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Implementation on Smart Home to Monitor the Electricity Bill as a Green Energy Initiative: An IOT Approach

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ABSTRACT: Home automation is becoming popular due to its numerous benefits. Home automation refers to the control of home appliances and domestic features by local networking or by remote control. Electricity is becoming more expensive while its consumption is getting higher. In order to get daily details of electric consumption in home, an effective electricity billing system is necessary. This system uses electric meter for getting continuous details of consumption of used electricity. Depending on the consumption of electricity, usage of electric appliance can be managed by our system. A Web based solution will be provided to monitor and control the home appliances to reduce the energy consumption.

KEYWORDS: Raspberry pi, IOT, Electricity bill, Temperature, Humidity

I. INTRODUCTION

The traditional manual Meter Reading was not suitable for longer operating purposes required human intervention thereby increasing their efforts and also material resources. It brings additional problems in calculation of readings and billing. Also there have been several issues of faulty energy meter and theft of electricity. Till date, the readings are manually collected at the end of the month by a person from EB department by visiting every home. Also, the user needs to pay the electric bills either through on-line or by visiting Electricity Board (EB) offices. Maintenance of such kind of meters is becoming a tedious job due to increase in the number of connections and hence there must be a way to overcome this issue. This prototype developed by us is for wireless control of the electric meter and calculating electric bill for the customer including a notification to the customer whenever necessary. Our project involves development of an advanced energy meter to ease the work of users as well as EB officers and thereby reducing human efforts to a greater extent. The present day electric meters do not have any provision to monitor the consumption of electricity and notify it to the customer. Till recent, Automatic Meter Reading (AMR) systems have been implemented that uses raspberry pi as data transfer medium to the server. Home automation refers to monitor and control home appliances remotely. With the never ending growth of the Internet connectivity, there is much potential and scope for remote access, control and monitoring of such network enabled. The present appliances and billing systems have many problems like User may not know the actual bill till the end of month, User cannot control the electrical appliances remotely, Billing system is slow, unreliable and costly. The Proposed System will be able to inform an individual at any point of time about the units consumed. This system will give the details of usage of electricity and transfers it to the web server by raspberry pi. An individual must be able to control the electrical appliances from mobile phone to control the electric bills as per his/ her requirement. The objectives of proposed system are:

- Updating electricity bill continuously from energy meter.
- To get status of home like electric bill, temperature in home, presence of person in home on web page.
- To provide a platform through which user can communicate at the webserver level directly with network nodes.

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- To save the Electricity by controlling the home appliances remotely through IoT which can save energy and this can lead to green initiative.

II. RELATED WORKS

This paper illustrates a methodology to provide a low cost Home Automation System (HAS) using Wireless Fidelity (Wi-Fi). This crystallizes the concept of internetworking of smart devices. A Wi-Fi based Wireless Sensor Network (WSN) is designed for the purpose of monitoring and controlling environmental, safety and electrical parameters of a smart interconnected home. The user can exercise seamless control over the devices in a smart home via the Android application based Graphical User Interface (GUI) on a smartphone [1].

The proposal of system is to develop an IoT based Interactive Industrial Home wireless system, Energy management system and embedded data acquisition system to display on web page using GPRS, SMS & E-mail alert. This device is essential for sensor data collection and controlling of the industrial Home Wireless Sensor Networks (WSN) in the Internet of Things (IoT) environment. It is planned to style a re-configurable sensible device interface for industrial WSN in IoT atmosphere, during which ARM is adopted as the core controller. Thus, it will scan information in parallel and in real time with high speed on multiple completely different device information. Intelligent device interface specification is adopted for this style. The device is combined with the most recent ARM programmable technology and intelligent device specification. By detecting the values of sensors it can be easily find out the Temperature, Smoke, and Fire present in the industrial environment on the Website and we can handle any situation from anywhere in the world through IOT. So that critical situation can be avoided and preventive measures are successfully implemented [2].

