# IOT BASED ENERGY METER MONITORING USING R-PI

**Abhijeet K.Sonawane[1], Omkar S.Jadhav[2],Vishal D.Shelke[3],Sapna P. Sonar[4]**

[1,2,3]Graduate students, [4]Head Of Department & Guide
Guru Gobind Singh College of Engineering and Research Centre

***ABSTRACT*: Traditional meter reading for any utility consumption and billing is done by human operator from houses to houses and building to building. This requires huge number of labor operators and long working hour to achieve complete area data reading and billing. Human operator billing are prone to reading error, also has errors while recording what was read and during data entry. Hard to access meters at rural accounts, indoor meters, obstacles. Conveying tamper recording remains on the meter reader's loyalty. Also no clue on demand/ over drawls by the consumer. If there is delay in meter readings, delay in bills delayed revenue, delay in cash- flow. Hence IOT based energy meter monitoring using R-PI is used to telemeter the consumption of electricity, gas, water, heat, liquid, oil and steam, since the direct physical access or visual reading of meters are very inconvenient.IOT based energy meter monitoring, is the technology of automatically collecting consumption, diagnostic, and status data from water meter or energy meter devices (gas, electric) and transferring that data to a android application for billing, troubleshooting, and analyzing. This technology mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real-time consumption rather than on estimates based on past or predicted consumption. This timely information coupled with analysis can help both utility providers and customer's better control the use and production of electric energy, gas usage, or water consumption.**

***Keywords*: IOT based energy meter, Automatic Electric utilization meter, Energy Consumption detailing. Energy Conservation, etc.**

**CHAPTER NO:- 1**

**INTRODUCTION**

Metering is essential for our modern life. The metering system includes water supply, electricity and domestic fuel etc. The charges incurred by a user can be calculated by using a metering system. For current typical metering system, four steps are usually involved. In the first step, a meter records the amount of water, power and fuel is consumed by the customer. Then, a worker records the reading of meter for each user. After that, the recorded readings input to a computer system to calculate the charge for each customer. Finally, a bill is generated and mailed to each customer. Collecting the meter reading is the most difficult task. A worker from each supplier visits every house regularly to record the reading of meter. The classical approach is simply writing down the reading in a hardcopy and data entries are done manually to the computer system in step 3. Another generic approach is inputting the reading directly to a PDA in a soft copy and later the data entries are done automatically using a program. Some of the meters are installed inside the houses; the worker would encounter more difficulties for recording the reading due to nobody there. As a result, the worker needs to revisit the house. To collect the reading of every customer, the worker also visits house by house. Visiting every customer to collect the reading of meter is the current majority approach for metering. Although the current approach has been used for very long time, it obtains room to improve. First, more manpower is required for current systems because all customers are visited regularly to collect the readings. Secondly, the process is time consuming because the data collection may not be completed in first visit. Finally, accuracy cannot be assured due to human error of incorrect readings.

To improve the efficiency and accuracy of metering, **IOT based energy meter monitoring using R-PI system** has been discussed and used for a long time. IOT is the technology of automatically collecting data from energy metering devices (water, gas, and electricity) and transferring the data to a central database for billing and/or analyzing. This collected or analyzed data stored in android app. This means that billing can be based on actual consumption rather than an estimate based on previous consumption, giving customers a better control of their use of electric energy, gas usage, or water consumption by using android application. By using this technology we reduced human errors i.e. done by the workers. This technology is the advanced version of GSM based energy meter reading using IOT. This system is introduced very soon.

In this project we used the GPS system for security purpose, this gps system to show the address and locations as per requirement. Then we used the raspberry pi controller, to collect data from energy meter and stored it. In this controller we learn the python language and doing the online and offline programming. When internet server works well (,i.e. high internet speed)at that time online programming used .but in case the internet server has been down thus offline programming is used to stored some data for required time period ,then internet server has working perfectly, then this data can be transmitted to android studio.

In this system we design the android application to show the data which collected from the energy meter. In this application we added some point to show or to indicate the continuous reading per day per hour. Then this application analyzed the power consumed by the different load basis (per load per Kwh).

For Example,

- Fan- unit consumed per hour
- Tube light- Unit consumed per hour
- Refrigerator- Unit consumed per hour

If consumer consumed some energy in day the energy consumed data notify to the consumer via notification. In this application to notify that in case the consumer extent at some limit to consumed the data he will get alert message or notification. Due to this transparency between provider and user gets strong as well as system flexibility increases.

