Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 6, July 2021 : 5855 - 5863

Research Article

Smart Home Management System

Alexander Jeevanandham Y [a], Deva.K [b], Kanivizhaiyan N [c], Meganathan.R [d], Nagarjun.N [e]

[a] Assistant Professor, Department of EEE, RMK Engineering College, Chennai, ajm.eee@rmkec.ac.in
[b,c,d,e] UG Scholars, Department of EEE, RMK Engineering College, Chennai

Abstract

Over the centuries this developing world has encountered various technological advancement in all possible fields so do electrical. In short the world is getting smarter with new ideas and the innovations. This paper mainly focused on showcasing the reliable smart home management system with the information being transmitted and stored in the cloud based systems, this smart home management system works by measuring current and voltage of each room and the appliances in it this is generally done using the current and potential transformer. This recorded values are sent and stored in the cloud that actually enable the customers or consumer and both suppliers to realize the actual amount or unit of electricity being consumed also prevent consumers from getting cheated by false billing system made via assumptions. Also this helps in scheduling the load thus by classifying the peak and non peak hour so the consumer can actually use high power consuming device more economically..

Keywords:

1. Introduction

Back in 1972 TED PARASKEVAKOS a BOEING based employee in Alabama had developed a digital monitoring system for fire scenario, security management and medical system alarm. This technology adopted from telephone line identification system. The patient for this technology was awarded to MR PARASKEVAKOS in the year 1972.he founded a company called METRETEK Inc after three years. This company had developed first automated remote metered readings and electrical consumer load management system. This energy meters are used in common to record the current, voltage, power factor and amount of energy consumed based on the recordings the bill has been served to the consumers .The energy meters are classified into three broad category namely electro-mechanical meter, electronic meter these electronic meters are further classified as electronic analogue & electronic digital meters and last comes the smart meters .The electro-mechanical meter does not measure the small loads hence it is considered to have less accuracy .The electronic analogue meter uses the voltage divider and current transformer to measure voltage and current which is connected straight to load .The electronic digital meter work as same as that of the analogue meter but the obtained values are converted into digital using analogue to digital converter (ADC) .This obtained digital values are converted as frequency then pulse .This pulse enables the mechanical counter to rotate which measures the current in the order of 1kw=1unit .This digital meters said to have higher accuracy .The smart meters on the other hand works on the principle of advanced metering infrastructure (AMI) .This AMI enables the two way connection between the meter and the central unit . Mr. Vichare Abhishek, Ms VermaShilpa (IJERA) (VNCET-30 mar 12) proposed on how to establish a contact between a microcontroller and the local area network or simply internet. D.Naresh, B.Chakradhar, S.Krishnaveni (IJETT) – Volume 4 Issue 9- Sep 2013 In this paper they have shown a gadget that can actually improve the safety in home and bank area. Tadimeti Hari Charan, Pulipati Manas (Ijsr), Volume 2 Issue 4, April 2013 This paper mainly focus on controlling the electrical appliances via personal computer. By using this system any one can control the switching ON/OFF of electrical appliances by using their personnel computer on hand. Vinay sagar K N,

Kusuma S M (IRJET) Volume: 02 Issue: 03 (June-2015) This paper exhibits how House appliances or loads by using Intel made Galileo processing chip which works on the combination of wireless communication and cloud networking, to provide remote operation to user to operate electrical loads in house such as Luminaries, air coolers and appliances in the house/office with data's being and stored in the cloud.

2. Components

Following components are being deployed in the smart home management system.

ARUDINO UNO

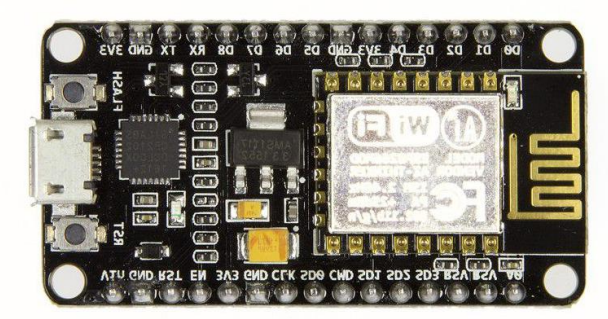
The ARUDINO UNO is a controller board, easily available in markets, which is based on microchip ATmega328p. This board comprising various sets of analog, digital pins/Ports connected to various extension boards, circuits, components such as crystal oscillator, serial communicator and voltage regulator. This board has provision of 6 analog input-output pins and 14digital input-output pins configured with ARUDINO using type b USB cable respectively. It also has power barrel jack, ICSP header and reset button. This can be powered using the external 9 volt battery or either by the USB cable its voltage range lies between 7 to 20 volts. This ARUDINO UNO belongs to ATmega328p family its operating voltage is considered to be 5v. DC current of capacity 40MA is given to the input pins and DC current of 50MA given to the output pins. In addition it has SRAM 2kb and EEPROM 1KB respectively and with flash memory of 32kb. The ARUDINO has various application such as prototyping of electronics product and systems, multiple DIY paper, paper requiring multiple I/O interface and communication.

