

INDUSTRIAL MONITORING SYSTEM BASED ON IoT

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree

in

Electronics and Communication Engineering

by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHISALAI, CHENNAI – 600119

APRIL - 2023



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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Final Year Project Report is the bonafide work of B.NIVAS KUMAR REDDY (39130072), K.BADRINATH REDDY (39130246) who carried out the project entitled "**INDUSTRIAL MONITORING SYSYTEM BASED ON IoT**" under supervision from November 2022 to April 2023.

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DECLARATION

We B.NIVAS KUMAR REDDY(39130072),K.BADRINATH REDDY(39130072) hereby declare that the Project Report entitled “**INDUSTRIAL MONITORING SYSYTEM BASED ON IoT**” done by us under the guidance of **Dr. M.R.EBENEZAR JEBARANI M.E., Ph.D.**, at **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Electronics and communication Engineering.

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DATE: 23.04.2023

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1 
2 

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ABSTRACT

Nowadays, gas leakage is a major issue in the home and as well as industries. The sense of the gas is very low means can't find it because of human negligence or lack of patience or some other external condition. If the gas level is increased, it causes some disaster. 1, to avoid this disaster in advance, the alternative idea is discussed. The system is developed with embedded sensors, controllers, and some IoT-based software. In this system monitoring the detection of LPG gas leakages with some alerting features. Some sensors are used to monitor the different parameters like Temperature sensors, gas sensors (MQ6), flame sensors (LM 2903), PIR sensors (HC-SR 501), and GSM module. The sensors all are collect their information in their respective field and send data and it will perform. Industrial safety is one of the main aspects of industry specially mining industry. In the industry safety is a very vital factor. To avoid loss of material and damaging of human health, protection system as well as faithful communication system is necessary inside the underground mines. To increase both safety and productivity in mines, a reliable communication must be established between workers, moving in the mine, and a fixed base station. Inside mines, the wired communication system is not so effective, because of wires can be damaged inside. In this project is going to monitor the parameters like abnormal gas, temperature and fire sensors to avoid the harmful gas or high temperature attacking the workers. In this project to avoid loss of material and damaging of human health in workers because of using Microcontroller. To design multi parameter monitoring system using Microcontroller that measures and controls various global parameters and the system comprises with wireless mode of communication. These process were managed using microcontroller. Microcontroller can sends data to the other system using wireless communication. The GSM will send the message to the particular user.

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
	ABSTRACT	v
	LIST OF FIGURES	vi
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 objective	1
	1.3 Internet of Things	2
2	LITERATURE SURVEY	18
3	EXISTING SYSTEM	21
	3.1 Existing system	21
4	PROPOSED SYSTEM	22
	4.1 proposed system	22
	4.2 Arduino UNO Controller	24
	4.3 Gas sensor	25
	4.4 Temperature sensor	27
	4.5 Fire sensor	29
	4.6 PIR sensor	31
	4.7 GSM Modem	32
	4.8 GPS Module	35
	4.9 Wi-Fi Module	36
	4.10 Software implementation	37

5	RESULTS AND DISCUSSIONS	40
6	CONCLUSIONS AND FUTURE SCOPE	42
	6.1 CONCLUSIONS	42
	6.2 FUTURE SCOPE	42
	REFERENCES	43

LIST OF FIGURES

FIGURE NO	TITLE	PAGE NO
1.1	IoT Diagram	2
1.2	IoT Cloud Diagram	3
1.3	IoT Architecture	4
1.4	Internet of Things	6
1.5	Basic Embedded System	7
1.6	Typical IoT Ecosystem	8
1.7	IoT Technology Stack	10
1.8	Decision Area of the IoT Decision Framework	10
1.9	Stages of IoT Solutions Architecture	12
1.10	The 4 stages IoT Solutions Architecture	13
1.11	Smart objects	14
1.12	IoT Devices	16
1.13	IoT Devices and Technology	17
3.1	Existing system diagram	21
4.1	Proposed system diagram	23
4.2	Arduino UNO	24
4.3	Gas sensor	25
4.4	Temperature sensor	27
4.5	Fire sensor	30
4.6	Flame sensor	31
4.7	PIR sensor	32
4.8	GSM Module	33
4.9	GSM Network Elements	33
4.10	GPS sensor	35
4.11	Wi-Fi Module	36

4.12	Open Arduino IDE	37
4.13	Arduino IDE platform	37
4.14	Select the required arduino board	38
4.14	Sketch in Arduino IDE	38
4.15	Upload the sketch to Arduino board	39
5.1	Hardware of the project	40
5.2	Ouput screenshots	41

CHAPTER-1

1.1 INTRODUCTION

With the boom of mechanization and automation, industrial revolution has occurred in all parts of the world. This has increased the living standards of the common man and also contributed to the economic growth of the country. IoT has transformed itself to suite various fields namely home automation, smart buildings, smart cities and also significantly contributing towards health monitoring. The concept of Industrial IoT (IIoT) gained sufficient propaganda with the introduction of automation. IIoT has become the most sought after area of research since it aims at increase in productivity and efficiency. The number of vehicles and machines has increased to double fold within a span of twenty years. This in turn adversely affected the environment by increase in air and water pollution which resulted in bad impact in healthy life of people. As per the environment reports, due to tremendous increase in population and industries increase of environmental pollution has increased day by day. Allergic problems related to throat, eyes are becoming common irrespective of the age groups. Heart problems, asthma and bronchitis are the adverse effects of pollution. This scenario gave rise to the need of an intelligent pollution monitoring system. The awareness of air quality monitoring and environmental responsibility is gaining popularity. Conventional air pollution monitoring can give accurate results by empirical analysis, but the big data analysis becomes complex with increased cost.

1.2 OBJECTIVE

IoT-enabled industrial monitoring systems have become increasingly popular in a variety of industries because they improve safety standards by providing real-time monitoring of critical parameters such as temperature, humidity, and smoke, as well as alerting officials and workers regularly

1.3 IOT (Internet of Things):

IoT stands for Internet of Things, which means accessing and controlling daily usable equipments and devices using Internet.

IoT tutorial includes all topics of IoT such as introduction, features, advantage and disadvantage, ecosystem, decision framework, architecture and domains, biometric, security camera and door unlock system, devices, etc.

1.3.1 What is an Internet of Things (IoT)

Let's us look closely at mobile device which contains GPS Tracking, Mobile Gyroscope, Adaptive brightness, Voice detection, Face detection etc. These components have their own individual features, but what about if these all communicate with each other to provide a better environment? For example, the phone brightness is adjusted based on my GPS location or my direction.

Connecting everyday things embedded with electronics, software, and sensors to internet enabling to collect and exchange data without human interaction called as the Internet of Things (IoT). As shown in below figure 1.1

The term "Things" in the Internet of Things refers to anything and everything in day to day life which is accessed or connected through the internet.

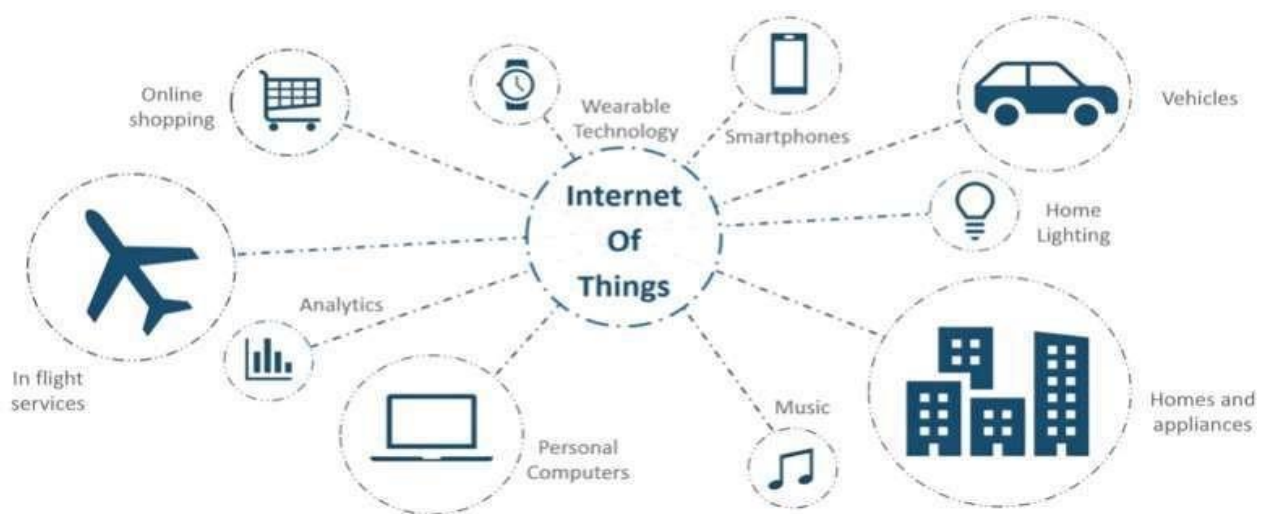


Figure 1.1 IoT Diagram

IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.

As a platform such as a cloud that contains all the data through which connect all the things around us. For example, a house, where can connect home appliances such as air conditioner, light, etc. through each other and all these things are managed at the same platform. Since have a platform, could connect car, track its fuel meter, speed level, and also track the location of the car and phenomenon has observed in the below figure 1.2



Figure 1.2 IoT Cloud diagram

If there is a common platform where all these things can connect to each other would be great because based on my preference, I can set the room temperature. For example, if I love the room temperature to be set at 25 or 26-degree Celsius when I reach back home from my office, then according to my car location, my AC would start before 10 minutes I arrive at home. This can be done through the Internet of Things (IoT).

