## Abstract

Today's world has become very advanced with smart applications & devices like Laptops, TV, smart phones with different features & their uses has been increasing day by day. Internet of things can be defined as a network of devices that can communicate the information gathered from monitored field through wireless links. The data is forwarded through multiple nodes & with gateway. The data is connected to other networks like wireless Ethernet.

Internet of things consists of base station & number of nodes these networks can be used to monitor conditions like sound, pressure, temperature. These parameters can be passed in co-operative manner through the network to main location. The IOT may contain hundreds of nodes & three main components of IOT are sensing, processing & monitoring.

IOT can be used to monitor different parameters at different locations in our project we will use IOT to monitor temperature at different locations. In this system we propose one database server with Linux operating system, & raspberry pi.

The project will be implemented in distributed manner to sense temperature at different location. The collect temperature data can be sending to the data server through the Wi-Fi. The project can be used to monitor physical parameter in intelligent building medicines and health care, agriculture also military target tracking and surveillance, energy and resources saving.

# CHAPTER 1

## 1.1 INTRODUCTION OF TEMPERATURE MONITORING SYSTEM USING IOT

The Internet is a living entity, always altering and evolving. New applications and businesses are created continuously. In addition to a developing Internet, technology is also changing the landscape. The Internet of Things is driven by a growth of the Internet through the inclusion of physical objects combined with an ability to provide better efficiency to the environment as more data becomes available. Internet of things technology is referred in our temperature based monitoring system, and it has been an expanding. Technology at which it provides a platform to enhance the system. We are entering a new age of technology that is Internet of Things. Machine to machine, machine to environment, the Internet of the whole thing, the Internet of smart Things, intelligent system call it what you want, but it's occurrence, and its possible is vast. We see the internet of things as billions of smart, connected "things", that will include every feature of our life, and its foundation is the intelligence that embedded giving out provides. Temperature Monitoring systems are requirement and we definitely can find their advantages in many industrial sector and also in residential sector. We can find many kind of temperature monitoring systems for different uses but the major challenge is to design a very simple, User-friendly and cost effective system. Keeping these in mind we designed a temperature monitoring system using user interface. We developed this project, which is relatively inexpensive to sense the temperature. The temperature is read by the ADC (Analog to Digital Converter) module of the pic microcontroller Unit. This ADC data is processed and converted into the actual temperature reading by the pic microcontroller. The temperature monitoring is in lot of industries, like food industry, the workshop, and industry and in environmental monitoring. Analog and digital Temperature sensors are available for sensing temperature for commercial purpose. Temperature sensors possessing temperature-dependent properties that can be measured electrically contain resistors, semiconductor mechanisms such as diodes, and thermocouples. This project aims at monitoring the real time temperature in a cost effective way. Here the monitoring node is raspberry pi. Programming language used for raspberry pi is Python. The Sensor LM35 temperature sensor. The sensor is interfaced with the raspberry pi. The temperature is sensed using the sensor LM35 and is read stored and displayed by the raspberry pi kit. Other sensors like humidity, atmospheric pressure or vibration can be clubbed with this system with ease to measure the atmospheric parameters. Temperature monitoring system will help you to avoid heat buildup at your telecom locations, like huts and other network nodes. Temperature monitoring is also important at less industrial "IT" locations like server rooms and data centers. Many things affect the weather. And weather also have effect on most of living as well as non-living things. At Weather station study of different environmental parameters using some instruments and equipment's has been done. So to meet the goal of weather monitoring we have designed IoT based real-time, low-cost, portable and high speed weather station using Raspberry Pi. At our weather station we are measuring some environmental parameters like temperature, humidity, light intensity, rain water level, pressure and altitude. GSM module, Wi-Fi module, Ethernet module along with ADC and microcontroller are used by many weather monitoring system for environmental parameters monitoring. ARM based Raspberry Pi board can handle many operations and same one is used in this system. In this system there is no need of any external module, microcontroller and ADC. The proposed system uses IDLE text editor where programs can be written in Python. Output data can be seen on thingspeak.com using HTTP protocol. IoT means Internet of Things. It provides inter-networking of physical devices, buildings, vehicles and other components like sensors and actuators. By giving network connectivity to systems embedded with electronics, software, sensors. These objects are able to collect and exchange data. By using IoT objects to be sensed or controlled remotely through existing network. It gives opportunity to connect physical world with computer-based systems. IoT improves efficiency, accuracy, economic benefits along with reduced manpower. IoT frameworks help for the interaction between "things". Also supports for more complex structures like distributed computing and development of distributed applications. Now a day's most of IoT frameworks seem to focus on real-time data logging solutions

## 1.2 NEED OF PROJECT

Temperature monitoring systems is most important factor to handle and check for safety purpose. Temperature monitoring systems are incredibly useful tools to monitor and manage your heat levels at all of your remote telecom sites. While "too much heat" is the most common problem when dealing with computer systems, "too cold" is also a very real problem in some climates. A temperature monitoring system will help you to avoid heat buildup at your telecom locations, like huts and other network nodes. Temperature monitoring is also important at less industrial "IT" locations like server rooms and data centers.

