

Smart IOT Energy Meter with Theft Protection

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Abstract: *∴ Energy theft is a common issue in countries like India, where usage of energy is continuously increasing as the population increases. Each year, utilities in the power system lose a significant amount of money because of energy theft. The newly constructed AMR for energy measurements demonstrates the idea and operation of a redesigned automated power metering system, but due to this a rise is seen in theft of electricity and regulatory losses due to irregular period examination at the customer's home. Going door to door with each customer makes it impossible to detect and solve theft. In this study, a redesigned procedure depended on the MICROCONTROLLER ESP8266 is used to find and restrict power theft in electricity metres as well as remotely disconnecting and reconnecting the service to resolve the issue a specific customer's (line) When unauthorised activity is detected, a message is automatically transmitted to the utility central server through the GSM module, and a special message is resend to the microcontroller to terminate the unauthorised supply. To address common losses, errors in readings, and voltage fluctuation complications, a novel process is used by interspersing the GSM characterised into smart metres enable with (SPDT) Single pole double throw relay. Customers will be able to use the prototype to learn about the billing system, collect data from smart metres, store it in a centralised database, and generate reports.*

Keywords: GSM, Power consumption, Billing, Smart Energy Meter

1. INTRODUCTION

The foremost requirements for the continuation of life's contents is electricity. It should be utilised with caution in order to get the most out of it. However, in our country, there are numerous locations where there is an excess of power, while many others do not have access to it. Our distribution practises are also partly to blame, because we are still unable to accurately anticipate our exact requirements, and power theft continues to be a problem. Consumers, on the other hand, are dissatisfied with the services provided by electricity firms. Most of the time, they receive grievances about analytical mistakes in monthly invoices. This allows us to monitor the metre and determine whether or not an issue exists. A circular metal strip rotates in the previous metre, and we calculate the consumption based on that revolution. However, our metre is based on a pulse that is generated based on consumption, and we previously linked an android board to monitor the pulse, and a bill is issued based on the pulse. We hope to obtain monthly electricity usage from distant places straight to a central office with the help of this project. We can reduce the amount of human work required to record electricity usages, which are now collected by visiting door to door.

2. EXSISTING SYSTEM

construction of a GSM and Arduino based power theft detection and protection:

GSM based power theft design, simulation and theft has been done. It discusses various forms of energy theft including the irresponsibility of the military, billing variabilities prompting decrease of assets by the service organizations has additionally been accomplished as this work forestalls individual contact between the end client and the specialists. With remote observing of meter perusing and sending SMS, at whatever point there are unusual readings, in client's power meter, the created framework can be prepared to assist utilities with lessening the ramifications of family power burglary A programmed electrical switch is frequently incorporated into the unit to somewhat stop power to the facility to the home or to the consumer trying to profit from the theft of electricity. This framework configuration chiefly centers around a solitary stage power appropriation framework. The robotization of the client charging framework has been accomplished in light of the fact that the meter monitors the purchaser's charge on time. This plan accordingly eliminates manual meter perusing with its tedious framework and bill taking care of outcomes which influences the business while adding higher bills to the buyer. It likewise centers around programmed disengagement and availability while charging is low and high, wiping out the additional expense of reconnecting.

Design of an Overload Trip Facility for a Smart Energy Meter:

We began this project with a proposed technique of energy management from the user's perspective, with the goal of educating the user about energy management so that he can manage his load, reduce his bill, and participate in energy conservation. So first, we looked at the many components that are required project and selected a microcontroller that is both cost-effective and meets all of the project's requirements. The ARDUINO UNO is used for this, and it is modified in C involving the Arduino IDE programming as a compiler, which effectively accumulated our code and afterward stacked it onto the microcontroller. Different electronic parts, such as GSM and ACS712, have been interfaced. We tested our hardware by connecting the Arduino on the Veero board to the relays. For each of the three phases, current and voltage are measured, and power is estimated based on how the load is managed When the user's predefined threshold value was exceeded, they received a notification stating "System Overload." Each phase uses a distinct method of reclosing: Phase I is reclosed by pressing a button, Phase II is reclosed after a one-minute delay, and Phase III is reclosed by pressing a button. Development of an IoT metering system based on Arduino for on-request energy checking.

