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IoT Based Smart Energy Meter Reading Using Raspberry Pi

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Abstract: It is a troublesome job for the power board authorities to physically take meter readings and compute charge as it is tedious and requires labor. Charging customers for energy utilization is not uniform. It is a repetitive employment for the power board authority to physically go and take meter readings of enormous industrialists and reset their greatest request in the wake of recording it. Subsequently considering every one of these components it is conceivable to outline an energy meter that supports automatic meter reading and billing system and corresponding amount will be displayed on the LCD continuously and communicate to controlling base station, and in the meantime makes a difference in finding the fault area of transmission lines. The same meter can be utilized to take the readings of industrialist which sends these readings to a secured information area and automatically reset it after of recording it. This paper is about making the energy meter smart by having a continuous automatic communication between the consumer's energy meter and the utility. The energy meter reading is communicated to the utility and to the consumer via internet. Raspberry Pi, a tiny computer onto which the programming (Python) is uploaded is used for internet connectivity. Considering all these features that can be done by a single energy meter it is called as SMART ENERGY METER.

KeyTerms— *Smart Energy Meter, Raspberry Pi, Internet, Automatic Billing.*

I. INTRODUCTION: The internet of thing allows object to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer based systems, and resulting in improved efficiency, accuracy and economic benefit. The increasing generation needs empowered gadgets by wireless technology which includes Bluetooth, Radio Frequency Identification, Embedded sensors and many more. In that IOT technology has grown from its beginning and now presently widely using it. The electricity plays an important role in our life. Now-a-days as the consumers are increasing rapidly it became very hard to handle the electricity requirements. Without electricity it's impossible to survive and also it is important to save the electricity loss. As the generation is increases the consumer's requirements also increasing so in accordance with it the technology improvement is needed. So we developed the system with faster and improved technology i.e. "IOT based energy meter reading using Raspberry pi". The electricity also contains some issues like miss use of power or power theft. Power theft is a measure crime and it also directly affects the economy of our country. Transmission, generation and distribution of electricity include the loss of electricity. To avoid the losses we need to monitor the power consumption and losses, so that we can efficiently utilize the generated power. Meter tempering is part of power theft and also illegal crime which we can minimize. Billing is a process in general the human operator goes to every consumer's home

then providing bill it will take lot of time. To resolve these issues we developed system on the base of IOT based energy meter reading. IOT based energy meter reading consists of three parts: Energy meter, Optocoupler and Raspberry Pi. Energy meter part plays a major role in the system. Where AC current is converted to DC current and sends the digital data to Raspberry Pi.Optocoupler is use to stop the unwanted AC current. Raspberry Pi calculates the amount for the unit generated in the meter and performs IOT operation in accordance with the energy meter, Subsequently it sends SMS to consumer monthly using IOT.

II. HARDWARE COMPONENTS: The major components used in the proposed have been discussed briefly:

A. *Raspberry Pi:* The Raspberry Pi is a great stage that can be utilized to assemble your own home automation framework. Plainly, the Raspberry Pi board is flawless while being utilized as a "centre point" for your home automation framework, interfacing with other open-source equipment parts. Raspberry pi is a charge card estimated single board PC which can do the whole employment that a normal desktop PC likes spread sheets, word handling, Internet, Programming, Games and so forth. It comprise of 1GB RAM, ARM v6 Processor,2 USB and an ethernet port, HDMI and RCA ports for display,3.5mm Audio jack,SD card opening (bootable), General purpose I/O pins, keeps running on 5v. The Raspberry Pi model is appeared in figure 1.