The right temperature monitoring system will enable you to keep track of critical temperatures at all of your sites that contain important computer gear. The first consideration you have in evaluating temperature monitoring systems is what type of sensor to use. Analog sensors are superior to digital sensors, because they measure temperature across a continuous range. Digital temperature monitoring, by contrast, will only tell you if the temperature is above or below a pre-determined value. There's no way to know how much the temperature has risen (or fallen) beyond the temperature you specify. Analog sensors are recommended in most cases when you're setting up a temperature monitoring system. That's because, even as they offer the ability to check the precise temperature at any time, they can send you alerts when a specific threshold is crossed (the only real value of a digital sensor). If cost is a big factor in your decision, however, a digital temperature sensor is 100% more useful than nothing at all.

## 1.3 SCOPE OF PROJECT

1. To develop a temperature monitoring and alert system using PIC microcontroller and Wi-Fi module that is connected to the raspberry pi.
2. To write a program that can send signal using assembly language in PIC C Compiler and also using python language.
3. To combine the system to be one complete system that can be user friendly.
4. To use this system any applications.

# CHAPTER 2

# LITRATURE REVIEW

(ColakIlhami 2008) developed Internet controlled heating Ventilation Air Conditioning (HVAC) system. The system can be controlled by three different units (web based remote control, remote control by hand-held device and keypad control mounted on AC). The hardware system of AC is controlled by PIC16F877 microcontroller. A DAQ board inserted into PCI bus of web server is used to control system over web. User is able to access system parameters over web by logging and setting parameters on forms available on main control page. User submits forms to web server having CGI program which performs requested tasks and reports status of system operation.

(Liu Zhong-xuan 2010) designed wireless temperature monitoring system based on the GPRS (General Packet Radio Service) and the MCU (Micro programmed Control Unit). System is based on 89C58 microcontroller and PIML GPRS-MODEM as the core, can collect data from eight sensors, control two-way Data Acquisition, in the local real-time display and support remote Internet monitoring. The data from sensors are encoded, sent to the WEB server (fixed IP address or fixed domain name website) through the GPRS channel. The system also accepts commands from temperature monitoring system.

(P. Susmithan 2014) the basic point of a work based on microcontroller is to manufacture an implanted framework to plan an air checking framework which empowers the saw of climate parameters in an industry. This type of work includes different sensors like Gas sensors, temperature sensors, and dampness sensors which were observed with the use of ARM 9 LPC1768 microcontrollers. The following framework utilizes a complex circuit developed with ARM 9 processor.

Embedded C programming is used. Scheduling is done with the use of JTAG in association with ARM 9 processor. In a work presented during it screens and shows the temperature, weight and similarly dampness of the sky, utilizing simple and advanced segments. The following Fig. 2 shows the microcontroller connected to sensor which provides digital signal to the microcontroller. Sensor module itself converts the analog signal into digital signals and sends serially to the microcontroller.

The basic point of a work based on microcontroller is to manufacture an implanted framework to plan an air checking framework which empowers the saw of climate parameters in an industry. This type of work includes different sensors like Gas sensors, temperature sensors, and dampness sensors which were observed with the use of ARM 9 LPC1768 microcontrollers. The following framework utilizes a complex circuit developed with ARM 9 processor. Embedded C programming is used. Scheduling is done with the use of JTAG in association with ARM 9 processor.

In GSM based systems a gadget for ongoing climate observing is displayed to screen the constant temperature, environmental weight, relative dampness and air's dew point temperature through such system which is utilizing simple and advanced parts. In the following system of digital signals are obtained from analog signals and database is altered according to the program designed for displaying user-friendly outcomes in terms of pressure on a display.

The microcontroller should be also low power consuming alongside all the remaining sensors also low power consuming. We have chosen LPC2148 which is low power microcontroller and works with only 3.3v. The next study went on the data logger methods on web page. The data collected from the sensors is mostly in the form of integer values representing the value of environmental parameter. The web page displaying the data of sensors directly will not make a simpler impression for the users. It should be in a graphical representation for easy understanding of the users. The data hosted on an own web page will be more expensive and have to pay for it in a rental basis. To make the system less expensive.

## 2.1 INTERNET OF THINGS

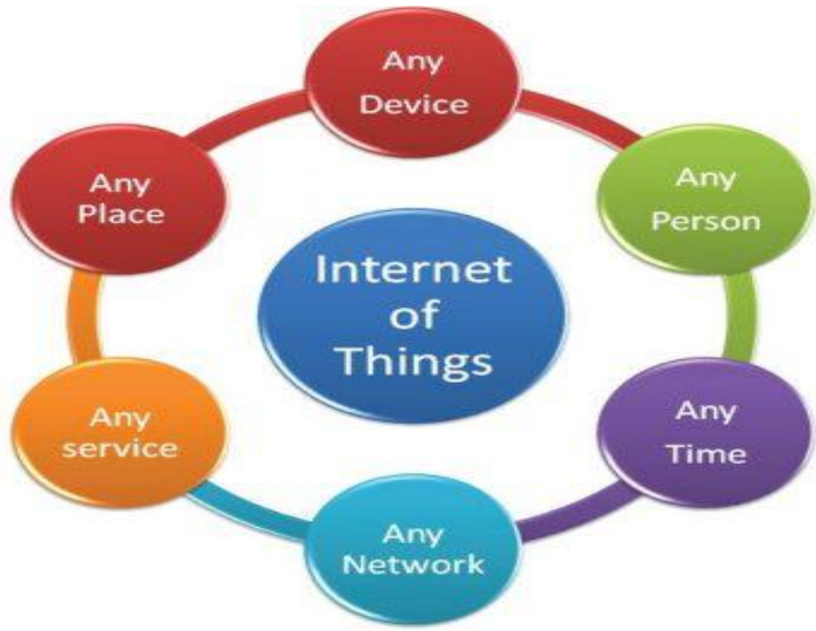


Fig 2.1 (a) diagram of IOT

The Internet of Things is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. As of 2016, the vision of the Internet of things has evolved due to a convergence of multiple technologies, including ubiquitous wireless communication, real-time analytics, machine learning, commodity sensors, and systems. This means that the traditional fields of embedded systems, wireless sensor networks, control system, automation systems and others all contribute to enabling the Internet of things.

