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RESEARCH ARTICLE

IoT based smart electricity monitoring with an integration of cloud environment

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ABSTRACT

It is smart in the sense that we can get our real time data anytime irrespective of any constraints. Just one needs a desktop or a mobile and one can see the power consumption. With the help of this one can always monitor and never exceed the threshold electricity limit and budget. With the help of such system one can always be aware of the energy consumption at any place and can never exceed the threshold electricity limit for a month or year or week or even a day, with the help of the real-time data getting loaded into our application. Besides it also provides the temperature at the filament, and can be useful in protecting against the short circuiting due to overheating of the filament. One doesn't need to worry about the storage of such large data, as all the data is updated into the cloud which is a cheap and good resource for storage. All they could services used are of Amazon Web Services. And in future, after sometime with sufficient data using various machine learning algorithms we can predict the future electricity bill and which electricity appliance is safe and more environment friendly.

Key words: IOT, Cloud Computing, Microcontroller.

INTRODUCTION

The aim of this paper is to give its users a smart electricity monitoring system. With the help of such system one can always be aware of the energy consumption at any place and can never exceed the threshold electricity limit for a month or year or week or even a day. And to include additional features such as temperature measurement, for safety. Besides using cloud owing to its huge potential and scalability. And to leave behind the scope of using various machine learning algorithms in future, with the data. smart in the sense that we can get our real time data anytime irrespective of any constraints. Just one needs a desktop or a mobile and one can see the power consumption. With the help of this one can always monitor and never exceed the threshold electricity limit and budget. We also, have implemented a safety measure with the help of which one is safe in the surroundings. If the temperature of the filament increases above the threshold value, one can see and protect oneself from short circuiting. We also have saved all the data in cloud using AWS. With the help of using all the data we can use machine learning algorithms like Linear Regression to get the future electricity bills and to know which appliance is ecofriendly.

Literature review

In paper (Manoj *et al.,* 2016) GSM Based Remote Energy Meter Monitoring Using RASPBERRY-Pi Board Neha Jodhe et al is used to collect week after week information about the number of units consumed with the estimated cost for the consumption of electricity.

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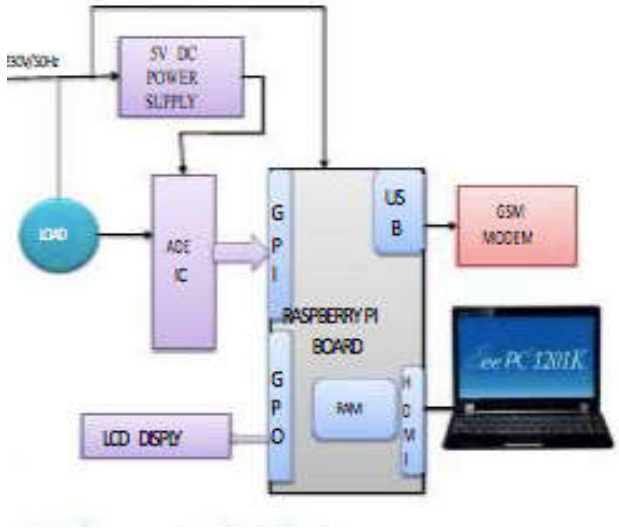
The components used in this project are RASPBERRY-PI board, GSM model, LCD display, energy meter circuit, and load. This framework empowers the power specialist co-op to peruse meter perusing routinely without the individual going by each house so manual meter perusing will get diminished. Clients will get regular updates about the power consumption on their mobile devices through SMSes. Power robbery can be recognized as this framework gives data about the no. of units expended alongside its cost. In paper (Manoj *et al.,* 2016) IOT based Energy Management System by Using Raspberry pi ARM cortex Manoj *et al* the purpose is to acquire the electrical parameters like current, frequency, voltage from a smart grid and send these real time data through IoT. The project is designed to protect the electrical circuitry by using electromagnetic relay. Client can send summons as IVR messages to peruse the remote electrical parameters. This framework additionally can naturally send the ongoing electrical parameters intermittently (based on time settings) as SMS and Web application. This framework likewise sends SMS cautions whenever the Circuit Breaker trips or whenever the Voltage or Current surpasses as far as possible, we utilise Raspberry pi as the core of the task to control all the work included. In paper (Jodhe *et al.,* 2015) Implementation of Automatic meter reading system using zigBeeIntegrated Raspberry Pi, GSM Network Priya *et al* this paper presents a micro-controller based Smart Meter utilising remote correspondence and Lab see reasonable for the Indian Energy Scenario. The advantages of these electric metering framework makes it a more exact measuring gadget than the ordinary electro-mechanical meter being used in developing countries. AMRs ability to consequently transmit information constant builds the unwavering quality of this metering framework, dissimilar to electromechanical meters which every so often make utilisation of past readings as a premise of the shopper's