1.3.2 How does Internet of Thing (IoT) Work?

The working of IoT is different for different IoT echo system (architecture). However, the key concept of there working are similar. The entire working process of IoT starts with the device themselves, such as smartphones, digital watches, electronic appliances, which securely communicate with the IoT platform. The platforms collect and analyze the data from all multiple devices and platforms and transfer the most valuable data with applications to devices that displayed in the below figure 1.3

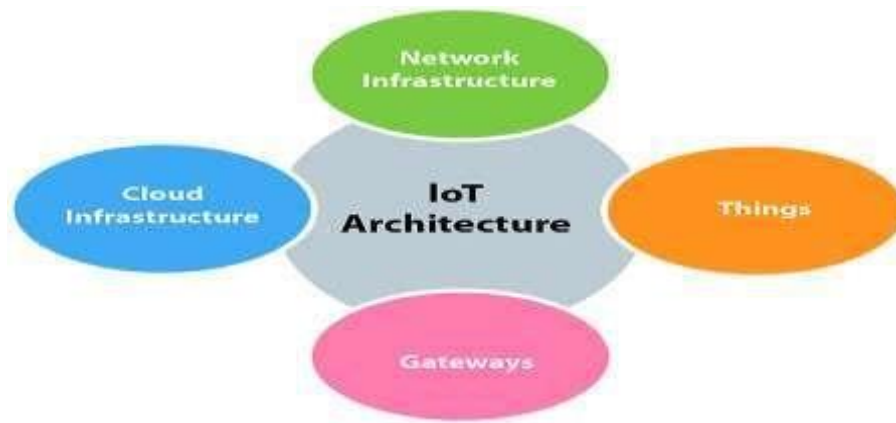


Figure 1.3 IoT Architecture

1.3.3 Features of IOT

The most important features of IoT on which it works are connectivity, analyzing, integrating, active engagement, and many more. Some of them are listed below:

Connectivity: Connectivity refers to establish a proper connection between all the things of IoT to IoT platform it may be server or cloud. After connecting the IoT devices, it needs a high speed messaging between the devices and cloud to enable reliable, secure and bi-directional communication.

Analyzing: After connecting all the relevant things, it comes to real-time analyzing the data collected and use them to build effective business intelligence. If have a good insight into data gathered from all these things, then call system has a smart system.

Integrating: IoT integrating the various models to improve the user experience as well.

Artificial Intelligence: IoT makes things smart and enhances life through the use of data. For example, if have a coffee machine whose beans have going to end, then the coffee machine itself order the coffee beans of your choice from the retailer.

Sensing: The sensor devices used in IoT technologies detect and measure any change in the environment and report on their status. IoT technology brings passive networks to active networks. Without sensors, there could not hold an effective or true IoT environment.

Active Engagement: IoT makes the connected technology, product, or services to active engagement between each other.

Endpoint Management: It is important to be the endpoint management of all the IoT system otherwise, it makes the complete failure of the system. For example, if a coffee machine itself order the coffee beans when it goes to end but what happens when it orders the beans from a retailer are not present at home for a few days, it leads to the failure of the IoT system. So, there must be a need for endpoint management.

1.3.4 Advantages and Disadvantages of (IoT)

Any technology available today has not reached to its 100 % capability. It always has a gap to go. So, could say that **Internet of Things** has a significant technology in a world that can help other technologies to reach its accurate and complete 100 % capability as well.

Let's take a look over the major, advantages, and disadvantages of the Internet of Things.

Advantages of IoT

Internet of things facilitates the several advantages in day-to-day life in the business sector. Some of its benefits are given below:

- **Efficient resource utilization:** If know the functionality and the way that how each device work definitely increase the efficient resource utilization as well as monitor natural resources.
- **Minimize human effort:** As the devices of IoT interact and communicate with each other and do lot of task for us, then they minimize the human effort.
- **Save time:** As it reduces the human effort then it definitely saves out time. Time is the primary factor which can save through IoT platform.
- **Enhance Data Collection:**

- **Improve security:** Now, if we have a system that all these things are interconnected then we can make the system more secure and efficient

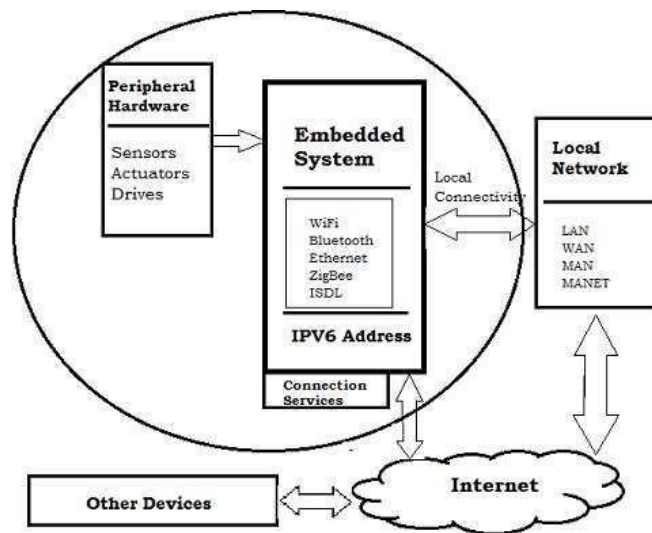
Disadvantages of IoT

As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below:

1.3.5 Embedded Devices (System) in (IoT)

It is essential to know about the embedded devices while learning the IoT or building the projects on IoT. The embedded devices are the objects that build the unique computing system. These systems may or may not connect to the Internet.

An embedded device system generally runs as a single application. However, these devices can connect through the internet connection, and able to communicate through other network devices and this connection has been observed in the below figure 1.4.



Internet of Things (IoT)
Figure 1.4 Internet of things

1.3.6 Embedded System Hardware

The embedded system can be of type microcontroller or type microprocessor. Both of these types contain an integrated circuit (IC).

The essential component of the embedded system is a RISC family microcontroller like Motorola 68HC11, PIC 16F84, Atmel 8051 and many more. The most important factor that differentiates these microcontrollers with the microprocessor like 8085 is their internal read and writable memory. The essential embedded device components and system architecture are specified below figure 1.5

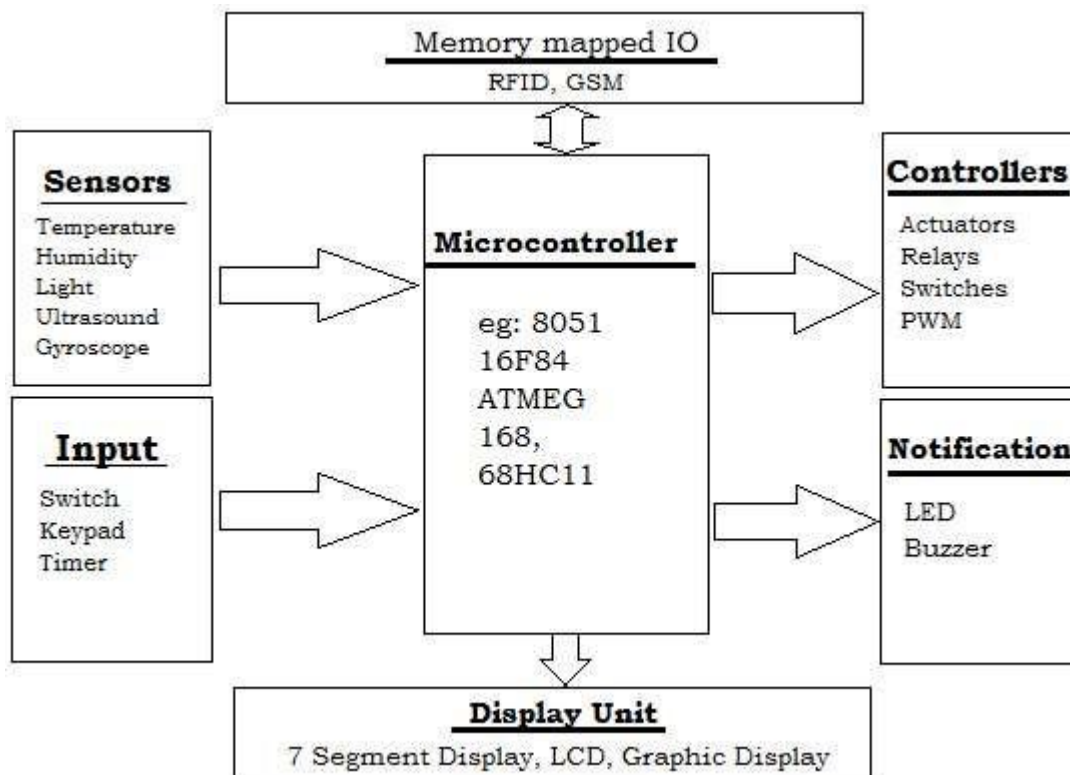


Figure 1.5 Basic Embedded System

The embedded system that uses the devices for the operating system is based on the language platform, mainly where the real-time operation would be performed. Manufacturers build embedded software in electronics, e.g., cars, telephones, modems, appliances, etc. The embedded system software can be as simple as lighting controls running using an 8-bit microcontroller. It can also be complicated software for missiles, process control systems, airplanes etc.

1.3.7 IoT Ecosystem

The IoT ecosystem is not easy to define. It is also difficult to capture its proper image due to the vastness and emerging possibility and the rapidity with which it is expanding in the entire sector. However, the IoT ecosystem is a connection of various kind of devices that sense and analyze the data and communicates with each other over the networks.

In the IoT ecosystem, the user uses smart devices such as smartphones, tablet, sensors, etc. to send the command or request to devices for information over the networks. The device response and performs the command to send information back to the user through networks after analyzed.

The typical IoT ecosystem is shown in below figure 1.6, where the smarter devices send and receive data from the devices themselves in the environment that are integrate over network and Cloud Computing.

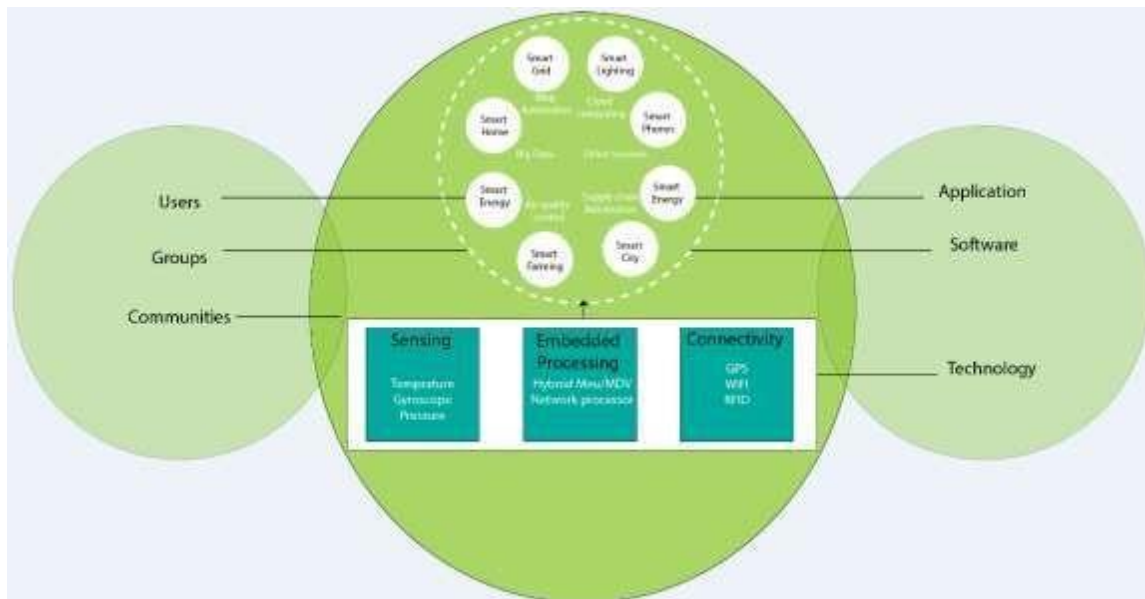


Figure 1.6 Typical IoT ecosystem

The IoT is itself an ecosystem of network devices that transfer the data. It is also well interconnected with Big Data and Cloud Computing.