Internet of Things A network of internet-connected objects able to collect and exchange data using embedded sensors. All the components that enable businesses, governments, and consumers to connect to their IoT devices, including remotes, dashboards, networks, gateways, analytics, data storage, and security. The IoT platform is a suite of components that enable: Deployment of applications that monitor, manage, and control connected devices. Remote data collection from connected devices. Independent and secure connectivity between devices. Device/sensor management.

The Internet of Things refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. The Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware.

### 2.1.1 APPLICATIONS

**(a) Media:**

In order to hone the manner in which things, media and big data are interconnected, it is first necessary to provide some context into the mechanism used for media process. It has been suggested by Nick Cloudy and Joseph Throw that practitioners in media approach big data as many actionable points of information about millions of individuals. The industry appears to be moving away from the traditional approach of using specific media environments such as newspapers, magazines, or television shows and instead tap into consumers with technologies that reach targeted people at optimal times in optimal locations. The ultimate aim is, of course, to serve or convey, a message or content that is (statistically speaking) in line with the consumer's mindset. For example, publishing environments are increasingly tailoring the messages (articles) to appeal to consumers that have been exclusively gleaned through various data-mining activities.

The media industries process big data in a dual, interconnected manner

- Targeting of consumers (for advertising by marketers)
- Data-capture

**(b) Environmental monitoring**

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource-constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile. It has been argued that the standardization IoT brings to wireless sensing will revolutionize this area

**(c) Infrastructure management**

Monitoring and controlling operations of urban and rural infrastructures like bridges, railway tracks, on- and offshore- wind-farms is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT

**(d) Manufacturing**

Network control and management of manufacturing equipment, situation management, or manufacturing process control bring the IoT within the realm of industrial applications and smart manufacturing as well. The IoT intelligent systems enable rapid manufacturing of new products, dynamic response to product demands, and real-time optimization of manufacturing production and supply chain networks, by networking machinery, sensors and control systems together.

Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT but it also extends itself to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability. Smart industrial management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by a large number of networked sensors.

**(e) Agriculture**

The IoT contributes significantly towards innovating farming methods. Farming challenges caused by population growth and climate change have made it one of the first industries to utilize the IoT. The integration of wireless sensors with agricultural mobile apps and cloud platforms helps in collecting vital information pertaining to the environmental conditions temperature, rainfall, humidity, wind speed, pest infestation, soil humus content or nutrients, besides others – linked with a farmland, can be used to improve and automate farming techniques, take informed decisions to improve quality and quantity, and minimize risks and wastes. The app-based field or crop monitoring also lowers the hassles of managing crops at multiple locations. For example, farmers can now detect which areas have been fertilized (or mistakenly missed), if the land is too dry and predict future yields.

**(f) Medical and Healthcare**

IoT devices can be used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fit bit electronic wristbands, or advanced hearing aids.[49] Some hospitals have begun implementing "smart beds" that can detect when they are occupied and when a patient is attempting to get up. It can also adjust itself to ensure appropriate pressure and support is applied to the patient without the manual interaction of nurses.

Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well. Other consumer devices to encourage healthy living, such as, connected scales or wearable heart monitors, are also a possibility with the IoT. More and more end-to-end health monitoring IoT platforms are coming up for antenatal and chronic patients, helping one manage health vitals and recurring medication requirements.

## 2.2 How the Internet of Things Works?

Many of us have dreamed of smart homes where our appliances do our bidding automatically. The alarm sounds and the coffee pot starts brewing the moment you want to start your day. Lights come on as you walk through the house. Some unseen computing device responds to your voice commands to read your schedule and messages to you while you get ready, then turns on the TV news. Your car drives you to work via the least congested route, freeing you up to get caught up on your reading or prep for your morning meeting while in transit.

We've read and seen such things in science fiction for decades, but they're now either already possible or on the brink of coming into being. And this entire new tech is forming the basis of what people are calling the Internet of Things. The phrase "Internet of Things" was coined by Kevin Ashton, likely in 1999 as the title of a corporate presentation he made at his place of employment, Proctor & Gamble. During his time there, Ashton came up with the idea of putting a RFID tag on each lipstick and having them communicate with a radio receiver on the shelf to track sales and inventory and signal when restocking was needed. He posits that such data collection can be used to solve lots of problems in the real world.

Billions of connected devices are part of the Internet of Things. They use built-in hardware and software to send and receive data via various communication protocols. They might use our smartphones as their gateway to the Internet, connect to some other piece of hardware in our homes that's acting as a hub or connect directly through our home Internet service. They often send data to cloud-computing servers where it's then aggregated and analyzed. We can usually access the results via apps or browsers on our mobile devices or home computers. Some can even be set up to update your status on various social networks.