This study created an IoT-based smart electric meter and investigated its assimilation process. The study produced a straightforward and usable remedy in the shape of an energy utilization rate remote metre using a Composite Design technique. The architecture was demonstrated to be capable of sensing current, power usage, and handling a customer's cost. The energy utilization and cost are communicated to the cloud server using these measures. Customers will be able to see their consumption rate more easily as a result of this. When compared to [18], the IoT smart meter created met these requirements: measurable, control and adjustment, and correspondence (productive sending and getting of information). capacity to get firmware updates, efficient power management, show and time synchronization These components are necessary for communication between the meter and the electricity supplier's framework. The concept of Request Side Management was successfully implemented in the work. However, the current study does not currently cover ideas for approving the framework particular guide as introduced in [20]. Therefore, future exploration will be completed to research the opportunities for computerized approval of the framework detail as far as necessities for

broadening GSM remote correspondence with WiMax (4G LTE) and optical fibre for significant distance interchanges. Additionally, an open tampering technique will be implemented in the IoT smart meter to screens any form of tampering. lower the load

Theft Detection Prepaid Electricity Meter,

The Prepaid electricity metre with theft detection project was successfully executed and has many applications in families, particularly in rural areas. This technology can be widely deployed due to its inexpensive cost and the fact that it prevents income leakage to already overburdened power boards due to electricity theft. This project's key benefit is its low-cost approach for prepayment metering of electricity usage, which also prevents theft of electricity at the household level. The tamper detection feature prevents any user invasions into the electricity metre in order to change or stop the computation of units consumed.

3. SYSTEM ARCHITECHTURE

Human personnel read power metres and charge customers in the current method, which is done from home to home and building to building. To achieve entire area data gathering and billing, a large number of personnel and a considerable working period are required. Billing by humans is prone to reading errors since the residential electric metre is sometimes positioned in an inaccessible location. The job of labour billing is sometimes limited and hampered by poor environmental conditions. Paper billing has a habit of getting lost in the mail. In developing countries like India, the rising development of residential housing and industrial buildings requires more human laborers and longer working hours to finish the utilization understanding undertaking. These builds the energy provider's working expenses for meter perusing.

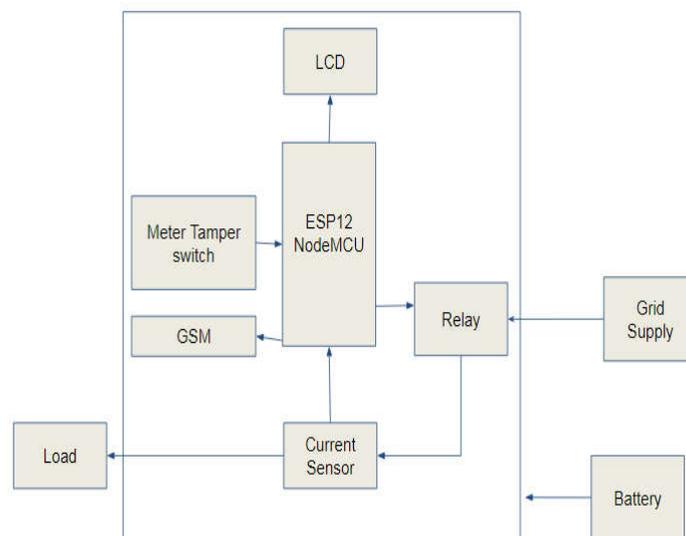


Figure.1. BLOCK Diagram

The energy metre keeps track of how much energy the load uses. There were electromechanical energy metres available in the past, and now there are digital energy metres available. The energy metre is primarily based on the fact that an increase in the amount of current flowing through the circuit spins the disk, which implies that the rotational speed of the plate is relative to how much current coursing through the circuit. In the same way that the power consumption per charge is recorded by the