ARUDINO UNO

ESP8266

The ESP8266 is a System On Chip with integrated TCP/IP protocol that enables the micro-controller to directly access to the Wireless network. The ESP8266 usually download all WIFI networking functions from other application processor/controller. Every ESP8266 has been tailored/ developed as programmed with different functions. AT command set firmware, it is so simple to configure with ARUDINO and get WIFI ability as good as the WIFI Shield provides. ESP8266 is extremely cheaper with less cost board..

ESP8266 has better storage and faster and reliable on-board processing. It has better connection with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. ESP8266 is an integrated chip provides access to minimum external circuit. The front-end module, which is designed as very compact and can be built in very small PCB area. The ESP8266 supports APSD for VoIP (Voice over internet protocol) applications. It also supports Bluetooth interfaces. This device's self-calibrated RF allowing it to function under all operating conditions and does not need any external RF parts.



ESP8266

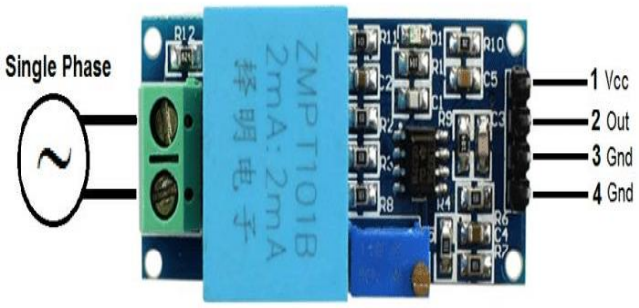
RELAY

Relay is electrically operated switch thus by receiving single from the external source it opens and close the circuit. Relay operates both electrically and mechanically. If the relay is not energized there is an open contact on other hand if the relay is energized there is a closed contact. In both these cases the applied current in the contact will not change their state. These relays are commonly used to switch small current in the control circuit also these relays are not deployed in the high power consuming devices except small motors which usually requires lower amps. These protection relays are used to protect electrical equipment from over current, overloads, reverse current, and under current. Relays also used to Switch ON audible alarms, pilot or indicating lamps and heaters elements etc. Relays are classified as general purpose relay, machine control relay, reed relay based on their usage purpose. Protection devices such as resisters and diodes should be deployed across the coil of the relays because they can produce large voltage due to coil de energizing while relays are off but it should be noted that the voltage spike which being reduced have the tendency of moving back to the control circuit which causes damage to the sensitive component present it.

RELEY

VOLTAGE SENSOR (ZMPT101B)

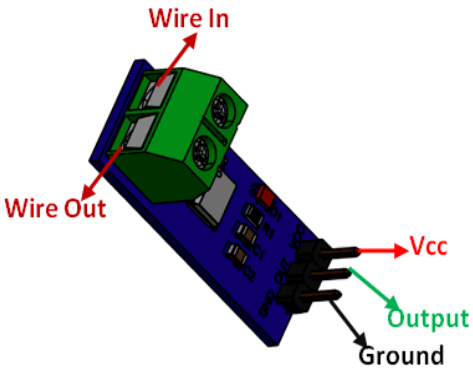
It is an Alternating Current Single phase voltage sensor which is developed with reference to the Potential transformer - ZMPT101b. This plays a vital role in DIY applications where accurate ac voltage measurement is critical by using the Potential transformer. This is widely used to measure the ac voltage using the raspberry/Esp8266pi. This is high precision Voltage/Potential transformer which makes it easy to monitor the ac mains supply up to 1000 volts. The length width and height of the sensor found to be (50mmx17mmx20mm) with the weight and shipment weight of 21g and 0.03kg respectively sensors shipment dimension found to be (12cmx8cmx4cm). In this voltage sensor zmpt101b the voltage can be measured up to 250 volts the operating temperature range from 40c +- 70c. The supply voltage of the sensor measured to be 5 volts to 30 volts. Zmpt101b has the rated input and output current of 2MA with isolation withstand voltage of 4000v and operating frequency of 50-50HZ including the turns ratio of 1000:1000. This sensor has following advantage such as high efficiency and accuracy, very consistent in measuring the voltage and measurement also the analogue output quantity can be measured.



