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GSM based Smart Energy Meter using Raspberry PI

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Abstract: ***The existing system for electricity meter reading is a manual labor method where the labor from the electricity board goes to each and every house in that particular locality and takes the reading manually and goes back to electric board to generate the electric bill. This method consists of various drawbacks such as time consuming, error in meter readings etc. In order to overcome this problem the proposed system is designed in such a way that it does not require any labor for manual reading of the electrical energy. This system uses a GSM module where the amount of energy consumed by the user is alerted via SMS. All the data i.e. energy consumption is sent to the cloud using Raspberry Pi controller and is being retrieved by using SVM algorithm ,this data is being processed and analyzed using power monitoring system and it is sent has SMS to the user if the limit is exceeded by the user so that they can control the usage of energy.***
Keywords: Smart energy meter, GSM technology, Power Monitoring, SVM algorithm, Raspberry Pi.

I. INTRODUCTION

In the present existing energy meter, billing and readings are taken manually. This procedure requires manual power and also it is a time consuming process, where the electricity person has to visit user's house to take meter readings. But this system as many drawbacks where electricity department people has to visit user's house is very difficult task if we consider the present situation, where our country is suffering from COVID-19 attack in this condition it's difficult to reach user's house to collect the meter readings and also due to some manual errors it causes wastage of energy. In order to overcome all these problems the proposed system is developed as an enhancement to the existing system. This system is having a Raspberry pi as a microcontroller, INA219 and DHT sensors and GSM as main components. Raspberry Pi is a low cost and credit card sized computer which runs raspbian os. Where in this system, the readings are taken automatically using some of the sensors and raspberry pi then, the data is loaded to the cloud (electricity department) and using GSM we can send the usage of electrical energy to the customers via SMS. And then the electricity department person can upload the usage of energy to particular user in the department website thereby, the user can login to the website and they can view their bill and do their payments.

II. LITERATURE REVIEW

A. Automated Smart Energy Meter Using WIFI Enabled Raspberry Pi

This paper presents an automated energy meter based on Raspberry pi which is being implemented using Zigbee protocol. The Raspberry Pi counts the number of pulses which is detected using light sensor module. The data generated is stored in google Spreadsheets via google API. Website and Android app is used to access these google Spreadsheets. WI-FI protocol is used which simplifies the system design.

B. Smart energy meter monitoring using Raspberry Pi

This paper presents an overview of consumption of electricity by the user and also detects the cost of the power consumed on daily basis. The user can keep track of energy consumption using Android App. Raspberry pi is used as an interface between the database and GSM module. EB board and consumer play a major role in this system. These both are communicated through a common website or an Android app and it takes place through the WI-FI module embedded in Raspberry pi.

C. An IOT Based Smart Energy Management System

This paper presents where the system is designed to read the data directly from the meter with the help of light sensor TCS 3200 and the data is fed into Arduino board. The Arduino board sends this data to Raspberry Pi which uploads the data to the cloud. Then the data from the cloud can be accessed using the website or Android app. Here, LED blinks continuously on the meter which counts the energy meter consumption.

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D. Raspberry Pi and GSM Based Smart Energy Meter for Advanced Metering and Billing System

In this paper, the system was provided with a prepaid energy meter which enables power utilities to collect electricity bills from the consumer prior to its consumption. Here, Raspberry pi board is used as a microcontroller, this digital energy meter has LED which blinks with specific number of times is measured as energy units consumed. The user has to recharge the meter in advance to buy electricity according to his/her requirement, where the user can easily recharge the meter by generating an SMS by their registered user's mobile number.

III. EXISTING SYSTEM

There are many problems in the existing energy meter where the electricity bills are generated manually where the meter reader has to go for user's house and take the meter readings and then he has to generate the electricity bill. This process requires more time and even due to errors in the meter results in wastage of energy. And here the users cannot monitor the usage of energy and even the users will not be having any knowledge how the bills are generated.

Drawbacks of the existing system:

1) Time consuming
2) Wastage of energy
3) Requires more manual power
4) No power monitoring

IV. PROPOSED SYSTEM

The proposed system is the enhancement of the existing smart energy meter. The additional feature added to this proposed system apart from the existing system is the power monitoring.