## CHAPTER NO.:- 2

## LITERATURE REVIEW

Automatic Meter Reading system (AMR) continuously monitors the energy meter and sends data on request of service provider through SMS. That system was allowed to the customers to pay online bill either by credit card, debit card or by net banking is explained by Abhinandan jain. Who has developed fully automatic energy meter having the capabilities of remote monitoring and energy meter controlling. In paper (2007) H. G. Rodney Tan et al. introduced working prototype of GAPMR system which is built to demonstrate the effectiveness and efficiency of automatic meter reading, billing and notification through GSM network. Ashna K, Sudhish N Gorgre proposed system which automatically reads the energy utilized and sends it to the service provider with the use of the existing short messaging services (SMS). Tian yew lim and tat Wai chan described a prototype automated meter reading system with use of the power lines and frequency shift keying modulation operated in the EN 50065-1 A Band. The system's performance and reliability aspects are presented by them. M Popa describes an AMR system based on Power Line Communications. Smart meters were connected through a Lon Work type industrial bus to the Gateway. In this The Gateway sends messages to meters and reads the collected information. The communication was, through GSM, with a Data Acquisition Center (DAC) where data is processed. The data received from an energy meter has been stored in database server which located at electricity board station through SMS gate way for further processing by energy provider, provider further sends electricity bills either by email, SMS or by post. Power lines are readily available and making the full use of them is most desirable for the energy suppliers. These papers presented an investigation of the LV power line characteristics in the A Band of European Committee for Electromechanical Standardization European Norm (EN) 50065-1 standard for implementation of automated meter reading in dense residential areas. A. Ali et al. presented AMR using radio frequency technologies provides electric utility service company the opportunity to increase operational efficiency, improve customer services, reduce data collection costs and quickly gather critical data that provide insight to the company decision makers. The existing digital electric meter in the marketing is upgraded by adding RF module to provide remote communication capabilities. Development of an automatic meter reading system based on ZigBee is wireless electric power management and control system. An automatic meter reading system focusing on the design for an energy meter implemented with ZigBee wireless communication protocol conforming to IEEE 802.15.4 standard. Where microcontroller is used to manage energy data and ZigBee to enable communication between the energy meter and data centers. The secure mobile agent concept was presented in which tell that energy meters can be organized in a group based upon the geographical location. In one location energy meters perform their jobs under a security manager. The concept of local mobile agent is proposed to avoid the visit of external mobile agent to energy meters directly. Local mobile agent carries the acceptable queries from security manager and visits energy meters. Embedded energy meter is developed in which maximum demand of energy of a consumer will be indicated in the meter used by the consumer. After exceeding the maximum demand, hence the connection will automatically be disconnected by an embedded system inserted in the meter itself.

## CHAPTER NO.:- 3

### Problem Statement

In Conventional metering system to measure electricity consumption the energy provider company hire persons who visit each house and record the meter reading manually. These meter readings are used for electricity bill calculation and this bill sent to consumer house by post. This is only a sluggish and laborious.

To measure electricity consumption the provider company hire person who visit each house and record the meter reading manually but the customer said worker to minimized the energy meter reading by giving some money or expenses, this is also big problem which increasing in day to day life.

In day to day life increase the power theft which line on unauthorized tapping is occurred so the customer paid extra charges. If the person who assigned for the reading of energy meter is not coming on time for taking readings due to that billing process gets delayed due to which consumer may be paid some extra charges.

**CHAPTER NO.:- 4**

**SYSTEM OVERVIEW**

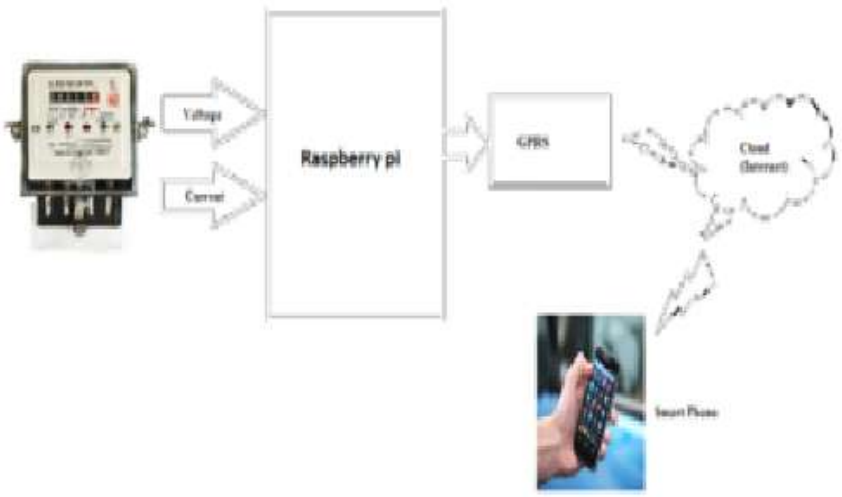



**Fig 4.1:- Block Diagram of IOT Based Energy Meter Monitoring Using R-Pi**

Figure shows the complete system description. In this system each and every meter is provided a particular ID number. This ID number is provided according to WiFi module number. This system continuously monitors every meter reading daily, weekly, monthly or on request and sends to central server of energy Provider Company. The meter reading is stored in database server through Wi Fi. After billing calculation a bill is issued by energy Provider Company which can be sent either by email, by web account. Customers can pay the bill using net banking. AMR also sends the information of power cut and power consumption through notification.