- **Sensing, Embedded processing, Connectivity:** The IoT ecosystem senses its surrounding like temperature, gyroscope, pressure, etc. and make the embedded processing using devices. These devices are connected through any type of devices such as GPS, WiFi, RFID, etc. over the networks.
- **Smart devices and environment, Cloud Computing, Big Data:** The data transfer or receive through smart devices and environments are communicated through Cloud Computing or others Servers and stored as Big Data.
- **Technology, Software, Application:** The IoT ecosystem uses any of different technologies, software and application to communicate and connect with smart devices and environment.
- **Users or groups of community:** The product or services generated by the IoT ecosystem are consumed by the users or the group of communities to serve the smart life.

1.3.8 IoT Decision Framework

The IoT decision framework provides a structured approach to create a powerful IoT product strategy. The IoT decision framework is all about the strategic decision making. The IoT Decision Framework helps us to understand the areas where need to make decisions and ensures consistency across all of strategic business decision, technical and more.

The IoT decision framework is much more important as the product or services communicates over networks goes through five different layers of complexity of technology and the connections of this technology stack shown in below figure 1.7

1. Device Hardware
2. Device Software
3. Communications
4. Cloud Platform
5. Cloud Application

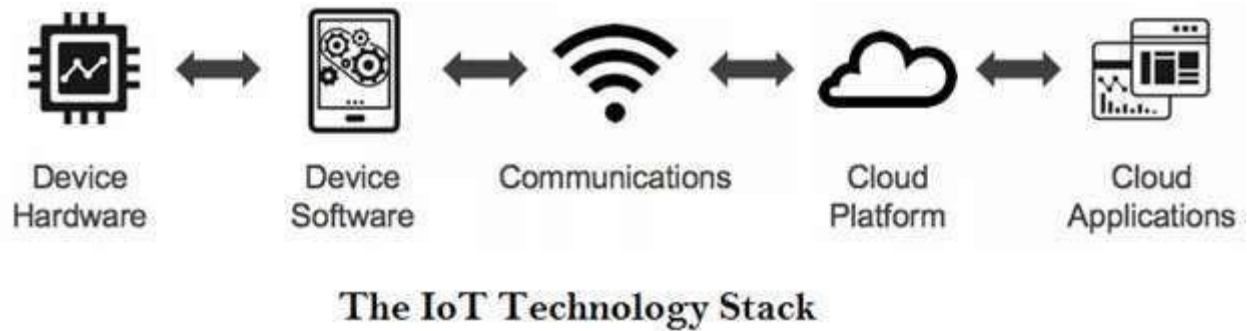


Figure 1.7 IoT Technology Stack

1.3.9 Decision Area

The IoT decision framework pays attention to six key decision areas in any IoT product. These decision areas are:

1. User Experience (UX)
2. Data
3. Business
4. Technology
5. Security
6. Standards & Regulations

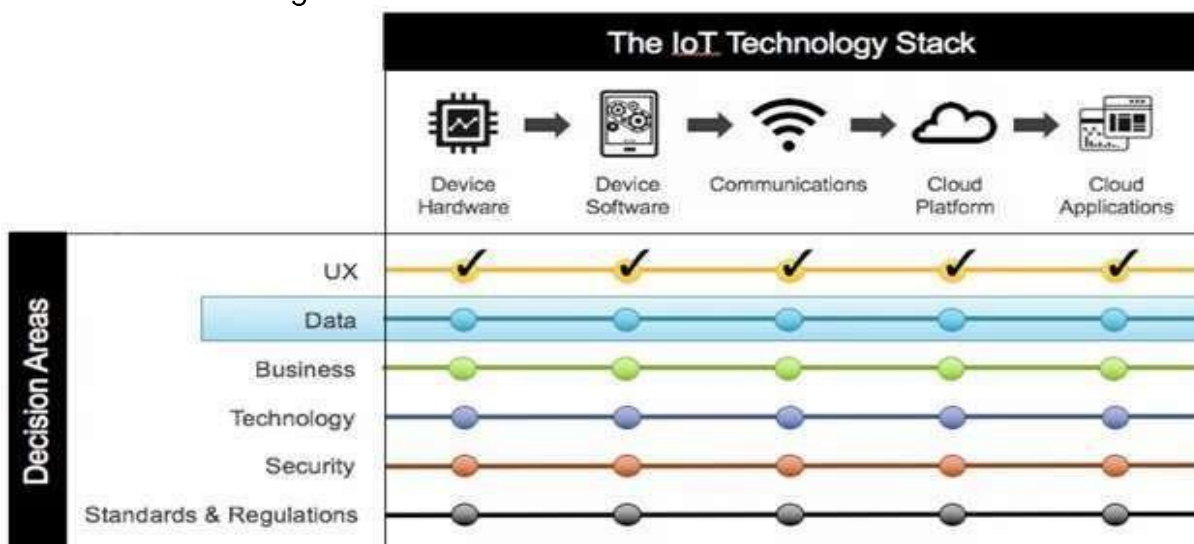


Figure 1.8 Decision Area of the IoT Decision Framework

Each of these decision areas is evaluated at each of the IoT Technology Stack. The User Experience will be evaluated at Device Hardware, Device Software and so to provide the better user experience. Then at the next step Data Decision Area, have to explore data considerations for all the stages of IoT Technology Stack data considerations for all the stages of IoT Technology Stack. figure 1.8 each of the Decision Area of IoT Decision Framework explained in detail:

1. **User Experience Decision Area:** This is the area where concentrate about who are the users, what are their requirements and how to provide a great experience at each step of IoT stack without worrying about the technical details.
2. **Data Decision Area:** In this area, make the overall data strategy such as the data flow over the entire IoT stack to fulfill the user's requirements.
3. **Business Decision Area:** Based on the previous decisions area, make the decision how product or services will become financial potential. At each of the IoT Stack level are monetized about the costs of providing services.
4. **Technology Decision Area:** In this area, work with the technology for each layer to facilitate the final solution.
5. **Security Decision Area:** After going through the implementation of technology it is important to decide and provide the security at each stage of the IoT Stack.
6. **Standards & Regulations Decision Area:** At the last stage of IoT Decision Area, identify the standards and regulations of product or services that will affect your product at each layer of the IoT Stack.

1.3.10 IoT Architecture

There is not such a unique or standard consensus on the Internet of Things (IoT) architecture which is universally defined. The IoT architecture differs from their functional area and their solutions. However, the IoT architecture technology mainly consists of four major components:

Components of IoT Architecture

- Sensors/Devices
- Gateways and Networks
- Cloud/Management Service Layer
- Application Layer

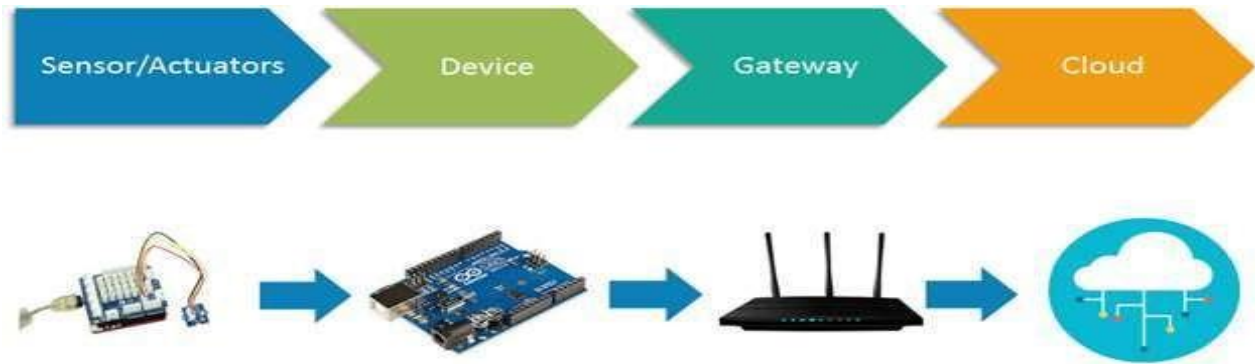


Figure 1.9 Stages of IoT Solutions Architecture

There are several layers of IoT built upon the capability and performance of IoT elements that provides the optimal solution to the business enterprises and end-users. The IoT architecture is a fundamental way to design the various elements of IoT, so that it can deliver services over the networks and serve the needs for the future. Following are the primary stages (layers) of IoT that provides the solution for IoT architecture.

1. **Sensors/Actuators:** Sensors or Actuators are the devices that are able to emit, accept and process data over the network. These sensors or actuators may be connected either through wired or wireless. This contains GPS, Electrochemical, Gyroscope, RFID, etc. Most of the sensors need connectivity through sensors gateways. The connection of sensors or actuators can be through a Local Area Network (LAN) or Personal Area Network.
2. **Gateways and Data Acquisition:** As the large numbers of data are produced by this sensors and actuators need the high-speed Gateways and Networks to

transfer the data. This network can be of type Local Area Network (LAN such as WiFi, Ethernet, etc.), Wide Area Network (WAN such as GSM, 5G, etc.).

3. **Edge IT:** Edge in the IoT Architecture is the hardware and software gateways that analyze and pre-process the data before transferring it to the cloud. If the data read from the sensors and gateways are not changed from its previous reading value then it does not transfer over the cloud, this saves the data used.
4. **Data center/ Cloud:** The Data Center or Cloud comes under the Management Services which process the information through analytics, management of device and security controls. Beside this security controls and device management the cloud transfer the data to the end users application such as Retail, Healthcare, Emergency, Environment, and Energy, etc and this 4 stages of connections are displayed in the below figure 1.10.

