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IOT Energy Meter with Theft Detection and Billing Notification into the Blynk App

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Abstract:

Energy crisis is one of the major problems that the world faces today. The energy crisis can be reduced to a certain extent by properly monitoring our energy consumption and avoiding energy wastage. Nowadays people face many problems like power theft. Power theft may be a measure crime and it also directly affects the economy of our country. This system will find energy theft easily and send the notification to the user. The energy meters are connected to the PIC Microcontroller through an optocoupler.PIC microcontroller process this data to the ESP8266 WI-FI module then WI-FI module send this data to the blynk app. The microcontroller kWh readings and billing display on LCD and also send this data into the blynk app. This design eliminates the human involvement in electricity maintenance.

Keywords:
PIC micro controller, LCD display, Energy meter, optocoupler, Relay, Blynk APP.

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1. Introduction:

If consumers can check their energy consumption using their mobile phone or laptop instead of checking energy meter, it will be a great leap in the area of energy management. Since most of the people are today 24*7 online, it will be really a boon if they can monitor their energy consumption online from anywhere on the globe. In this paper, we are describing a method of electricity energy meter reading using IoT concept.

The Internet of things (stylized Internet of Things or IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In the proposed system, energy meters are connected to the internet using IoT concept. So there is a provision for the consumers to track their energy consumption, billing and theft detection from anywhere in the world. This method is useful for both the consumer and the supplier. This system break the power supply through relay when the theft was occur. This method eliminates the need of human power during disconnection and reconnection of the load. Another major advantage of this method is that it will inform the supplier side about any theft that is happening in the system.

In this project using electromagnetic relay to break the power supply. It's works as a switch. To measure the power consumption using digital energy meter which is interfaced to the PIC microcontroller through an optocoupler. The optocoupler sensor gives an interrupt each time the meter LED ashes to the programmed PIC microcontroller. ESP8266 WIFI module is used to send the notification about theft, and send the kWh readings, billing to the user mobile into the blynk app also monitoring on LCD display.

The main controlling device of the project is PIC microcontroller. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

2. LITERATURE SURVEY:

The basic idea is to get an appropriate reading from the energy meter through the SMS service by a GSM module is implemented by Rahman [1]. The system presents the update module in which SMS service is replaced by the WiFi module so that it includes even more features with the help of internet also system provides more flexibility to the consumers to revote his/her conventional post-paid meter to work as a prepaid one presented by Rahul Rajesh B, Mohan Kumar S, Nayab Z Sharief [2]. The system presented by Karthikeyan S, Bhuvaneswari P.T.V is cost effective as it requires a simple upgrade on the existing meters than complete replacement because it is light weight and compact due to SoC for control and communication, the basic idea is too strengthened and also to enhance performance of an Energy Meter [3]. Modern day smart grid technology relies heavily on communication networks for two-way communication between load, generation, transmission, and control center so considering this an advanced metering infrastructures (AMI) is used in this system, proposed by Saikat Saha, Swagata Mondal [4].

3. HARDWARE IMPLEMENTATION:

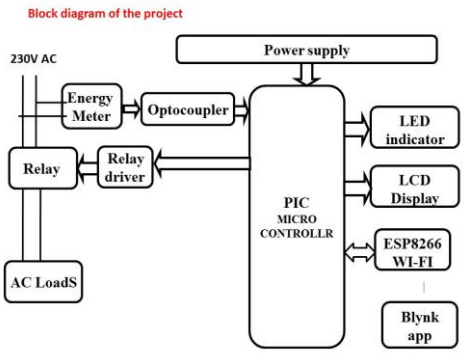

Fig: Block diagram of IOT Energy Meter with Theft Detection and Billing Notification into the BLYNK App

The main blocks of this paper are: power supply, PIC Microcontroller, Energymetr, optocoupler, Relay, LCD.

This project makes use of a PIC micro controller, which is programmed, with the help of embedded C instructions. This PIC Microcontroller is capable of communicating with input and output modules. In this system, a micro controller is interfaced with an energy metering circuit, current sensing circuit, WI-FI communication and a contactor to make or break power line. In this project we are connecting loads through relay and CT. Whenever theft was detected by the system then the microcontroller check the load status and immediately isolate the power supply through electromagnetic relay and send the notification to the user mobile into the blynk app through Wi-Fi. Here relay works as switch to on/off the power supply which is connected to the load.

4. Related Work:

The brief introduction of different modules used in this project is discussed below:

4.1. ESP8266 WI-FI Module:

Fig: **WI-FI module**

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

Features:

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units
- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10uA
- 1MB Flash Memory
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 1.1 / 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO

- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)

4.2. Energy meter:

Fig: Energy meter

An energy meter is a device that measures the amount of electrical energy consumed by a residence, business, or an electrically powered device.