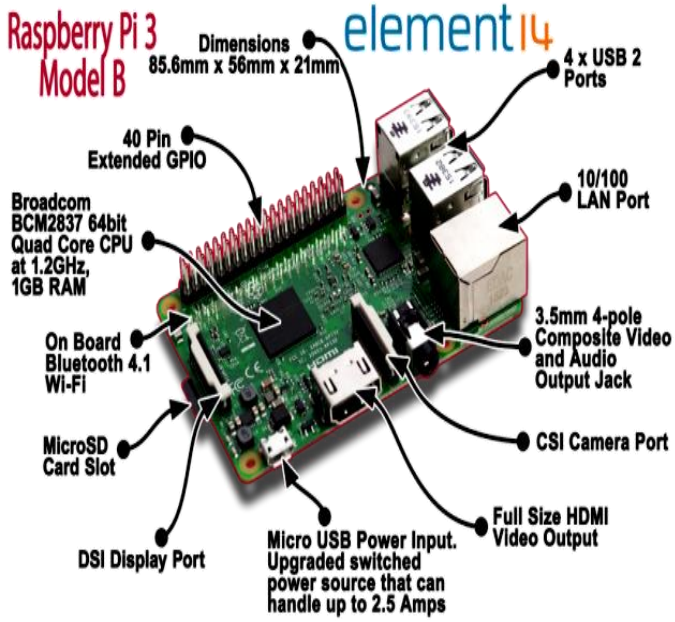

Figure1: **Raspberry Pi 3 Model B**

Raspberry pi keeps running on Linux bit based working frameworks. It boots and keeps running from the SD card. It doesn't have any inner memory other than the ROM. It has a SD card space which is fit for perusing up to 32 GB. The GPIO pins of the raspberry pi are modified utilizing Python programming dialect. The Electro-valve is associated with GPIO pins with the assistance of transistor and transfer so we can turn on turn off it at whatever point required.

B. *GPIO:* One powerful feature of the Raspberry Pi is the row *of GPIO (general purpose input/output) pins.*

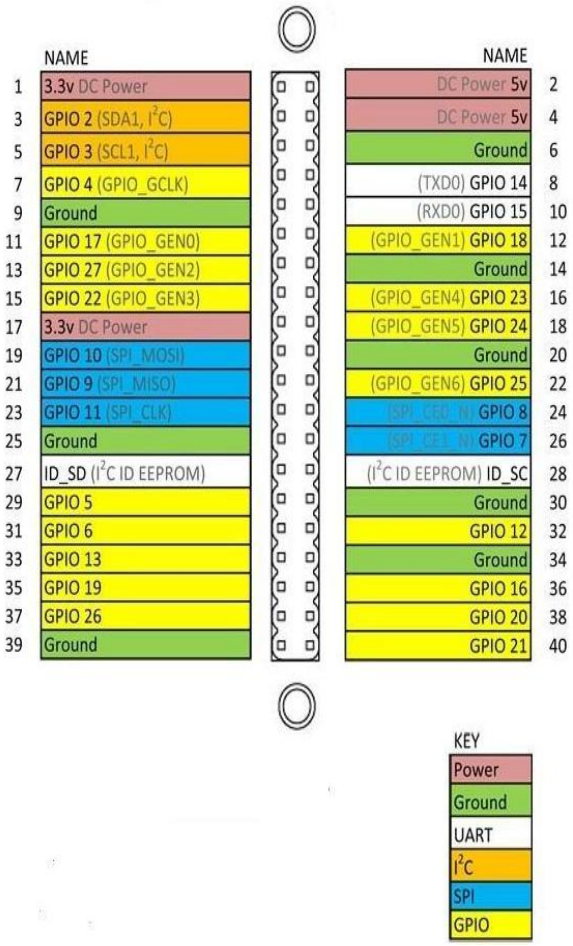

Figure 2: **GPIO Pin Configuration**

The program can be composed on the pins to interface in astonishing courses with this present reality. Information sources don't need to originate from a physical switch; it could be contribution from a sensor or a flag from another PC or gadget, for instance. The yield can likewise do anything, from turning on a LED to sending a flag or information to another gadget. In the event that the Raspberry Pi is on a system, you can control gadgets that are joined to it from anyplace and those gadgets can send information back. Network and control of physical gadgets over the web is an intense and energizing thing, and the Raspberry Pi is perfect for this.