The 4 Stage IoT Solutions Architecture

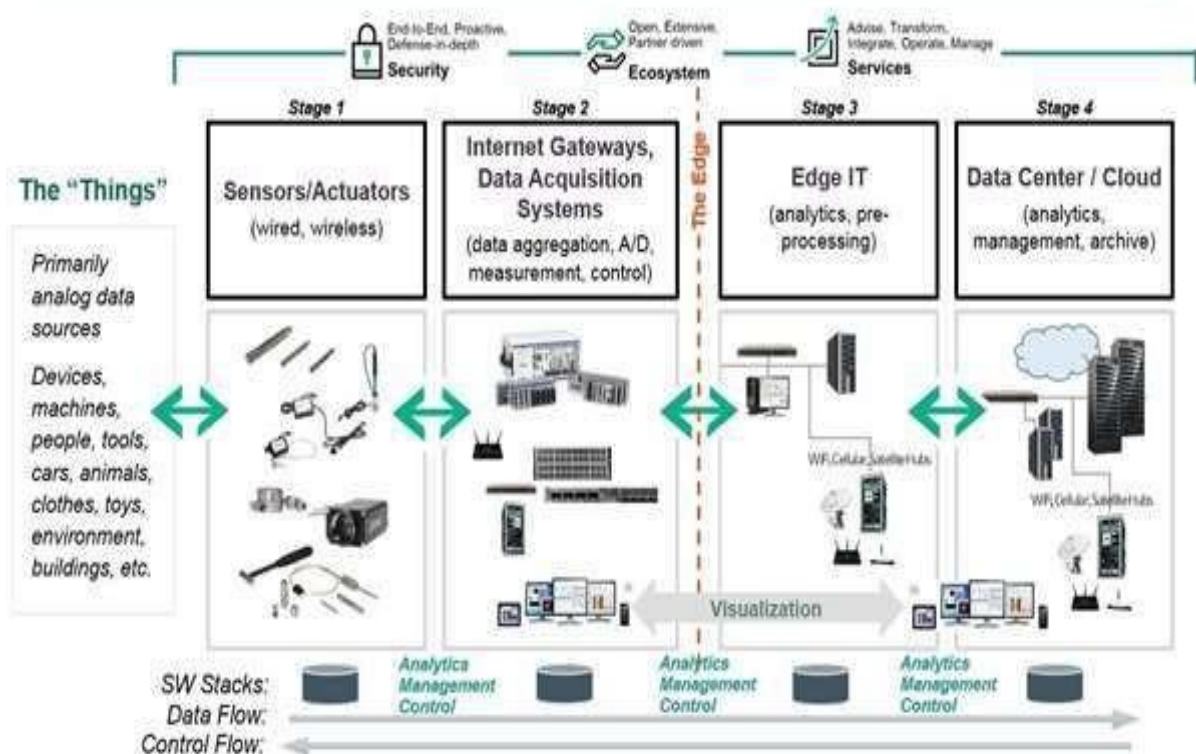


Figure 1.10 The 4 Stages IoT Solutions Architecture

Smarts Objects in IoT

The concept of smart in IoT is used for physical objects that are active, digital, networked, can operate to some extent autonomously, reconfigurable and has local control of the resources. The smart objects need energy, data storage, etc.

A **smart object** is an object that enhances the interaction with other smart objects as well as with people also. The world of IoT is the network of interconnected heterogeneous objects (such as smart devices, smart objects, sensors, actuators, RFID, embedded computers, etc.) uniquely addressable and based on standard communication protocols.

In a day to day life, people have a lot of object with internet or wireless or wired connection. Such as:

- Smartphone
- Tablets
- TV computer



Figure 1.11 smart objects

These objects can be interconnected among them and facilitate daily life (smart home, smart cities) no matter the situation, localization, accessibility to a sensor, size, scenario or the risk of danger. Some of the devices are located below figure 1.11

Smart objects are utilized widely to transform the physical environment around us to a digital world using the Internet of things (IoT) technologies.

A smart object carries blocks of application logic that make sense for their local situation and interact with human users. A smart object sense, log, and interpret the occurrence within themselves and the environment, and intercommunicate with each other and exchange information with people.

The work of smart object has focused on technical aspects (such as software infrastructure, hardware platforms, etc.) and application scenarios. Application areas range from supply-chain management and enterprise applications (home and hospital) to healthcare and industrial workplace support. As for human interface aspects of smart-object technologies are just beginning to receive attention from the environment.

1.3.11 IoT Devices

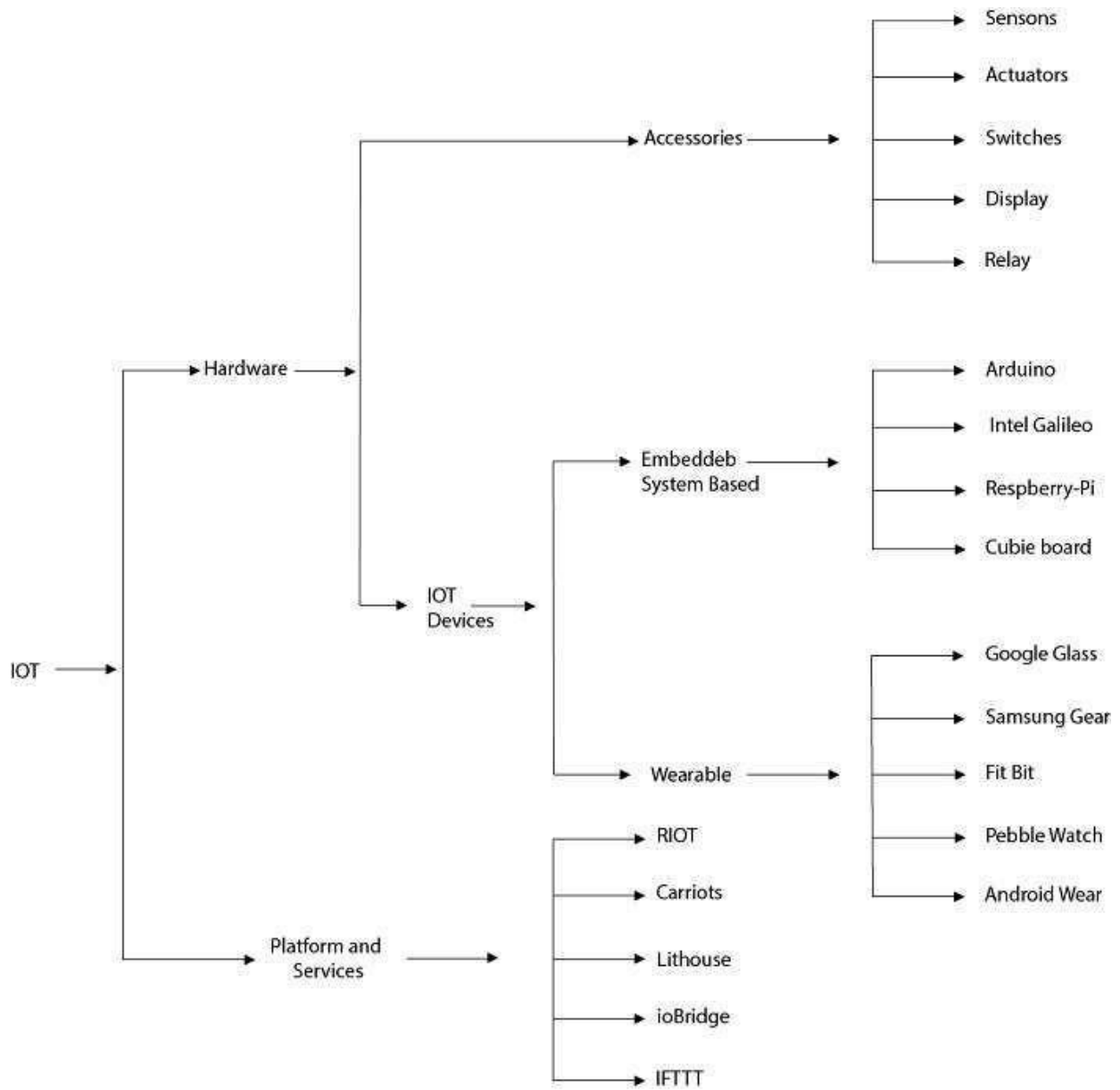
Internet of Things Devices is non-standard devices that connect wirelessly to a network with each other and able to transfer the data. IoT devices are enlarging the internet connectivity beyond standard devices such as smartphones, laptops, tablets, and desktops. Embedding these devices with technology enable us to communicate and interact over the networks and they can be remotely monitored and controlled.



Figure 1.12 IoT Devices

In the above figure 1.12 are explain about connections between IOT and devices. There are large varieties of IoT devices available based on IEEE 802.15.4 standard. These devices range from wireless motes, attachable sensor-boards to interface-board which are useful for researchers and developers. IoT devices include computer devices, software, wireless sensors, and actuators. These IoT devices are connected over the internet and enabling the data transfer among objects or people automatically without human intervention.

Some of the common and popular IoT devices are given below figure 1.13:



IoT Devices and Technologies

Figure 1.13 IoT Devices and Technologies

CHAPTER-2

LITERATURE SURVEY

Ulrich Kogelschatz (2003) proposed the Dielectric-barrier discharges: Their history, discharge physics, and industrial applications .Dielectric-barrier discharges (silent discharges) are used on a large industrial scale. They combine the advantages of non-equilibrium plasma properties with the ease of atmospheric-pressure operation. A prominent feature is the simple scalability from small laboratory reactors to large industrial installations with megawatt input powers. Efficient and cost-effective all-solid-state power supplies are available. The preferred frequency range lies between 1 kHz and 10 MHz, the preferred pressure range between 10 kPa and 500 kPa.

U. Roland.et.al., (2002) developed the Improved oxidation of air pollutants in a nonthermal plasma.The performance of non-thermal plasma (NTP) for the removal of organic air pollutants (especially in low concentrations) is improved by the introduction of ferroelectric and catalytically active materials into the discharge zone of an NTP reactor. Experiments with model systems (various contaminants and packed-bed materials) have shown that such a modification of a homogeneous gas-phase plasma can overcome the most serious restrictions of the NTP technique at its present state of the art: the incomplete total oxidation (i.e. the low selectivity to CO₂) and the energetic inefficiency. Placing a ferroelectric packed-bed material in the discharge zone was shown to result in a lowering of the energy input required.

M. Higashi et.al.,(1998)identified the treatment of exhaust gas from vehicles by discharge plasma reactors .The exhaust gas from diesel engines is one of the major causes of air pollution. As one method for pollution control, the authors have been developing plasma reactors. The authors' reactor is a concentric cylinder type which has a glass tube barrier between electrodes. Connecting two of these reactors in series, the NO_x (NO + NO₂) component from diesel engine exhaust gas is decomposed up to 93%.. As one method for pollution control, the authors have been developing plasma reactors

C. H. Tsai et.al., (2008) presented Effects of ethylene on NO conversion and product distributions in an rf discharge reactor. High concentration of NO in N_2/O_2 mixtures could be converted mainly into N_2 via a radio-frequency discharge approach at a low pressure (4 kPa). To enhance the efficiency of NO removal, C_2H_4 was added to elevate significantly the NO conversion in this study. The results showed that at inlet C_2H_4/NO molar ratio of 1 and 120 W in the C_2H_4/NO (1%)/ O_2 (6%)/ N_2 mixtures, the NO conversion reached 93.7% with a C_2H_4 conversion of 100%, to much higher than without C_2H_4 condition (NO conversion = 77.6%).