VOLTAGE SENSOR (ZMPT101)

Current Sensor (ACS712)

It is a single phase AC current sensor which is actually based on the current transformer (ACS712). This sensor measure current based on the Hall Effect principle. ACS712 sensor built with 2.1kvrms voltage isolation and integrated low resistance conductor. This current/Ampere sensor measures direct current or alternating current ranging +/- 5A +/- 20A and +/- 30A. This device has the bandwidth of 80KHZ.Output analogue voltage of 0 to 5volts. Bandwidth is set out through new filter pin and it is expected to provide stable output offset voltage with 0(zero) magnetic hysteresis. The output sensitivity of this sensor found to be 66 to 185MVA it also provides low noise analogue signal path with the internal conductor resistance of 1.2milli ohm. This ACS712 has two phoenix terminal connectors with the mounting screws this two phoenix terminals are the way which the wire has to be passed on the other side it has three pins. VCC is connected to the +5v in order to power up the current sensor and the ground is connected to the ground of the MCU system. The analogue output from current/Ampere sensor is read using the analogue pin present on the micro-controller. The current flows through the hall sensor circuit and Hall Effect sensor detect the current using the principle of magnetic field radiation. Using the detectable current magnetic field, it induces a voltage which is directly proportional to the magnetic field.



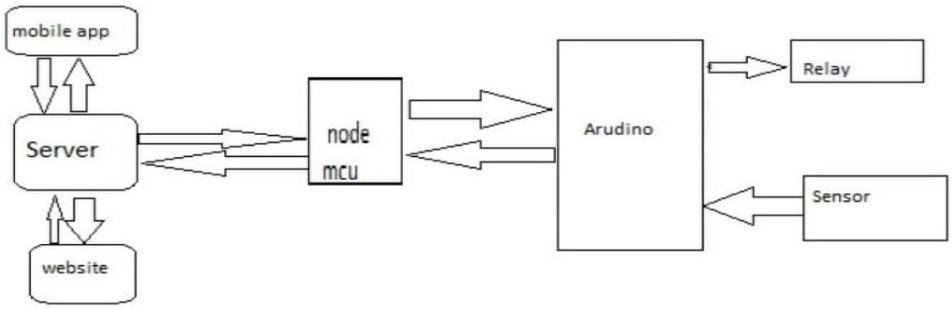
CURRENT SENSOR -ACS712

3. Proposed System

The proposed system improves the customer awareness about the energy consumption with higher accuracy in measurement. The Energy measurement taken can be assessed by the customer and the utility. This will make the customer to understand and learn the shifting of load based on the peak hour so that the peak load demand will be reduced. The proposed system block diagram has Arudino, Wireless connector, Voltage sensor, Current sensor, relay and Node MCU for server communication

