Air Pollution Monitoring through Internet of Things

Project report submitted in fulfillment of the requirement for the
Degree of Bachelor of Technology
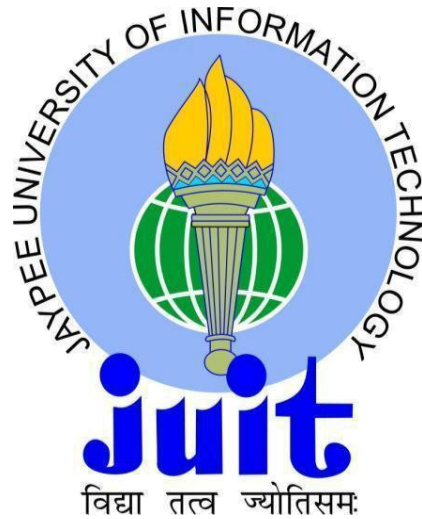
In

Information Technology

By

Pankhuri Arora (141431)

Nayanabh Chakravarty (141446)

Under the supervision of

Dr. Pradeep Kumar Gupta

To

Department of Computer Science & Engineering and Information Technology

**Jaypee University of Information Technology Waknaghat,
Solan-173234, Himachal Pradesh**

CERTIFICATE

Candidate's Declaration

This is to certify that the work which is being presented in the report entitled **"Air Pollution Monitoring through Internet Of things"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology Waknaghat is an authentic record of our own work carried out over a period from August 2017 to May 2018 under the supervision of **Dr. Pradeep Kumar Gupta** (Associate Professor, Computer Science & Engineering and Information technology Department).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Pankhuri Arora, 141431   **Nayanabh Chakravarty (141446)**

This is to certify that the above statement made by the candidates is true to the best of my knowledge.

Dr. Pradeep Kumar Gupta
Associate Professor
Computer Science & Engineering and Information Technology Department
Dated:

ACKNOWLEDGEMENT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Air Contamination is a major issue these days. It is essential to screen Air Quality and monitor it for future and sound living for all. So, we propose an Air Quality observing system that help us to find and check live air quality through IOT.

It utilizes air sensor to detect nearness of destructive gases found all around and transmits this information to microcontroller. The sensor associated with forms this information and sends it over to the web. This enables us to screen air contamination in various zones and make a move to combat it. In addition, there is a temperature sensor for estimating the temperature of a room.

1. <u>INTRODUCTION</u>

 In this project we will make an IOT Based Air Pollution Monitoring System in which we will screen the Air Quality over a web server utilizing web and it will trigger an alert when the air quality goes down past a specific level, implies when there are adequate measure of hurtful gases are available noticeable all around like CO2, smoke, liquor and furthermore temperature.

It will demonstrate the air quality in PPM as on website page with the goal that we can screen it effectively.

The proposed project is an implementation of an application of the Internet of Things.

The undertaking is that is to give an implementation of IOT to estimate the room temperature as well as the air quality. The undertaking highlights the management of sensors to retrieve the data. The major advantage of using sensor is that the user will have a seamless experience; the user is not required to sanction to feed any marker for Internet of Things to work. Hence the efficiency is greater and here after the anticipation taken to execute, user interrogation is pity than distinctive mechanisms. The working of the application is also further more described in this documentation. The documentation furthermore lists out the requirements for the project implementation.

1.1) PROBLEM STATEMENT

An effective natural observing framework is essential to screen and estimate the conditions in the event of surpassing endorsed level of parameter (for example, commotion, CO and radiation levels). At the point when the items like condition furnished with sensor gadgets, smaller scale controller and different programming applications turn into a self – securing and self-observing condition.

Amid past decades, as consequence of human advancement and urbanization there is a tremendous development in polluting businesses, open consuming of reject and leaves, monstrous amounts of development squander, generous loss of timberlands and vehicles (especially diesel driven autos) on streets that offer ascent to wellbeing imperiling contamination. Along these lines, it is important to consistently screen and report the unsafe effects from air contamination. To screen the nature of air, another system is recommended that screens the parameters of the earth around us, for example, CO2, CO, nearness of smoke, liquor, LPG, temperature and dampness with the assistance of GSM, Bluetooth and WSN.

1.2)   OBJECTIVE

Short-term – The short-term objective of the project is complete understanding of the project assigned. The concepts related to the project should be clear and the objective behind the project should be known to the entire team. The focus should not be only on theoretical concepts but also on practical implications of them. The technology used to implement the projects should be familiar and also one should be able to apply them on our respective project.

Long-term – Long-term objective includes that students are exposed to the industrial environment which should help us in future when we will work in real-time projects. One should gain experience of working with a team and learn to cooperate with our team members.

1.3)   METHODOLOGY

To alleviate the effects of air and clamor contamination on human wellbeing, worldwide condition and overall economy, governments have set up enormous endeavors. With nitty gritty data of the air and clamor contamination circumstance, researchers, arrangement creators and organizers can settle on educated choices on overseeing and enhancing the living condition. An answer for checking the clamor and air quality levels utilizing inserted registering is proposed. The inserted framework used to screen the vacillation of parameter like clamor and air contamination level from typical levels.
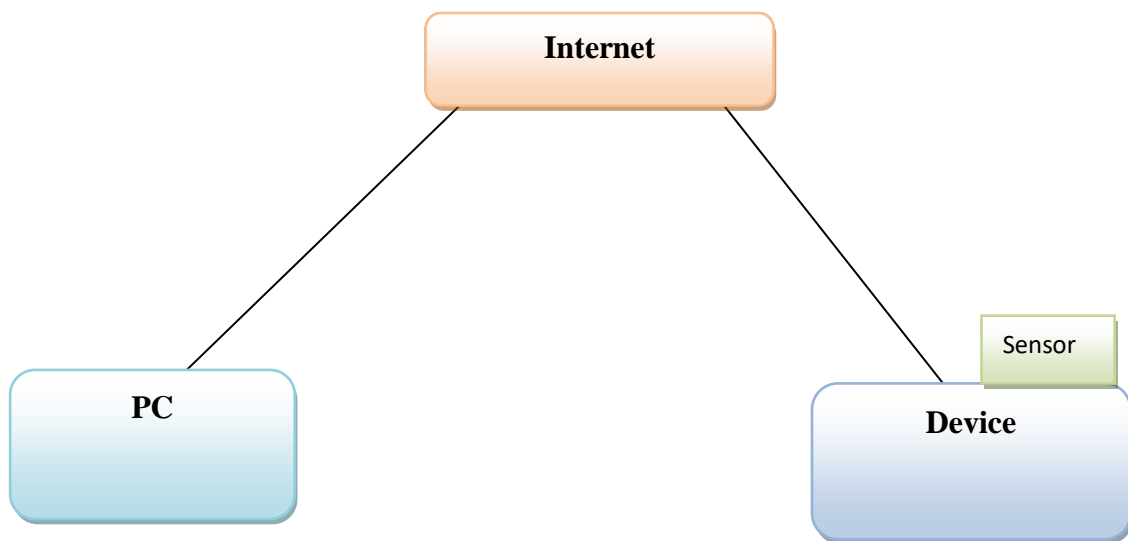
2. <u>LITERATURE SURVEY</u>

2.1) Title: "IOT Based Air Pollution Monitoring System using Raspberry Pi "(2017)

In this setting savvy sensor systems are a rising field of research which joins numerous difficulties of software engineering, remote correspondence and hardware. In this, an answer for observing the commotion and air contamination levels in mechanical condition or specific region of enthusiasm utilizing remote implanted registering framework is done. The arrangement incorporates the innovation Internet of Things which is result of consolidated field of software engineering and gadgets.

Here the recognizing contraptions are related with the introduced figuring structure to screen the change of parameters like tumult and air pollution levels from their run of the mill levels. This model is adaptable and for any infrastructural condition that necessities relentless watching, controlling and direct examination.

The working execution of the proposed exhibits is surveyed using model use, involving raspberry pi, sensor devices and python programming reinforce package.

The use is striven for a couple of parameters like uproar and radiation levels concerning the average lead levels or given particulars which gave a hand over the tainting seeing to influence nature to canny.

2.1.1) Contrast between Internet Of Things and Cloud Computing

Internet Of Things	Cloud Computing
IOT alludes to interfacing particular gadgets to the Internet. Be that as it may, not the general gadgets like PCs, workstations, and cell phones. In the event that we associate a few gadgets to determine a particular issue that goes under the Internet of Things	Cloud computing alludes to putting away and recovering any kind of information over the web from server farms. The information can be of any kind like application information, recordings, photographs, reports, sound and the sky is the limit from there.

Table 1: Contrast between IOT and Cloud Computing
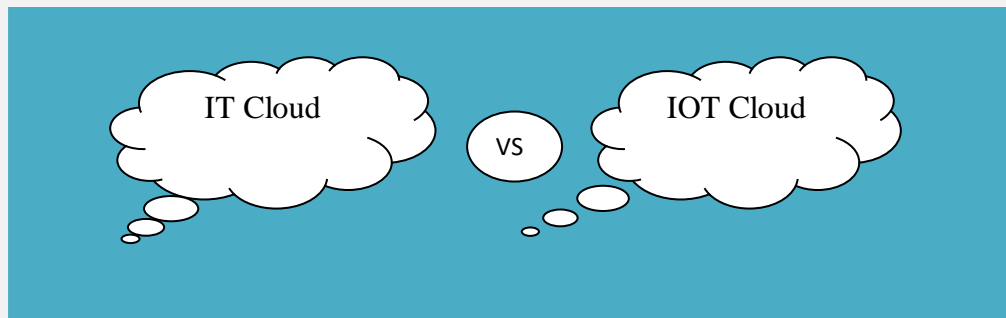
Figure 1: IOT vs Cloud

2.1.2) System Requirements
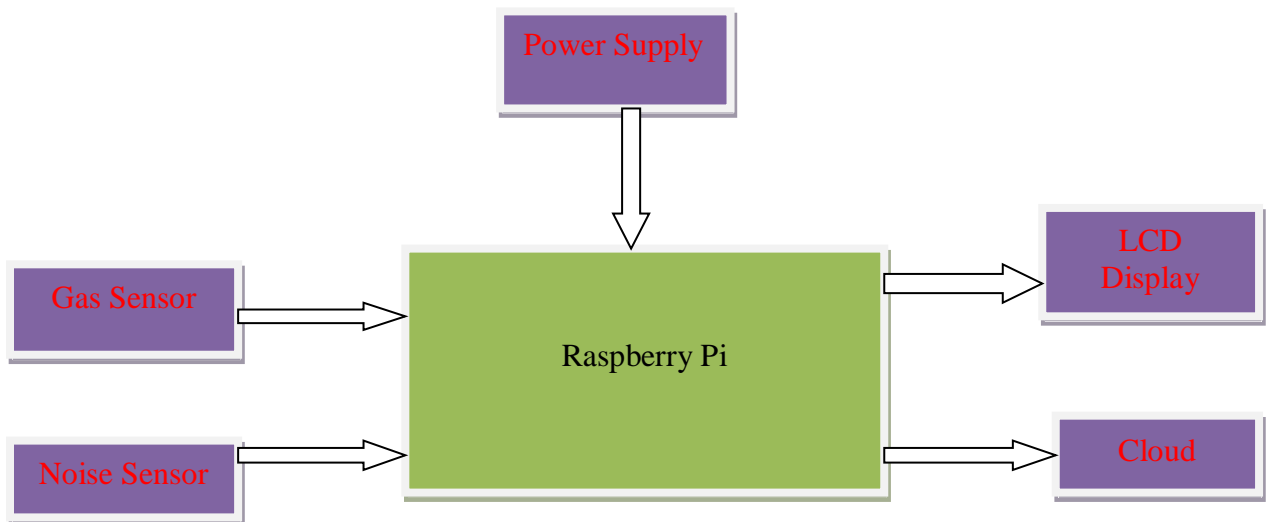
Figure 2: Schematic System

Raspberry Pi :

Raspberry Pi is an ace card estimated PC at first expected for preparing, propelled by the 1981 BBC Micro. Creator Eben Upton's goal was to attempt contraption that would improve programming capacities and gear understanding at the pre-school level. However, in light of its little size and open esteem, it was instantly grasped by tinkerers, makers, and equipment sweethearts for wanders that require more than a fundamental microcontroller, (for instance, Arduino contraptions).

MQ 135 Gas Sensor:

MQ-135 Module sensor has cut down conductivity in clean air. Exactly when the target combustible gas exist, the sensors conductivity is higher nearby the gas obsession rising. Change over contrast in conductivity to relate yield banner of gas center. MQ135 gas sensor has high affectability to Ammonia, Sulfide and Benzene steam, in like manner sensitive to smoke and other destructive gases. It is with negligible exertion and sensible for different applications, for instance, damaging gases/smoke disclosure.