Chawla et.al., (2022) proposed the controlling home appliances through the smart phone. Main aim of this project is controlling the home appliances through the smart phone. Wi-Fi is used for communication protocol, RaspberryPi is act as a server. In this paper, IR(infra red) sensor is used to identify the humans or animals. LDR (Light Dependent Resistor) is used to detect when fire is detected. When fire is detected the camera is take a snap short and send to the owner's smart phone, so that the will take immediate action for the accident.

Ganga,D et.al., (2018) proposed cares for home and industrial safety using fire and gas detection systems. This system detects the leakage of gas and fire using sensing circuit, which is then controlled by microcontroller which in turns triggers the alarm system to alert the leakage of gas and fire. Using GSM modems, SMS are being sent to notify the user. In addition, it is designed with mechanism to sprinkle the water using water sprinkler when there is a fire or gas leakage. MQ-6 and MQ-9 used as gas sensors to detect the gas leakage. IR flame sensor is used for fire detection, which detects the fire and notifies the user using SMS.

Dai, B.et.al.,(2019)presented this paper focuses on integrating all the contextual data, to provide accurate and relevant information as per the need. System information that already exists but has not been integrated into the monitoring system like 3D models and manuals. It is context aware industrial monitoring systems, which provide information based on system state, environmental conditions and functionalities of the devices in that environment.

Lee,C. et.al.,(2017) developed insisted on automation of many small tasks around us using Internet of Things (IoT) in order to improve the quality of living. IoT is used for enhancing existing safety standards, using automation process. Gas leakages in open or closed areas can prove to be dangerous and fatal. Traditional gas leakage systems can able to detect the leakage but cannot able to alert the user. Alerting System can be established to alert the authorized person and to perform the data analytics from the obtained readings.

Luampon .R et.al., (2019) Observes the toxic gases present in the air to ensure the safety of the people in that environment and make it available at any place in the world for monitoring. The composition of chemicals in air like carbon monoxide, LPG, methane and flammable gases is monitored using sensors and this data is sent to the cloud server, which is then represented pictorially for better understanding of the statistics.

Eidheim.O.et.al.,(2019) insists on using intelligent sensors for pollution monitoring. Collected data from the sensors are sent to the Google cloud makes it possible to monitor the air pollution from anywhere in the world. In case of threatening levels of air pollution, alerting is used. This is used in industry and the pollution by vehicular emissions. Rajalakshmi.R et al.

CHAPTER -3

EXISTING SYSTEM

3.1 Existing system

The microcontroller is programmed to do mainly three functions namely: Comparison, timer and triggering. When the smoke sensor output is more than the threshold value, the microcontroller triggers the timer circuit and an alarm is set on to inform the driver of the pollution in the vehicle and that it will come to the halt state. Semiconductor sensor MQ-2 is used to detect the smoke whose range is 300ppm to 10000ppm. CO Sensor having low conductivity in a clean environment is connected to an PIC microcontroller When this sensor is exposed to the pollutants its conductivity increases generating a signal in the circuit which disables the motor. An automatic SMS is also generated by a GSM module which is connected in the circuit. As shown in below Figure 3.1.

3.1.1 Key points of existing system:

- Process monitoring and management is not done.
- No master and slave communications.
- Not automated.
- More man power.
- High maintenance.

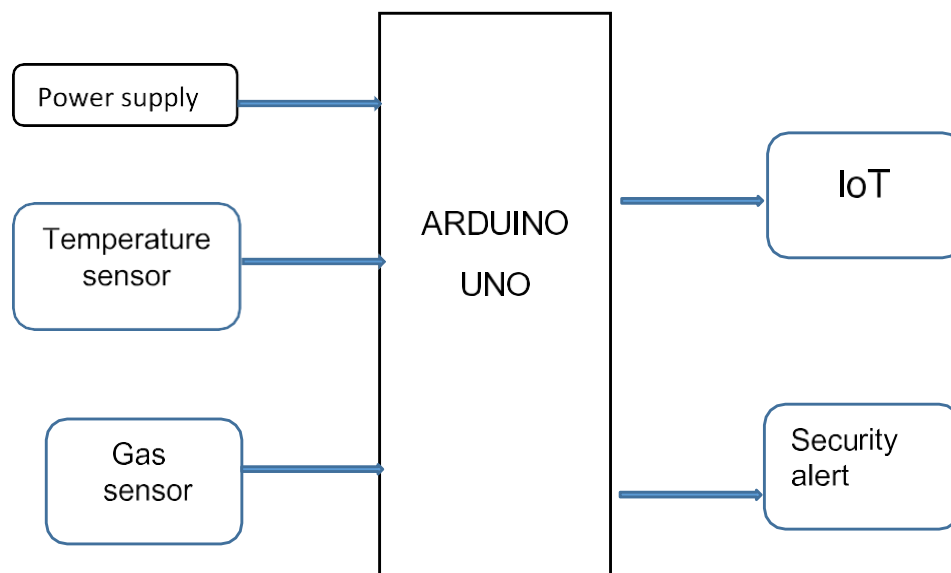


Figure 3.1 Existing system diagram

CHAPTER-4

PROPOSED SYSTEM

4.1 Proposed system

In proposed system design process is based on data, which is collected through several sorts of sensors like PIR sensors, flame sensors, gas sensors, and temperature sensors. These sensors are installed in the required locations, such as where the gas has leaked. The temperature sensors are used to display the readings, the flame sensor is used to detect fire, and the PIR sensor is used to notify unauthorized entry. These sensors gather data continuously and communicate it to the microcontroller (Arduino UNO). Arduino UNO is programmed with a specific threshold value. If the value is less than the threshold, the situation is normal. If it exceeds the threshold value, the Arduino UNO sends a signal to the corresponding output. If the gas is leaking, a buzzer sound is produced when the sense is very low. When the perception of smell is strong, the exhauster fan is activated. If a fire is detected by the flame sensor, the Arduino UNO is triggered, and the water sprayer is used to extinguish it if the fire is bright. Anyone who enters the industry without being allowed is tracked using a PIR sensor. Over IoT, data is sent and shared utilizing a Wi-Fi module. From Wi-Fi network, could control the Wi-Fi module. The WiFi module allows microcontrollers to connect to wireless networks. The IOT website is used to provide graphical representations of all types of data from sensors including gas, flame, PIR, and temperature sensors. Have developed a fully autonomous IoT wireless sensor-actuator network for the monitoring of the environment. Here GSM Connected to Arduino Controller it will message and call if any incident will happen in Industry and also GPS also will send the location of that industry. Expressed the below Figure 4.1.

4.1.1 Advantages

1. One of the main advantages of the IOT and Arduino based Industrial detection system is that it does not require any human intervention once the system is installed.
2. This System could help in saving lives if appropriate measures are taken in time.

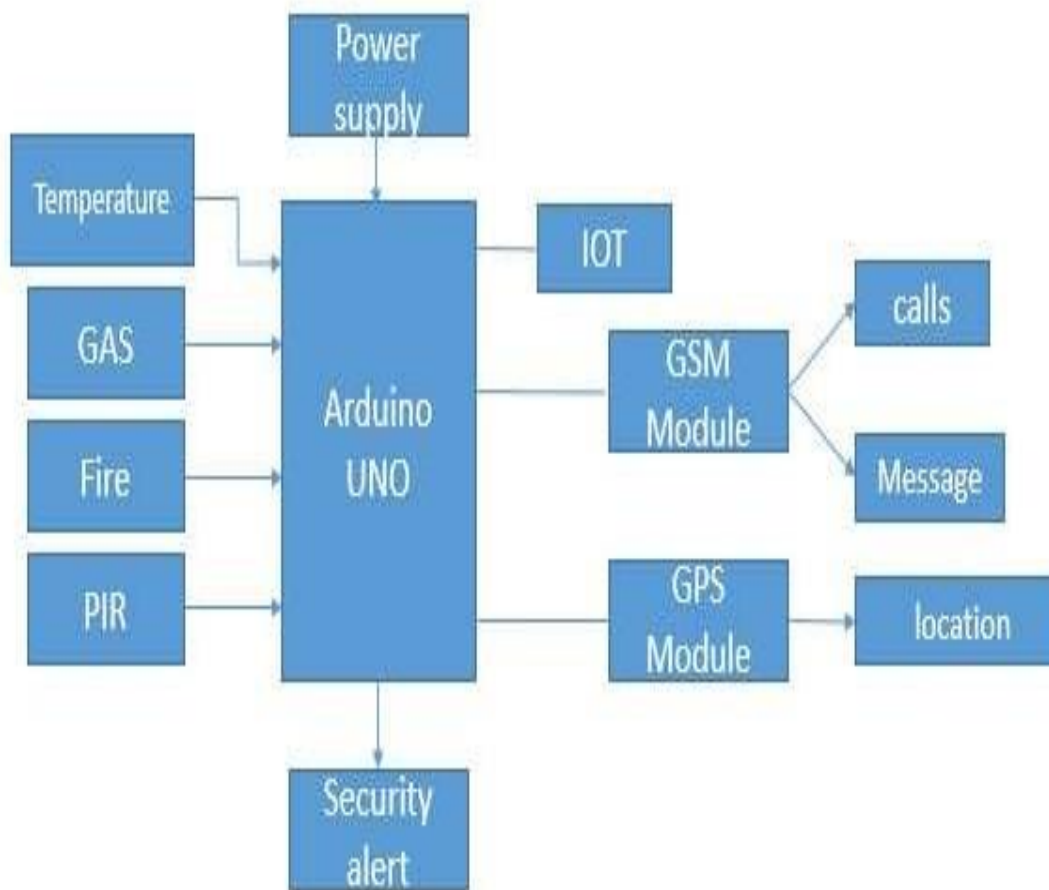


Figure 4.1 block diagram

4.1.2 Hardware requirements

Arduino UNO Controller

Temperature sensor

Gas sensor

Fire sensor

PIR sensor

Buzzer

Wifi module

GSM module

GPS

Power supply

4.2 Arudino UNO Controller

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free. The picture of UNO is placed the figure 4.2

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

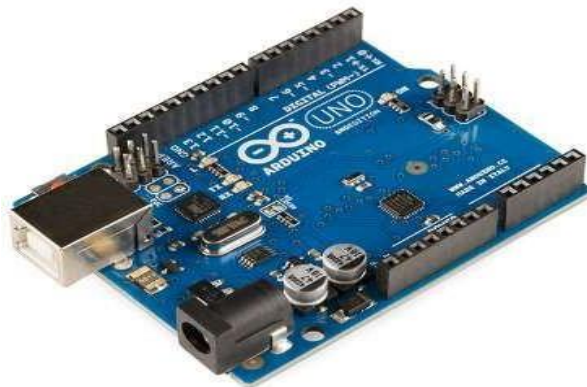


Figure 4.2 ARDUINO UNO

4.3 Gas sensor

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a **methane gas sensor** that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. It presented the figure 4.3.