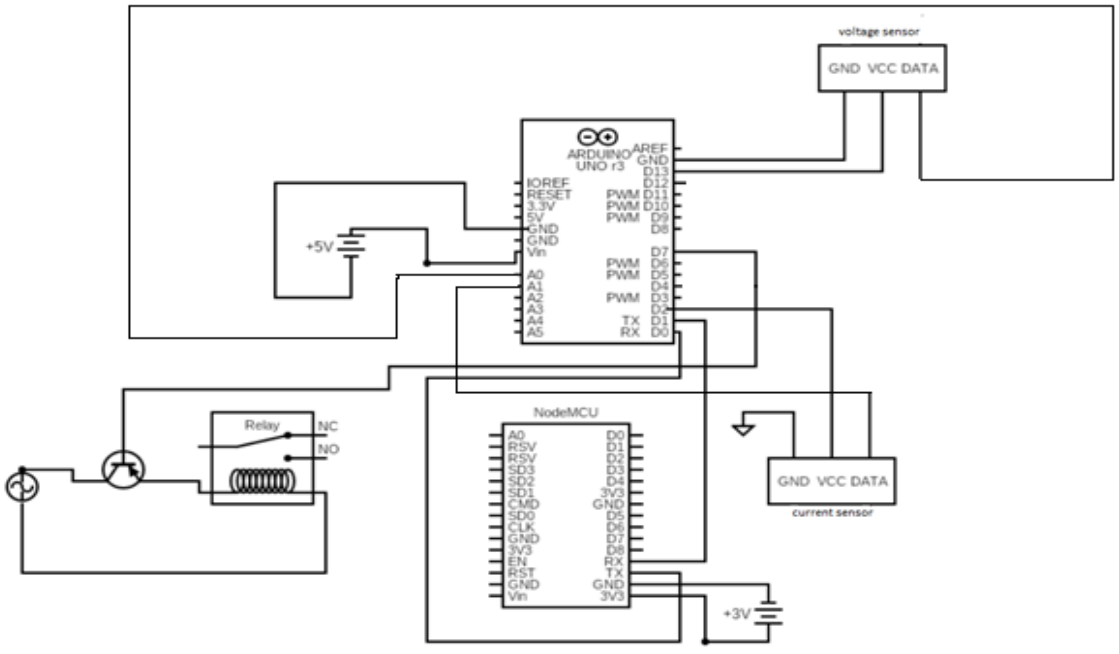
User provides command using ARUDINO to the server using esp8266 node MCU on UBIDOTS server. We connect esp8266 with the UBIDOTS server by providing API token using MQTT protocol and by establishing the connection between them, then the command and the data transferred between them. The data received through ARUDINO from the sensor are transferred to the esp8266 through serial communication and then these data are buffered and sent to the server using MQTT. And the command given in the website are processed and moved to node MCU using same MQTT protocol from their IOT is transferred to the ARUDINO through serial

communication then ARUDINO controls the relay through the transistor. The sensors sends data in analogue format which is being processed before sent to esp8266.