2.1.3) Methodology

In this execution show they utilized raspberry pi 3 as implanted gadget for detecting and putting away the information in cloud. Raspberry pi interfaces the implanted gadget to web and sensors are associated. The relating sensors read to its advanced esteem and from computerized esteem the comparing natural parameters will be assessed. The raspberry pi 3 has inbuilt wifi module is to be built up to exchange sensor information to the end client.

2.1.4) Conclusion

By keeping the implanted gadgets in nature for viewing draws in self security to the earth. To execute this need to send the sensor gadgets in nature for get-together the information and examination. By sending sensor gadgets in the earth, we can convey nature into true blue living. By then the gathered information and examination results will be available to the end client. The tumult and air polluting checking framework with Internet of Things (IOT) thought likely took a stab at watching two parameters. It in like way sent the sensor parameters to the cloud.

This model can be also reached out to screen the making urban territories and current zones for pollution checking. To shield the general prosperity from tainting, this model gives a gainful and negligible exertion respond in due order regarding constant seeing of condition.

2.2) Title: "Air Quality Monitoring System based on Arduino Microcontroller" (2016)

Remembering the ultimate objective to screen nature of air, a Wireless sensor organize (WSN) based new framework is proposed which relies upon data securing and transmission. The parameters of the earth to be watched are picked as temperature, sogginess, volume of CO, volume of CO2, area of spillage of any gas - smoke, alcohol, LPG. The estimations of these parameters are transmitted by using Zigbee Pro (S-2) to a base station where they are being watched. The estimation of temperature and dampness are transmitted over Bluetooth in like manner so every person in the extent of the system can check it over their propelled cell phones and PCs as these parameters hold hugeness to everyone. CO, a dangerous parameter is checked with an extra protect. A text is sent to the base station through GSM module at whatever point its volume outperforms a particular safe limit got ready for a particular application.

2.2.1) Wireless Sensor Network

Remote sensor compose is an arrangement of sweeping number of flexible and static sensor center points with correspondence system which helps in recording and watching parameters like temperature, weight, stickiness, speed and twist course, stable power, light power, vibration drive, control line voltage, basic body limits substance obsessions and toxin levels using multi-ricochet and self-affiliation technique.

WSN comprises of sensor hubs from handfuls to thousands contingent on their use and each hub has basic element to register, spare and communicate information. In the time of awesome mechanical improvement, the word remote is getting to be well known in each field and therefore WSN will be next mechanical market for profiting. The advances utilized as a part of WSN are time synchronization, arrange convention, limitation, security organization, information total and power administration. Impediments in specific parameters, for example, handling power, transmission capacity, vitality also, capacity makes the assignment of giving security to the system extremely troublesome.

The steering of WSN is actualized in unexpected path in comparison to traditional directing of a settled system; in this manner investigation of steering conventions is a key point to outline any remote systems which are appeared in Fig.3
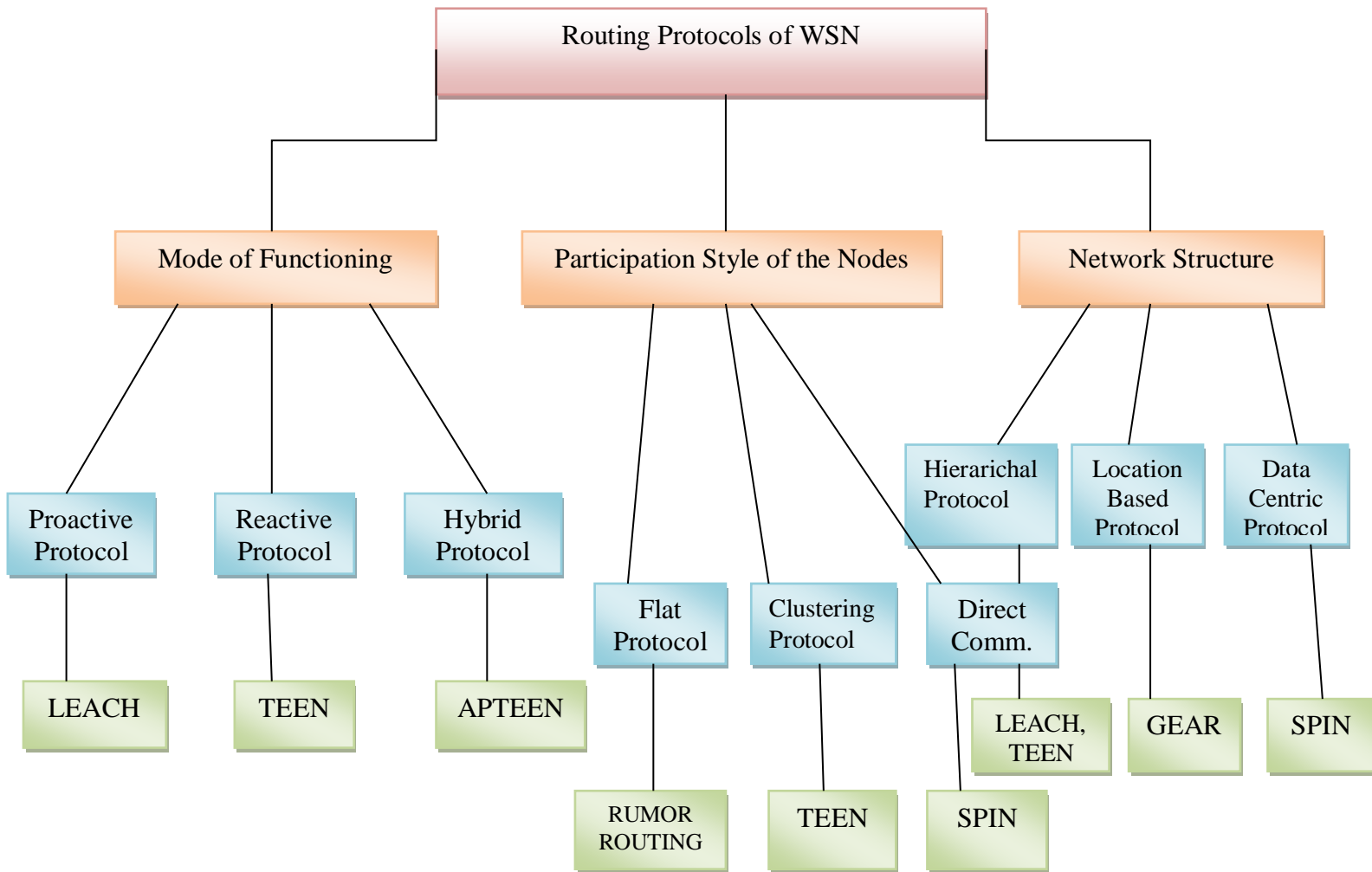
Figure 3: Routing Protocols of WSN

2.2.2) Related Work

GIS based system is formed, executed and endeavored to screen the air contamination of any region. It contains a microcontroller, gas sensors, flexible unit, a transient support and a server with web arrange which accumulates data from different regions close by compose information at certain period of a day. The data for particular territory are touched base at the midpoint of in a close time and space. The GPS module is added to a structure to give correct depiction of defilement sources in a district. The recorded data is discontinuously traded to a PC through a GPRS affiliation and after that the data will be appeared on the submitted site with customer affirmation. In this manner generous number of people can be benefitted with the broad information gathering framework.

GSM/GPRS based framework for recording ecological information, for example, temperature and mugginess utilizing Arduino Uno Microcontroller is proposed in which esteems are put away utilizing SD card joined to GPRS module instead of Arduino Uno memory. The GPRS module is utilized to give different capacities like the transmission of the information, continuous clock usefulness, and information stockpiling on a Micro SD card.

Contamination can be adequately observed with the utilization of WSN is equipped for giving a continuous contamination information. The adjustment of gas sensors like CO2 gas sensors, NO2 gas sensor is finished by utilizing different reasonable alignment innovations and after that WSN is shaped utilizing a multi jump information conglomeration calculation. The contamination information is appeared in the type of number and outlines with the assistance of web interface and is accessible on web too. Temperature and mugginess parameters are estimated alongside the gases and information is dissected information combination.

The framework is sent in people in general transport like transports which have dependable and settled courses. The model incorporates Portable Sensing Box (MSB) which comprises of a microcontroller, sensors, GPS framework and a cell modem. The power supply is given by associating with the transport battery to work this model. The grouping of CO and particulate issue is estimated in the proposed framework. The framework comprises of different observing stations, which are ready to discuss remotely with the utilization of backend server, outfitted with the metro legitimate sensor and gas sensor for recording information remotely. The constant information which is gathered through a backend server is changed over to the valuable data for the client with the assistance of online interfaces.

2.2.3) Air Quality Parameters

The imperative parameters that are considered in the proposed structure include:

Carbon Monoxide Gas: Carbon Monoxide (generally called CO) is a bleak, unscented unsafe gas and is a normal yet behind death from hurting far and wide. Around half of the going from startling CO harming result from the internal breath of smoke from blazes. Other basic causes are vehicle exhausts and going in present day/business settings.

Carbon Dioxide Gas: Carbon dioxide is accessible in the Earth's condition at a low concentration and goes about as an ozone hurting substance. In its solid state, it is called dry ice. It is a significant piece of the carbon cycle.
Climatic carbon dioxide gets from various consistent sources including volcanic out gassing, the start of regular issue, and the breath methods of living fiery living creatures; man-impacted wellsprings of carbon dioxide to desire the most part from the expending of various oil based commodities for control age and transport use.
 Additionally, plants in like manner release oxygen to the earth, which is thusly used for breath by heterotrophic living creatures, encircling a cycle.

Smoke: Smoke is a social event of solid and liquid particles and gases emanated when a material encounters start together with the measure of air that is mixed into the mass. It is routinely an unwanted symptom of blazes (chimneys, oil lights, and stacks), Smoke is used as a piece of functions where incense, sage, or pitch is seared to make an aroma for significant purposes. Smoke is on occasion used as a flavoring administrator, and added substance for various foodstuffs. Smoke is in like manner a section of internal consuming engine exhaust gas, particularly diesel vapor.

LPG: Liquefied oil gas in like manner are ignitable mixes of hydrocarbon gases used as fuel in warming machines, cooking apparatus, and vehicles. It is dynamically used as a fuel and refrigerant supplanting cfc's with a true objective to decrease mischief to the ozone layer. Right when especially used as a vehicle fuel it is much of the time implied as auto gas. In the northern side of the equator winter, the mixes contain more propane, while in summer, they contain more butane. In the United States, transcendently two assessments of LPG are sold: business propane and HD-5. These judgments are conveyed by the GPA and ASTM.

2.2.4) Block Diagram
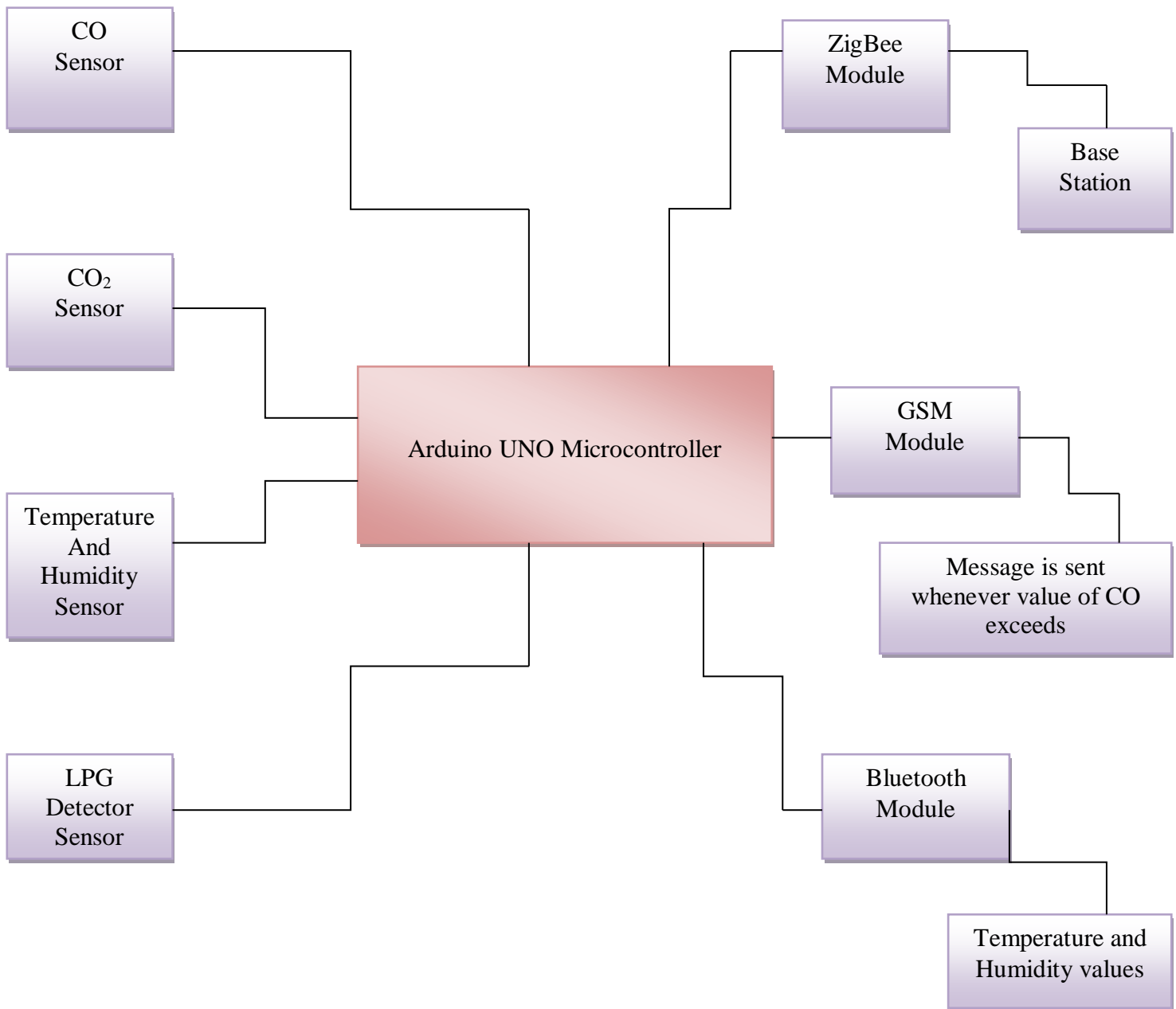
Figure 4: Block Diagram