Figure 4.3 Gas sensor

The **gas sensor module** consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

Image shows externals of a standard gas sensor module: a steel mesh, copper clamping ring and connecting leads. The top part is a stainless steel mesh which takes care of the following:

Filtering out the suspended particles so that only gaseous elements are able to pass to insides of the sensor.

- ✓ Protecting the insides of the sensor.

- ✓ Exhibits an anti-explosion network that keeps the sensor module intact at high temperatures and gas pressures.

In order to manage above listed functions efficiently, the steel mesh is made into two layers. The mesh is bound to rest of the body via a copper plated clamping ring.

The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part. They are casted from copper and have tin plating over them. Four of the six leads (A, B, C, D) are for signal fetching while two (1, 2) are used to provide sufficient heat to the sensing element. The pins are placed on a Bakelite base which is a good insulator and provides firm gripping to the connecting leads of the sensor.

The hexapod structure is constituted by the sensing element and six connecting legs that extend beyond the Bakelite base.

Using a ceramic substrate increases the heating efficiency and tin oxide, being sensitive towards adsorbing desired gas' components (in this case methane and its products) suffices as sensing coating.

The leads responsible for heating the sensing element are connected through Nickel-Chromium, well known conductive alloy. Leads responsible for output signals are connected using platinum wires which convey small changes in the current that passes through the sensing element. The platinum wires are connected to the body of the sensing element while Nickel-Chromium wires pass through its hollow structure. While other wires are attached to the outer body of the element, Nickel-Chromium wires are placed inside the element in a spring shaped. Image shows coiled part of the wire which is placed on the inside of the hollow ceramic

Image shows the ceramic with tin dioxide on the top coating that has good adsorbing property. Any gas to be monitored has specific temperature at which it ionizes. The task of the sensor is to work at the desired temperature so that gas molecules get ionized. Through Nickel-chromium wire, the ceramic region of the sensing element is subjected to heating current. The heat is radiated by the element in the nearby region where gases interact with it and get ionized. Once, ionized, they are absorbed by the tin dioxide. Adsorbed molecules change the resistance of the tin dioxide layer. This changes

the current flowing through the sensing element and is conveyed through the output leads to the unit that controls the working of the gas sensor.

4.4 Temperature sensor

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges. Temperature is one of the most commonly measured variables and it is therefore not surprising that there are many ways of sensing it. Temperature sensing can be done either through direct contact with the heating source, or remotely, without direct contact with the source using radiated energy instead. There are a wide variety of temperature sensors on the market today, including Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared, and Semiconductor Sensors. It is expressed below figure 4.4.



Figure 4.4 temperature sensor

4.4.1 SENSOR ICS

There are a wide variety of temperature sensor ICs that are available to simplify the broadest possible range of temperature monitoring challenges. These silicon temperature sensors differ significantly from the abovementioned types in a couple of important ways. The first is operating temperature range. A temperature sensor IC can operate over the nominal IC temperature range of -55°C to $+150^{\circ}\text{C}$. The second major difference is functionality. A silicon temperature sensor is an integrated circuit, and can therefore include extensive signal processing circuitry within the same package as the sensor. There is no need to add compensation circuits for temperature sensor ICs. Some of these

are analogue circuits with either voltage or current output. Others combine analogue-sensing circuits with voltage comparators to provide alert functions. Some other sensor ICs combine analogue-sensing circuitry with digital input/output and control registers, making them an ideal solution for microprocessor-based systems. Digital output sensor usually contains a temperature sensor, analog-to-digital converter (ADC), a two-wire digital interface and registers for controlling the IC's operation. Temperature is continuously measured and can be read at any time. If desired, the host processor can instruct the sensor to monitor temperature and take an output pin high (or low) if temperature exceeds a programmed limit. Lower threshold temperature can also be programmed and the host can be notified when temperature has dropped below this threshold. Thus, digital output sensor can be used for reliable temperature monitoring in microprocessor-based systems. Above temperature sensor has three terminals and required Maximum of 5.5 V supply. This type of sensor consists of a material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by circuit and it calculates temperature. When the voltage increases then the temperature also rises. Could see this operation by using a diode. Temperature sensors directly connected to microprocessor input and thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost processors without the need of A/D converters. An example for a temperature sensor is **LM35**. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 operates at -55° to $+120^{\circ}\text{C}$. The basic centigrade temperature sensor ($+2^{\circ}\text{C}$ to $+150^{\circ}\text{C}$) is shown in Figure below.

Features of LM35 Temperature Sensor:

- Calibrated directly in $^{\circ}$ Celsius (Centigrade)
- Rated for full -55° to $+150^{\circ}\text{C}$ range
- Suitable for remote applications

- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Low self-heating,
- $\pm 1/4^{\circ}\text{C}$ of typical nonlinearity

Operation of LM35:

- The LM35 can be connected easily in the same way as other integrated circuit temperature sensors. It can be stuck or established to a surface and its temperature will be within around the range of 0.01°C of the surface temperature.
- This presumes that the ambient air temperature is just about the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature.

The temperature sensors have well known applications in environmental and process control and also in test, measurement and communications. A digital temperature is a sensor, which provides 9-bit temperature readings. Digital temperature sensors offer excellent precise accuracy, these are designed to read from 0°C to 70°C and it is possible to achieve $\pm 0.5^{\circ}\text{C}$ accuracy. These sensors completely aligned with digital temperature readings in degree Celsius.

4.5 FIRE/FLAME SENSOR MODULE

A key aspect of fire protection is to identify a developing fire emergency in a timely manner, and to alert the building's occupants and fire emergency organizations. This is the role of fire detection and alarm systems. Depending on the anticipated fire scenario, building and use type, number and type of occupants, and criticality of contents and mission, these systems can provide several main functions. First they provide a means to identify a developing fire through either manual or automatic methods and second, they alert building occupants to a fire condition and the need to evacuate. Another common

function is the transmission of an alarm notification signal to the fire department or other emergency response organization. They may also shut down electrical, air handling equipment or special process operations, and they may be used to initiate automatic suppression systems. Fire sensor is shown in given figure 4.5.

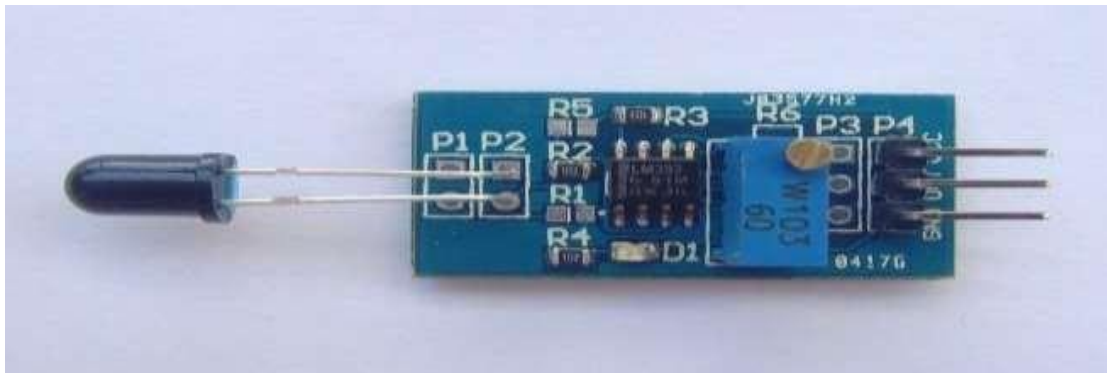


Figure 4.5 fire sensor

4.5.1 GENERAL DESCRIPTION:

Flame sensor is the most sensitive to ordinary light that is why its reaction is generally used as flame alarm purposes. This module can detect flame or wavelength in 760 nm to 1100 nm range of light source. Small plate output interface can and single-chip can be directly connected to the microcomputer IO port. The sensor and flame should keep a certain distance to avoid high temperature damage to the sensor.

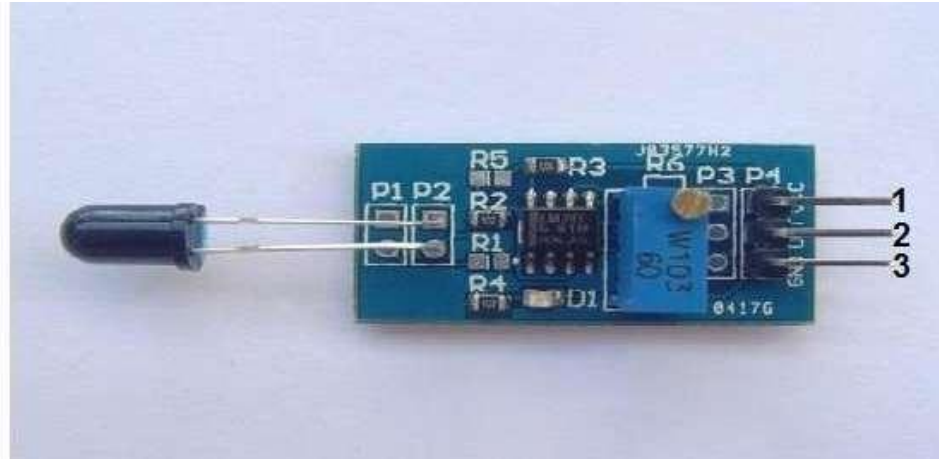
The shortest test distance is 80 cm, if the flame is bigger, test it with farther distance. The detection angle is 60 degrees so the flame spectrum is especially sensitive. The detection angle is 60 degrees so the flame spectrum is especially sensitive. It is displayed in below figure 4.6.

SPECIFICATIONS:

- ☐ On-board LM393 voltage comparator chip and infrared sensing probe.
- ☐ Support 5V/3.3V voltage input.
- ☐ On-board signal output indication, output effective signal is high level, and the same time the indicator light up, output signal can directly connect with

microcontroller IO.

- ☐ Signal detection sensitivity can be adjusted.
- ☐ Reserved a line voltage compare circuit (P3 is leaded out).
- ☐ PCB size: 30(mm) x15(mm).