present charging. It additionally puts shoppers off guard as the exactness of energy utilisation readings is being traded off. In paper (Priya *et al.,* 2015) GSM Based Automatic Meter Reading System Using Raspberry PI Controller Brundha et al aims at minimizing the queue at the electricity counters and restrict the use of electricity if bill is not paid. The work system uses a new technology called 'Prepaid electricity'. GSM technology is used to notify the customers through messages about the consumption of electricity and the approximate amount it has reached. The usage of this undertaking will help in better energy administration, preservation of energy and furthermore in getting rid of the pointless bothers over mistaken charging. The mechanized charging framework will monitor the ongoing utilization and will leave little degree for contradiction on utilization and charging. In paper (Leccese *et al.,* 2014). A GSM Based Energy Management System using Automatic Prepaid Energy Meter Saranya Nair M et al propose an effective and efficient automatic prepaid metering system which deduces the amount from the balance with any human interaction. This system also provides notification on the consumption of electricity with the help of GSM technology so that customers can manage their consumption. This system provides the necessary measurement of power consumption and payment with prepaid billing.

System design



Proposed method

Algorithm

The basic algorithm used in this project is of capturing the humidity and temperature and projecting it into the thing speak website. The POWER UNITS from the bulb is projected onto the website. The current rating is taken and power calculation is done in terms of units of electricity. This data is then sent to the cloud and monitored.

Algorithm

```
myapi = "YCZ9JK9VP5YWAD2A"
myDelay = 15 #how many seconds between posting data
GPIO.setmode(GPIO.BCM)
defgetSensorData():
RHW, TW = Adafruit_DHT.read_retry
(Adafruit_DHT.DHT11, DHTpin)
# return values
return (str(RHW), str(TW))
while True:
try:
RHW, TW = getSensorData()
p = x*220
u = p/1000
```

Explanation

In our proposed system we have included a safety measure which at every time gives us the temperature readings which helps in short circuiting. And we have made it flexible for the use of various machine learning algorithms in future for the data collected by the sensors, thereby analyzing and producing various results such as categorization which appliance is safe for using and environmental friendly. We will also get the daily electricity consumption at any point. All the components used are specified above and our architecture is as follows. In the architecture shown above we can see that we have used a raspberry pi, a current sensor, a DST 111 sensor, a bulb, cloud (AWS). With the help of raspberry pi we have integrated all the components. First of all we have installed the raspberry pi OS, Raspian OS, into our system.

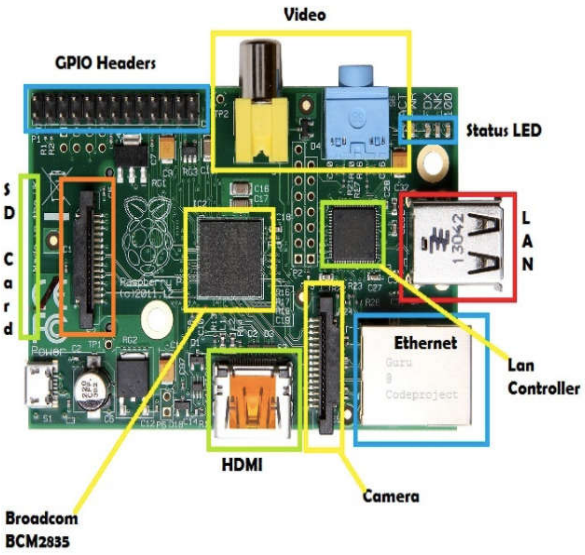
Then using the current sensor we took all the current readings and did some calculations and presented all the data from the raspberry pi into our application, in the form of graphs. In the same way our DST 111 sensor works. This DST 111 sensor is responsible for measuring the temperature and humidity. All the data from the sensor gets uploaded into our application using raspberry pi. This whole process takes place with the help of python codes. We have also used a 100W bulb which is used as an initial prototype of this model. All the electricity consumption readings are first used from the electric bulb and correspondingly the temperature readings. Besides there are female to female jumper wires used to connect the various sensors to our raspberry pi board and also for connecting the electrical components like the bulb.