C. *16x2 Character LCD:* Liquid crystal display (LCD) is a at panel display, electronic visual display, video display that uses the light

modulating properties of liquid crystals(LCs). LCs do not emit light directly. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no actual liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer. In most of the cases the liquid crystal has double refraction. The surface of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is uni-directionally rubbed using, for example, a cloth. The direction of the liquid crystal alignment is then defined by the direction of rubbing. Electrodes are made of a transparent conductor called Indium Tin Oxide (ITO).

D. *Optocoupler:* An Optocoupler, also known as an Opto-isolator or Photo-coupler, is an electronic components that interconnects two separate electrical circuits by means of a light sensitive optical interface.

We know transformers that they can not only provide a step-down voltage, but they also provide "electrical isolation" between the higher voltage on the primary side and the lower voltage on the secondary side.

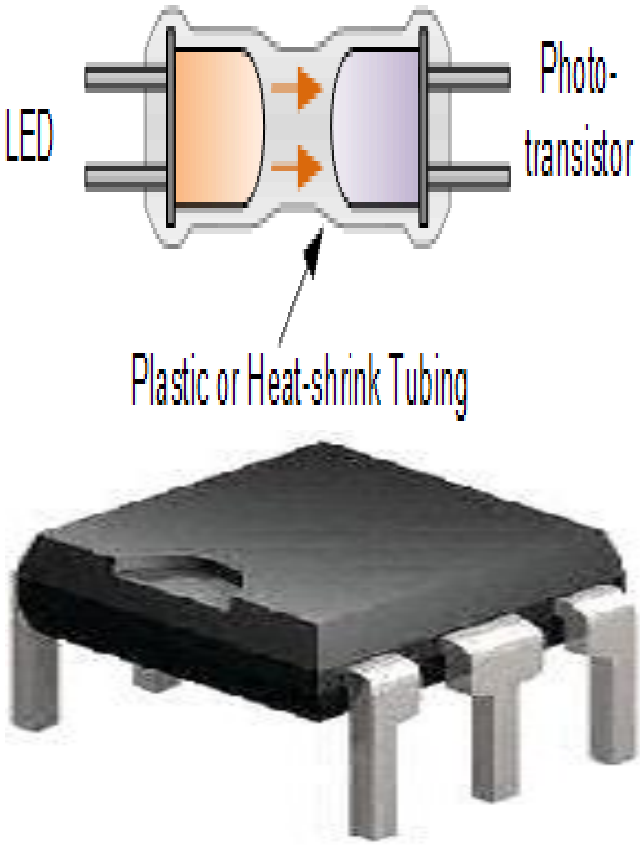

Figure 3: **Opt coupler**

But we can also provide electrical isolation between an input source and an output load using just light by using a very common and valuable electronic component called an Optocoupler. 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. Both the LED and photo-sensitive device are enclosed in a light-tight body or package with metal legs for the electrical connections as shown. An optocoupler or opto-isolator consists of a light emitter, the LED and a light sensitive receiver which can be a single photo-diode, photo-transistor, photo-resistor, photo-SCR, or a photo-TRIAC with the basic operation of an optocoupler being very simple to understand.