## 2.3 PYTHON

Python is a widely used high-level programming language for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java. It has a large and comprehensive standard library. Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. CP python, the reference implementation of Python, is open source software and has a community-based development model, as do nearly all of its variant implementations. CP python is managed by the non-profit Python Software Foundation.

### 2.3.1 HISTORY

Python was conceived in the late 1980s and its implementation began in December 1989 by Guido van Rossum at Centrum Wiskunde &Informatics (CWI) in the Netherlands as a successor to the ABC language (itself inspired by SETL) capable of exception handling and interfacing with the operating system Amoeba. Van Rossum is Python's principal author, and his continuing central role in deciding the direction of Python is reflected in the title given to him by the Python community. About the origin of Python, Van Rossum wrote in 1996. Python 2.0 was released on 16 October 2000 and had many major new features, including a cycle-detecting garbage collector and support for Unicode. With this release the development process was changed and became more transparent and community-backed.

Python 3.0 (that early in its development was commonly referred to as Python 3000 or py3k), a major, backward-incompatible release, was released on 3 December 2008 after a long period of testing. Many of its major features have been back ported to the backwards-compatible Python 2.6.xand 2.7.x version series. The End of Life date (EOL, sunset date) for Python 2.7 was initially set at 2015, then postponed to 2020 out of concern that a large body of existing code cannot easily be forward-ported to Python.

## 2.4 RASPBERRY PI

The raspberry pi is a small computer about the size of a credit card and Indian costs approximately Rs4095. It was developed in the UK by the Raspberry pi foundation with the hope of inspiring a generation of learners to be creative and to discover how computer are programmed and how they function. The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Foundation to 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 have been sold before February 2015, making it the best-selling British computer. By November 2016 they had sold 11 million units in March 2017 12.5m making it the third best-selling "general purpose computer" ever. Several generations of Raspberry pi have been released. The first generation (Raspberry Pi 1 Model B) was released in February 2012. It was followed by the simpler and cheaper Model A. In 2014, the Foundation released a board with an improved design in 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) RAM**

On the older beta Model B boards, 128 MB was allocated by default to the GPU, leaving 128 MB for the CPU. On the first 256 MB release Model B (and Model A), three different splits were possible. The default split was 192 MB (RAM for CPU), which should be sufficient for standalone 1080p video decoding, or for simple 3D, but probably not for both together. 224 MB was for Linux only, with only a 1080p frame buffer, and was likely to fail for any video or 3D. 128 MB was for heavy 3D, possibly also with video decoding (e.g. XBMC).Comparatively the Nokia 701 uses 128 MB for the Broadcom Video Core IV. The Raspberry Pi 2 and the Raspberry Pi 3 have 1 GB of RAM. The Raspberry Pi Zero and Zero W have 512 MB of RAM.

**b) Networking**

The Model A, A+ and Pi Zero have no Ethernet circuitry and are commonly connected to a network using an external user-supplied USB Ethernet or Wi-Fi adapter. On the Model B and B+ the Ethernet port is provided by a built-in USB Ethernet adapter using the SMSC LAN9514 chip. The Raspberry Pi 3 and Pi Zero W (wireless) are equipped with 2.4 GHz Wi-Fi 802.11n (150 Mbit/s) and Bluetooth 4.1 (24 Mbit/s) based on Broadcom BCM43438 Full MAC chip with no official support for Monitor mode but implemented through unofficial firmware patching and the Pi 3 also has a 10/100 Ethernet port

**c) Real-time clock**

None of the current Raspberry Pi models have a built-in real-time clock, so they are unable to keep track of the time of day independently. As a workaround, a program running on the Pi can retrieve the time from a network time server or from user input at boot time, thus knowing the time while powered on. To provide consistency of time for the file system, the Pi does automatically save the time it has on shutdown, and re-installs that time at boot. A real-time hardware clock with battery backup, such as the DS1307, which is fully binary coded, may be added (often via the $I^2C$ interface).

### 2.4.1 THE TYPES OF RASPBERRY PI

**a) Raspberry Pi 3 Model B**

Raspberry Pi is a tiny affordable computer that can be programmed easily. It can be easily connected to network using an external user supplied USB Ethernet or Wi-Fi adapter. It has internal RAM to store the data and also it has micro SD port for loading operating system and storing data. It is used as central control and monitoring unit. It has Broadcom BCM2837 ARM7 quad core processor. The main task of raspberry pi is to process data coming from Wi-Fi, after processing give response to it. Whenever bill is paid by customer then set point is fixed by the raspberry pi. All the record of individual flat is collected by the Wi-Fi module and stored in it.

Fig. 2.4.1(a) Raspberry Pi 3 module B

**FEATURE:**

1. Broadcom BCM2837 64bit ARMv7
2. 1GB RAM
3. BCM43143 Wi-Fi on board
4. Bluetooth Low Energy (BLE) on board
5. 40pin extended GPIO
6. 4 x USB 2 ports
7. 4 pole Stereo output and Composite video port
8. Full size HDMI

**b) Raspberry Pi 2 Model B**


Fig 2.4.2(b) Raspberry Pi 2 Model B

The Raspberry Pi 2 delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte.The Raspberry Pi 2 Model B is the second-generation Raspberry Pi. It replaced the original Raspberry Pi 1 Model B in February 2015.