2.2.5) Conclusion

The framework to screen different parameters of condition utilizing Arduino microcontroller, WSN and GSM Technology is proposed to enhance nature of air. With the utilization of advancements like WSN and GSM improves the procedure of observing different parts of condition, for example, air quality checking issue proposed in this paper. The discovery furthermore, checking of perilous gases is considered in a genuine way and related safeguards have been considered here as an alarm message and a bell so the fundamental move might be made. It is assessed that this framework will have an incredible acknowledgment in the market as it is a unified framework for an entire observing work.
This checking framework can be improved by including remote system card for capacity of qualities from sensors appended to microcontroller and additionally more gas sensors could be utilized like Nitrogen dioxide (NO2), Ammonia (NH3), Sulfureted Hydrogen (H2S), liquor and so on. Another part of estimating particulate issue can be acquainted with make it more progressed.

**2.3)   Title: "IOT Based Air And Sound Pollution Monitoring System"(2014)**

This paper benefits the modern society with the increasing use of IOT .

Current task and such different activities like shrewd homes, for example, control and mechanization of warming, ventilation, cooling and so forth utilizes Wi-Fi for remote checking. Task would likewise work in dealing with home and environment as we could screen the parameters from anyplace under the Wi-Fi get to which enables experts to screen air contamination in various territories and make a move to control the issue. Principle thought process of this venture is to keep the unsafe impacts of contaminations display in air with the goal that sound environment can be kept up by information investigation of put away information in IOT cloud.

2.3.1) Existing System Model:

Following framework display is introduced in figure 5 utilizes Zigbee based remote sensor systems to screen ecological condition with a large number of use in many fields. The sensor hubs specifically spoke with the moving hubs sent on the question of intrigue which maintained a strategic distance from the utilization of complex steering calculation yet nearby calculations are exceptionally insignificant. RFID is a method for putting away and recovering information through electromagnetic transmission to a RF perfect incorporated circuit. It has an extraordinary distinguishing proof (ID) number and a memory which is utilized to store extra information, for example, maker, item write, and ecological factors, for example, temperature, mugginess, and so forth. Through Wireless Communication the per user is proficient to compose as well as read information to labels., needing distinguishing proof or following, labels are installed or connected into objects in an ordinary RFID application. These labels can be grouped into three noteworthy classes by their energy source: dynamic labels, aloof labels, and semi inactive (semi-dynamic) labels are inserted or connected into objects in an ordinary RFID application.

A WSN inbuilt of numerous near sensor those are reasonable, that can gather, store, process a natural data, and to speak with hubs those are neighbors to each other.

Remote sensor organize administration display comprises of end gadget, switch, portal hub and administration observing focus. To gather remote sensor organize information, and to send them to major hub, Hence last gadget is dependable, information is sent to portal hub from hub specifically or through assistance of switch.
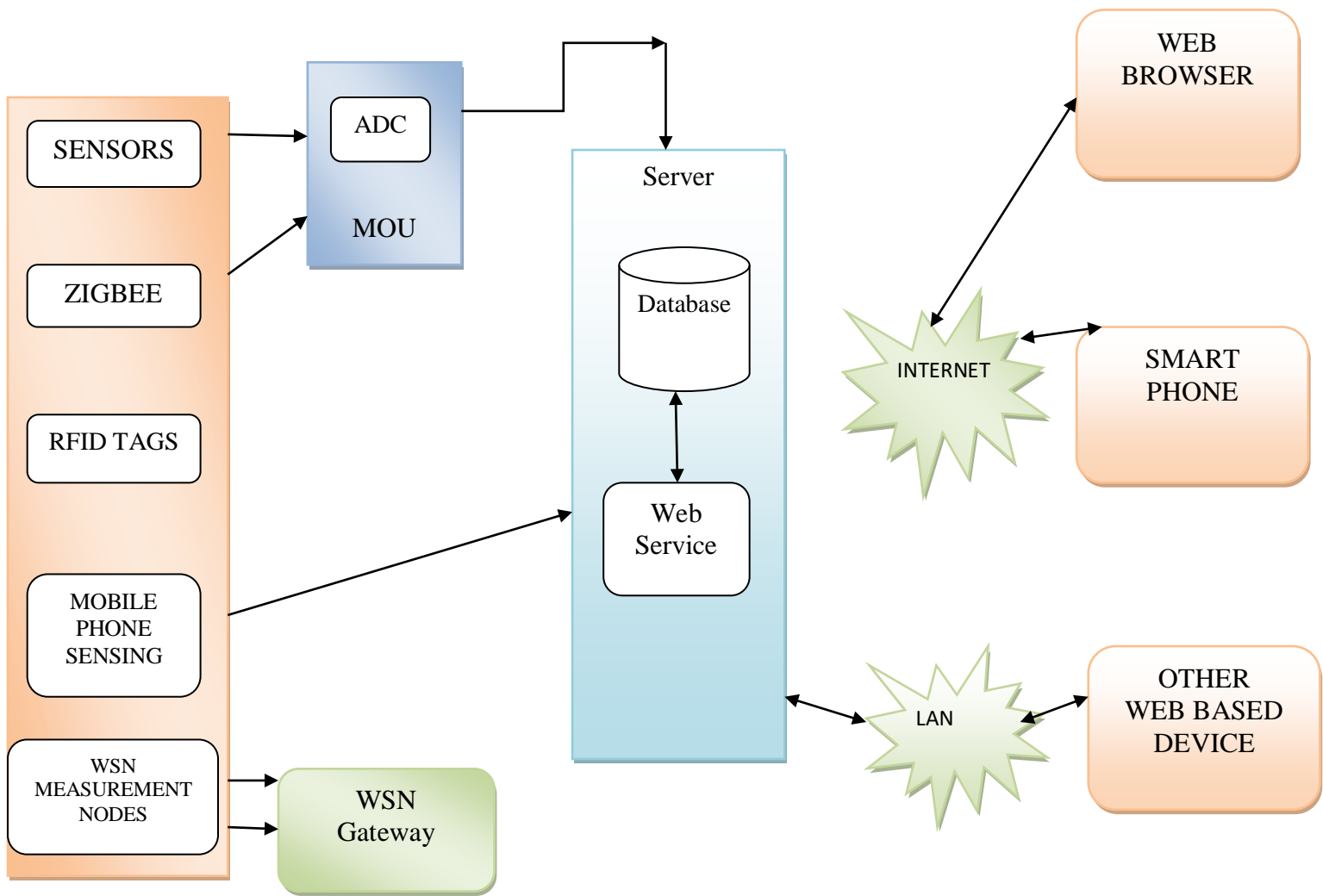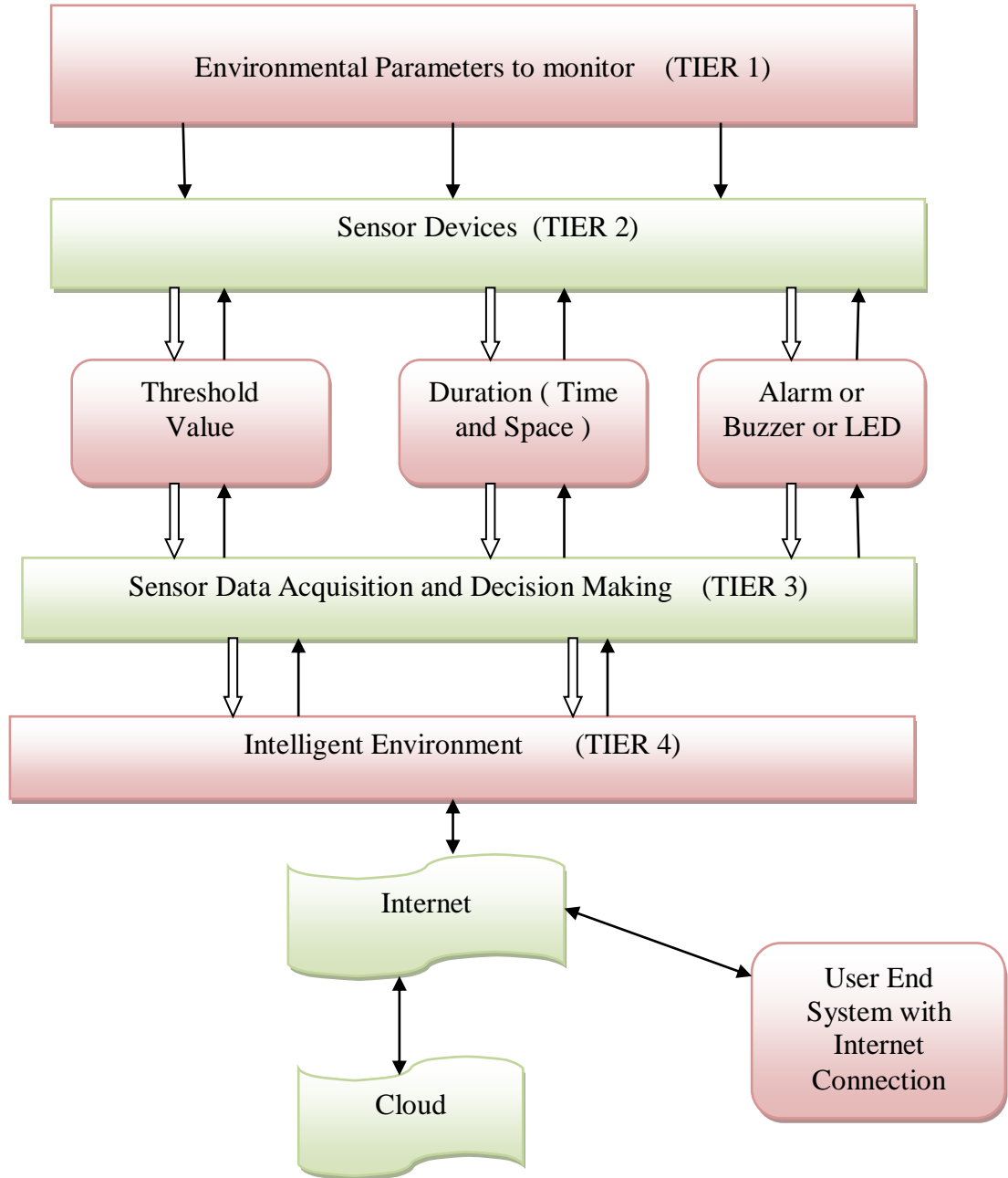
Figure 5: System Model

**2.3.2) Proposed Model:**

Figure 6

The proposed inserted gadget is for checking clamor and harmful levels in the climate to enable the earth to be smart or through remote correspondence. The formed display is appeared in figure 2 that is more efficient and good in nature to screen the ecological parameter. The proposed design is talked about in a 4-level model with the elements of every individual modules produced for commotion and air contamination observing. The display comprises of 4-levels. The level 1 is the earth, sensor gadgets in level 2, sensor information obtaining and basic leadership in level 3 and clever condition in level 4.The proposed engineering is appeared in figure 6.