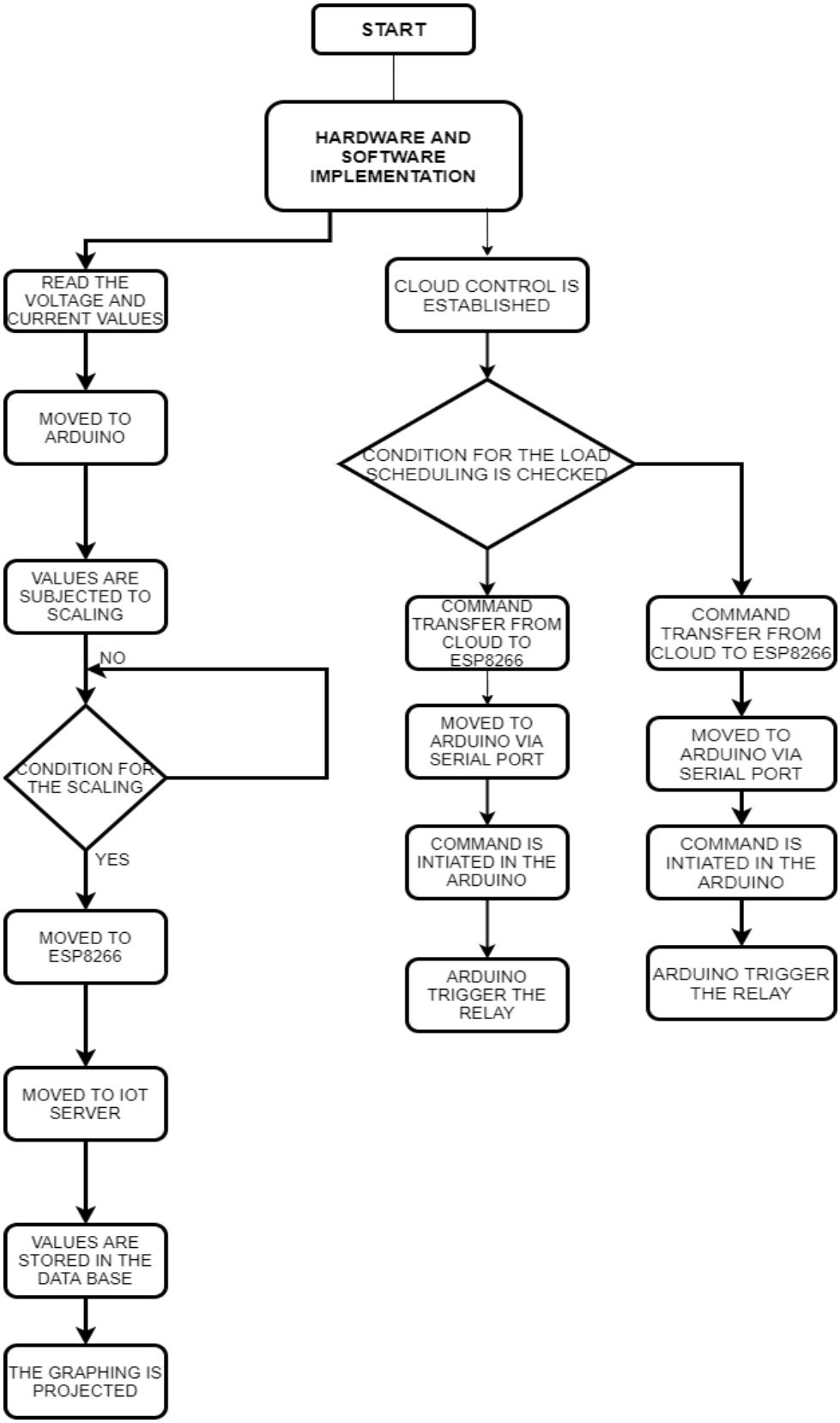


Block Diagram

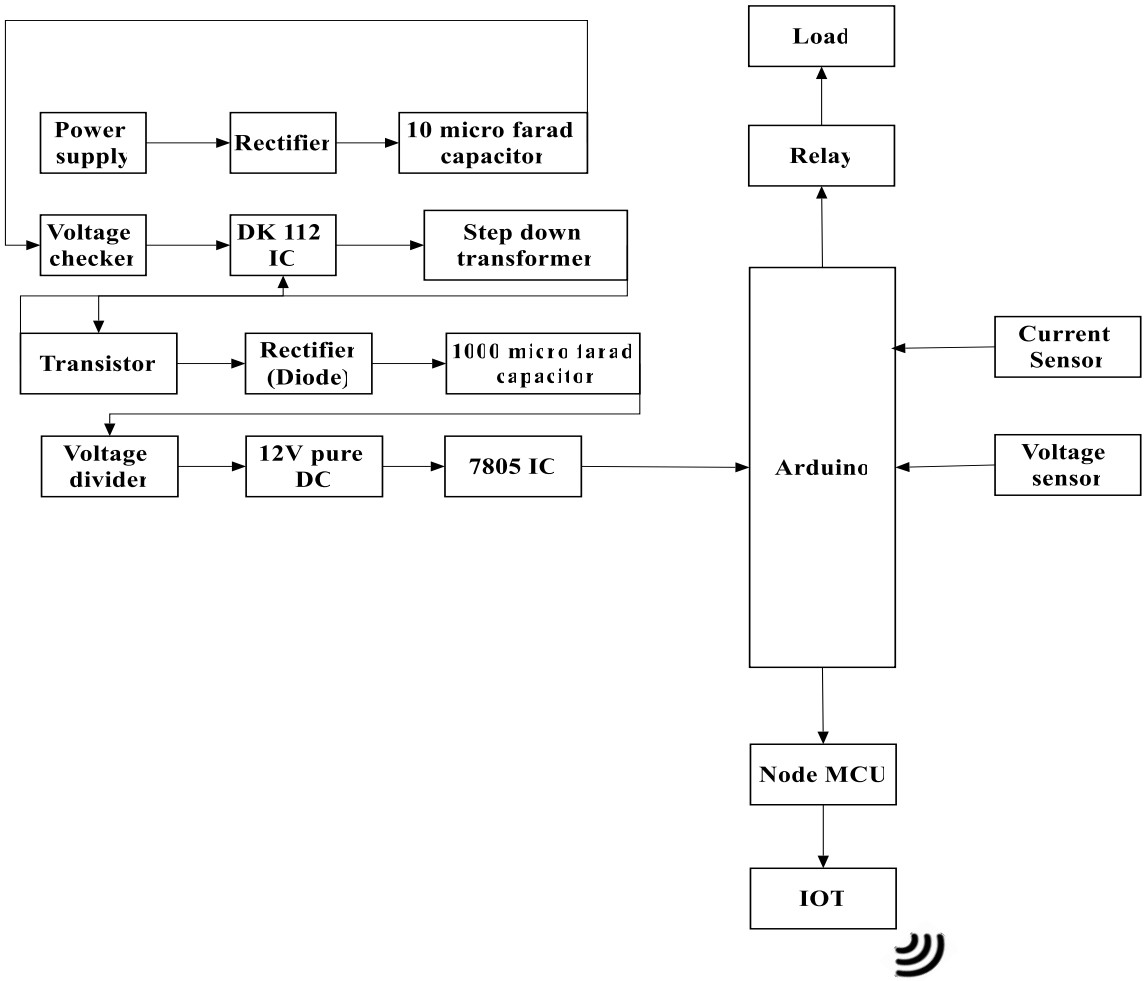
The Arudino act as a control unit. Current and voltage sensor output pin terminal is connected to the Arudino UNO analogue pin A0, A1 pins then the supply is given through VCC pin in Arudino or by keeping the digital pin high which gives 5v as output and this power is sufficient enough to operate the current and voltage sensors. The ground is given to the sensors on the opposite terminal wire to which value has to be measured is connected. Serial connection is given for current sensor and parallel connection for voltage sensor. Then the values got from the sensors are in the range of 0 to1023. And these values converted to the current and voltage values. The power of the system is found by using V x I Power formula. Then the data is transferred to the esp8266 through serial connection. The connection is made by connecting the RX of the Arudino to the TX pin of the esp8266.TX pin of Arudino is connected with RX of esp8266. By this way serial communication is established between the set baud rate of 9600. Arudino digital pin D7 is connected to the transistor base. Collector of the transistor is connected to the relay excitation coil pin and the emitter of transistor is connected to the power source. The opposite terminal is connected to the switch using state case connection. Initially the pin D13 and D2 which is connected to VCC of voltage sensor and current sensor respectively should be kept high.