4.6 flame sensor

PIN CONFIGUREURATION:

1. VCC
2. Output
3. Ground

4.6 PIR Sensor

A **passive infrared sensor (PIR sensor)** is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.

PIR sensors detect general movement, but do not give information on who or what moved. For that purpose, an imaging IR sensor is required. As like as given below figure 4.7.

PIR sensors are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector". The term passive refers to the fact that PIR devices do not radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects.



Figure 4.7 PIR sensor

- Pin1 corresponds to the drain terminal of the device, which connected to the positive supply 5V DC.
- Pin2 corresponds to the source terminal of the device, which connects to the ground terminal via a 100K or 47K resistor. The Pin2 is the output pin of the sensor. The pin 2 of the sensor carries the detected IR signal to an amplifier
- Pin3 of the sensor connected to the ground

4.7 GSM MODEM:Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz.Below figure 4.8 is GSM module.



Figure 4.8 GSM Module

4.7.1 THE GSM NETWORK

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS). The basic GSM network elements are shown in below *Figure 4.9*.

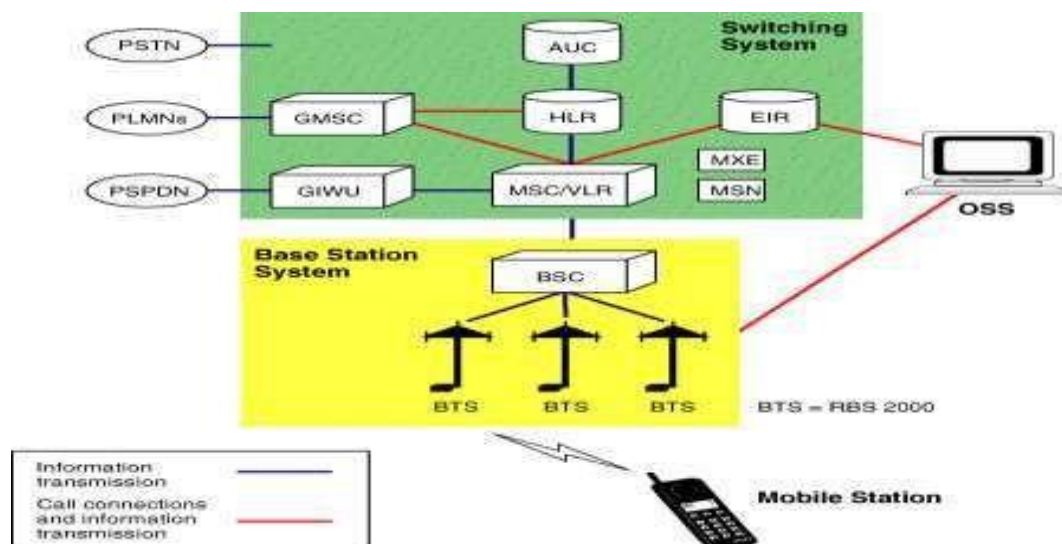


Figure 4.9 GSM Network Elements

4.7.2 GSM MODEM:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots

As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low – only about six to ten SMS messages per minute.

4.8 Global Positioning System (GPS)



Figure 4.10 Global Positioning System (GPS)

A variety of GPS modules designed for many different applications. The modules are classified into two families: FGPMOSLx and FGPMOPAx series (x denotes the model number). The major difference between these two families is the inclusion of smart patch antenna. PAX comes with the ceramic antenna, while SLx does not. These GPS modules provide a complete GPS solution that excels in position, speed, and accuracy performances as well as high insensitivity and tracking capabilities in urban environment. The GPS module are powered by MediaTek Inc. GPS chipset, the world's leading digital media solution provider and largest fab-less IC Company in UART 0 (RX/TX) –Serial Interface .Above displayed the figure 4.10.

UART is the default interface, and it supports transfer baud rate ranging from 4800 bps to 115200 bps. The logic is TTL level. If the RS232 logic-level is needed for application, then the use of level shifters is necessary. Please leave RX open if it is not used, there is an internal pull-up to VCC. Please don't use an external pull-up for unexpected current draw.

Antenna Design , ANTENNA_IN

GPS antenna is a receiving device to acquire week GPS signal from sky. Popular solution would be ceramic patch antenna due to its small form factor with low cost. There are two types of antennas, passive and active. Passive antenna is with solely antenna itself. Active antenna is with LNA to have high gain with the cost of current supply.

Antenna can be chosen according to radiation efficiency, radiation pattern, gain, bandwidth, form factor and cost. Make sure the ground plane is sufficient for the

antenna to operate with acceptable performance. And place the matching circuit between antenna and GPS module to compensate the frequency shift due to PCB layout.

4.9 Wi-Fi Module



Figure 4.11 Wi -Fi Module

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community. Above placed the figure 4.11.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section

below you will find many resources to aid you in using the ESP8266, even instructions on how to transform this module into an IoT (Internet of Things) solution!

