormal conditions is usually handled manually or through basic protective devices like circuit breakers, without intelligent monitoring or communication features.

2. Proposed System

The proposed system is an IoT-based smart energy meter that monitors real-time power consumption and enables load control. A microcontroller such as Arduino Uno processes sensor data and sends it through an ESP32 to an IoT platform for remote monitoring. The system automatically disconnects loads during overload conditions using a relay to ensure safety and energy efficiency.

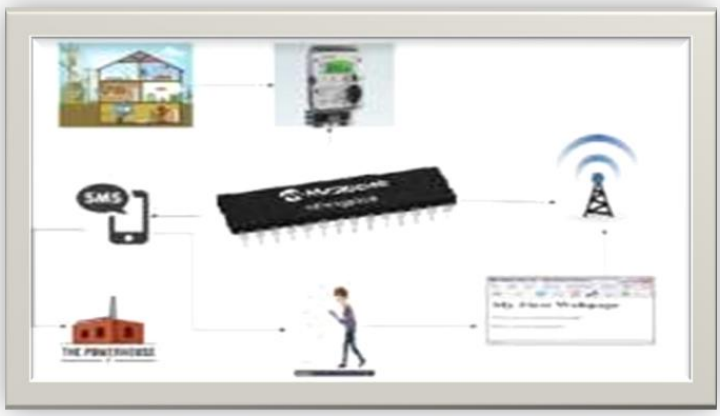

Fig 1: Architectural Diagram

Overview of the architectural model:-

Whilst the numerous home equipment of the family devour power the electricity meter reads the reading constantly and this consumed load can be seen on meter. We will see that the LED on meter continuously blinks which counts the meter reading based at the blinking, the devices are counted normally, 3200 blinks is one unit. In our challenge we're trying to broaden,

A machine in which Arduino Uno act as primary controller, which continuously screen strength meter. As in line with the blinking of LED on electricity meter the Arduino will degree the unit consumption. The measured studying with the calculation of the value can be constantly displayed on web page that we've got designed. Threshold price may be set

on website with the help of Wi-Fi, as per the consumer‟s requirement. When the consumers analyzing could be close to approximately to the set threshold fee it's going to send a notification cost to the patron. When the patron gets the notification he can go to the website and trade the threshold fee

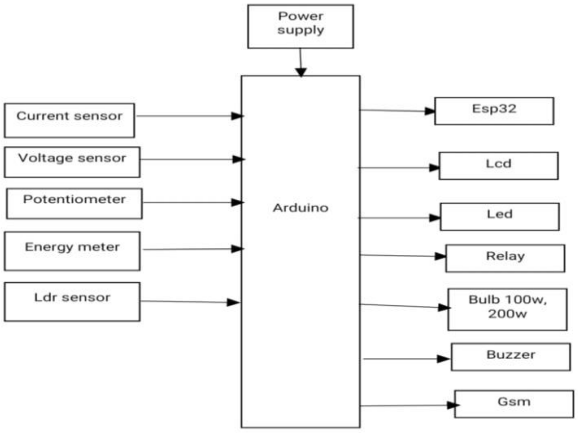

Fig 2: Block Diagram

4. Hardware description

1]Arduino UNO

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

Fig 3: Arduino UNO

Table1: Pin Description Of Arduino UNO

Pin No.	***Pin Name***	***Type***	***Description***
1	*RESET*	*Input*	*Resets the microcontroller*
2–13	*Digital Pins*	*I/O*	*Digital input/output pins*
3,5,6,9,10,11	*PWM Pins*	*Output*	*Provide PWM output*
0 (RX), 1 (TX)	*Serial Pins*	*I/O*	*Used for serial communication*
A0–A5	*Analog Pins*	*Input*	*Read analog values*
AREF	*Input*	*Input*	*Reference voltage for analog input*

Pin No.	***Pin Name***	***Type***	***Description***
GND	*Ground*	*—*	*Ground connection*
5V	*Power*	*Output*	*Regulated 5V supply*
3.3V	*Power*	*Output*	*3.3V supply*
VIN	*Power*	*Input*	*External power input*

2]ESP32 Microcontroller

The ESP32 is a powerful and versatile microcontroller with built-in Wi-Fi and Bluetooth capabilities, making it ideal for IoT applications. It features a dual-core processor, low power consumption, and a variety of input/output pins, allowing for easy integration with sensors, displays, and other peripherals. The ESP32 supports both 2.4 GHz Wi-Fi and Bluetooth (Classic and Low Energy), enabling wireless communication in real-time systems. Its high processing power, flexible development environment, and low cost make it a popular choice for projects requiring network connectivity, sensor interfacing, and automation

Fig 4**:** ESP 32 (Node MCU)

3]Energy Meter

Power meter is a tool that measures the amount of electric power fed on via a house. they're usually calibrated in billing units, the maximum commonplace one being the kilowatt hour (kWh). two fundamental classes, electromechanical and electronic, the most common kind of strength Meter is the electromechanical watt-hour meter.