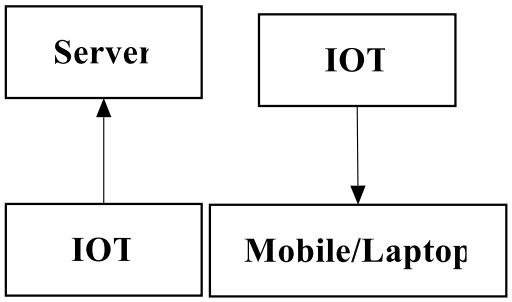
Pin Diagram


START
HARDWARE AND SOFTWARE IMPLEMENTATION
READ THE VOLTAGE AND CURRENT VALUES
MOVED TO ARDUINO
VALUES ARE SUBJECTED TO SCALING
NO
CONDITION FOR THE SCALING
YES
MOVED TO ESP8266
MOVED TO IOT SERVER
VALUES ARE STORED IN THE DATA BASE
THE GRAPHING IS PROJECTED
CLOUD CONTROL IS ESTABLISHED
CONDITION FOR THE LOAD SCHEDULING IS CHECKED
COMMAND TRANSFER FROM CLOUD TO ESP8266
MOVED TO ARDUINO VIA SERIAL PORT
COMMAND IS INTIATED IN THE ARDUINO
ARDUINO TRIGGER THE RELAY
COMMAND TRANSFER FROM CLOUD TO ESP8266
MOVED TO ARDUINO VIA SERIAL PORT
COMMAND IS INTIATED IN THE ARDUINO
ARDUINO TRIGGER THE RELAY

Flowchart

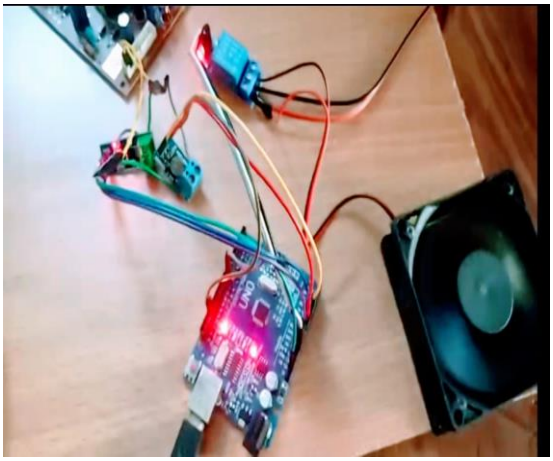


Communication Diagaram



IOT communication

The above flowchart explains the entire automation process working flow. The below are the Short over view of this paper: We have deployed current sensor and voltage sensor at rear side of miniature circuit board (MCB) at each room in a house to record the current, voltage and power factor of the each room. These gathered data are being transmitted and stored in a cloud based system via internet sources. Consumers can get an access to the cloud platform via server which we have



Implementation Diagram

provided. Actually this is to benefit all the consumers by providing them a detailed idea about unit they consumed, proper billings, and provide them a knowledge about peak and non-peak hour and this helps them in scheduling their usage of high power consuming device.