microcontroller by the flashing frequency of the LED integrated in the meter, the old sort rotating impact of disc type metre causes the stuff component to act correspondingly. The current kind of energy meter likewise had a flickering driven for counting beats are shipped off the microcontroller and these readings are put away in the microcontroller's external memory. The main central processing unit in this project is a nodemcu based on ESP12. This controller is wifi-based, allowing data to be monitored and sent to an IoT cloud server. The grid phase wire passes via the current transformer, which detects the wire current caused by the load and calculates the load and unit KWH. On a daily basis, data on power use is sent to a cloud server. If the metre outer cover is attempted to be opened, the metre tamper switch is activated, and an SMS is sent to the authorised person and grid company that the meter tampering occurred.

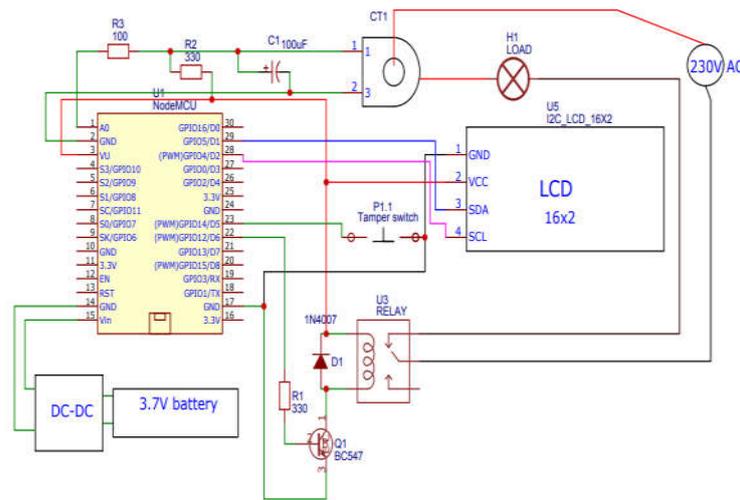


Figure.2. Circuit Diagram

4. REQUIRMENT ANALYSIS

1. Software Requirement

- Arduino IDE

2. Hardware Requirement

- Arduino
- Node Microcontroller ESP12
- ESP8266
- GSM Module
- CURRENT TRANSFORMER
- LCD DISPLAY
- BATTERY

5. COMPONENTS DETAILS

5.1. Arduino:

The boards give digital and analog I/O pins that can be associated with different extension boards (safeguards) and different circuits. The cards include sequential communication interfaces, including Universal Serial Bus (USB) on certain models, and are additionally utilized to load programs from personal computers. Microcontrollers are usually programmed with a vernacular of highlights of the C and C++ programming

dialects. Also the typical compiler toolchains, the Arduino project includes an integrated development environment (IDE) depended on the processing language project.

5.2. Arduino IDE:

The Arduino Integrated Development Environment (IDE) is a cross-platform application written in the Java programming language given by the Arduino project. It was created from the IDE of the programming languages Processing and Wiring. And Insert, find and replace text content, auto indent, bracket matching and syntax highlighting, and compile and import to an Arduino board with one click. Also included are a transmission box, a text content terminal, a button toolbar of not uncommon functionality, and an order of working menus

.Downloading Arduino IDE

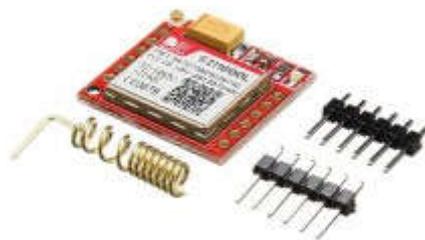
First transfer the Arduino IDE to ensure that you simply have the newest code version (some older versions won't work), access the subsequent URL: <https://www.arduino.cc/en/Main/Software>. The CH340G may be a low cost serial to USB programming chip and doesn't escort native windows or waterproof drivers. but it's been created terribly simple to install.