Here, the level 1 give data of parameter under the locale that is to be observed for commotion and contamination reach. Level 2 manages the sensor gadgets with reasonable qualities, highlights and every one of these sensor gadgets are worked and controlled in light of their affectability and in addition the scope of detecting. In the middle of level 2 and level 3 fundamental detecting and controlling moves will be made relying on the conditions, such as settling the limit esteem, periodicity of detecting, messages (caution or signal or LED) and so on.

Level 3 portrays about the information securing from sensor gadgets and furthermore incorporates the basic leadership. In this demonstration level 4 manages the wise condition. Which implies it will distinguish the varieties in the sensor information and fix the limit esteem contingent upon the recognized clamor levels. In this level detected information will be prepared, put away in the cloud i.e. in to the Google spread sheets.

Sensors are associated with uno board for checking, ADC will change over the comparing sensor perusing to its computerized esteem and from that esteem the relating natural parameter will be assessed. The Wi-Fi association must be set up to exchange sensors information to end client and furthermore send it to the distributed storage for future utilization. Before sending the detected information to cloud, the information will be prepared in matlab for examine and imagine information to end client.
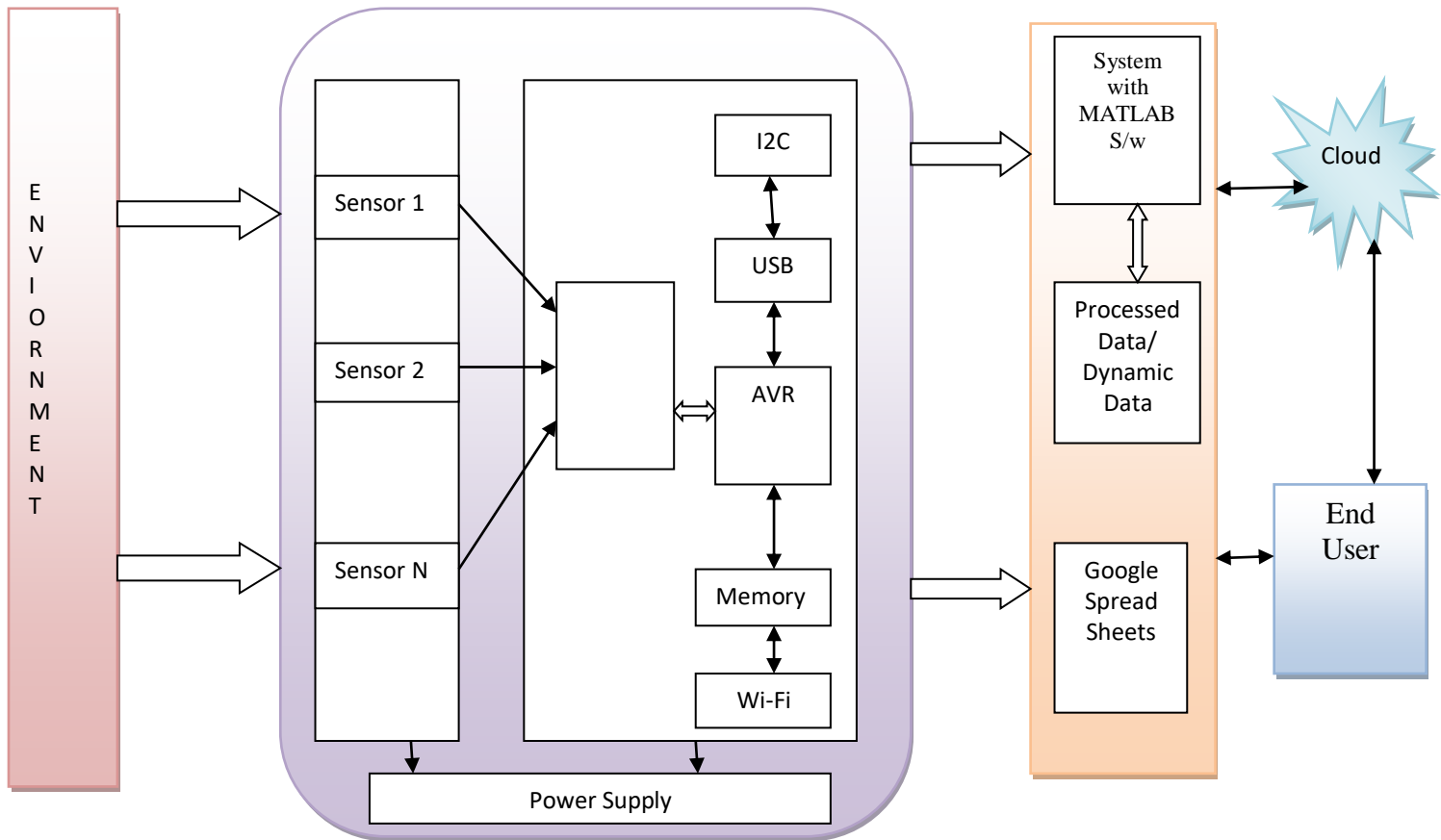
Figure 7: Schematic Diagram of Implementation Model

2.3.3) Advantages :

- Sensors are effortlessly accessible.
- Connect many sensors to know substance of all gases display in air.
- Recognizing an extensive variety of gases, including CO, MH4, liquor, smoke and so forth.
- Straightforward and reduced.
- Sensors have long duration.
- Straightforward Drive circuit.
- Framework is Real time.
- Visual yield.
- Consistent refresh of progress in level of value.

2.3.4) Applications :

- To estimate the pollution.
- To monitor the industry perimeter.
- Selecting sight for reference stations .
- Indoor Air Quality Monitoring.
- To design server and upload data on that server with date and time.
- To make data available to all.
- To establish a danger limit on that server and inform authorities to take actions.

2.3.5) Conclusion :

To execute this to convey the sensor gadgets in the earth for gathering the information and investigation..At that point the gathered information and investigation results will be accessible to the end client through the Wi-Fi.

In the proposed engineering elements of various modules were talked about. The commotion and air contamination checking framework with Internet of Things (IoT) idea tentatively tried for observing two parameters. It additionally sent the sensor parameters to the cloud (Google Spread Sheets).

2.4)   Title: "Noise and Air Pollution Monitoring System using IOT"(2013)

This paper aims to gather data by the sensors which could be utilized by the specialists to take fundamental activities, for example, crisis cautioning messages and clearing of individuals to spare places. Pollution observing framework will survey low awful air contamination is from everyday and spare nature from assist pollution .The hand-off is utilized as a part of the mechanical plant naturally to keep it from alerts issues. Therefore they went for contamination checking framework utilizing pic microcontroller in implanted system. The data that are gathered by the sensors could be utilized by the experts to take important activities, for example, crisis cautioning messages and departure of individuals to spare places. Pollution observing framework will evaluate low awful air contamination is from everyday and spare the earth from encourage pollution. The transfer is utilized as a part of the modern plant consequently to keep it from alerts issues.

2.4.1) Construction:

The sensors contain two or three terminals. The anodes are manufactured by settling a maximum zone beneficial metal on to the permeable film. The working terminal contacts both the electrolyte and the including air to be checked overall through a permeable film. The electrolyte most ordinarily utilized is a mineral damaging, however customary electrolytes are in like way utilized for a few sensors.

While electrochemical sensors offer various purposes of intrigue, they are not fitting for every gas. Since the revelation framework incorporates the oxidation or abatement of the gas, electrochemical sensors are by and large suitable for gases which are electrochemically unique, in any case it is possible to perceive electrochemically idle gases if the gas associates with another species in the sensor that by then makes a response. Sensors for carbon dioxide are an instance of this approach and they have been mechanically open for a significant extended period of time.

2.4.2) Block Diagram:
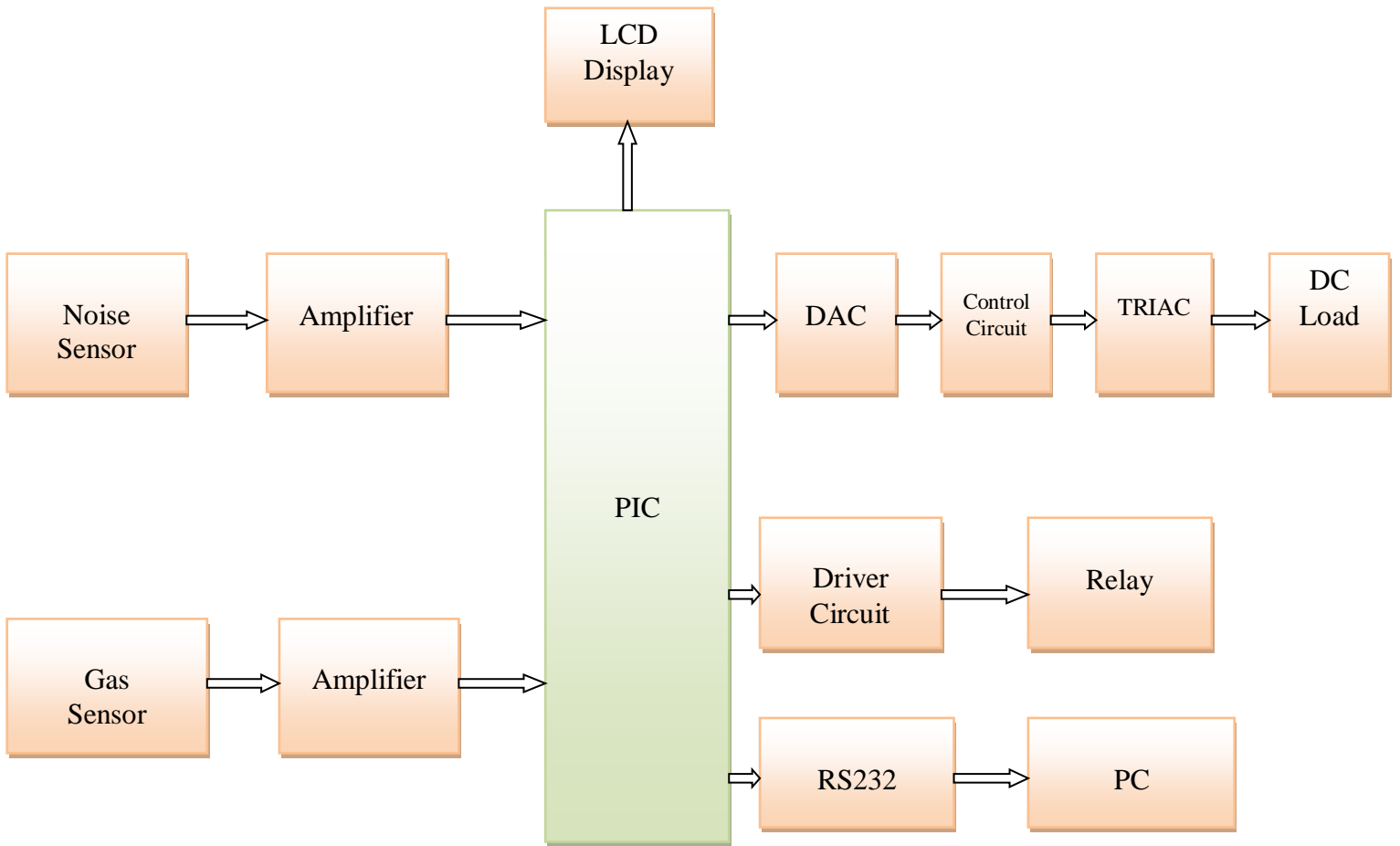
Figure 8: Block Diagram

2.4.3) Features of PIC Microcontroller:

- It has RISC (lessened guideline set PC) design.
- It contains ROM of size 2mb.
- It has on chip-code read just memory.
- It contains RAM (arbitrary access memory) between 256 bytes to 4096 bytes.
- It has Electrical Erasable Programmable Read Only Memory.
- It incorporates Clocks.
- It has ADC.
- It has USART PROTOCOL.
- It contains I/O port pins.
- All I/O port enroll are bit available and port open both.

2.4.4) Conclusion:

Turning away ecological contamination is one of the monotonous errands since the people are in charge of this dangerous nature which postures risk to entire world. What's more, we are dependable destroy contamination issues. For all intents and purposes all emanations shift every now and then. It is an incredible idea that will demonstrate another measurement. In spite of the fact that the general and particular target is fundamentally the same as the innovative arrangements utilized are altogether different.

2.5) Title: "Environmental Monitoring using sensor based wireless embedded system and ANN"

This paper depicts the exercises of requirements to happen to screen the nature of the earth. Ecological checking is a methodical approach for watching and concentrates the state of the earth. It is one of the real utilization of remote sensor organize.

The reason for checking the ecological conditions isn't just to gather the information yet in addition to perform fundamental examination with a specific end goal to give the data which is required by the researchers, organizers, strategy producers to settle on a choice on enhancing and dealing with the earth in this way settling issues worried about nature.