**FEATURE:**

1. 4 USB ports
2. 40 GPIO pins
3. Full HDMI port
4. Ethernet port
5. Combined 3.5mm audio jack and composite video
6. Camera interface (CSI)
7. Display interface (DSI)
8. Micro SD card slot
9. Video Core IV 3D graphics core

**c) Raspberry Pi Model B+**

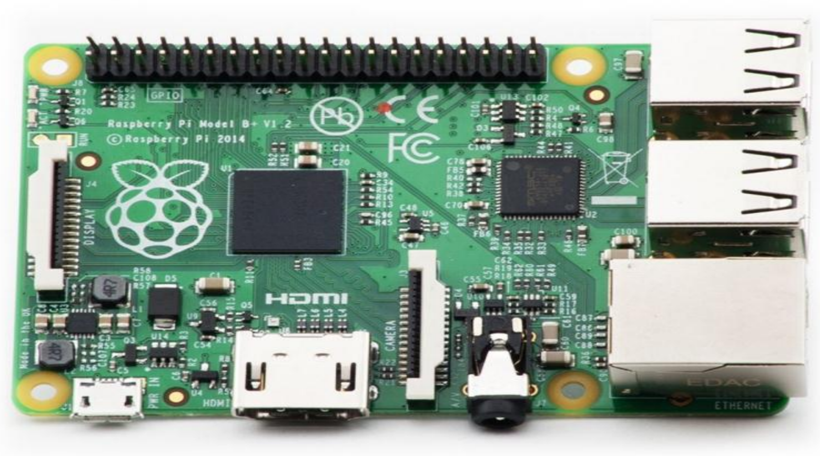

Fig 2.4.3(c) Raspberry Pi Model B+

The Raspberry Pi has the capability to run operating systems based in Kernel Linux 1 or even Android. It was created by the Raspberry Pi Foundation with intention of promoting the teaching of basic computer science in schools [1]. Actually it is possible to find numerous interesting projects for this device. The Raspberry Pi could be consider as a complete computer therefore, has the main features of this as processor, RAM memory and input and output peripherals I/O like USB, Ethernet, HDMI. Nowadays there are 2 versions, the model A and model B.

**FEATURE:**

1. Broadcom BCM2387 chipset.
2. 1.2GHz Quad-Core ARM Cortex-A53.
3. Memory (SDRAM) 256MB 512MB
4. USB Ports - 2.
5. On-board Networking None 10/100.
6. Ethernet Power Ratings 300mA 700mA.

## 2.4.2 DIFFERENCE BETWEEN VERSIONS OF RASPBERRY PI

| **Parameter** | **Raspberry Pi Model B+** | **Raspberry Pi 2 Model B** | **Raspberry Pi 3 Model B** |
|---|---|---|---|
| **Released** | February 2012 | February 2015 | February 2016 |
| **CPU** | ARM 1176JZES | ARM Cortex A7 | ARM Cortex A53 |
| **CPU Speed** | 700MHz | 900MHz | 1200MHz |
| **RAM** | 512MB | 1GB | 1GB |
| **GPU** | Broadcom video core IV | Broadcom video core IV | Broadcom video core IV |
| **Storage** | Micro SDHC slot | Micro SDHC slot | Micro SDHC slot |
| **USB Port** | 2port | 4port | 4port |
| **Wi-Fi** | NO | NO | NO |

## 2.5 TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4° cover a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and aplastic TO-220 package

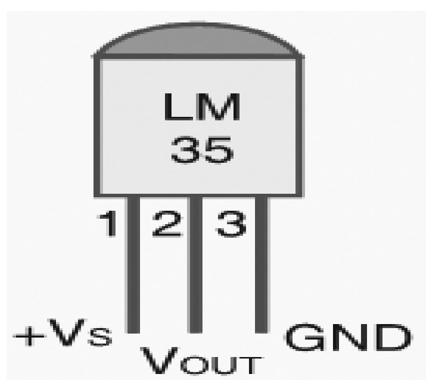


Fig 2.5 (a) pin diagram of LM35

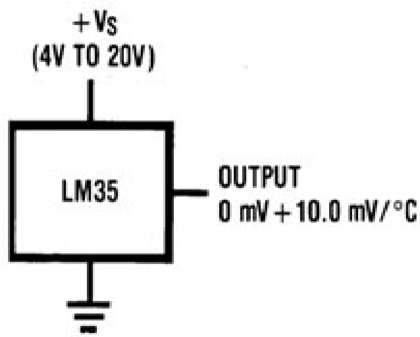


Fig 2.5 (b) Connection diagram

### 2.5.1 Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 W for 1 mA

## 2.6 WIRELESS TRASMISSION 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. 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.