transfer and install the drivers through the wemos website: <https://www.wemos.cc/product/d1-mini.html>

Install driver and search in Device Manager that COM port is detected when connecting NodeMCU

5.3. GSM Modem :

A GSM module is a specific shape of modem that acknowledges a SIM card and capabilities on a cell consumer's membership, just like a telecellsmartphone. A GSM modem seems to a cell operator to be equal as a cell telecellsmartphone. When a GSM modem is associated to a laptop, the laptop can talk over the cell community the use of the GSM modem. While maximum of those GSM modems are used to offer cell net access, a lot of them will likewise be utilized to ship and get hold of SMS and MMS messages. A GSM modem is probably a standalone modem with a serial, USB, or Bluetooth connection, or it may be a cell telecellsmartphone with GSM modem functionality. In this paper, the time period GSM modem is used as a trendy time period to consult a modem that helps many protocols withinside the GSM Evolution family, including 2.5G technology.



5.4.NODE Microcontroller ESP12 :

The board we are the use of is called "NodeMCU " and it comes with an ESP8266 module that we are going to programme. It comes pre-mounted with the maximum latest model of Micro Python, in addition to all the drivers we will need. Because the ones forums have been firstly made for a unique software, the D0, D1, D2. numbers imprinted on the board range from what Micro python uses. To figure out which pins belong together, look at the image below. It connects to the computer through a micro-USB port. A resetting button is located on the side of the board. Two rows of pins run down the sides of the board, to which we will connect wires. The following is the meaning of the symbols: 3v3 - This is a fancy way of writing 3.3V, which is the internal voltage of the board. Consider this pin to be the positive side of a battery. The ground is indicated by the letters gnd and G. Consider it the battery's negative side. "gpio" stands for "general purpose input output "Use these pins to send and receive signals to and from the various devices you connect to. They can be used as an output, similar to a switch that your application can link to plus or minus. They can also be used as input, informing your software whether they are attached to the plus or minus side. The analogue pin is labelled a0. It can detect and measure voltage, but only up to 3.3V. This pin is connected to your computer's 5V power supply. It's also useful for a variety of other things.

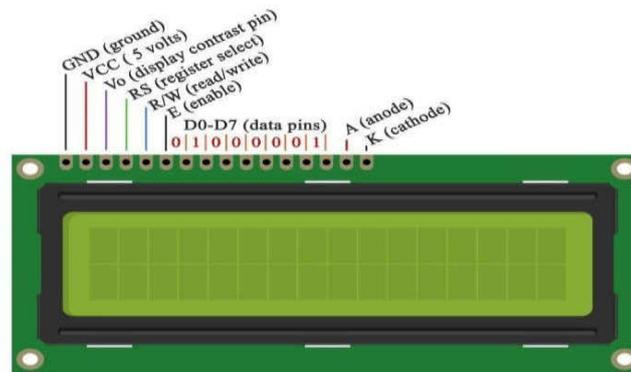


5.5.ESP8266 :

In the Internet of Things business, the Espress ESP8266EX provides a exceptionally incorporated Wi-Fi SoC answer to satisfy consumers' regular expectancies for green strength utilisation, compact layout, and dependable overall performance. The ESP8266EX can act as a stand-on my own utility or as a slave to the host MCU with complete standalone WiFi networking capabilities. When the utility is hosted with the aid of using the ESP8266EX, it's going to release without delay from flash. The embedded high-velocity cache facilitates enhance device overall performance and reminiscence optimization. ESP8266EX also can be utilized as a Wi-Fi adaptor in some microcontroller structure the usage of SPI/SDIO or UART interfaces. Antenna switches, RF baluns, strength amplifiers, low noise acquire amplifiers, filters, and strength control components are all covered into the ESP8266EX. The small format decreases the scale of the PCB and removes the want for outside circuitry. The small layout shortens PCB length and removes the want for outside hardware. Beside Wi-Fi, the ESP8266EX consists of an progressed model of Tensilica's L106 Diamond collection 32-bit CPU in addition to on-chip SRAM. The GPIOs may be used to attach it to outside detectors and different gadgets . Test code for diverse packages is furnished thru the Software Development Kit (SDK). The Smart Connectivity Platform (ESCP) from Espressif Systems affords superior capability such as:

5.6.LCD DISPLAY :

LCD (Liquid Crystal Display) display cover is an digital show elements and discover a extensive variety of implementation. A 16x2 LCD show may be extremely fundamental elements and may be extremely typically utilized in numerous gadgets and circuits. These designs are desired over seven segments and different multiphase LEDs. The motives being: LCDs are practical; without problems programmable; don't have any predicament of showing unique even custom characters (dislike in seven sections), activites, etc.



5.7. Current Transformer:

To connect a CT sensor to an Arduino, the CT sensor's output signal must be conditioned to match the Arduino analogue inputs' input criteria, which are a positive voltage between 0V and the ADC reference voltage. It's is too hard to measure AC current with an Arduino. It's achievable thanks to the Itead TA12-100 current transformer. A voltage current transformer with a 1000:1 ratio is used in the device. A 200 ohm resistor is connected to the output of this transformer. The voltage drop across the resistor is used to compute the AC current. It comes in handy for measuring current at line frequency.

5.8. RELAY:

A relay may be a switch that may be turned on and off by electricity. Electromagnets are unremarkably wont to automatically actuate switches in relays, however different in operation principles appreciate solid-state relays are used. Relays are used once circuits ought to be controlled by discrete low power signals, or at the point when various circuits should be constrained by one signal. Transfers were regularly utilized in telephone trades and early PCs to hold out intelligent cycles. Contactors are a type of transfer that could deal with the unreasonable energy expected to control electric right away powered automobiles and different loads. Solid-country relays use solid-country gadgets to carry out switching operations as opposed to transferring factors to manipulate the circuit. Relays with calibrated running traits and, in a few cases, two or three running curls are utilized to watch electric circuits from over-burdens or disappointments. In current energy frameworks, those abilities are nonetheless carried out with the aid of using virtual gadgets called "safety relays".



Early relays were used as repeaters in long-distance telegraph circuits, continuance signals from one circuit to another.

6. CONCLUSION

The motivation behind this archive is to give an outline of prepaid energy meters which will be used to control the amount of power consumed by consumers to avoid wasting energy. Prepaid energy meters are an inexpensive way to reduce theft of electricity. Users do not have to pay excessive amounts. Instead, they only have to pay what they need. Prepaid energy meters are more reliable and easier to use. In the power business, this prepaid remote energy meter is a godsend. It regulates consumer electricity usage in order to prevent power waste. It contributes to the nation's income by forestalling current stealing and rebuffs deceptive clients. On the opposite hand, the look should meet some specified requirements. the sole concern is that the security and privacy of the info} because it is prone to cybe attacks. However, mistreatment GSM on this specific system has several blessings over antecedently used methods. knowledge transmission is charged at guidelines SMS rates, so fees don't seem to be supported the length of knowledge transmission. Cost-effectiveness of reading. The developed system conjointly provides information on everyday, month to month, and annually consumed energy. consumption. Everyday power utilization subtleties work with clients deal with their power utilization. This created framework is solid and secure because of just supported people will get to the framework. The sole issue is that the security and privacy of knowledge that's prone to cyber attacks. However, using GSM in this system has many advantages over previous methods. Data transmissions are billed at normal SMS rates, so there are no costs based on the duration of the data transmissions. The cheapest indicator. The developed system also provides daily, monthly, and annual power consumption data. Consumers can better adjust their electricity consumption if they have access to information about their daily consumption. It is solid and secure on the grounds that main approved people can get to this planned framework.

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