2.5.1) Literature Review:

The creators introduced the development and working of an extremely basic, simple to utilize and practical Environment Monitoring framework which keeps running on battery control. It is an essential model that screens temperature in "Celsius" and Light Intensity in "Lumens". It begins filling in when it is exchanged on and ceaselessly demonstrates checked information on a LCD screen and revives itself at regular intervals. This is very advantageous for ease mechanical applications, voyaging circumstances, outside conditions, essential military purposes and family unit applications.

They introduced a neural system based calculation for anticipating the temperature. The utilization of neural systems us in gauging the climate and the working of most intense expectation calculation got back to engendering calculation is clarified.

They at that point introduced an overview of existing examination on applying ANNs to climate expectation. This test utilized a dataset containing climate factors recorded at regular intervals through the span of a year by an individual climate accumulation station.

They considered the use of remote sensor arrange (WSN) innovation to long-length and huge scale ecological checking. Genuine cases taken from their work in this field are utilized to outline the mechanical troubles and difficulties that are involved in meeting end-client necessities for data gathering frameworks.

2.5.2) Proposed Model:
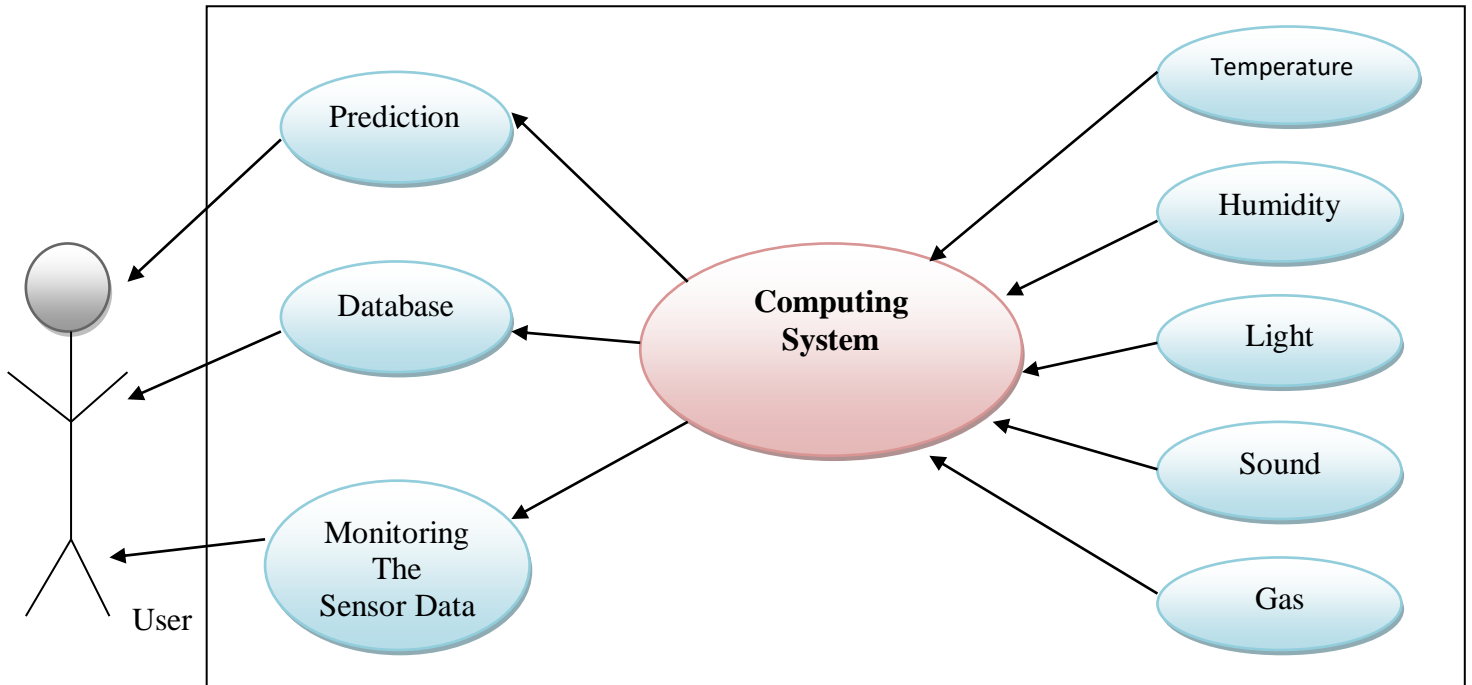
Figure 9: Use Case Diagram of the model

The proposed model of natural checking framework implements the capacity to perform information securing on the sensor framework and further perform expectation on the gathered information. The point is to gather information from sensors and plan dataset comprising of natural parameters like temperature, stickiness, light, stable, air quality and so forth.

Wi-Fi availability is given to the model through which sensor information is transferred to the web which can be gotten to inside the Wi-Fi extend.

The proposed framework is executed in two stages, to be specific:
a) Data observing stage
b) Data forecast stage

In the first stage, sensors which screen ecological parameters, for example, temperature, air quality, light force and dampness are interfaced to the Intel Galileo board. Arduino code is keep running in its IDE which persistently recovers the sensor information and presentations them on its serial screen. This information is sent out into content records which are utilized as a part of the information expectation stage
In the next stage, Back Propagation Neural Network calculation is connected to the datasets put away in content documents.

The Datasets created are contribution to the system alongside weights and predisposition also, yields are created in like manner. The dataset containing the temperature esteems is given as contribution to the neural system.
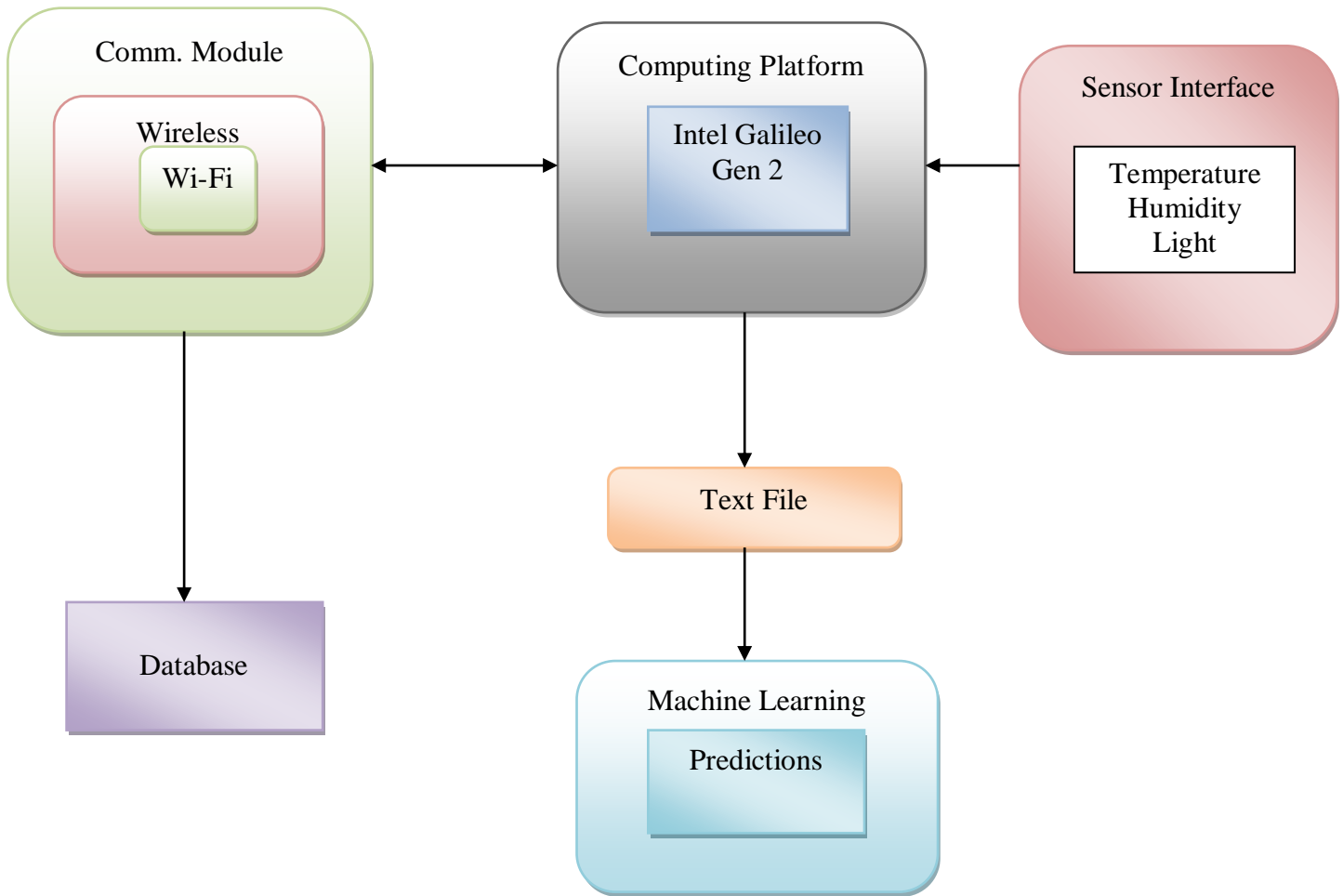
Figure 10: Generic Design of the System

2.5.3) Outcome:

Input	Expected Output	Actual Result	Error
21, 22, 23	25 ,26	24.999996 , 25.99996	0.00003
25,24,23	24,22	23.997 , 21.998	0.00002
23,24,27	25,27	22.9997, 26.9997	0.00004

Table 2: Temperature Dataset

Input	Expected Output	Actual Result	Error
202,230,260	250, 276	246.996 , 215.996	0.00004
250,240,345	214,220	273.997 , 281.998	0.00003
267,284,379	259,320	220.97, 269.997	0.00005

Table 3: Humidity Dataset

2.5.4) Conclusion:

In this paper, back spread neural systems expectation calculation is connected to the installed framework by giving a preparation dataset to the organize. Through the usage of this framework, it is outlined, how an installed framework for example, Intel Galileo can be proficiently incorporated with a neural system expectation display. The dataset comprising of various qualities has been prepared and tried utilizing the Neural Networks which predicts the ecological parameters with most extreme precision furthermore, slightest mistake. Subsequently a remote framework for activation of the natural observing and forecast of different conditions is given.

Later on, condition basic leadership parameters can be assembled by utilizing unsupervised learning calculation.

3. <u>SYSTEM DEVELOPMENT</u>

3.1) SOFTWARE REQUIREMENTS:

- Proteus for designing circuit.
- Arduino IDE
- Web Browser

3.2) HARDWARE REQUIREMENTS:

- Node MCU
- Transformer
- Relay
- Capacitor
- Resistors
- Voltage Regulator
- LDR
- Wires

3.3) SYSTEM REQUIREMENTS:

- CPU: 2.2 GHz Processor and above
- RAM: 4 GB or above
- OS: Windows 7 or above

3.4) Using Node MCU:

We need to program the Node MCU on Arduino IDE:

Steps to be followed are as under:

- **Connect your Node MCU to the computer.**
  Use USB cable to connect it, you will see the blue led flickering, which indicates it is connected.

- **Install the COM/Serial Port Driver.**
  So as to transfer code to the ESP8266 and utilize the serial port, interface any information proficient small scale USB link to ESP8266 IOT Board and the opposite side to your USB's port.

- **Install the Arduino IDE.**

- **Install the ESP8266 Board Package.**

- **Setup ESP8266 support.**

- **Select the things in the Tools > Board and Serial Port that compare to the board you are utilizing as the software engineer (not the board being customized).**
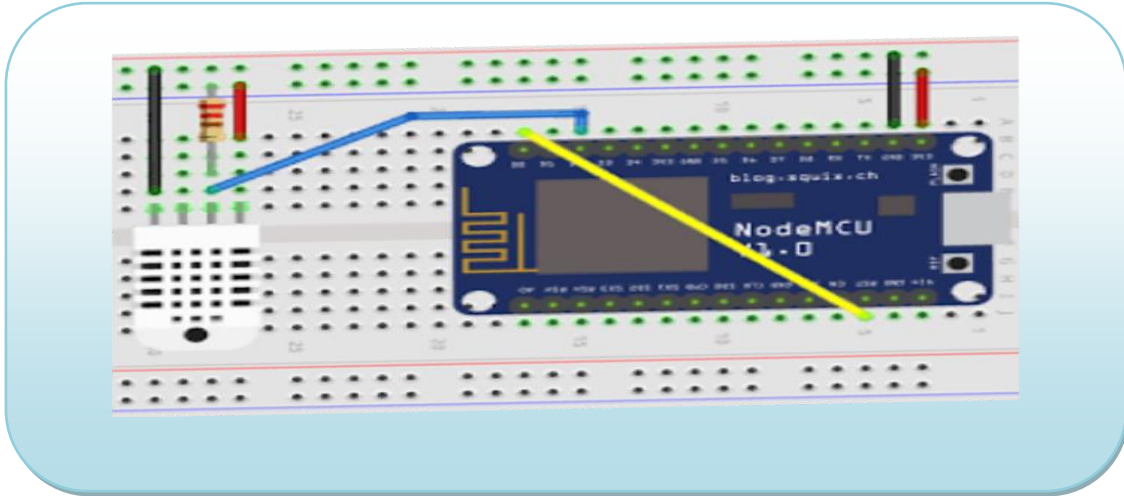
- **Now select the item in the Tools > Board menu select the target board on which we want to upload the code.**

- **Now open the SKETCH that you want to upload on target microcontroller.**

- **Now go to file menu and select the option "upload using programmer".**

3.5) Hardware Specifications:

3.5.1) Node MCU:

Figure 11: Node MCU

Node MCU is an open source IOT stage. The expression "Node MCU" as a matter of course   alludes to the firmware instead of the advancement units. Node MCU was made soon after the ESP8266 turned out.