In this paper, we are presenting a proposed system for Smart Home Automation technique with Raspberry Pi using IoT and it is done by integrating cameras and motion sensors into a web application. To design this system, we are using a Raspberry Pi module with Computer Vision techniques. Using this, we can control home appliances connected through a monitor based internet. Raspberry Pi operates and controls motion sensors and video cameras for sensing and surveillance. For instance, it captures intruder's identity and detects its presence using simple Computer Vision Technique (CVT). Whenever motion is detected, the cameras will start recording and Raspberry Pi device alerts the owner through an SMS and alarm call [3].

Without the individual going to each house so most likely the manual meter perusing will be evaded. Clients will get week by week refresh the power utilization by methods for SMS. Power robbery can be kept away from absolutely by this paid ahead of time robotized power meter and furthermore gives data about the quantity of units overwhelmed by cost per unit. This framework encourages making viable utilization of power along these lines it will limit the power emergency in our nation and enhances the economy of electricity board. [4]

In this paper we design implement and develop an Android application for power measuring and payment a bill using a wireless plug. This system is designed to monitor the energy consumption and sent the consumption to the smart phone and also electricity office. We can pay our bill of consumption of power using android application without going to the bill payment office. Users can monitor consumption of energy units and its bill at anywhere and any point of time using android application. This system consists of three main parts which include data gathering and data processing and smart phone [5]

A new embedded technology based approach for automated energy meter reading system is proposed which enables the meter readings to be updated onto the web server automatically on a regular interval basis and sends bills to customers each month. It provides a facility of recharging the energy meters remotely. Customers can pay bills of postpaid meters and can recharge the prepaid meters by sending a message to the service provider. The meter readings are sent to nearby located central station (gateway) using RF link and from there to web server using GSM. It also provides the facility of electricity tamper detection. The wireless controlling of meter reading system is mainly done using ARM 7 microcontroller. Embedded C is used for ARM coding and web server is designed using HTML. Database is created using MySQL.[6]

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In this paper, they propose an improved energy-efficient, secure, and privacy-preserving communication protocol for the smart home systems. In our proposed scheme, data transmissions within the smart home system are secured by a symmetric encryption scheme with secret keys being generated by chaotic systems. Meanwhile, we incorporate Message Authentication Codes (MAC) to our scheme to guarantee data integrity and authenticity. We also provide detailed security analysis and performance evaluation in comparison with our previous work in terms of computational complexity, memory cost, and communication overhead.[7]

In this paper, Apriori algorithm for a smart home automation and metering system using IoT is presented. The main purpose of this system is to control the home appliances and electronic devices with the help of a supervisory system. The supervisory system is designed in such a way that everyone can access it. The system provides users with the ability to control, manage the electronic devices, can monitor the consumption of electricity, and to pay the electricity bills, securely and reliably. The supplier can also monitor and accordingly and maintain the issues in an efficient manner [8].

III. PROPOSED ARCHITECTURE

The fig.1 shows the block diagram for Design and Implementation of smart home monitoring using Raspberry pi.