Raspberry PI

Pi is a small scale computer in the size little bigger than a credit card, it packs enough power to run games, word processor like open office, image editor like Gimp and any program of similar magnitude. Pi was introduced as an educational gadget to be used for prototyping by hobbyists and for those who want to learn more about programming. It certainly cannot be a substitute for our day to day Linux, Mac or Windows PC. Pi is based on a Broadcom SoC (System of Chip) with an ARM processor [~700 MHz], a GPU and 256 to 512 MB RAM. The boot media is an SD card [which is not included], and the SD card can also be used for persist data. Now that you know that the RAM and processing power are not nearly close to the power house machines you might have at home, these Pi's can be used as a Cheap computer for some basic functions, especially for experiments and education. The Pi comes in three Configurations and we will discuss the specifications of those in the coming sections. The cost of a Pi is around $35 for a B Model and is available through many online and physical stores.

Raspberry PI components

Below are the basic things you would need to get started with using a Pi.



Computer	A Raspberry Pi
Storage	SD Card and a SD card reader to image the OS [These days laptops have inbuilt card readers]
Power supply	5 volt micro USB adapter, mostly your android phone charger would work
Display	An TV/Monitor with DVI or HDMI port
Display connector	HDMI cable or HDMI to DVI converter cable
Input	USB Mouse
Input	USB Keyboard
Network	Ethernet cable
Case	If you really need one, you can get them online based on the model you have

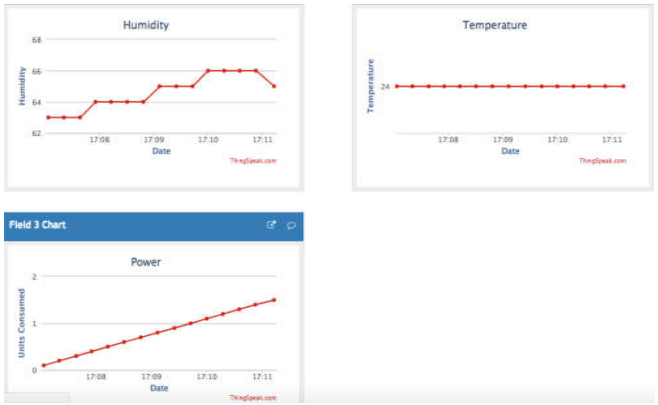
Current sensor

A current sensor is a device that detects electric current (AC or DC) in a wire, and generates a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control

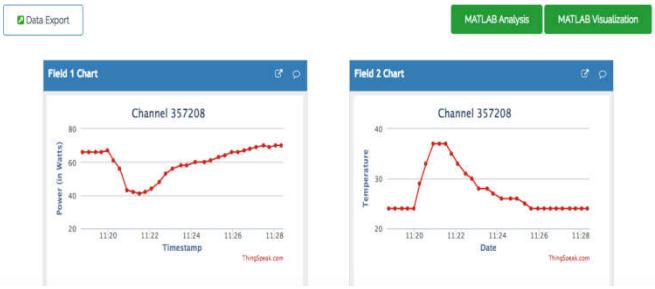
Current measurement is of vital importance in many power and instrumentation systems. Traditionally, current sensing was primarily for circuit protection and control. However, with the advancement in technology, current sensing has emerged as a method to monitor and enhance performance. Knowing the amount of current being delivered to the load can be useful for wide variety of applications. Current sensing is used in wide range of electronic systems, viz., Battery life indicators and chargers, 4-20 mA systems, over-current protection and supervising circuits, current and voltage regulators, DC/DC converters, ground fault detectors, programmable current sources, linear and switch-mode power supplies, communications devices, automotive power electronics, motor speed controls and overload protection, etc.

RESULTS AND DISCUSSION

The results obtained using our model we have the following results. In figure 1, we can see the electricity consumption. At any point of time we can see the real time data. We can see the previous data also which is getting stored in the cloud.



In the figure 2, we can see all the temperature and humidity data. At any point of time we can see the real time data. We can see the previous data also which is getting stored in the cloud.So one can view the data and monitor his/her consumption and also remain safe with help of the temperature sensor data.



Conclusion and future work

Thus, we have implemented a model with the help of which we can monitor our electricity consumption details. And we also with the help of temperature data remain safe. This project can be used anywhere there one needs to monitor the electricity where it is scarce. Like in the case of data centres where we have to reduce the electricity consumption, this model can be efficiently used to monitor it and to see where the electricity can be cut down and how. It can be also be used to make a secure and fault tolerant system as it is working well from a safety point of view. In the future few additions can be made into it such as using various machine learning algorithms. With the help of various algorithms such as Linear Regression once can predict the future electricity bills, categories the appliance based on their energy uses, and find out the safest and ecofriendly appliances.

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