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IOT Based Smart Energy Meter

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Abstract -We can see a person standing in front of our house from electricity board, whose duty is to read the energy meter and handover the bills to the owner of that house every month. This is nothing but meter reading. According to that reading we have to pay the bills. The main drawback of this systemis that person has to go area by area and he has to read the meter of every house and handover the bills. Many times errors like extra bill amount or notification from electric board even though the bills are paid. To overcome this drawback we have come up with an idea which will eliminate the third party between the consumer and service provider, even the errors will be overcome. In this paper idea of smart energy meter using IoT and microcontroller have been introduced. In this method we are using ARM7 LPC2148 microcontroller because it is energy efficient. In this paper, energy meters which are already installed at our houses are not replaced, but a small modification on the already installed meters can change the existing meters into smart meters. One can easily access the meter working through web page that we designed.

Key Words:Energy Meter, ARM7 LPC2148, LM35 Temp Sensor, LDR, IOT web server.

1.INTRODUCTION

In the present billing system the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be taken into account for designing an efficient energy billing system. The present project "IoT Based Smart Energy Meter" addresses the problems faced by both the consumers and the distribution companies. The paper mainly deals with smart energy meter, which utilizes the features of embedded systems i.e. combination of hardware and software in order to implement desired functionality. The paper discusses use of controllers, and the application of GSM modems to introduce 'Smart' concept. With the use of GSM modem the consumer as well as service provider will get the used energy reading with the respective amount, Consumers will even get notification in the form text through GSM when they are about to reach their threshold value, that they have set. Also with the help of GSM modem the consumer can monitor his consumed reading. This system enables the electricity department to read the meter readings monthly without a person visiting each house. This can be achieved by the use of microcontroller unit that continuously monitor and records the energy meter reading in its permanent (non-volatile) memory location. This systemcontinuously records the reading and the live meter reading can be displayed on webpage to the consumer on request. This system also can be used to disconnect the power supply of the house when needed.

1.2. LITERATURE REVIEW

In recent years enormous research and papers have proposed the design and development of energy meter monitoring system. Still there are a few issues in the framework, which influence the nature of administrations and in this manner the level of fulfillment of end clients or open. Among numerous uncertain issues, one of the issues knows the consumption by consumer's zone wise/region wise. Indeed, even after establishment of more precise electronic or advanced meters, the issue is preceded in numerous areas across the country. In present framework the system received by the greater part of intensity supply organizations/offices for getting perusing for power utilization is the manual meter perusing or a portion of its variations like photograph realistic perusing, perusing SMS etc [1].

The proposed model evaluates previously mentioned methodology drawbacks and the present techniques with a computerized framework to remotely gather /control energy meter readings getting a capacity to continuous observing the power utilization. The model recommends establishment of Wi-Fi/GPRS empowered energy meters at consumer end. Such meters have capacity to get associated with the system (through remote or GPRS framework). Such system associated meters can be connected remotely to the server, status of perusing information and also other required information put away in the meters memory can be gathered whenever[2].

In [3] the author proposed a Wi-Fi based single-phase smart meter based on IoT. The author used a digital meter, ESP8266 Wi-Fi module and a web application for the user interface. The ESP8266 Wi-Fi module has attached into the meter. The ESP8266 Wi-Fi module has been implemented by TCP/IP protocol as the means of communication between the meter and web application. The proposed system is secured and open source but costly.

In [4] an Automatic Meter Reading (ARM) based Power Meter with Wi-Fi Communication Module scheme has been proposed and developed software based on Linux.

In [5] the author presented a survey report on the utilization of smart electricity meters and some key aspects of the metering process. As well as opportunities arising due to the

advent of big data and the increasing popularity of the cloud environments challenges are highlighted by the author.

In [6] the author proposed a system where Arduino Uno has been developed with an Ethernet shield that can monitor all the necessary activities in the flow of electricity, the use of current and electricity costs and mentioned hope of reducing the problems associated with payment, calculate the cost of the unit of electricity.

In [7] the author proposed a real-time monitoring system for residential energy meter. The presented system provided inclusive and continuous access to energy consumption to the consumer by exploiting the advancement of IoT technology.

2. PROPOSED SYSTEM

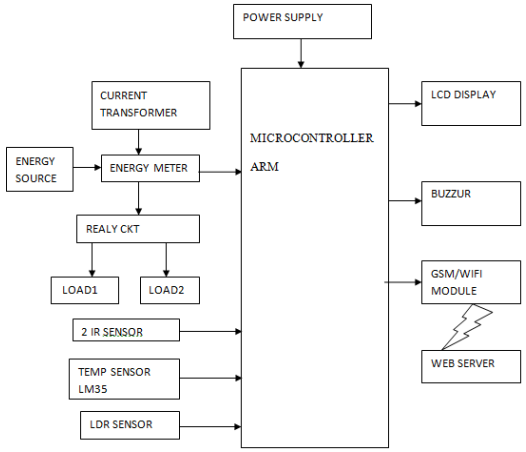

Fig -1: Block Diagram

This system principally monitors electrical parameters of appliances and subsequently calculates the units consumed. As WSN's are having many advantages, here we have designed smart meters predicting the usage of power consumption. However it is low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements, IOT technology for networking and communication, because it has low-power characteristics, which enable it to be widely used in home and building environments.The proposed system uses ARM7-LPC2148 Processor that can process the instructions according to our requirements such as power delivered to appliances and status of devices i.e on state or off state.