In summer 2015 the makers deserted the firmware venture and a gathering of free yet devoted givers assumed control. By summer 2016 the Node MCU included in excess of 40 distinct modules. Because of asset limitations clients need to choose the modules pertinent for their task and fabricate a firmware customized to their requirements.

SPECIFICATIONS:

Operating system	**XTOS**
CPU	**ESP8266(LX106)**
Memory	**128kBytes**
Storage	**4MBytes**
Power	**USB**

Table 4

Node MCU provide link to the General Purpose Input/Output (GPIO)pins.

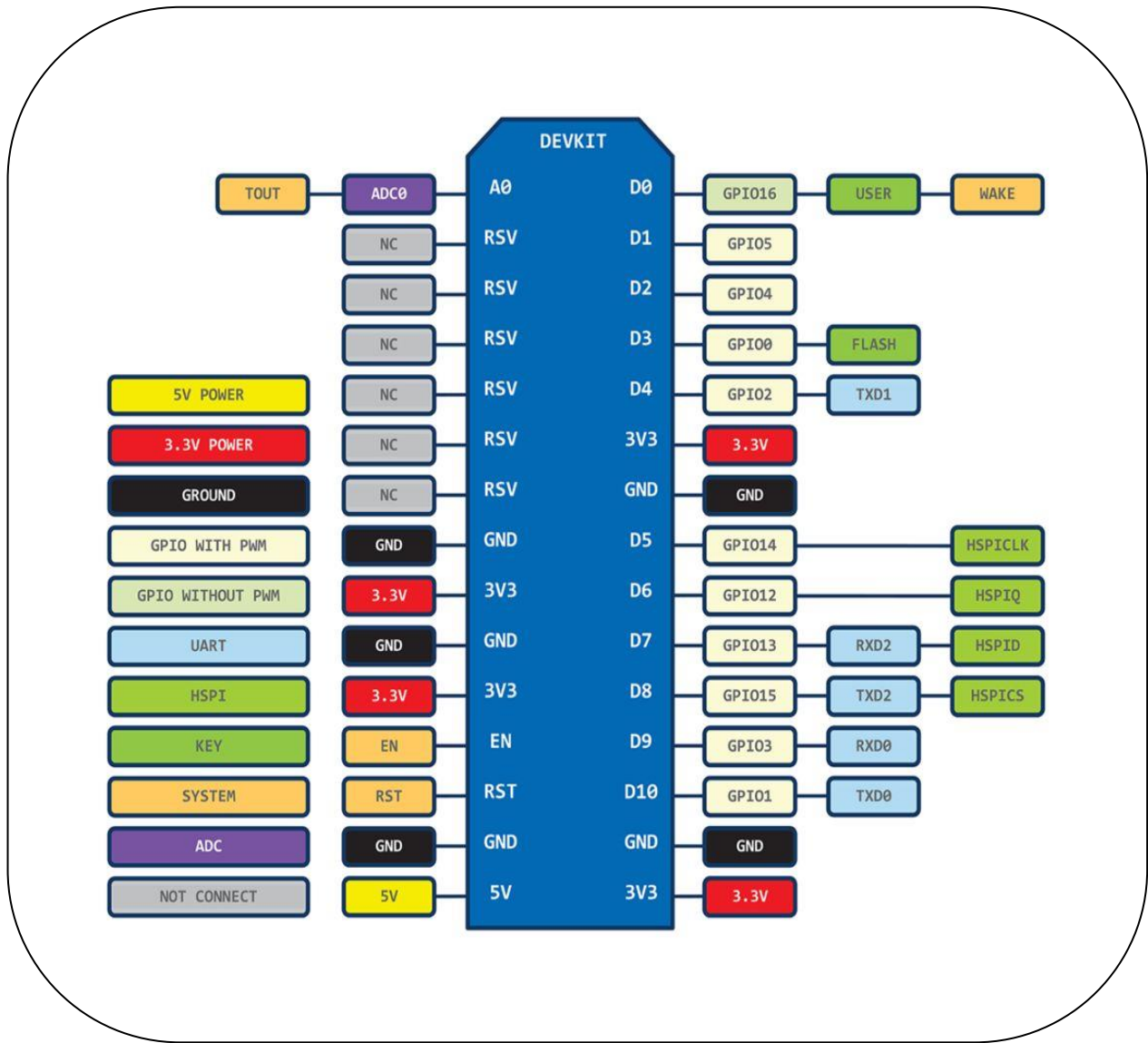| IO index	ESP8266 pin	IO index	ESP8266 pin
0 {*}	GPIO16	7	GPIO13
1	GPIO5	8	GPIO15
2	GPIO4	9	GPIO3
3	GPIO0	10	GPIO1
4	GPIO2	11	GPIO9
5	GPIO14	12	GPIO10
6	GPIO12	---	---

Table 5: GPIO Pins

Figure 12: **Pin out of Node MCU**

3.5.2) Arduino IDE:

A Code for Arduino may be formed in any programming vernacular for a compiler that produces twofold code for the goal processor. Atmel gives a change space to their microcontrollers, AVR Studio and the more up and coming Atmel Studio.

The Arduino wander gives the Arduino fused headway condition (IDE), which is a cross-organize application written in the programming tongue Java. It began from the IDE for the tongues Processing and Wiring. It joins a code editor with features, for instance, content reordering, looking for and supplanting content, customized indenting, bolster organizing, and semantic structure highlighting, and gives fundamental a solitary tick parts to assemble and exchange tasks to an Arduino board. It moreover contains a message locale, a substance bolster, a toolbar with gets for fundamental limits and a hierarchy of leadership of action menus.


```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repe

  This example code is in the public domain.
*/

void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);   // set the LED on
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // set the LED off
  delay(1000);              // wait for a second
}
```

Figure 13: **Arduino IDE**

A program created with the IDE for Arduino is known as a draw. Representations are spared cash on the change PC as substance records with the archive expansion .ino. Arduino Software (IDE) pre-1.0 saved diagrams with the extension .pde.

The Arduino IDE supports the lingos C and C++ using uncommon standards of code arranging. The Arduino IDE supplies an item library from the Wiring wander, which gives various essential information and yield methods.

Customer created code just requires two basic limits, for starting the framework and the standard program circle, that are collected and associated with a program stub crucial() into an executable cyclic authority program with the GNU toolchain, in like manner included with the IDE transport.

The Arduino IDE uses the program avrdude to change over the executable code into a substance record in hexadecimal encoding that is stacked into the Arduino board by a loader program in the board's firmware.

3.5.3) Gas Sensor:

It is a device that distinguishes the closeness of gases in a domain, routinely as an element of a prosperity system. This kind of rigging is used to recognize a gas spill or distinctive radiations and would interface have the capacity to with a control system so a technique can be thusly shut down. A gas pointer can sound an alarm to heads in the area where the gap is going on, allowing them to get out. This sort of device is crucial in light of the way that there are various gases that can be risky to normal life, for instance, individuals or animals.

Figure 14: MQ135 Gas Sensor

Types

Gas locators can be assembled by the movement instrument (semiconductors, oxidation, reactant, photograph ionization, infrared, et cetera.). Gas markers come packaged into two guideline outline factors: advantageous devices and settled gas locators.

Helpful discoverers are used to screen the atmosphere around work compel and are either hand-held or worn on dress or on a belt/furnish. These gas identifiers are for the most part battery worked. They transmit sees by methods for fit for being heard and unmistakable signs, for instance, cautions and blasting lights, when unsafe levels of gas vapors are recognized.

Settled compose gas markers may be used for area of no less than one gas makes. Generally, present day sensors are presented on settled kind smooth steel structures and a connection relates the discoverers to a SCADA framework for perpetual checking. A faltering interlock can be authorized for an emergency condition.

The MQ sensor can recognize NH3, NO_x, alcohol, Benzene, smoke, CO2 and some unique gases, so it is faultless gas sensor for our Air Quality Monitoring Project. When we will relate it to Arduino then it will distinguish the gases, and we will get the Pollution level in PPM (parts per million). MQ gas sensor gives the yield in sort of voltage levels and we need to change over it into PPM. So to change over the yield in PPM, here we have used a library for MQ sensor.

Sensor gave us approximation of 90 when there was no gas near it and the protected level of air quality is 350 PPM and it should not be more than 1000 PPM. When it exceeds the breaking point of 1000 PPM, at that point it starts to cause Headaches, tiredness and dormant , if surpasses above 2000 PPM then it causes expanded heart rate and numerous different illnesses.

At the point where the esteem will be below 1000 PPM, at that point the LCD and website page will show "Natural Air". At this point the esteem will build 1000 PPM, at that point the ringer will begin beeping and the LCD and site page will show "Poor Air, Open Windows". In the event that it will increment 2000 then the bell will continue to beep and the LCD and webpage will show "Threat! Move to outside Air".

3.6) List of Components:

S.NO	Name	Quantity	Color	Pins
1	MQ135	1	Black	40
2	LDR	1	-	2
3	Voltage regulator 7805	1	Black	3
4	Ribbon wires			
5	NOD MCU	1		
6	Relay	1	Black	6
7	Transformer (0-12v)	2	Black	
8	ULN2003			
9	LM35	1		-
10	Led (Red)	1	RED	-
11	Diodes	1		-
12	Capacitor 1000uf			-
13	IC Base (8,16 pin)	3	Black	-
14	7805 Voltage Regulator	1		-

Table 6: Components

3.7) Block Diagram of the Project:
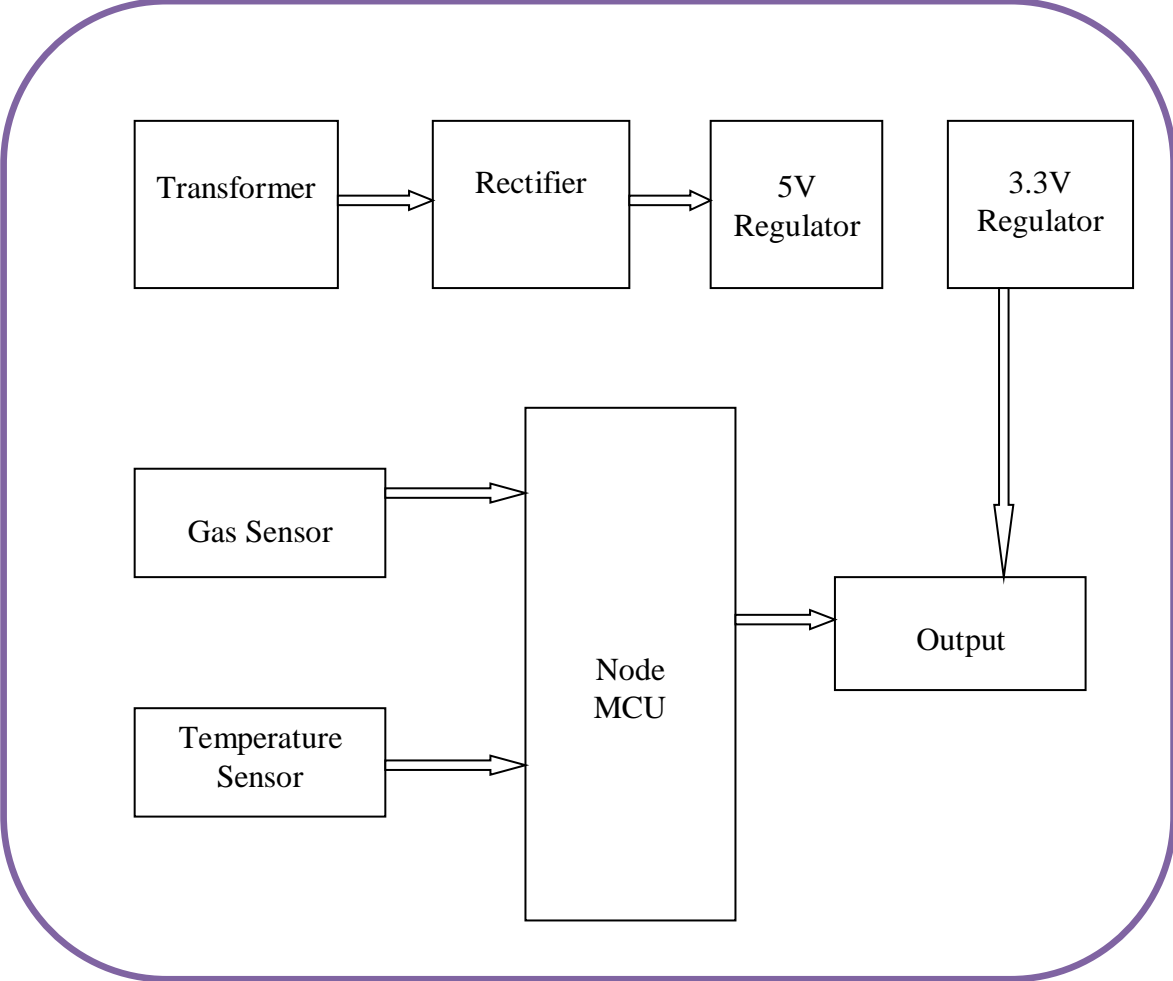
Figure 15: **Block Diagram**