Fig 2.6 (a) Symbol of Wi-Fi

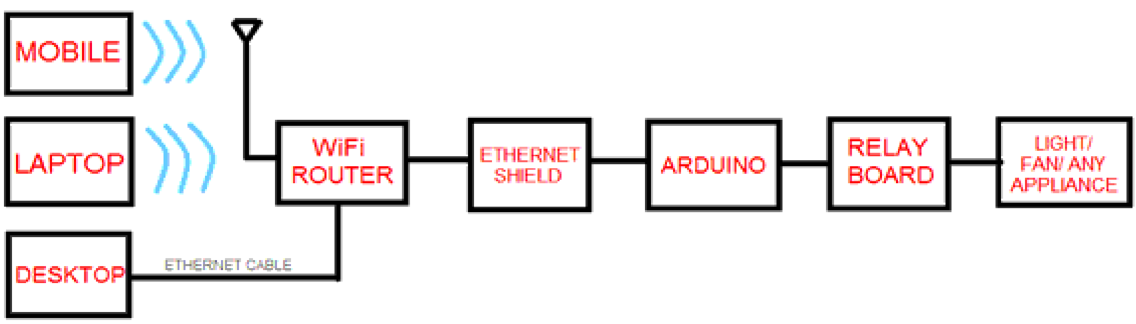


Fig 2.6 (b) Block Diagram of Wi-Fi

The Wi-Fi signal range depends on the frequency band, radio power output, antenna gain and antenna type as well as the modulation technique. Line-of-sight is the thumbnail guide but reflection and refraction can have a significant impact. An access point compliant with either 802.11b or 802.11g, using the stock antenna might have a range of 100 m (0.062 mi). A wireless network uses radio waves, just like cell phones, televisions and radios do. In fact, communication across a wireless network is a lot like two-way radio communication. Here's what happens:

- A computer's wireless adapter translates data into a radio signal and transmits it using an antenna.
- A wireless router receives the signal and decodes it. The router sends the information to the Internet using a physical, wired Ethernet connection.

The process also works in reverse, with the router receiving information from the Internet, translating it into a radio signal and sending it to the computer's wireless adapter.

Here we used Wi-Fi module which is having TCP/IP protocol stack integrated on chip. So that it can provide any microcontroller to get connected with Wi-Fi network. Wi-Fi is a preprogrammed SOC and any microcontroller have to communicate with it through UART interface. It works with a supply voltage of 3.3v. The module is configured with AT commands and the microcontroller should be programmed to send the AT commands in a required sequence to configure the module in client mode.

The module can be used in both client and server modes. Once it gets connected in a Wi-Fi network, we'll get one IP address which is accessible in its local network. The module is additionally having 2 GPIO pins alongside UART pins. It is also having inbuilt SPI protocol by using the two pins of UART as data lines and by configuring the two GPIO pins as control lines and clock signal. It is also having 1MB on-chip flash memory. Internally it is having power management unit with all regulators and PLLs. The on-chip processor it is having is a 32 bit CPU.

### 2.6.1 DIFFERENCE BETWEEN WIRELESS TRANSMISION

| PARAMETER | BLUETOOTH | ZIGBEE | Wi-Fi |
|---|---|---|---|
| **Frequency band** | 2.4GHz | 2.4GHz | 2.4GHz |
| **Physical layer** | IEEE 15.802.1 | IEEE 802.15.4 | I<br>EEE 15.11b |
| **Range** | 9M | Indoor –up to 30M<br>Outdoor-up to 90M | 75-90M |
| **Data rate** | 1Mbps | 250kbps | 11Mbps |
| **No. of channels** | 19 | 16 | 13 |
| **Minimum bandwidth** | 15MHz | 3MHz | 22MHz |
| **Maximum no. of nodes** | 7 | 64k | 32 |
| **Protocol stack size** | 250kb | 32kb | 1Mb |
| **Current consumption** | 60mA | 25-35mA | 400mA |

## 2.7 PIC16F877 MICROCONTROLLER

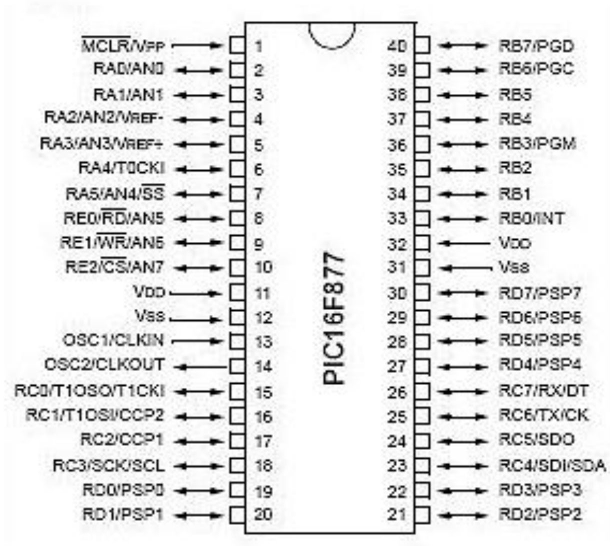


Fig. 2.7 (a) Pin diagram of PIC16F877 microcontroller

PIC is Peripheral Interface Controller. PIC a family of modified Harvard architecture microcontroller made microchip technology original developed by general instrument division. PIC16F877 Many things should be considered before choosing a microcontroller as the controller. There is more no. of microcontrollers that was easy to find at electronics store such as ATMEL, Motorola's family and microchip product which is PIC. Basically this entire microcontroller capable to act as a controller but it's depends on the types of project that we build. It is because some of these microcontrollers have limited abilities in terms of lacking data memories and less of Input/output pins. Amongst these microcontrollers, PIC6F877 have extra advancement. This device was built with special features such as 100,000 erase/write cycle enhanced flash program memory typical, self-reprogrammable under software control, In-Circuit Serial Programming via two pins, programmable code protection and power saving sleep mode.