The energy meter that is connected to LPC 2148 through current transformer will regularly calculates the number of units consumed and the billing amount. The same will be displayed on LCD along with the same information will send to web server about number of units consumed in terms of graph.As we are defining the prepaid energy meter we need to refill the number of units that are required approximately per month by estimating the consumable load. However we could able to add the units if completed early.The hardware implementation of this projected system consists of an ARM7 microcontroller, Energy Meter with current transformer for connecting with processor, appliances connected through relays to micro controller.

2.1ARM7 LPC2148 microcontroller:

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

Fig -2: ARM7 LPC2148 Microcontroller

2.216*2 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

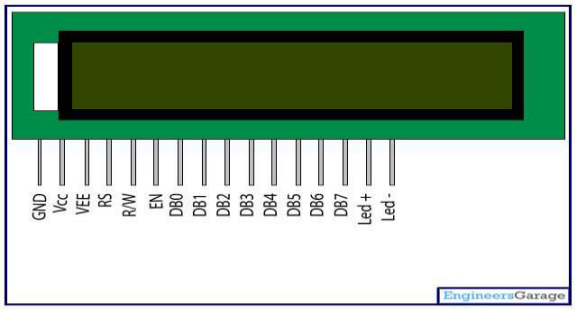

Fig -3: LCD Display

The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16

characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

2.3IR Sensor:

Proximity Sensor is used to detect objects and obstacles in front of sensor. Sensor keeps transmitting infrared light and when any object comes near, it is detected by the sensor by monitoring the reflected light from the object. It can be used in robots for obstacle avoidance, for automatic doors, for parking aid devices or for security alarm systems, or contact less tachometer by measuring RPM of rotation objects like fan blades.

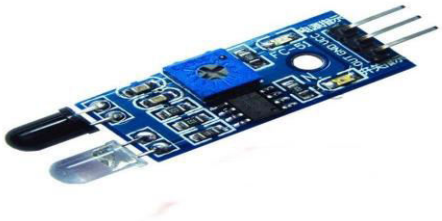

Fig -4: IR Sensor

2.4. GSM module:

This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open a connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands.

Fig -5: GSM Module

2.6. Temperature Sensor (LM35):

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

Features:

- Calibrated directly in Celsius (Centigrade)
- Linear + 10.0 mV/ C scale factor
- 0.5 C accuracy guarantee able (at +25 C)
- Rated for full -55 to +150 C range

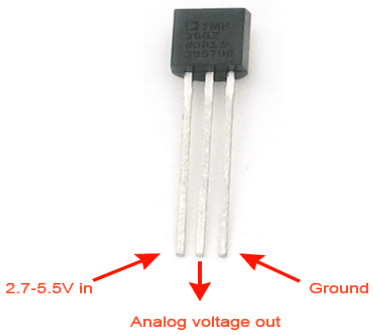

Fig -6: Temp sensor

2.7. LDR:

A photoresistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. Photoresistors work based off of the principle of photoconductivity. Photoconductivity is an optical phenomenon in which the material's conductivity is increased when light is absorbed by the material. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band.

Fig -7: LDR

2.7. Relay Driver Circuit:

A relay driver circuit is a circuit which can drive, or operate, a relay so that it can function appropriately in a circuit. The driven relay can then operate as a switch in the circuit which can open or close, according to the needs of the circuit and its operation. Since DC and AC voltages operate differently, to build relay drivers for them requires slightly different setup. We will also go over a generic relay driver which can operate from either AC or DC voltage and operate both AC and DC relays. Now that we're using a transistor to drive the relay, we can use considerably less power to get the relay driven. Because a transistor is an amplifier, we just have to make sure that the base lead gets enough current to cause a larger current to flow from the emitter of the transistor to the collector. Once the base receives sufficient power, the transistor will conduct from emitter to collector and power the relay.

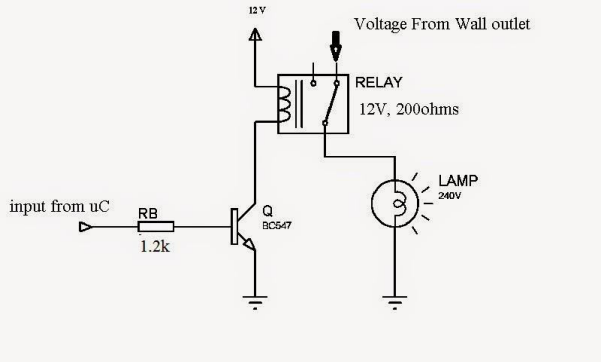

Fig -8: LDR

3. CONCLUSIONS

An attempt has been made to make a practical model of 'IoT Based Smart Energy Meter.' The propagated model is used to calculate the energy consumption of the household, and even make the energy unit reading to be easy and accurate. Hence it reduces the wastage of energy and brings awareness among all. Even it will deduct the manual intervention. Here we are also using different sensors for automation like LDR sensor for lights ON/OFF, temp sensor for Fan ON/OFF. The data will be displayed on LCD along with the same information that will send to the webserver about several units consumed in terms of a graph.

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