III. DESIGN PROCEDURE:

A. Block Diagram

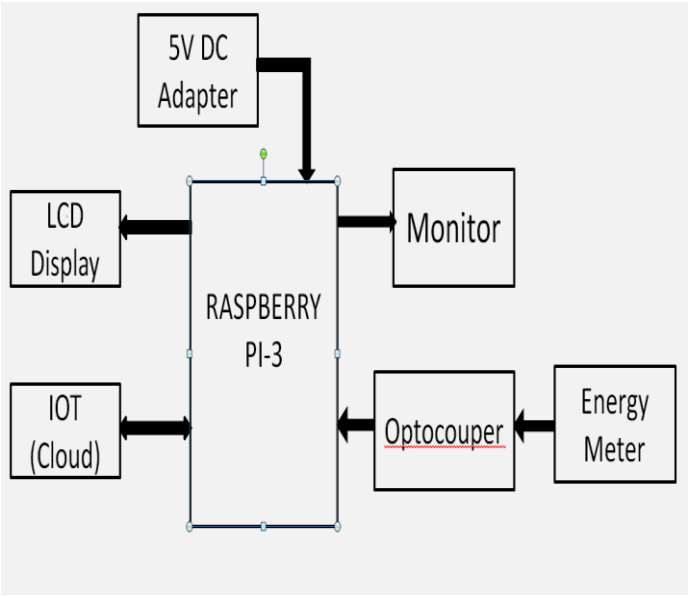

Figure 4: **Block Diagram**

The above fig.4 is a clear cut view of IOT based smart energy meter reading using raspberry pi. The block diagram consists of seven blocks namely Power supply, Raspberry Pi3, LCD display, IOT cloud, Monitor, Energy meter and House load. Here as the above block diagram illustrates raspberry pi is the heart of the system. Initially the raspberry pi is interfaced with single phase multifunction static watt-hour meter is given 230v power supply, house load and is interfaced with optocoupler. At first the energy meter take the load as it input and converts the AC load to DC and the pure DC output is given to the raspberry pi through the optocoupler which is used to stop the

unwanted AC current. The raspberry pi that takes the input from the energy meter and calculates the load that is applied and according it calculates the units and update the coast on the units simultaneously. Finally the amount of load applied, units and billing amount is displayed on the LCD display, is uploaded to internet such that the consumer gets the bill through SMS and updates the data base in power station.

B. Circuit diagram

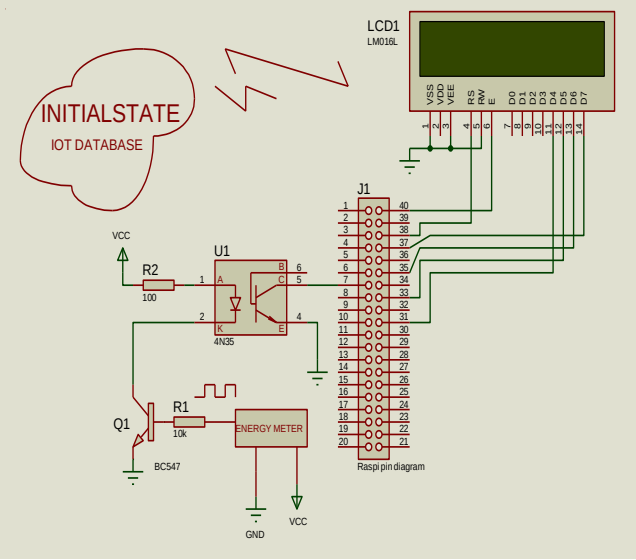

Figure 5: **Circuit Diagram**

The hardware components that are connected to the raspberry pi are LCD display, Optocoupler, Energy meter here, the LCD is connected to pins (40, 38, 37, 35, 33, 31), the opt coupler output is connected to pin 7. Here the energy meter generates the pulsed data to the optocupler the optocoupler that connected to the raspberry pi pin 7 reads the data from the energy meter through the optocoupler and calculates the load that applied on the meter, calculate number of units based on the load applied and calculate the bill amount according t the slab rate. The output data that is load applied, number of units, bill amounts are continuously displayed on LCD, upload in internet that is in initial state for online monitoring and sends SMS to the customer through twillo web site.

IVCONCLUSIONS: The conclusion of this project is to read the data from the Energy Meter and calculate the amount for the units consumed for the consumer and sends the billing data to the initial state, twillo for sending SMS and on LCD display on board. The results of the project are shown in the below figures.