3.8) Circuit Diagram:

Figure 16: **Circuit**
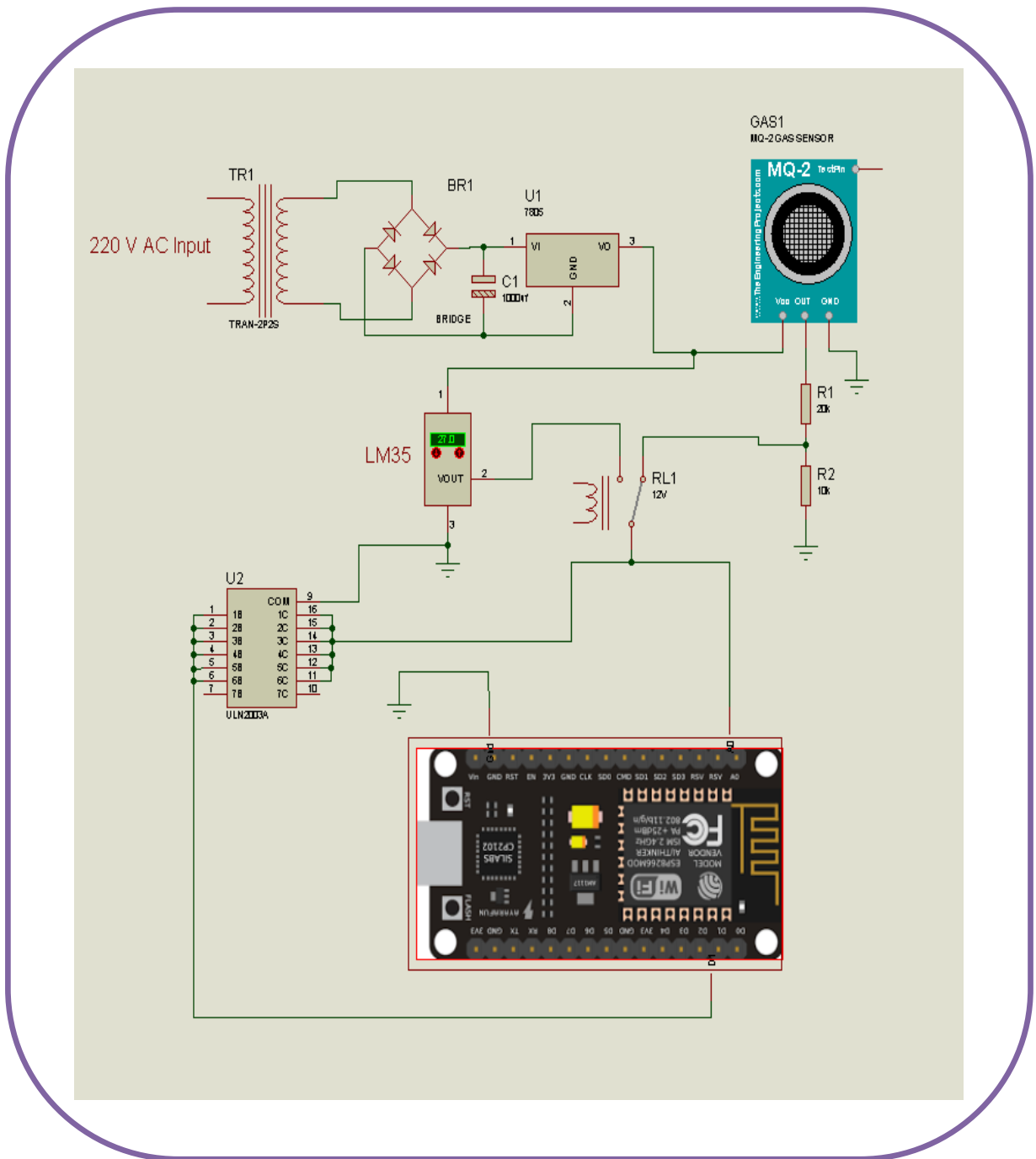
3.9) Coding:

```cpp
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>
#include <Math.h>

// Replace with your network credentials
const char* ssid = "iP";
const char* password = "abcdefgh";

ESP8266WebServer server(80);   //instantiate server at port 80 (http port)

String page = "";
float data;
float data1;
void setup(void)
{
 pinMode(4, OUTPUT);
 pinMode(5, OUTPUT);
  pinMode(A0, INPUT);

  delay(1000);
 Serial.begin(115200);
  Serial1.begin(115200);
 WiFi.begin(ssid, password); //begin WiFi connection
 Serial.println("");
// Wait for connection
  while (WiFi.status() != WL_CONNECTED) {
   delay(500);
   Serial.print(".");
  }
 Serial.println("");
 Serial.print("Connected to ");
 Serial.println(ssid);
 Serial.print("IP address: ");
```

```
Serial.println(WiFi.localIP());
 server.on("/", []()
 {
   page = "<h1>Sensor to Node MCU Web Server</h1> <h3>Temperature Sensor Data(Celcius):"+String(data)+"</h3>
<h3>Gas Sensor Data(Raw):"+String(data1)+"</h3>";
   server.send(200, "text/html", page);
 });

 server.begin();
 Serial.println("Web server started!");
}

void loop(void)
{
 digitalWrite(5, HIGH);
 data = analogRead(A0);              // 0-1023
 data= (data)*0.0032258064516129*100;    //
 delay(1000);

 digitalWrite(5, LOW);
 data1 = analogRead(A0);
 delay(1000);

 server.handleClient();
}
```

3.10) SYSTEM DESIGN:

3.10.1) USECASE DIAGRAM

A use case schematic is a document of steps, necessarily defining reciprocation reined by a management (known in Unified Modeling Language (UML) as an ―actor) and a course of action, to go already of a goal.
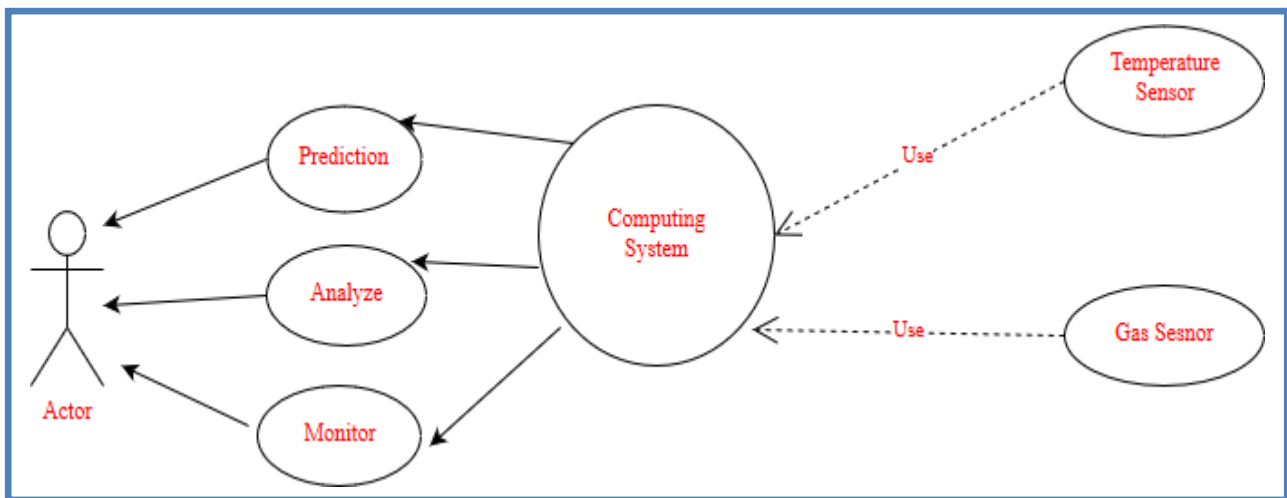

Figure 17: **Use case Diagram**

\

Flow of events:

Temperature Sensor: Estimates the room temperature.
Gas Sensor: Estimates the concentration level of gas in PPM.
Prediction phase: For predicting the values.
Analyze phase: For analyzing the predicting values.
Monitor phase: For monitoring the analyzed phase.