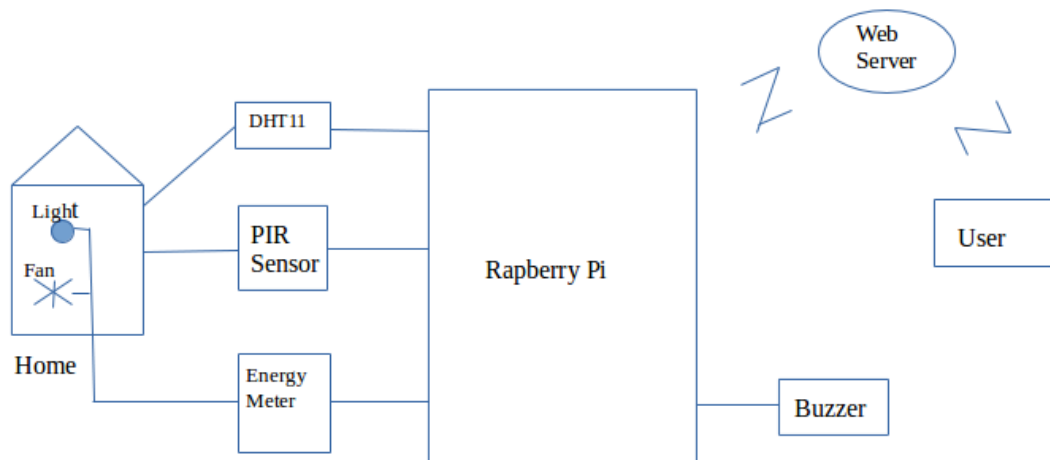


Fig.1. Block Diagram of proposed system

Proposed system uses energy meter to take automatic meter reading. In this project, Raspberry Pi is used because it is a sort of minicomputer. We can't install Microsoft Windows on it as it uses a different kind of processor. But you can install several versions of the Linux operating system which feels very much like Windows. If we want to, we can use the Raspberry Pi to surf the internet, send an email and many more using a word processor. Easy to use but powerful, affordable and difficult to break, the Raspberry Pi is the perfect for pursuing computer scientists. Proposed system uses a temperature sensor to monitor home temperature, PIR motion sensors to check for the unwanted presence at their homes. If temperature exceed above threshold value then buzzer will be on. Energy meter is connected to raspberry pi for getting electrical bill details. Finally the bill is send to the webservice from raspberry pi so that we can get daily updates of electric bill easily. Light and fan (here DC fan) are connected to energy meter to detect energy consumed by them.

Here in this project raspberry pi is used as central unit to control and monitor all devices. This also used to update bill details daily to the webservice. In this module temperature sensor is used to sense temperature/humidity as well as presence of person in home. The prototype is designed keeping many factors into consideration. The status of home i.e. temperature, presence of person and electric bill get easily.