4.10 SOFTWARE IMPLEMENTATION

4.10.2 ARDUINO SOFTWARE:

1. Open Arduino IDE as shown below figure 4.12.

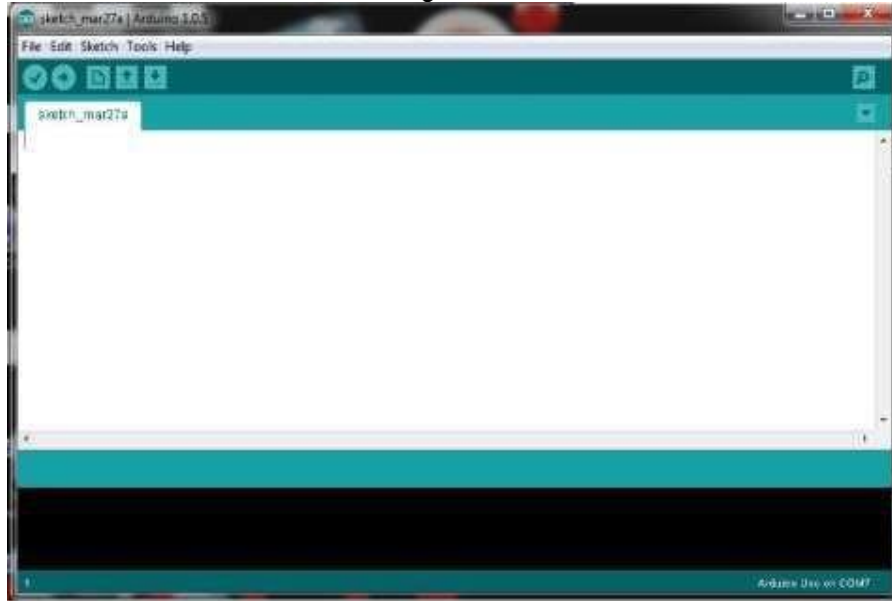


Figure 4.12 open Arduino IDE

2. Select the COM Port from tool as like as below figure 4.13.

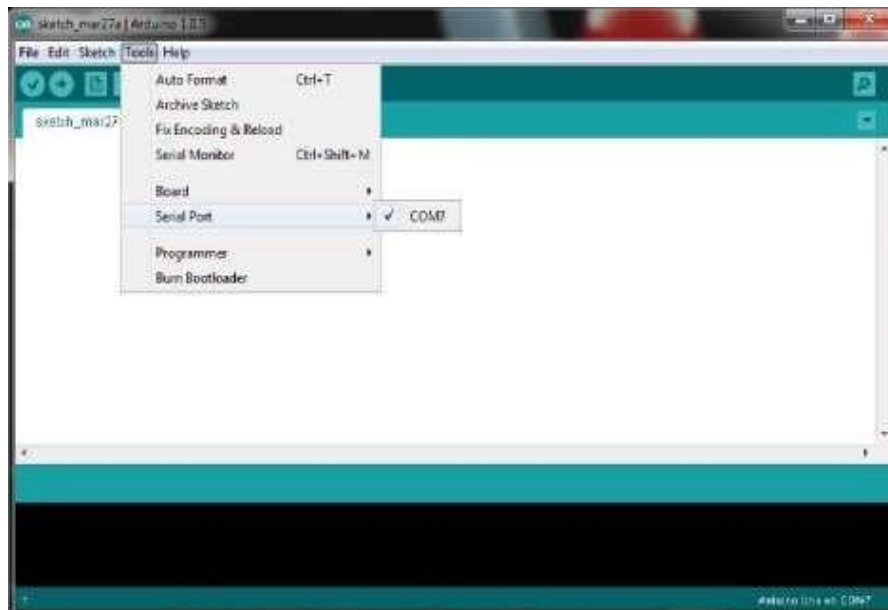


Figure 4.13 Arduino IDE

3. Select the required Arduino board from Tools as shown below figure 4.14

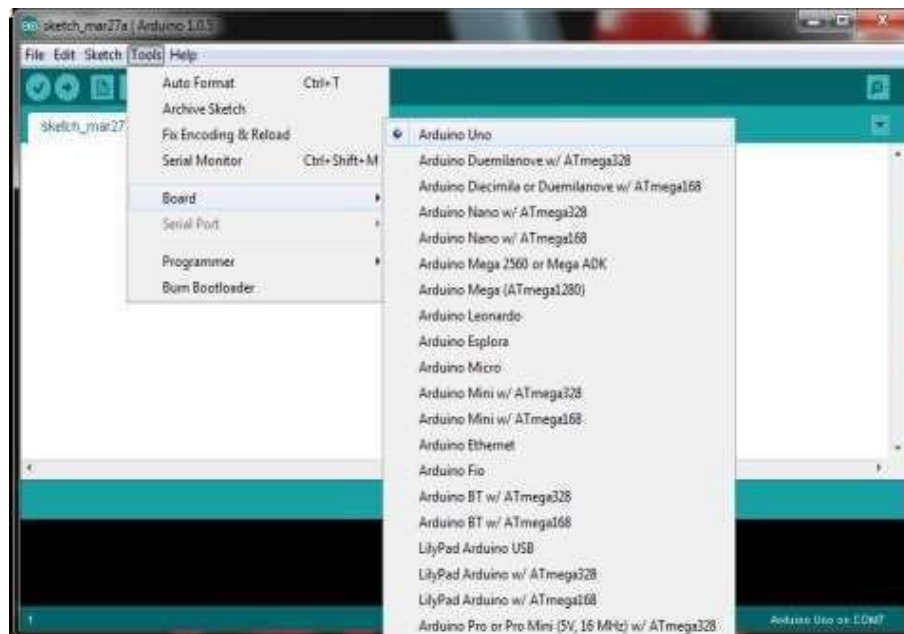


Figure 4.14 Select the required Arduino board

4. Write the sketch in Arduino IDE figure 4.15 below.

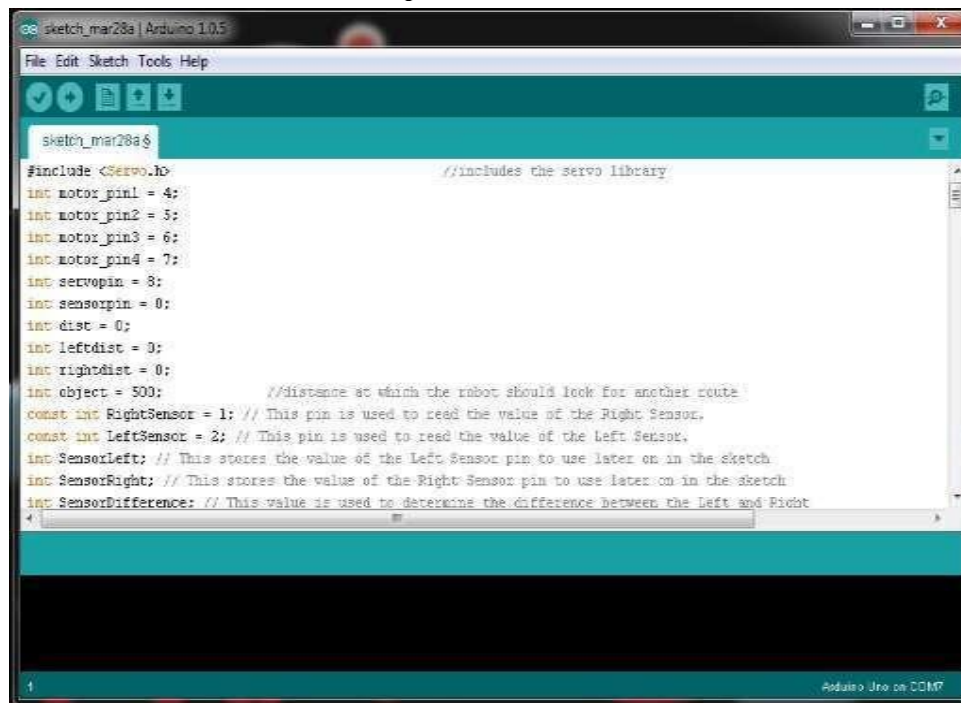


Figure 4.15 Sketch in Arduino IDE

5. Compile and upload the Sketch to Arduino board in figure 4.16

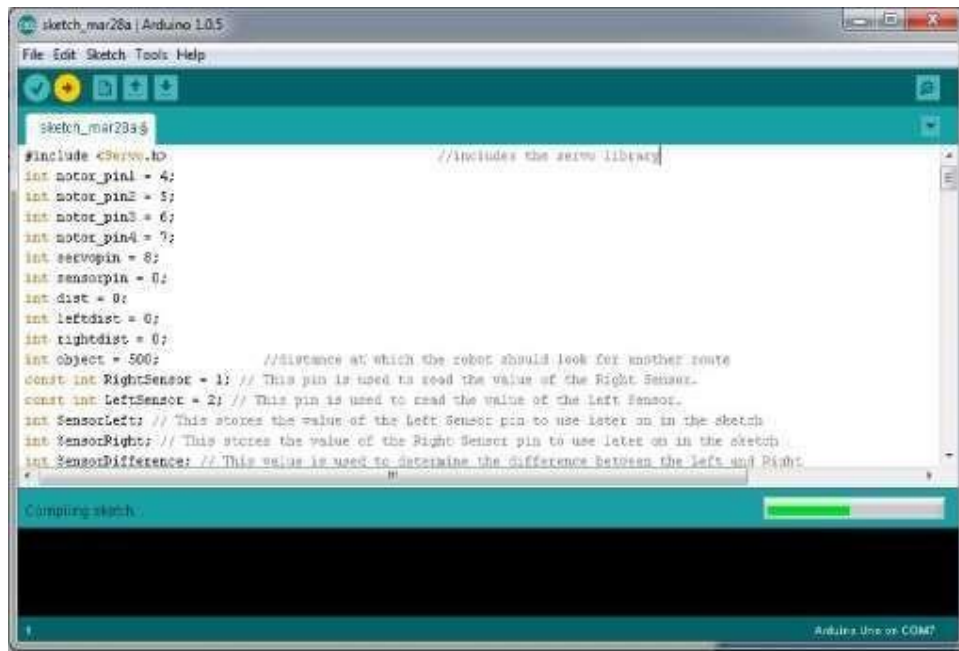


Figure 4.16 upload the Sketch to Arduino board

CHAPTER-5

RESULTS AND DISCUSSIONS

5.1 RESULTS AND DISCUSSIONS

By providing additional functionality to industry staff via an Android application to boost industry control and watching, the IoT-based study can be improved even further. In case of fire or hazardous gas leak, and temperature sensor detect the sudden changes in temperature and PIR sensor can detect the motion of any persons in restricted areas personnel and goods can be protected by fire, temperature, gas and PIR sensors that can be connected to the system. Data can be used to track accident in power plants, ensure safety quick-paced sectors, reduce industrial risks in high-profile firms, and access nuclear safety standards, among other kinds. GSM module can send the message and call to the particular user. The GPS will send the location of the accident in the industry to alert the workers and government sectors like fire stations and hospitals etc. Fast delivery of the information can save time. Monitoring real-time systems built on live models are needed for trustworthy damage and fault detection. Result shown in figure 5.1 and figure 5.2.

5.1.1 HARDWARE PHOTOS



Figure 5.1 Hardware photos

5.1.2 OUTPUT SCREEN SHOTS

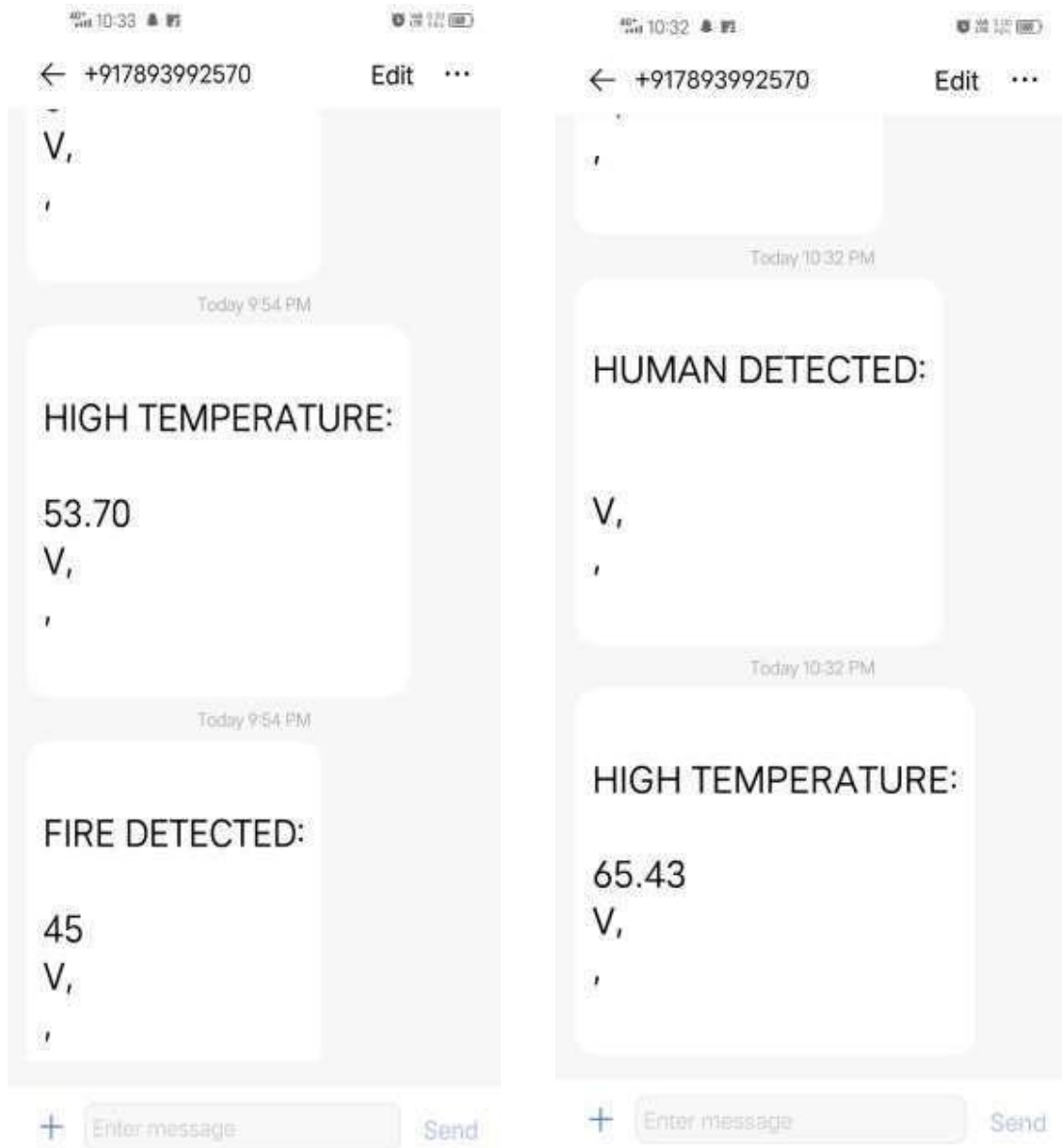


Figure 5.2 Output screenshots

CHAPTER- 6

CONCLUSIONS AND FUTURE SCOPE

6.1 Conclusions

In this project, a comparative analysis on various systems developed for the controlling and monitoring system for the industry is proposed. Design and implementation of the existing system is also discussed. After reviewing the existing studies, a cost efficient system has been proposed for industrial monitoring and controlling based on IoT framework. In system various parameters are continuously monitored remotely that to without any human interference. The system ensures a safety work environment for the worker. Facial recognition based logging system is designed to prevent the network intrusion.

6.2 Future scope

This prototype helps the industrial site from gas leakage deduction and faster resolution of problems afforded by a higher level of expertise focused on control system. This methodology could be applied to monitor distribution network of natural gas as well as industrial, commercial, residential gas pipelines in order to provide a safe operation and to avoid severe human health injuries caused by gas leakages. Proposed solution can act as a automatic vehicle health feed for manufacturer to improve their quality by providing regular vehicle services.

This paper based on IoT can be further expanded by providing additional facility to the industry person with the help of Android app for achieving better control and monitoring of industry. Further, smoke and gas sensors can be interfaced with the system to ensure security of industry workers and goods in case of fire or toxic gas leakage

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