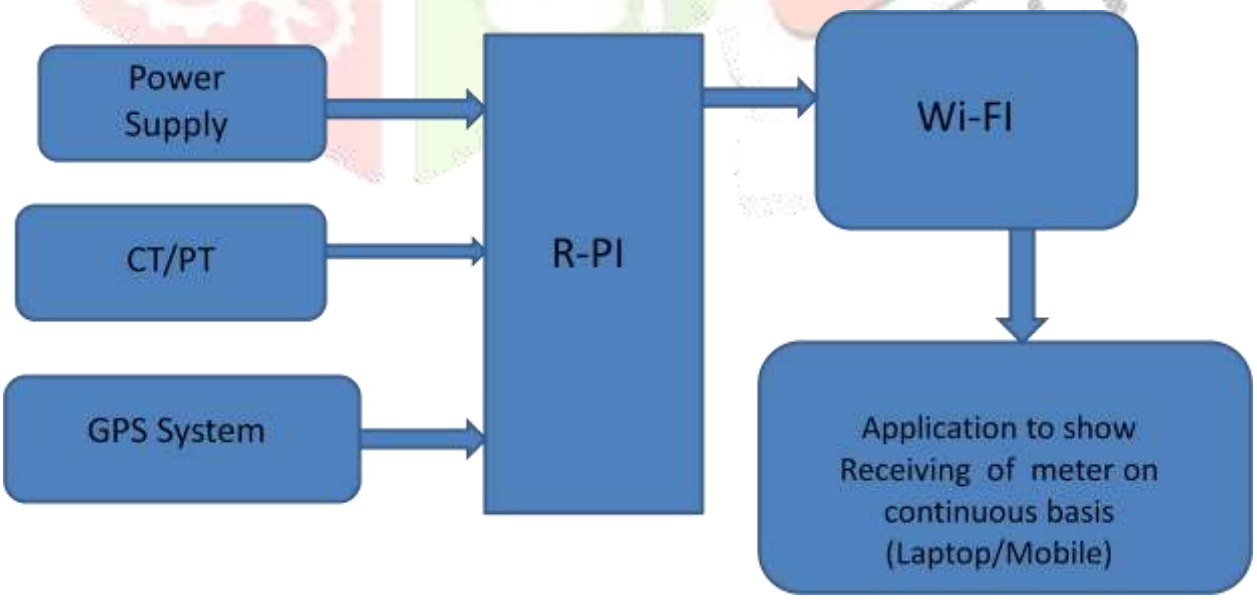



**Fig 4.2:- Block Diagram of IOT Based Energy Meter Monitoring Using R-Pi**

**Working-**

Energy meter has been indicated or show the power consumed in day by day. Then we connected the current sensor and voltage sensor with energy meter to measuring the power as per rating.

This module we connected to GPS system for security purpose. This GPS System to show the address and location as per requirement. In this project the main component is R-pi controller. This controller collects some data from energy meter and stored it. So this collected data to be transmitted in android application by using wifi

This controller interfacing or automated with android application. In this controller we learn the python language so this project we used two type of programming 1.ON-line programming 2.OFF line programming. In case of on line programming the internet server is perfectly working then the on line programming has been work properly cam collect the data from current sensor and voltage sensor and to be transmitted in android application. But in case if internet server has been down then off line programming stored some data collecting from current sensor and voltage sensor for some required time period and when internet server works properly then the stored data transmitted in android application. This android application is use to show the continuous reading per day per hour and to measure the power rating or unit consumed by different loads (per load per Kwh).

For Example,

- Fan- unit consumed per hour
- Tube light- Unit consumed per hour
- Refrigerator- Unit consumed per hour