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IV. HARDWARE MODEL

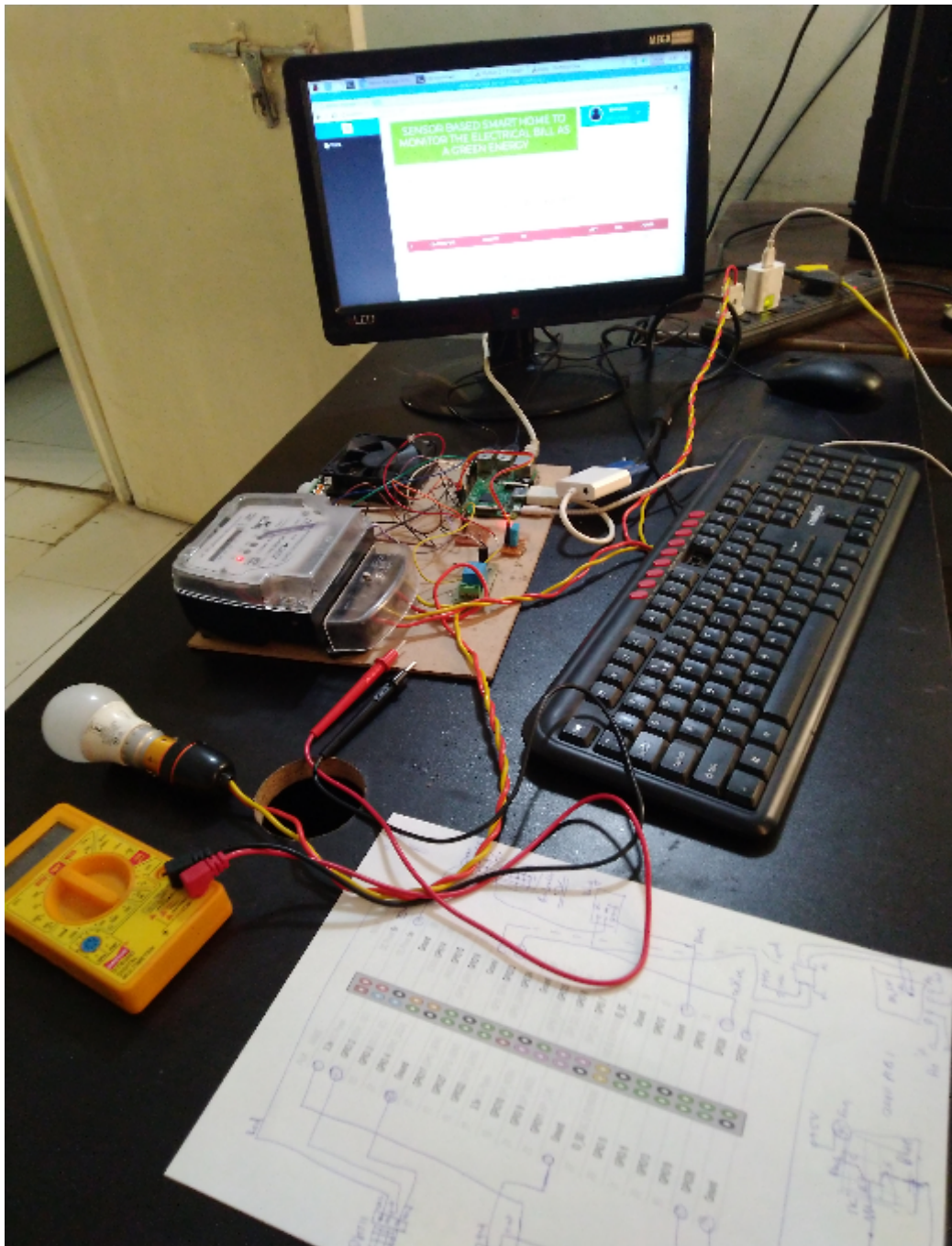


Fig 2 Hardware model of the system

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V. RESULT

In this project we have connect the four loads of 100W bulb each considering them as one single room so there will be four different rooms where load is present total load for the system is 400W. On GUI of system we have two modes manual mode and system mode. As well as different options for making load ON/OFF using the buttons form the GUI. In manual mode we apply load to the system manually by the buttons presents on the GUI. As shown in table 5.1 we have divide the 24 hours into different time slots according to the peak energy usage during those respective hours on which we set the different threshold to do some energy saving during this time slots. Also during high peak we have highest energy charge similarly for different peak different energy charge. After which we apply system mode as shown in table 1 depending on set conditions it