PIC16F887 devices have a Watchdog Timer which can be shut-off only through configuration bits. It runs off its own RC oscillator for added reliability. There are two timers that offer necessary delays on power-up. One is the Oscillator Start-up Timer (OST), intended to keep the chip in Reset until the crystal oscillator is stable. The other is the

Power-up Timer (PWRT), which provides a fixed delay of 72 ms (nominal) on power-up only. It is designed to keep the part in reset while the power supply stabilizes. With these two timers on-chip, most applications need no external reset circuitry. The data EEPROM and Flash program memory is readable and writable during normal operation. This memory is not directly mapped in the register file space. Instead, it is indirectly addressed through the Special Function Registers. These devices have 128 or 256 bytes of data EEPROM with an address range from 00h to FFh. On devices with 128 bytes, addresses from 80h to FFh are unimplemented and will wraparound to the beginning of data EEPROM memory. For PIC16F877, addresses above the range of the respective device will wraparound to the beginning of program memory.

The EEPROM data memory allows single-byte read and writes. The Flash program memory allows single-word reads and four-word block writes. Program memory write operations automatically perform an erase-before write on blocks of four words. A byte write in data EEPROM memory automatically erases the location and writes the new data (erase before-write). The write time is controlled by an on-chip timer. The write/erase voltages are generated by an on-chip charge pump, rated to operate over the voltage range of the device for byte or word operations. When the device is code-protected, the CPU may continue to read and write the data EEPROM memory. Depending on the settings of the write-protect bits, the device may or may not be able to write certain blocks of the program memory; however, reads of the program memory are allowed. When code-protected, the device programmer can no longer access data or program memory; this does NOT inhibit internal reads or writes.

# CHAPTER 3

# SYSTEM REVIEW

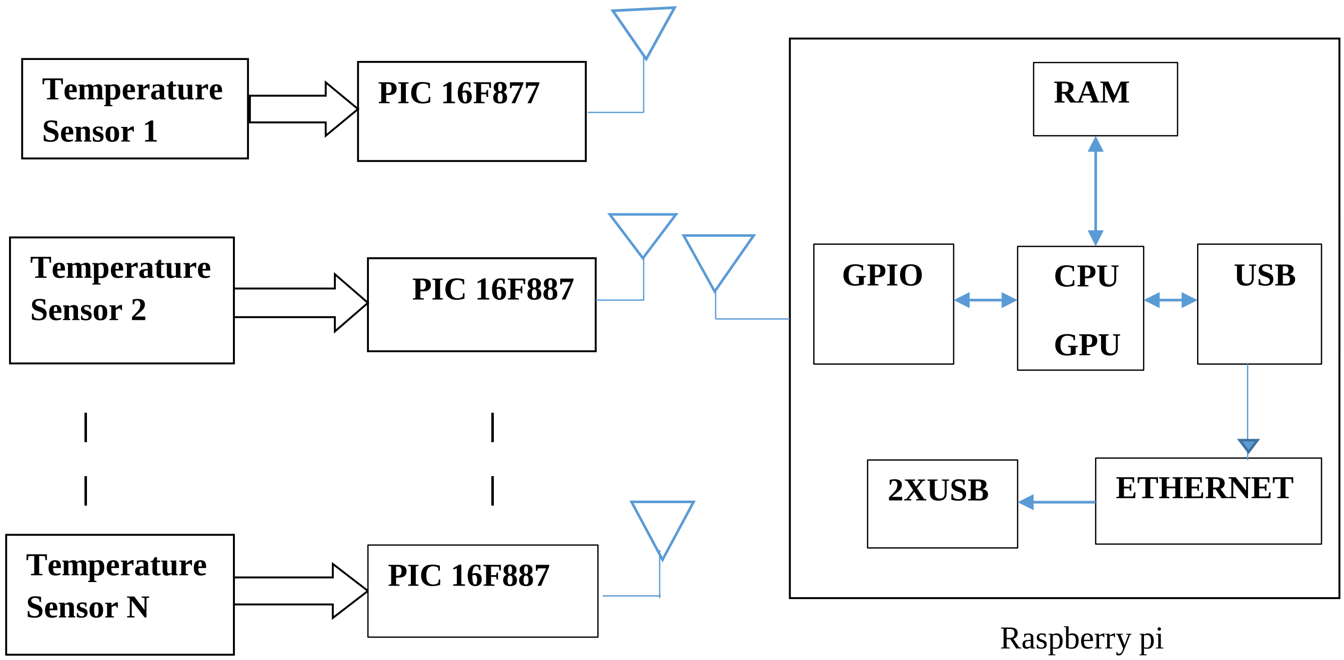


Fig 3.1 diagram of system

## 3.1 System description

This system is a Temperature Monitoring System Using Wireless Sensor Network. The system consists of more number of temperature sensors, more number of PIC 16F877 microcontroller, Wi-Fi module and development board of Raspberry pi. Temperature sensor sense the temperature. Sensor unit is a basically consists of temperature sensors, which detects the temperature of the environment. The information being sensed by the sensors are the analog values, but the PIC microcontroller works on digital values. The analog values are converted in digital values by the analog to digital convertor, which is in built in PIC microcontroller. Using the Wi-Fi modules at the transmitting side, the pic microcontroller sends the data at the monitoring unit.