❖ **SYSTEM COMPONENT =**

- **Hardware:**

i. Raspberry pi-

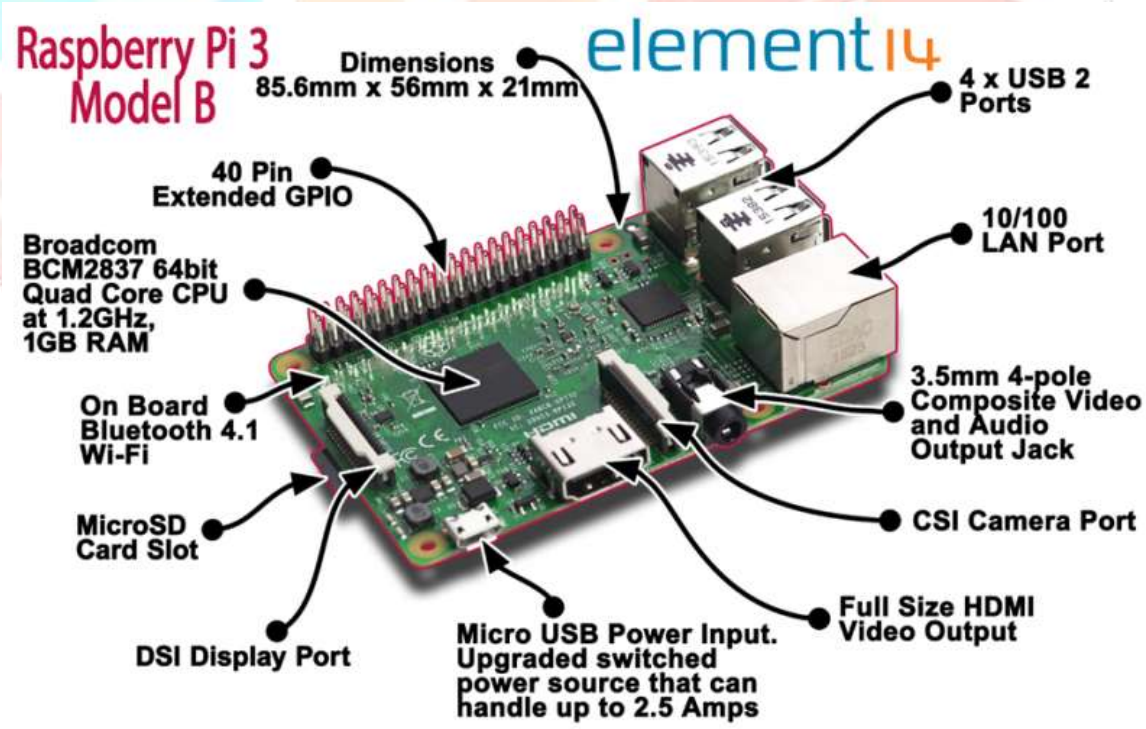



**Fig 4.3:- R-Pi3**

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Foundations promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside of its target market for uses such as robotics. Peripherals (including keyboards, mice and cases) are not included with the Raspberry Pi. Some accessories however have been included in several official and unofficial bundles.

According to the Raspberry Pi Foundation, over 5 million Raspberry Pi's have been sold before February 2015, making it the best-selling computer. By November 2016 they had sold 11 million units reaching 12.5m in March 2017, making it the third best-

selling "general purpose computer" ever. In July 2017 it was announced that the total sales have now reached nearly 15 million units

Several generations of Raspberry Pi's have been released. All models feature a Broadcom system on a chip (SOC) with an integrated ARM compatible central processing unit (CPU) and on-chip graphics processing unit (GPU).

Processor speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on-board memory range from 256 MB to 1 GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either SDHC or Micro SDHC sizes. Depending on the model; the boards have either a single USB port or up to four USB ports. For video output, HDMI and composite video are supported, with a standard 3.5 mm phono jack for audio output. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. The B-models have an 8P8C Ethernet port and the Pi 3 and Pi Zero W have on-board Wi-Fi 802.11n and Bluetooth.

The first generation (Raspberry Pi 1 Model B) was released in February 2012, followed by the simpler and cheaper Model A. In 2014, the Foundation released a board with an improved design (Raspberry Pi 1 Model B+). These boards are approximately credit-card sized and represent the standard *mainline* form-factor. Improved A+ and B+ models were released a year later. A "Compute Module" was released in April 2014 for embedded applications. The Raspberry Pi 2 which added more RAM was released in February 2015.

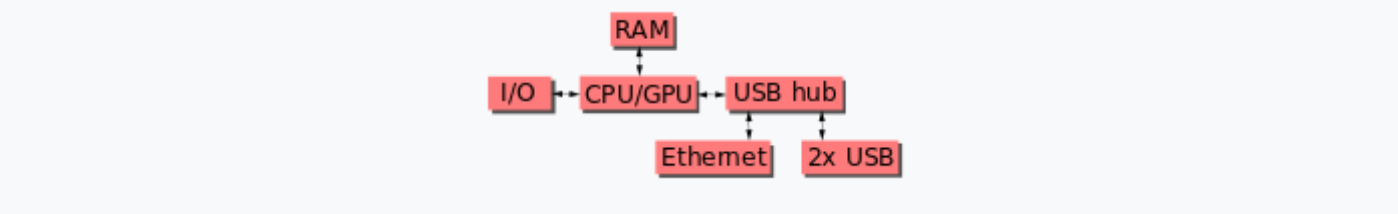
A Raspberry Pi Zero with smaller size and reduced input/output (I/O) and general-purpose input/output (GPIO) capabilities was released in November 2015 for US$5. Raspberry Pi 3 Model B released in February 2016 and is bundled with on-board Wi-Fi, Bluetooth and USB boot capabilities As of January 2017; Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. Raspberry Pi boards are priced between US$5–35. On 28 February 2017, the Raspberry Pi Zero W was launched, which is identical to the Raspberry Pi Zero, but has the Wi-Fi and Bluetooth functionality of the Raspberry Pi 3

The organisation behind the Raspberry Pi now consists of two arms. Originally developed under the auspices of the Raspberry Pi Foundation, the success of the Pi Model B prompted the Foundation to set up Raspberry Pi Trading, with Dr Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity that exists to get that message out to schools. Raspberry Pi Trading reinvests about a third of its profit in R&D, and the rest goes to the foundation

The Foundation provides Raspbian, a Debian-based Linux distribution for download, as well as third-party Ubuntu, Windows 10 IOT Core, RISC OS, and specialized center distributions. It promotes Python and Scratch as the main programming language, with support for many other languages. The default firmware is closed source, while an unofficial open source is available.

**Hardware**

The Raspberry Pi hardware has evolved through several versions that feature variations in memory capacity and peripheral-device support.




This block diagram depicts Models A, B, A+, and B+. Model A, A+, and the Pi Zero lack the Ethernet and USB hub components. The Ethernet adapter is internally connected to an additional USB port. In Model A, A+, and the Pi Zero, the USB port is connected directly to the system on a chip (SoC). On the Pi 1 Model B+ and later models the USB/Ethernet chip contains a five-point USB hub, of which four ports are available, while the Pi 1 Model B only provides two. On the Pi Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

**Processor**

The Broadcom BCM2835 SoC used in the first generation Raspberry Pi is somewhat equivalent to the chip used in first modern generation Smartphone's (its CPU is an older ARMv6 architecture)which includes a 700 MHz ARM1176JZF-S processor, Video Core IV graphics processing unit (GPU),and RAM. It has a level 1 (L1) cache of 16 KB and a level 2 (L2) caches of 128 KB. The level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible.