Energy is the product of power and time for which power is used i.e

Energy= power × time

Induction watt hour meter (Energy meter) which are commonly used measure electrical energy in KWH (killo watt-hour).Digital Energy Meter gives fixed number of pulses per KWH. These pulses are given to microcontroller for calculating the units consumed. Microcontroller calculates the power consumption for each pulse and displays. The energy meter we are using gives 3200 pulses per KWH.

4.3. LCD Module:

Fig: **LCD display**

One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the many microcontrollers are 16x2 displays. This means 16 characters per line by 2 lines respectively. In this project we are display the speed of the DC motor ON LCD module with help of IR sensor and PIC microcontroller.

4.4. PIC micro controller:

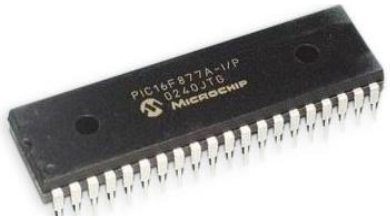

Fig: PIC micro controller

The PIC microcontroller features 5 channels of 8-bit Analog-to-Digital (A/D) converter with 2 additional timers, capture/compare/PWM function and the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus. All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications. The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB.

Peripheral Features:-

- High Sink/Source Current: 25 mA
- Timer0: 8-bit timer/counter with 8-bit pre-scaler
- Timer1: 16-bit timer/counter with pre-scaler, can be incremented during SLEEP via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, pre-scaler and post-scaler
- Capture, Compare, PWM (CCP) module- Capture is 16-bit, max. resolution is 12.5 ns- Compare is 16-bit, max. resolution is 200 ns- PWM max. resolution is 10-bit
- 8-bit, 5-channel analog-to-digital converter
- Synchronous Serial Port (SSP) with SPI™ (Master/Slave) and I2C™ (Slave)
- Brown-out detection circuitry forBrown-out Reset (BOR)

4.5. OPTOCOUPLER:

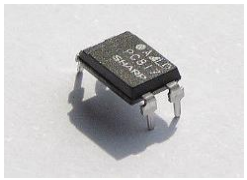

Fig: Optocoupler

Optocouplers are used for providing optical isolation between an input source and output load just by using light. The basic design of an optocoupler consists of an LED that produces infra-red light and a semiconductor photo-sensitive

device that is used to detect the emitted infra-red beam. The pulses from the energy meter are converted into digital signals by using an optocoupler.

4.6 RELAY:

Fig : Relay

Relay is an electromagnetic switch. . It consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a movable iron armature, and a set, or sets, of contacts; two in the relay pictured. The armature is hinged to the yoke and mechanically linked to a moving contact or contacts. When an electric current is passed through the coil, the resulting magnetic field attracts the armature and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact.

5. CONCLUSION:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the idea of the paper has been successfully designed and tested. The paper presented "IOT Energy Meter with Theft Detection and Billing Notification into the BLYNK App" was designed a smart energy meter using IOT and blynk app. All input and output modules are interfacing to the PIC Microcontroller and PIC microcontroller process this data to the to the blynk app.

7. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

8. RESULTS:

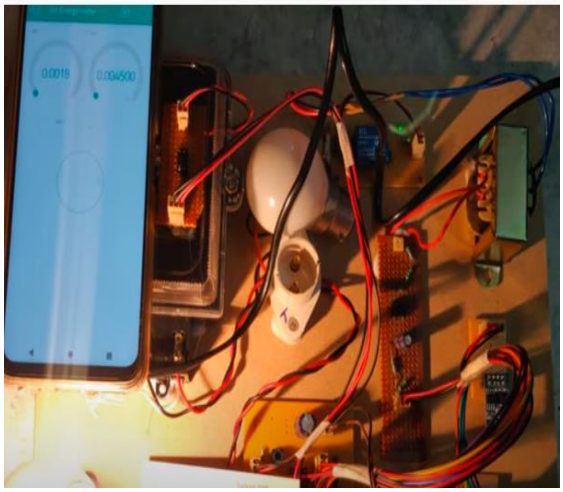

Fig: KWH readings and billing into the blynk app

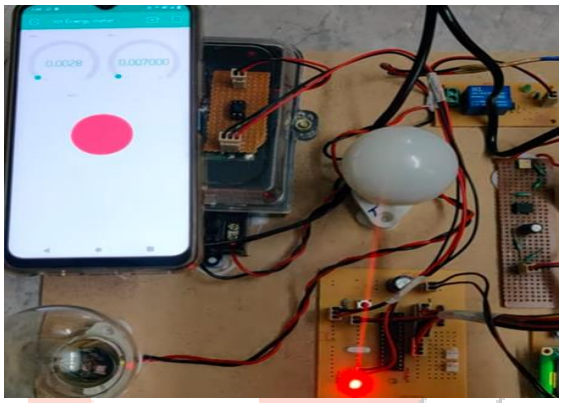

Fig: Theft detection status into the blynk app

Fig: Readings and status on LCD

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