A. The Components used in this Proposed System Are

1) Raspberry Pi: It is a microcontroller which is also a small sized computer which has all the input and output plugins embedded in it. It is more advanced than Arduino kit as it consists of Bluetooth, Wi-Fi ports and various slots for other plugins. It has standard mouse and keyboard embedded in it. The operating system used is Raspbian OS

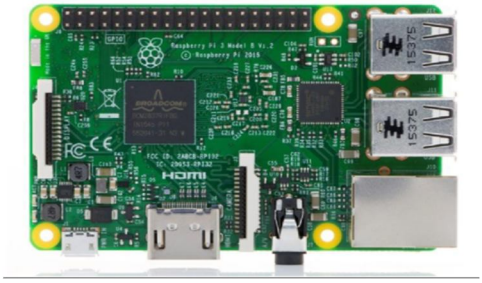


Fig 1: Raspberry pi

2) GSM: Global System for Mobile communication It is a cellular digital network used for the transmission of messages through mobile phones. It converts analog signals into digital signals. The warning messages about the exceeding of the energy limits are sent via SMS to customers through this GSM module.

3) INA 219 Sensor: It is a sensor used for measuring the high voltage and DC current. It is used instead of energy meter. This sensor senses the current and voltage of the load such as electric bulb, fan or any other electrical device when connected to it.

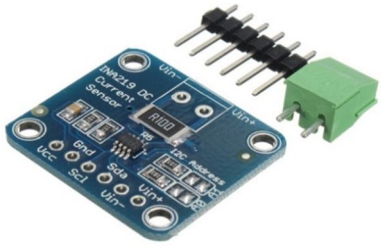


Fig 2: INA219 sensor

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4) *Website:* It is a software where admin (electricity department person) can upload the energy consumption details to the particular user account in the website. And then the customers can view all the details of their electrical energy consumption by login in to the website using their user id and password. It is developed using HTML and CSS files.
5) *Power Monitoring [DHT 11and INA219 Sensor]:* This feature is the enhancement of the existing system where the system can keep track of all the data of the electrical energy consumption from the cloud. It alerts the user by sending a warning message if the consumption of the electrical energy exceeds the limit and also if the user is wasting energy. So, the user can control the usage of electrical energy.

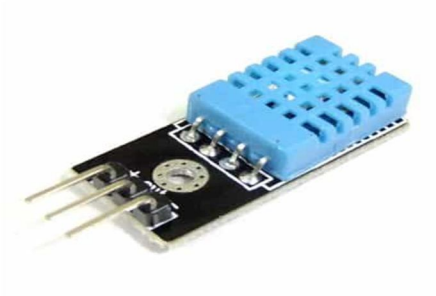


Fig 3: DHT 11 sensor (temperature and humidity)

B. System Architecture

In the proposed system when the load (led light or fan) switches on, the INA219 sensor senses the current and voltage and the DHT 11 sensor measures the temperature and humidity this data is fed through the Raspberry pi then displays on the LCD by including the RTC (Real Time Clock) count.

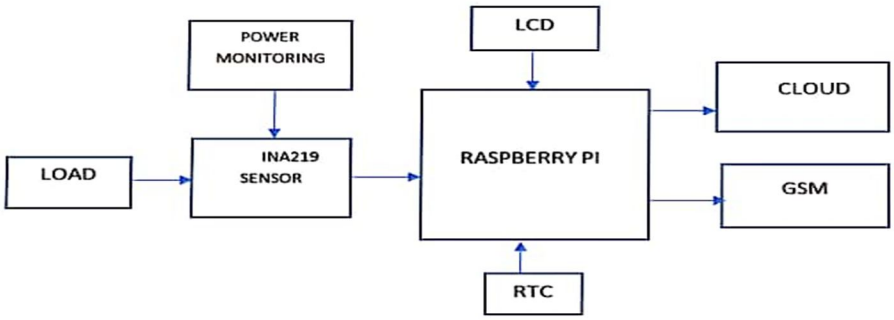


Fig 4: Block diagram of proposed system

Then the data is stored in the Thing Speak cloud. Thing speak cloud is a freely available source to store data. Later this data is retrieved by electric department and SVM algorithm and linear regression is applied for classification of data and uploaded to the website for bill generation of the particular user. Then user can login using their login id where they can view and pay the bill from where they are. The meter readings can also sent through the GSM to the user mobiles. If the user is wasting energy or if the usage of energy has crossed the limit, using sensors [INA219 and DHT11] warning messages will be sent to the user through GSM. The user can control the usage of energy by these warning messages sent by the electricity department. This system reduces manual power, the time consumption and also has the ability to monitor the power.