The earlier models of Raspberry Pi 2 use a Broadcom BCM2836 SoC with a 900 MHz 32-bit quad-core ARM Cortex-A7 processor, with 256 KB shared L2 cache.[24] The Raspberry Pi 2 V1.2 was upgraded to a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, the same SoC which is used on the Raspberry Pi 3.

The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache

**Performance**

The Raspberry Pi 3, with a quad-core Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1.This was suggested to be highly dependent upon task threading and instruction set use. Benchmarks showed the Raspberry Pi 3 to be approximately 80% faster than the Raspberry Pi 2 in parallelized tasks.

Raspberry Pi 2 includes a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM. It is described as 4–6 times more powerful than its predecessor. The GPU is identical to the original In parallelized benchmarks, the Raspberry Pi 2 could be up to 14 times faster than a Raspberry Pi 1 Model B+.While operating at 700 MHz by default, the first generation Raspberry Pi provided a real-world performance roughly equivalent to 0.041 GFLOPS.On the CPU level the performance is similar to a 300 MHz Pentium II of 1997–99. The GPU provides 1 Gpixel/s or 1.5 Gtexel/s of graphics processing or 24 GFLOPS of general purpose computing performance. The graphical capabilities of the Raspberry Pi are roughly equivalent to the performance of the Xbox of 2001.

**ii. Voltage sensor**


**Fig 4.4:- Voltage Sensor**

The **Voltage Sensor** block represents an ideal **voltage sensor**, that is, a device that converts **voltage** measured between two points of an electrical circuit into a physical signal proportional to the **voltage**. Connection V is a physical signal port that outputs the measurement result.The voltage sensor can detect the supply voltage from 0.025 to 25.

Features:-

1. Operating voltage output: 3.3 to 5V max.
2. Input voltage range: 0.025 to 25V max.
3. Analog Input.

**iii. Current sensor**


**Fig 4.5:- Current Sensor**

Description The Allegro™ ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switch mode power supplies, and over current fault protection. The device is not intended for automotive applications. The device consists of a precise, low-offset, linear Hall circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path

generates a magnetic field which the Hall IC converts into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilized BiCMOS Hall IC, which is programmed for accuracy after packaging. The output of the device has a positive slope (>VIOUT(Q)) when an increasing current flows through the primary copper conduction path (from pins 1 and 2, to pins 3 and 4), which is the path used for current sampling. The internal resistance of this conductive path is 1.2 mΩ typical, providing low power loss. The thickness of the copper conductor allows survival of the device at up to 5× overcurrent conditions. The terminals of the conductive path are electrically isolated from the signal leads (pins 5 through 8). This allows the ACS712 to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques. The ACS712 is provided in a small, surface mount SOIC8 package. The lead frame is plated with 100% matte tin, which is compatible with standard lead (Pb) free printed circuit board assembly processes. Internally, the device is Pb-free, except for flip-chip high-temperature Pb-based solder balls, currently exempt from RoHS. The device is fully calibrated prior to shipment from the factor

**Features and Benefits**

▪ Low-noise analog signal path ▪ Device bandwidth is set via the new FILTER pin ▪ 5 µs output rise time in response to step input current ▪ 80 kHz bandwidth ▪ Total output error 1.5% at TA= 25°C ▪ Small footprint, low-profile SOIC8 package ▪ 1.2 mΩ internal conductor resistance ▪ 2.1 kVRMS minimum isolation voltage from pins 1-4 to pins 5-8 ▪ 5.0 V, single supply operation ▪ 66 to 185 mV/A output sensitivity ▪ Output voltage proportional to AC or DC currents ▪ Factory-trimmed for accuracy ▪ Extremely stable output offset voltage ▪ Nearly zero magnetic hysteresis ▪ Ratiometric output from supply voltage

The maximum pixel clock rate for HDMI 1.0 is 165 MHz, which is sufficient to allow 1080p and WUXGA (1920×1200) at 60 Hz. HDMI 1.3 increases that to 340 MHz, which allows for higher resolution (such as WQXGA, 2560×1600) across a single digital link. An HDMI connection can either be single-link (type A/C/D) or dual-link (type B) and can have a video pixel rate of 25 MHz to 340 MHz (for a single-link connection) or 25 MHz to 680 MHz (for a dual-link connection). Video formats with rates below 25 MHz (e.g., 13.5 MHz for 480i/NTSC) are transmitted using a pixel-repetition scheme

**iv. Wi-Fi**


**Fig 4.6:- Wi-Fi**

**Wi-Fi** is a technology for wireless local area networking with devices based on the IEEE 802.11 standards. *Wi-Fi* is a trademark of the Wi-Fi Alliance, which restricts the use of the term Wi-Fi Certified to products that successfully complete interoperability certification testing.

Devices that can use Wi-Fi technology include personal computers, video-game consoles, phones and tablets, digital cameras, smart TVs, digital audio players and modern printers. Wi-Fi compatible devices can connect to the Internet via a WLAN and a wireless access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can be as small as a single room with walls that block radio waves, or as large as many square kilometers achieved by using multiple overlapping access points.