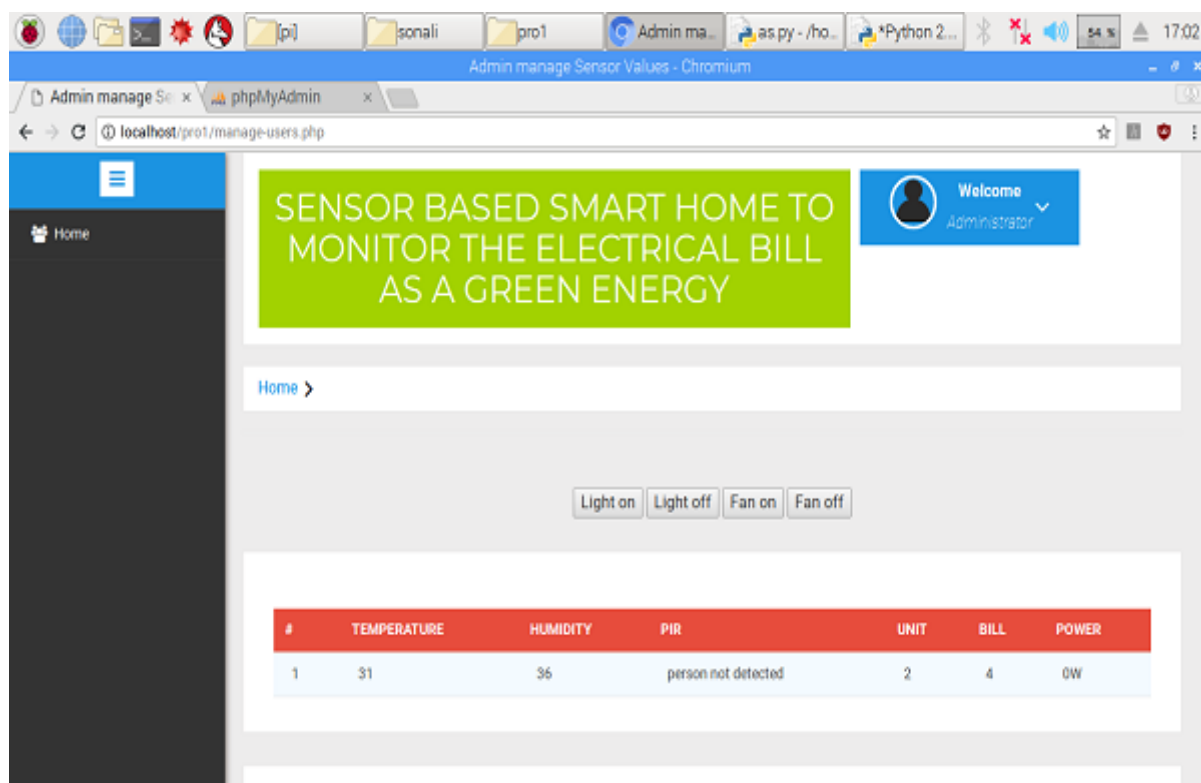


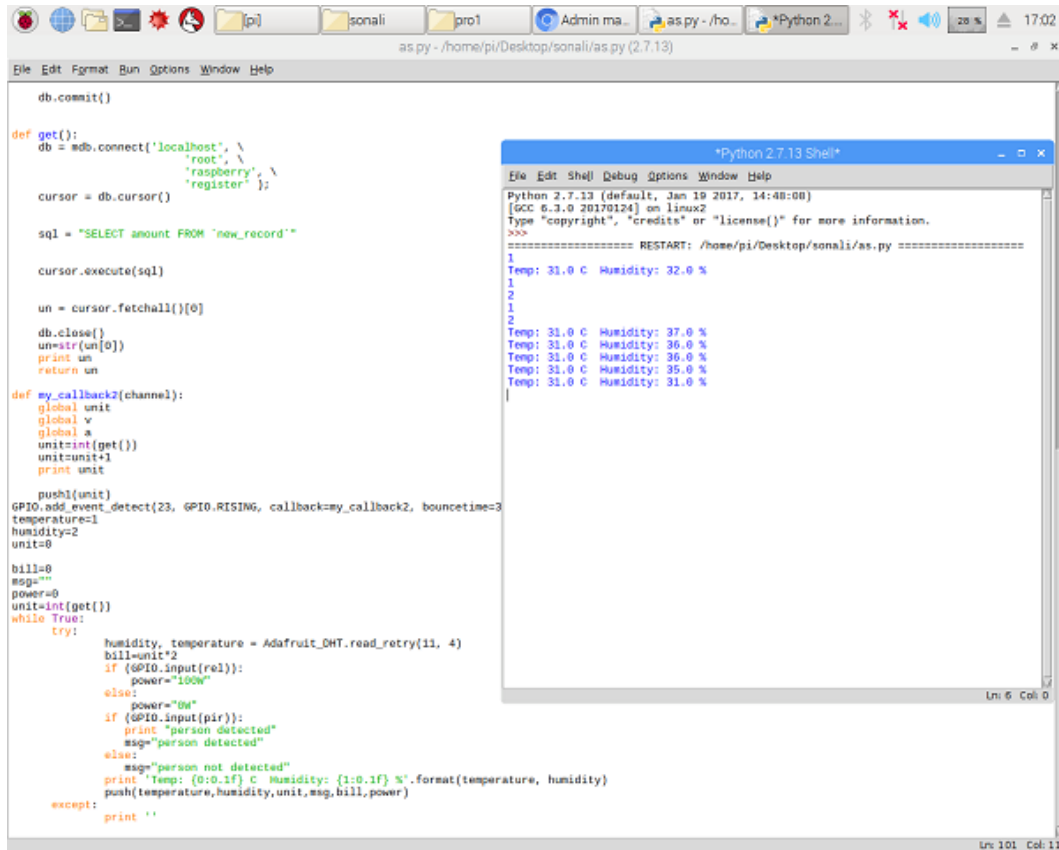
Fig 3: Webpage

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```

db.commit()

def get():
    db = mdb.connect('localhost', \
                    'root', \
                    'raspberrypi', \
                    'register' );
    cursor = db.cursor()

    sql = "SELECT amount FROM 'new_record'"

    cursor.execute(sql)

    cursor.fetchall()

    un = cursor.fetchall()[0]

    db.close()
    un=str(un[0])
    print un
    return un

def my_callback2(channel):
    global unit
    global v
    global a
    unit=int(get())
    unit=unit+1
    print unit

    push1(unit)
    GPIO.add_event_detect(23, GPIO.RISING, callback=my_callback2, bouncetime=3)
    temperature=1
    humidity=2
    unit=0

    bill=0
    msg=""
    power=0
    unit=int(get())
    while True:
        try:
            humidity, temperature = Adafruit_DHT.read_retry(11, 4)
            bill=unit*2
            if (GPIO.input(rel)):
                power="10W"
            else:
                power="0W"
            if (GPIO.input(pir)):
                print "person detected"
                msg="person detected"
            else:
                msg="person not detected"
            print "Temp: {0:0.1f} C Humidity: {1:0.1f} %".format(temperature, humidity)
            push1(temperature,humidity,unit,msg,bill,power)
        except:
            print ""
    
```

```

Python 2.7.13 Shell
Python 2.7.13 (default, Jan 19 2017, 14:48:08)