V. CONCLUSION AND FUTURE SCOPE

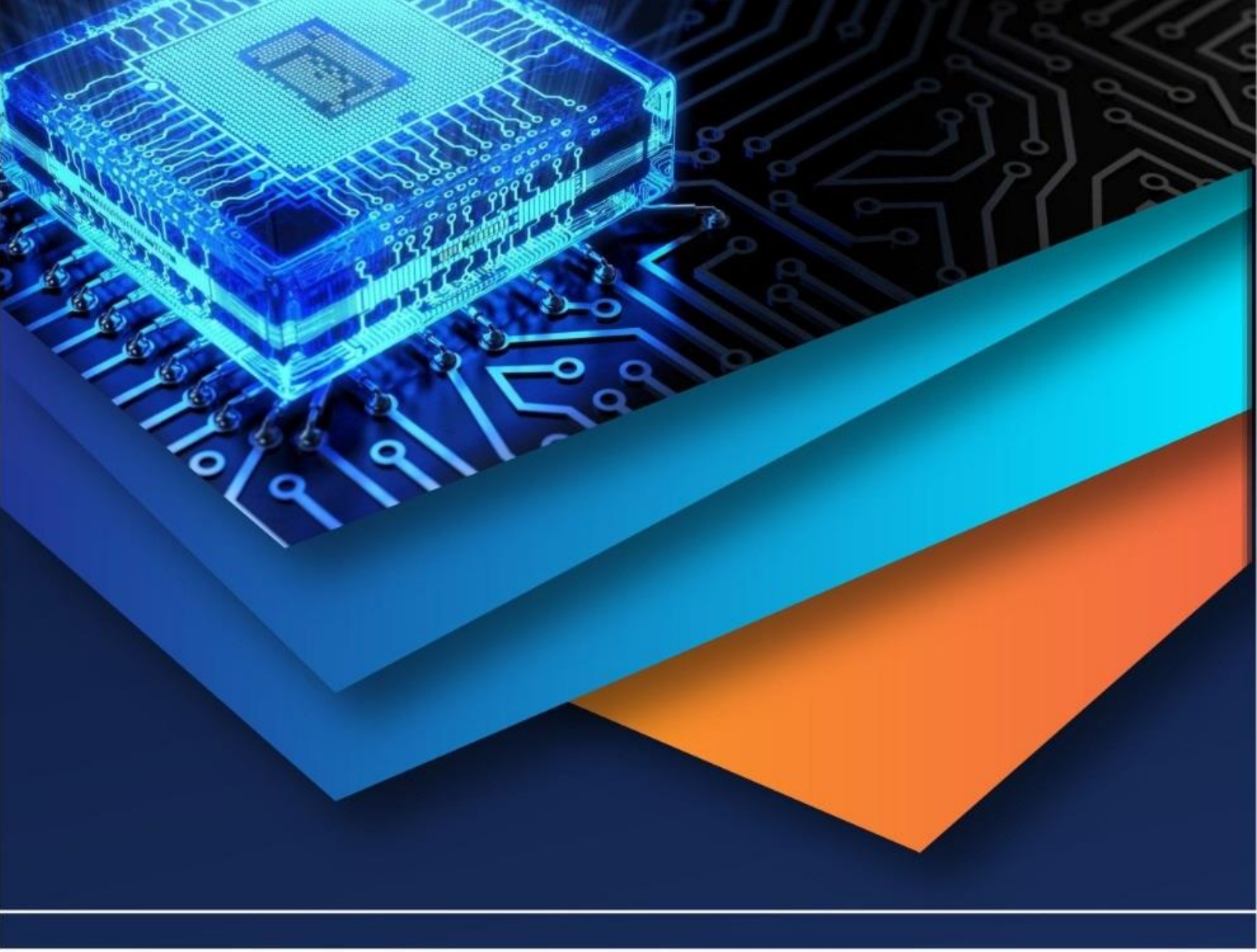
In this article we have discussed one step further by implementing the energy monitoring system in Smart energy system, Where we are not only providing the user with the web page for viewing and paying the bill online and messaging the amount of energy consumed by them through GSM, but also, energy consumed by the user will be tracked from time to time and if it exceeds the threshold then user will get the warning messages, which trigger the user to reduce the energy consumption. In future, it can be developed to control the energy consumption by user, meaning instead of just monitoring the usage, it can also be controlled so that they can even control the bill.

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