**v. GPS System**

**Fig 4.7:- GPS System**

How GPS Works Over the years, people have used a variety of techniques to navigate across the globe. Traditionally, people relied on stars and landmarks to travel between various locations, while maps and compasses helped to prevent people from getting lost. The advent of the Global Positioning System, or 'GPS' for short, means people no longer have to rely on these traditional (and often complex) positioning techniques to find their way around. The GPS project first began in 1973 and became fully operational in 1994. The system is run by the United States Department of Defence and was originally intended for military applications only, but was made available for public use on completion. The GPS system consists of a network of 24 active satellites (and 8 spares) located nearly 20,000 km above the earth's surface - that's the same as driving from Melbourne to Perth six times! Each satellite broadcasts different signals which can be tracked by a GPS receiver on earth, which are then analyzed by the GPS receiver to determine its precise location. The signals operate in all weather conditions but can't penetrate through solid objects, so GPS receivers perform best when they have a clear view of the sky. GPS receivers come in all different shapes and sizes, are widespread and are affordable. Today, GPS receivers can be found in watches, phones, tablets, computers, cars and a wide variety of other devices. Figure 1 GPS receivers are available as stand-alone devices, but can also be found in cars, tablets and watches. FAST FACTS 1. The GPS system became fully operational in 1994. 2. On average, it costs the US Government $2 million every day to run, but it is free for public use. 3. A typical GPS satellite travels through the sky at nearly 14,000 km per hour! 4. GPS receivers can determine your position anywhere on earth – even in the outback, the ocean or in Antarctica. 5. GPS works 24 hours a day in all weather conditions – rain, fog, hail or shine. 6. Satellite signals can travel through most plastics and glass, but not wood, rock or concrete. GPS in Schools – How GPS Works Produced by the University of Tasmania in conjunction with Geoscience Australia as part of the AuScope GPS in Schools Project – 2014. 2 Determining Your Position So if a GPS receiver is tracking signals from multiple satellites, how does it convert these into a position that can be used for navigation? GPS receivers use a mathematical process called trilateration. This process can be a little tricky to comprehend in three-dimensional space, so let's begin with an example in two-dimensions… You are travelling through outback Australia and find yourself at a lookout near an unfamiliar lake. At the lookout, there is a signpost with distances to three Australian towns. The first sign tells you that you are 740 km from Adelaide. This fact alone isn't particularly useful, as you could be anywhere on a circle around Adelaide that has a radius of 740 km. The second sign informs you that you are also 1,500 km from Cairns. If you combine these two facts, you can limit your location to one of two possibilities (A or B, shown by the intersection of the two circles. The third sign also tells you that you're 1,430 km from Sydney. Using this final bit of information, you can eliminate Location B from Figure 2 and quickly determine that you're at Location A - Lake Eyre in South Australia (see Figure 3). Trilateration also works in three-dimensions as well, but involves using spheres instead of circles and requires four distances to form a unique solution instead of three. GPS receivers use three-dimensional trilateration to tell you A) where you are on the earth and B) your current height. Figure 2 Figure 3 Location A Location B Location A GPS in Schools – How GPS Works Produced by the University of Tasmania in conjunction with Geoscience Australia as part of the AuScope GPS in Schools Project – 2014. 3 In order to make this calculation, every GPS receiver must know the following things: 1. The location of at least four GPS satellites above it and; 2. The distance between the receiver and each of those GPS satellites. The GPS receiver figures both of these things out by analysing radio signals transmitted from the GPS satellites and timing how long it takes for the signal to travel from the satellite to the receiver. If a GPS receiver cannot do this for at least four satellites, it will not be able to figure out where it is. If more than four satellites are detected, the accuracy of the trilateration increases.

**vi. Adapter**

**Fig 4.8:- Adopter**

An AC adapter, AC/DC adapter, or AC/DC converter is a type of external power supply, often enclosed in a case similar to an AC plug. Other common names include plug pack, plug-in adapter, adapter block, domestic mains adapter, line power adapter, wall wart, power brick, and power adapter. Adapters for battery-powered equipment may be described as chargers or rechargers (see also battery charger). AC adapters are used with electrical devices that require power but do not contain internal components to derive the required voltage and power from mains power. The internal circuitry of an external power supply is very similar to the design that would be used for a built-in or internal supply.

External power supplies are used both with equipment with no other source of power and with battery-powered equipment, where the supply, when plugged in, can sometimes charge the battery in addition to powering the equipment.

Use of an external power supply allows portability of equipment powered either by mains or battery without the added bulk of internal power components, and makes it unnecessary to produce equipment for use only with a specified power source; the same device can be powered from 120 VAC or 230 VAC mains, vehicle or aircraft battery by using a different adapter. Another advantage of these designs can be increased safety; as the hazardous 120 or 240 volt mains power is transformed to a lower safer voltage at the wall outlet, and the appliance which is handled by the user is powered by this lower voltage.