Fig 5: Energy Meter

4]LCD Display-

Working and good judgment for liquid crystal display:-

LCD can add a lot to your software in phrases of offering a beneficial interface for the user, debugging an application or just giving it a "expert" appearance. LCD‟s can be added pretty easily to a utility and use as few as three digital output pins for control. As

for cost, liquid crystal displays may be frequently pulled out of vintage devices or determined in surplus shops for much less than a dollar.

Table2: LCD pin description

Pins	Description
1	Ground, (VSS)
2	+5 V power supply, (VCC)
3	Power supply to control contrast voltage, (VEE)
4	"R/S" _Instruction/Register Select
5	"R/W" _Read/Write LCD Registers
6	"E" Enable Clock
7 – 14	The 8 bit Data Bus (I/O Pins)

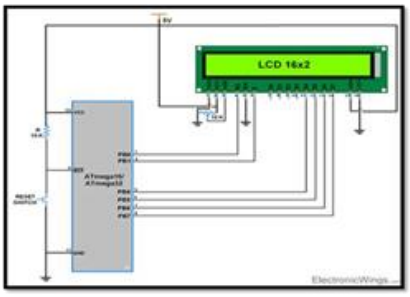

Fig 6**:** LCD Display

5. Software requirements

1]Arduino Ide-

The open-supply Arduino software (IDE) makes it smooth to jot down code and upload it to the board. It runs on home windows, Mac OS X, and Linux. The environment is written in Java and based totally on Processing and other open-source software program. This software can be used with any Arduino board. refer to the Getting commenced web page for installation commands.

Fig 7: Arduino Ide

2. Proteus Design Suite –

The Proteus layout Suite is a proprietary software device suite used commonly for electronic design automation. The software is used in particular by electronic layout engineers and technicians to create schematics and electronic prints for manufacturing revealed circuit forums..

Fig 8: Proteus Design Suite

3. Dip Trace-

Convert schematic to PCB and lower back annotate without problems. speedy and clean introduction and import of recent additives. real-time 3D PCB preview on any stage of development.

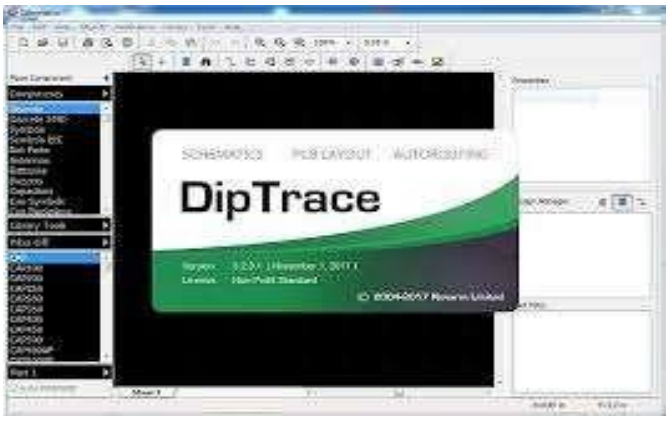

Fig 9**:** Dip Trace

Advantages

1. Eliminates manual monthly meter readings
2. Monitors the electric system much more quickly
3. Makes it possible to use power resources more efficiently
4. Provides real-time data that is useful for balancing electric loads while reducing power outages
5. Enables dynamic pricing, which raises or lowers the cost of electricity based on demand
6. Avoids the capital expense of building new power plants
7. Helps to optimize income with existing resources

Applications

- Smart Homes
- Industries
- Commercial Buildings
- Power Plants
- Energy Management

Future Scope

- The undertaking specially pursuits at supplying normal infrastructure of the strength meter presently used for the clever city concept. the primary improvement for the destiny goes to make energy meter readings, Tampering identity techniques, and connection and disconnection and additionally the pre-records.

- Providing to the users all is going to take place on wireless internet. in which we're going to increase some Wireless hotspots in every area through which all the power meters are get linked and set four to five Parameters which is also going to be monitored.

6. CONCLUSION

In this discussion we proposed the clever energy meter machine may be used extra comfortably to avoid mismatch inside the billing system also It offers the connection among the power board segment and client phase using IOT. With this advances the device can be used more quite simply in rural location in addition to in commercial vicinity.

REFERENCES

1) *Sharma, R., et al., "IoT-Based Smart Energy Meter for Real-Time Monitoring," IEEE, 2021.*
2) *Kumar, S., & Singh, P., "Smart Energy Meter with Load Control," IJERT, 2022.*
3) *Patel, A., et al., "IoT-Based Energy Management for Smart Homes," IEEE Access, 2020.*
4) *Reddy, M., & Rao, K., "ESP32-Based Smart Metering System," IEEE, 2023.*
5) *Mehta, T., & Shah, D., "Non-Intrusive Energy Monitoring Using Optical Sensors," Elsevier, 2022.*
6) *Gupta, V., et al., "GSM-Based Energy Alert System," Springer, 2021.*