[GCC 6.3.0 20170124] on linux2
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: /home/pi/Desktop/sonali/as.py =====
1
Temp: 31.0 C Humidity: 32.0 %
1
2
1
2
Temp: 31.0 C Humidity: 37.0 %
Temp: 31.0 C Humidity: 36.0 %
Temp: 31.0 C Humidity: 36.0 %
Temp: 31.0 C Humidity: 35.0 %
Temp: 31.0 C Humidity: 31.0 %
    
```

Fig 4: Sensor Reading

VI. ANALYSIS

Time	Temperature (C)	Humidity(%)	PIR sensor	Energy meter (unit)
10AM	33.2	88.0	Person Detected	2
12AM	33.40	87.22	Person Not Detected	2
2 PM	34.0	88.01	Person Not Detected	3
6PM	33.09	88.02	Person Not Detected	4
8PM	34.01	87.39	Person Not Detected	4

Table.1. ANALYSIS

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PIR sensor detects human at 10AM, 6 and 8PM. Since fan is ON at 2, 6 PM and 10, 12 AM whereas light is ON at 6 and 8 PM and 10 AM.

VII. CONCLUSION

With the help of proposed system, we can get the daily bill details of our home. Also, we can monitor and control it because of its advantage. Energy bill will be displayed on web page at any point of time.

Also, from the PIR sensor which is motion sensor we can detect the Human being to Switch on or off the Devices not in use.

DHT 11 which is temperature and humidity sensor is used to measure our home temperature and humidity and depending on its reading we can control the Electrical Appliances. Finally energy can be saved which in turn reduces the carbon footprints in atmosphere.

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