Originally, most AC/DC adapters were linear power supplies, containing a transformer to convert the mains electricity voltage to a lower voltage, a rectifier to convert it to pulsating DC, and a filter to smooth the pulsating waveform to DC, with residual ripple variations small enough to leave the powered device unaffected. Size and weight of the device was largely determined by the transformer, which in turn was determined by the power output and mains frequency. Ratings over a few watts made the devices too large and heavy to be physically supported by a wall outlet. The output voltage of these adapters varied with load; for equipment requiring a more stable voltage, linear voltage regulator circuitry was added. Losses in the transformer and the linear regulator were considerable; efficiency was relatively low, and significant power dissipated as heat even when not driving a load.

Early in the twenty-first century, switched-mode power supplies (SMPSs) became almost ubiquitous for this purpose. Mains voltage is rectified to a high direct voltage driving a switching circuit, which contains a transformer operating at a high frequency and outputs direct current at the desired voltage. The high-frequency ripple is more easily filtered out than mains-frequency. The high frequency allows the transformer to be small, which reduces its losses; and the switching regulator can be much more efficient than a linear regulator. The result is a much more efficient, smaller, and lighter device. Safety is ensured, as in the older linear circuit, because there is still a transformer which electrically isolates the output from the mains.

A linear circuit must be designed for a specific, narrow range of input voltages (e.g., 220–240 VAC) and must use a transformer appropriate for the frequency (usually 50 or 60 Hz), but a switched-mode supply can work efficiently over a very wide range of voltages and frequencies; a single 100–240 VAC unit will handle almost any mains supply in the world.

However, unless very carefully designed and using suitable components, switching adapters are more likely to fail than the older type, due in part to complex circuitry and the use of semiconductors. Unless designed well, these adapters may be easily damaged by overloads, even transient ones, which can come from lightning, brief mains overvoltage (sometimes caused by an incandescent light on the same power circuit failing), component degradation, etc. A very common mode of failure is due to the use of electrolytic capacitors whose equivalent series resistance (ESR) increases with age; switching regulators are very sensitive to high ESR (the older linear circuit also used electrolytic capacitors, but the effect of degradation is much less dramatic). Well-designed circuits pay attention to the ESR, ripple current rating, pulse operation, and temperature rating of capacitors.

vii. **LCD (16*2)**


**Fig 4.9:- LCD**

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, video game devices and clocks. LCD screens have replaced heavy, bulky cathode ray tube (CRT) displays in nearly all applications. LCD screens are available in a wider range of screen sizes than CRT and plasma displays, with LCD screens available in sizes ranging from tiny digital watches to huge, big-screen television sets.

Since LCD screens do not use phosphors, they do not suffer image burn-in when a static image is displayed on a screen for a long time (e.g., the table frame for an aircraft schedule on an indoor sign). LCDs are, however, susceptible to image persistence. The

LCD screen is more energy-efficient and can be disposed of more safely than a CRT can. Its low electrical power consumption enables it to be used in battery-powered electronic equipment more efficiently than CRTs can be. By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes.

viii. **HDMI** (**High-Definition Multimedia Interface**)

**Fig 4.10:- HDMI**

It is a proprietary audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or digital audio device.HDMI is a digital replacement for analog video standards.

HDMI implements the EIA/CEA-861 standards, which define video formats and waveforms, transport of compressed, uncompressed, and LPCM audio, auxiliary data, and implementations of the VESA EDIDCEA-861 signals carried by HDMI are electrically compatible with the CEA-861 signals used by the digital visual interface (DVI). No signal conversion is necessary, nor is there a loss of video quality when a DVI-to-HDMI adapter is used. The CEC (Consumer Electronics Control) capability allows HDMI devices to control each other when necessary and allows the user to operate multiple devices with one handheld remote control device.

Several versions of HDMI have been developed and deployed since initial release of the technology but all use the same cable and connector. Other than improved audio and video capacity, performance, resolution and color spaces, newer versions have optional advanced features such as 3D, Ethernet data connection, and CEC (Consumer Electronics Control) extensions.

Production of consumer HDMI products started in late 2003. In Europe either DVI-HDCP or HDMI is included in the HD ready in-store labeling specification for TV sets for HDTV, formulated by EICTA with SES Astra in 2005. HDMI began to appear on consumer HDTVs in 2004 and camcorders and digital still cameras in 2006. As of January 6, 2015 (twelve years after the release of the first HDMI specification), over 4 billion HDMI devices have been sold.

**Specifications**

The HDMI specification defines the protocols, signals, electrical interfaces and mechanical requirements of the standard. The maximum pixel clock rate for HDMI 1.0 is 165 MHz, which is sufficient to allow 1080p and WUXGA (1920×1200) at 60 Hz. HDMI 1.3 increases that to 340 MHz, which allows for higher resolution (such as WQXGA, 2560×1600) across a single digital link. An HDMI connection can either be single-link (type A/C/D) or dual-link (type B) and can have a video pixel rate of 25 MHz to 340 MHz (for a single-link connection) or 25 MHz to 680 MHz (for a dual-link connection). Video formats with rates below 25 MHz (e.g., 13.5 MHz for 480i/NTSC) are transmitted using a pixel-repetition scheme.

➢ **Software:**

- IDLE
- Proteus 8
- Android App
- ORCAD

## CHAPTER NO.:- 5

## METHEDOLOGY

- We analyzed the previous system and get information to how the pervious system was.