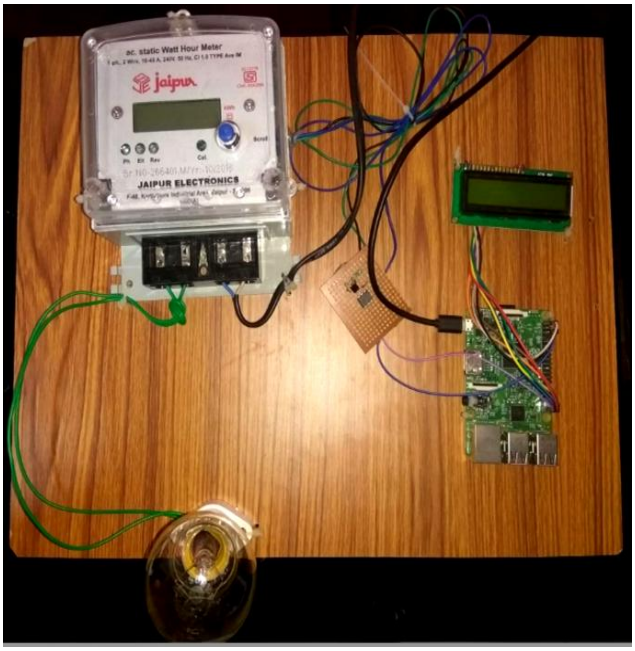

Figure 6: **Hardware of Smart Energy Meter**

The above fig.6 illustrates the overview of the IOT based smart energy meter reading using Raspberry Pi3. Here we use raspberry pi3, Energy Meter, LCD display and optocoupler. The billing of the electricity consumed is implemented through Raspberry Pi3.

Figure 7: **LCD Display of Energy Billing and Consumed Units**

The above fig.7 shows the billing output on LCD display. Here we observe amount of load applied, units that consumed according to the load applied and amount according to the slab rate.

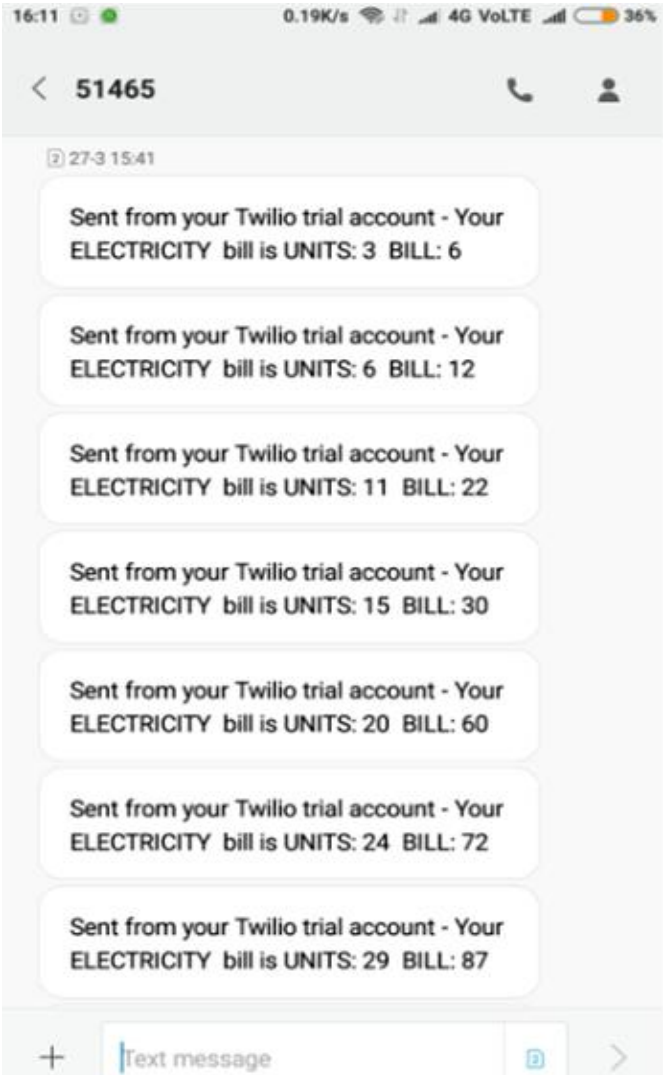

Figure8: **Text Message to Registered Mobile Number**

The below fig.8 shows the text message of the electricity bill that sent to registered mobile number from twillo web site. Here in the message we get the number units that customer consumes and amount for the units based on the slab rate.

Figure 9: **Display Consumed Units on Web Server**

The above fig 9 shows the amount of load applied and the number of units consumed through internet using the web site named Initial state. Here in this we usually have a login id and password for every individual to the access meter through internet.

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