4. Conclusion

Finally we conclude that by providing this optimized smart home management system; We make job easy for our consumers with various specified aspects such as load analysis by acknowledging them with peak and non-peak hours which helps in operating the high power consuming devices also helps them in scheduling their daily loads. Cloud system is being implemented which gives them a easy access to the data stored since it is a WIFI enabled module makes it even more handy and easy accessible. Also smart home management system is cost effective even a normal people in society can get their hands on it. This innovation made for country like India which is actually known for middle class society

References

[1] Benqiang Yang, Shuli Liu, Mark Gaterell and Yang Wang, " Smart metering and systems for low energy households:challenges, issues and benefits", Advances in Buinding Energy Research,2017,pp.80-100

[2] Milanpreet Kaur, Dr. Lini Mathew, Alokdeep and Ajay Kumar,"Implementation of Smart Metering based on Internet of Things",IOP Conference Series: Materials Science and Engineering,2018

[3] Mr. Vichare Abhishek, Ms VermaShilpa Embedded Web Server for Home Appliances (IJERA) (VNCET-30 mar 12)

[4] D.Naresh, B.Chakradhar, S.Krishnaveni Bluetooth Based Home Automation and Security System(IJETT) – Volume 4 Issue 9- Sep 2013

[5] Vinay sagar K N, Kusuma S M Home Automation Using Internet of Things (IRJET) Volume: 02 Issue: 03 (June-2015)

[6] https://www.elprocus.com/arduino-basics-and-design/

[7] https://www.arduino.cc/en/guide/introduction

[8] Tadimeti Hari Charan, Pulipati ManasOverview Of Automation Systems And Home Appliances Control Using Pc And Microcontroller(Ijsr) , Volume 2 Issue 4, April 2013.

[9] www.electropeak.com

[10] http://www.seeedstudio.com/blog/2020/02/15/acs712-current-sensor-features-how-it-works-arduino-guide/

[11] http://www.electronicscomp.com/zmpt101b-ac-single-phase-voltage-sensor-module

[12] http://espressif.com/en/products/hardware/esp8266ex/overview

[13] https://www.engineersgarage.com/arduino/acs712-current-sensor-with-arduino/

[14] http://hackaday.com/2014/08/26/new-chip-alert-the-esp8266-wifi-module-its-5/

[15] https://web.archive.org/web/20120618121911/http://history-computer.com/ModernComputer/Basis/relay.html

[16] http://www.gedigitalenergy.com/multilin/notes/artsci/

[17] https://www.simform.com/home-automation-using-internet-of-things/

[18] https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT

[19] http://www.linux.com/NEWS/21-OPEN-SOURCE-PAPERS-IOT

[20] https://web.archive.org/web/20160505124414/https://www.reuters.com/article/research-and-markets-idUSnBw195490a%2B100%2BBSW20150119

[21] http://www.t3.com/features/the-smart-home-guide

[22] Vinay sagar K N, Kusuma S M, " Home Automation Using Internet of Things", International Research Journal of Engineering and Technology, 2015,pp.1965-1970

[23] Tejesh B S S and Neeraja S, " A Smart home auromation system using IOT and open source Hardware", International Journal of Engineering & Technology, 2018, pp.428-432

[24] Ramses Miramontes Meza, Laura Victoria Escamilla del Río and Raúl Teodoro Aquino Santos, "Mobile Remote Control for Home Automation", International Journal of Interactive Mobile Technologies, 2013,pp.21-26

[25] Imran Ashraf ,Muhammad Umer ,Rizwan Majeed,Arif Mehmood,Waqar Aslam,Muhammad Naveed Yasir and Gyu Sang Choi, "Home automation using general purpose household electric appliances with Raspberry Pi and commercial smartphone", 2020

[26] A. Vinodha Krishnan, J. Indira Priyadharshini and T. Sivaranjani, "Smart Home Automation System Using Arduino", International Journal Of Engineering Sciences & Research Technology, 2017