A. GSM based energy meter monitoring.
B. Smart energy meter and automatic energy meter reading monitoring
C. New development in energy meter monitoring.

- Then we collected the news over power thefts and energy loses in different states.

A. Time of India news paper said, the 54% electricity stolen or lost in Bihar.
B. Power distribution losses of Rs.69108 Crore reported in 2012-13.

- We find the problems over power thefts, extra billing, corrupt system, poor energy supply etc.
- We discuss over this problem and how to minimize those problems, what we can do to overcome all problem.
- We read the various pervious references to get some extra knowledge about our concept.

A. GSM based power meter reading and control system.
B. H. G. Rodney Tan, C. H. Lee and V. H. Mork, "Automatic power meter reading systems using GSM network", IEEE, 8th International Power Engineering Conference, pp. 465-469, 2007.
C. M.Popa, "Gateway design and implementation in an automatic meter reading system based on power line communication", 7th International Conference on Networked Computing and Advanced Information Management (NCM), pp. 295-298, 2011.

- To neglect some issues we modify the system by using RASBERRY PI controller and GPS system.
- After all the discussion and data collection process, we check the hardware specifications to know the components are compatible to our system or not.
- After that we design the concept of our project.
- We buy the component as per required our project.
- Then we interface the hardware component as per requirement.
- We use python language programming in this system.
- And we develop the android application for knowing our daily energy consumption.

## CHAPTER NO.:- 6

### Future Scope

o The present system is used for meter reading for electricity using power line communication. The system can be further modified to detect power theft between pole and individual subscribers by installing the units at each subscriber end
o For the readings of Electricity, Water, Gas or any other meters in the customer premises to be transmitted to a central base station for further processing, billing etc. With tens of millions of meters to be read periodically and regularly, this alone represents an enormous market.
o The present system is implemented to send non voice data only. The system can be further developed to transfer voice data through power line. But the system should be robust enough to handle interference in the power line

### EXPECTED RESULT

- Transparency between provider and user
- In case the old energy meter are more consumption of power but the collection of reading or unit consume is not expected as per the consumption of power. So in this system we knowing that whatever user consume the energy in daily and monthly than the user paid the charges for consuming energy or power.
- The android studio or application to show the proper reading or data as per requirement.
- For offline programming works properly, when the system goes out stages.
- Current sensor and voltage sensor work properly to measuring the power.
- Save cost which paid for the worker who assign for the taking reading of energy meter in assign area and this worker will assign for the maintenance or other purpose.

**CHAPTER NO.:- 7**

**REFERENCE**

[1]. Abhinandan Jain, Dilip Kumar, Jyoti Kedia, "Smart and intelligent GSM based automatic meter reading system", International Journal of Engineering Research & Technology (IJERT), ISSN: 22780181, Vol 2, Issue 3, pp. 1-6, May 2012.

[2]. H. G. Rodney Tan, C. H. Lee and V. H. Mork, "Automatic power meter reading systems using GSM network", IEEE, 8th International Power Engineering Conference, pp. 465-469, 2007.

[3]. Ashna K, Sudhish N Gorgre, "GSM based automatic energy meter reading system with instant billing", IEEE International conference held at Kottayam, pp. 65-72, 2013.

[4]. Tian yew lim and tat Wai chan,"Experimenting remote kilowatthour meter reading through low voltage power lines at dense housing estates", IEEE Transactions on Power Delivery vol. 17, Issue 3, pp. 708-711, Jul 2002.

[5]. M.Popa, "Gateway design and implementation in an automatic meter reading system based on power line communication", 7th International Conference on Networked Computing and Advanced Information Management (NCM), pp. 295-298, 2011.

[6]. G Thavasi Raja and T.D. Sudhakar, "Electricity consumption and automatic billing through power line", International Power Engineering Conference (IPEC), pp. 1411-1415, 2007.

[7]. A.Ali, N.A. Razali, N.H.Saad, N.Vitee, "Implementation of Automatic meter reading using radio frequency module", IEEE International Conference on Power and Energy (PEcon), pp. 876-879, Dec 2012.

[8]. Guilin Zheng, Zhifu Zhang, "Intelligent wireless electric power management and control system based on ZigBee technology", International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE) Changchun, China, pp.1120-1124, December 16-18, 2011.

[9]. Champ Prapasawad, Kittitach pornprasitpol, Wanchalerm pora, "Development of an automatic meter reading system based on ZigBee pro smart energy profile IEEE 802.15.4 standard", International Conference on Electronic Devices and Solid State Circuit (EDSSC), pp.1-3, Dec2012.

[10]. Najmus Saqib malik, Friedrich kupzog, Michael Sonntag, "An approach to secure mobile agents in automatic meter reading", IEEE, International Conference on Cyberworlds, computer society, pp. 187193, 2010.

[11]. Subhashis Maitra, "Embedded Energy Meter- A new concept to measure the energy consumed by a consumer and to pay the bill", Power System Technology and IEEE Power India Conference, 2008.

[12]. Priya Kamble, Sonali Bodkhe, "A new approach for design and implementation of AMR in Smart Meter", International Journal of Advanced Engineering Sciences and Technology, Vol. 2, PP. 5761, 25April 2011.