The ADC is convert analog temperature into digital temperature PIC 16F877 High-Performance RISC CPU and Only 35 single word handling instructions all single-cycle instructions. Up to 8K x 14 words of Flash Program Memory. Sensor node also called as mote in North America. Function of sensor node is sense the input signal and it gives the output in the form of analog voltage using ADC we can convert it into digital. Sensor means which stimulus input like pressure, temperature, sound, vibration, motion and convert it into analog or digital depends upon types of sensor.

PIC 16F877 perform data processing and control the functions of sensor node. We are using Wi-Fi for wireless communication. 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. We are using Wi-Fi because it provides networking topology. It provides large communication range between devices. These are two main advantages over Bluetooth so that we are using Wi-Fi for this project. Wi-Fi is a specification a suite of high level communication protocols using small, low-power digital radio or wireless home area networks, such as wireless light switches with lamps, electrical meters with in-home-displays, consumer electronics equipment via short-range radio.

The technology defined by the specification is intended to be simpler and less expensive than other WPAN such as Bluetooth. Wi-Fi is targeted at radio frequency (RF) applications that require a low data rate, long battery life, and secure networking. Wi-Fi is wireless mesh networking standard. First, the low cost allows the technology to be widely deployed in wireless control and monitoring applications. Second, the low power-usage allows longer life with smaller batteries. Third, the mesh networking provides high reliability and more extensive range. Bluetooth it is a short range personal area network.

Measuring temperature is one of the most common technique used because it is important for many operations and tasks to be performed like in any industries where heaters are used, heat up to a certain temperature is required. When it comes to sensing temperature, a temperature sensor is used that is installed at a place whose temperature is to be sensed. The temperature of that place can be monitored through internet using internet of things. Monitoring is employed in various applications, including temperature, pressure, flow rate, capacity, acceleration, and so on. According to the quantities, distribution and detected frequency of the monitored objects, there are different monitoring methods to acquire the measurements. Several problems usually occur during the monitoring process of the temperature in a room. For example, a server room must be kept between 15 to 20 degree Celsius to monitor a temperature in or else the server might crash and can cause a loss of hundreds thousands. Management has to choose either to place a person to monitor the temperature, or to save on human capital by developing a system that can monitor the temperature from other places at any given time.

In order to solve the problem, the web-based temperature monitoring system that can be access anywhere and anytime through the Internet is build. With this system a user can remotely monitor the room temperature from anywhere which could save the human expenses. IoT Based Temperature Monitoring is one type of temperature recorder that monitors a temperature in a room and stores the data into a database and display the current temperature on the website through a web server. The system will continuously monitor the temperature condition of the room and the data can be monitored at anytime and anywhere from the Internet. The temperature monitoring is widely used in various processes like in automotive industries, air conditioning, power plant and other industries that need the data to be saved and analyzed. The main purpose of this system model is to make it easy for the user to view the current temperature.

# CHAPTER 4

## 4.1 ADVANTAGES, DISADVANTAGES, APPLICATIONS

### 4.1.1 Advantages

Advantages of Temperature Monitoring System Using IOT are following

1. This system gives real time response.
2. This system can protect human life.
3. It has low cost.
4. This system is an autonomous early detection.
5. It is possible to remote area application using renewable energy sources.
6. This system is low power consumption and easy to install.
7. It requires no operating system for this hardware which results in reduction of cost and portability.
8. This system continuous surveillance is done through monitoring section.

### 4.1.2 Disadvantages

Disadvantages of Temperature Monitoring System Using IOT are following

1. This system susceptibility to self-heating error.
2. This system due to temperature variations after sometimes its efficiency may decreases.

### 4.1.3 Applications

Applications of Temperature Monitoring System Using IOT are following

1. This system is used in intelligent building medicines
2. This system used in health care.
3. This system used in military target tracking and surveillance, energy and resources saving.
4. This system used in intelligent agricultural and environmental sensing is the most important application.

# CHAPTER 5

## FUTURE SCOPE

The Internet of Things which can work perfectly and monitor the area and received information can be stored into the database. We can work to test network performances in industrial applications. We can also connect external sensors to the DAC and further it can be used in Temperature monitoring system. In future it is possible to develop a system for monitoring and controlling. More research work needs to be done in future. Needs to be implemented in an Internet of Things with mobile number nodes. The effective of very large node densities need to be investigated. The feasibility of using the clustering technique and data aggregation needs to be tested needs to be tested in the same Internet of Things.

# CHAPTER 6

## CONCLUSION

This project presents the Real time Temperature sensing using Raspberry Pi. Other supplementary sensors like Piezo Vibration Sensor, Humidity sensor, Barometer Sensor, Presser Sensor, DHT Sensor can be connected to the Raspberry Pi kit making it effectively storing and displaying atmospheric conditions in real time. The detected data can be transferred from Raspberry pi to the Laptop and in the subsequent pace it can be stored into the cloud from Laptop for remote monitoring and further retrieval. The research and implementation of a system for monitoring the environmental parameters using IoT scenario is accomplished. The system provides a low power solution for establishing a weather station. The system is tested in an indoor environment and it is successfully updated the weather conditions from sensor data. It is also a less expensive solution due to usage of low power wireless sensors and SoC contained Wi-Fi module

# CHAPTER 7

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