3.10.2) CLASS DIAGRAM

A class chart inside the UML could be a center of static unequivocal calendar graph that portrays the techniques for a program by demonstrating the framework's classifications, their properties, operations (or strategies), and consequently the connections midway protests.
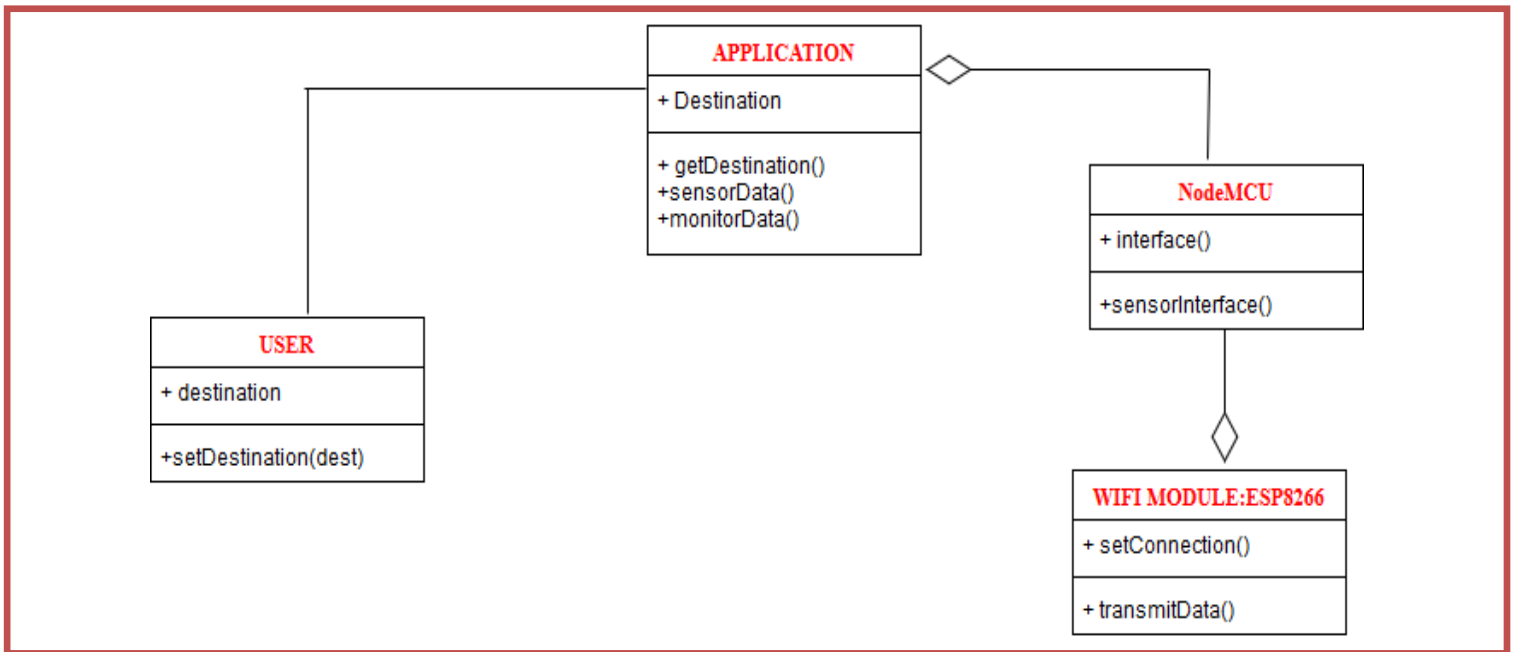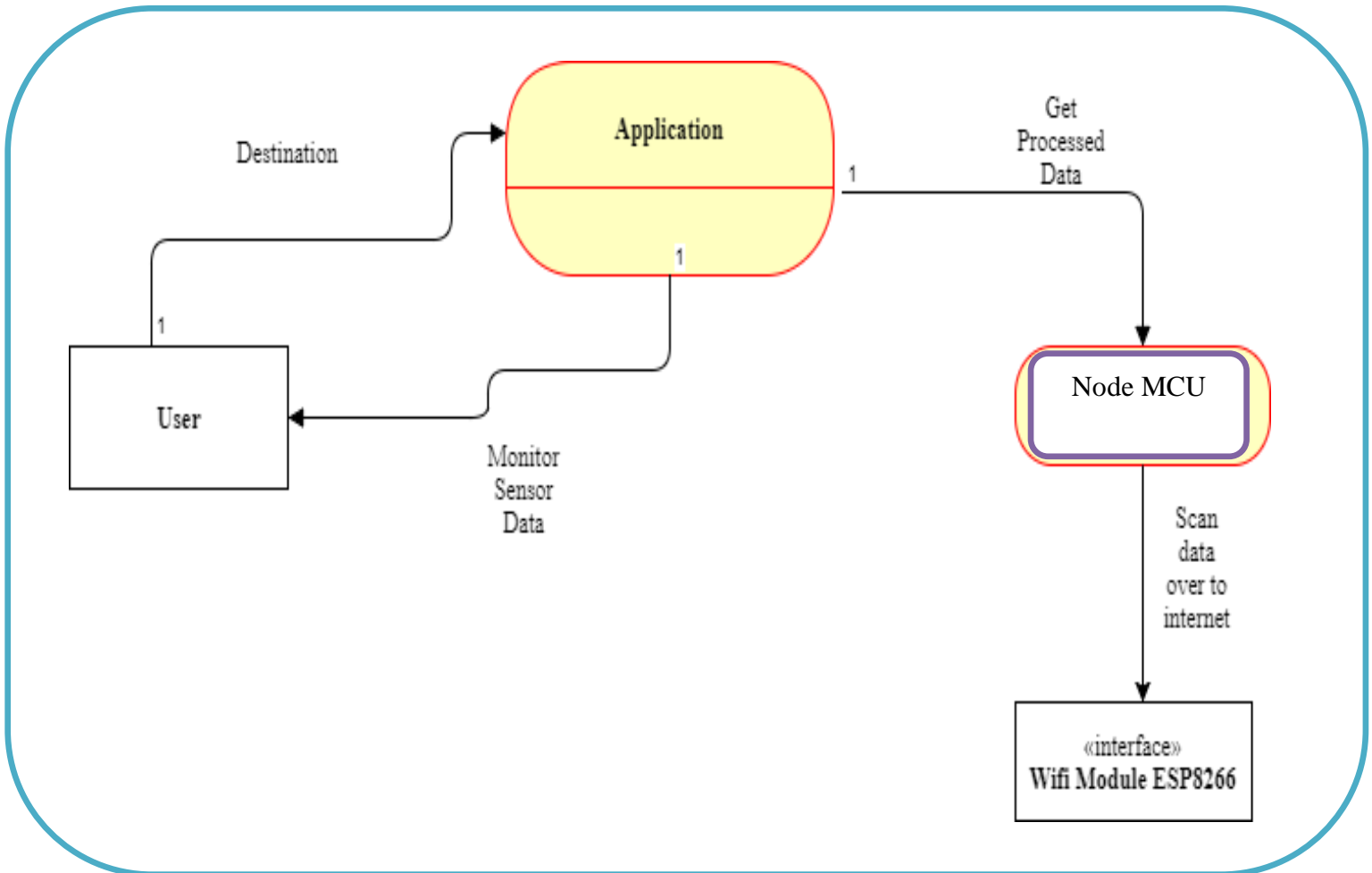

Figure 18: **Class diagram**

3.10.3) DATA FLOW DIAGRAM

Data Flow Diagrams (DFD) helps us in recognizing existing capacity forms. It is a brought pressure to get success from particularly once we defy business style re-engineering. At its least difficult, a data flow diagram monitors which point information flows over a framework.


Figure 19: Data flow diagram

4.PERFORMANCE ANALYSIS

4.1) SYSTEM TESTING

It is done on a fast, perfect system to act with respect to the system by all of its specified. It is usually very similar perfect test case forming. In test case exchange of letter we should devise the test scenarios & act with regard to use cases.

4.1.1) BLACK BOX TESTING:-

This to a large extent working is an approach of code testing that looks at the use of concerned application while not seeing coordinated towards its internal forms or tasks.
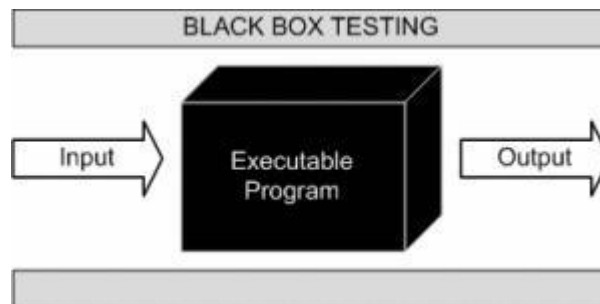

Figure 20: Black Box testing

4.1.2) UNIT TESTING:-

It is an item testing infers surrendered units of source internal voice, sets of a required or superiorly PC framework modules together by the entire of related approach data, use system, and working procedures, are attempted to check whether they are exist for swarm. Normally, a popular can get a unit as the little testable dissent of an application. In procedural programming, an unforeseen may might be a full module, however not by the whole of standing it's additional unremarkably an individual use or method.

The choice of unit testing is to finish up each challenge of the system and reveal that the individual parts are true.
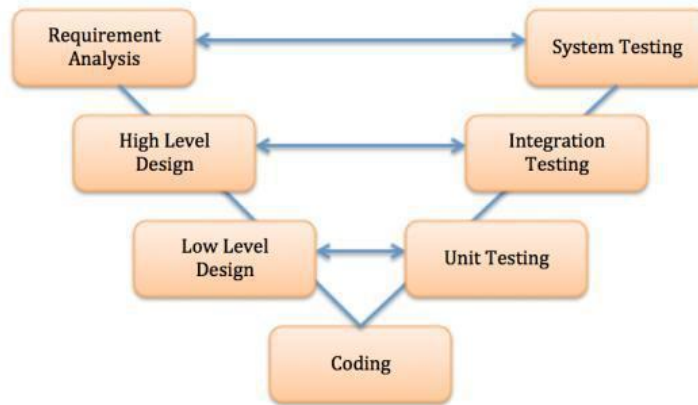
Figure 21: Unit Testing
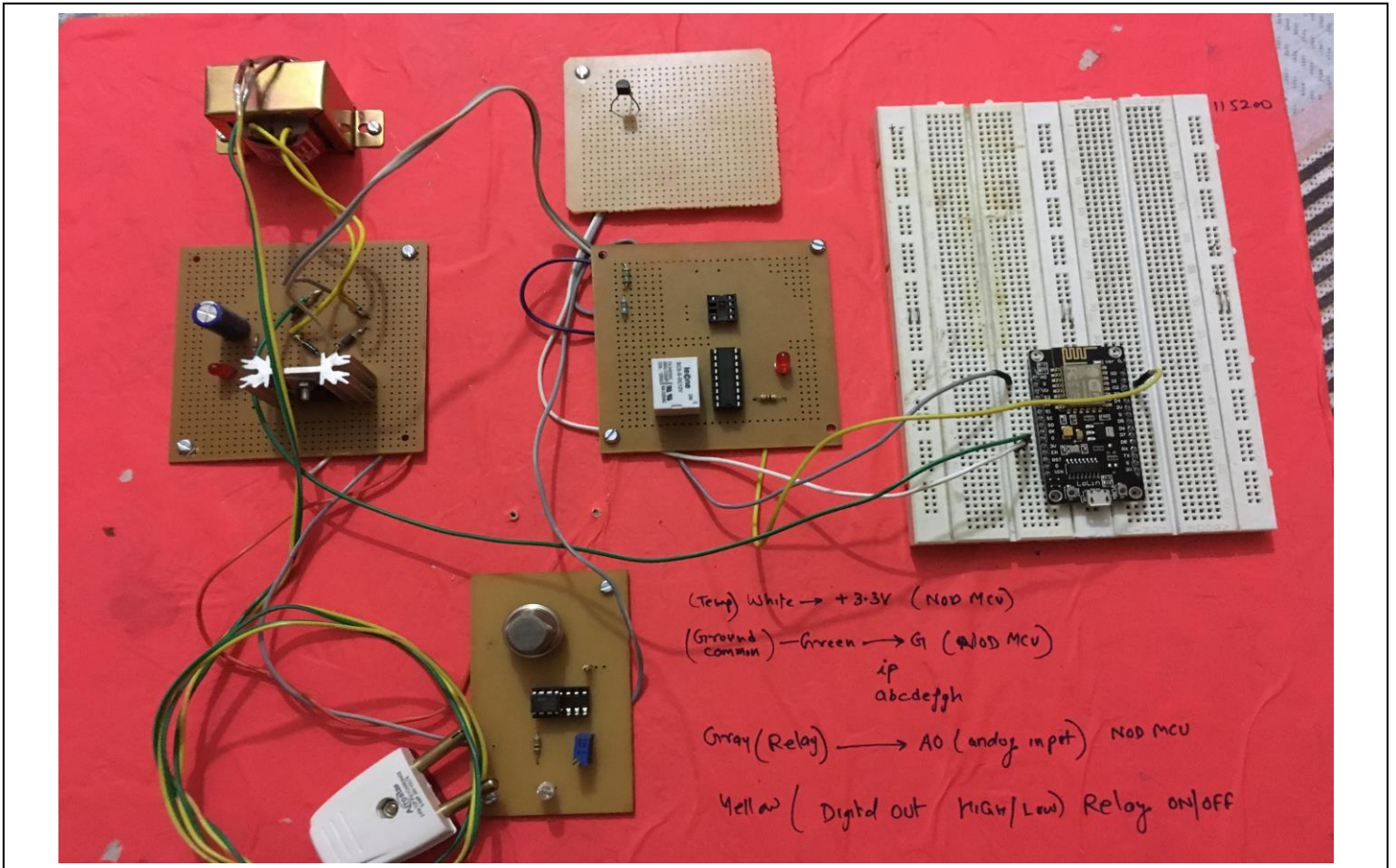
4.2)   RESULT
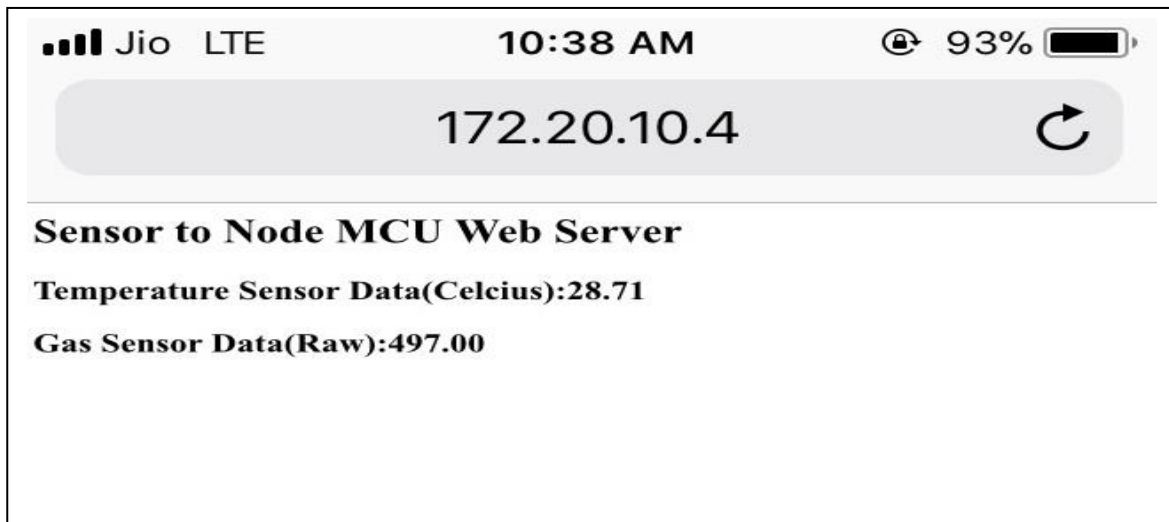

Figure 22: Project Hardware

Figure 23: End Result

5. CONCLUSION

The framework to screen the demeanor of condition utilizing Arduino IDE and Node MCU, IOT Technology is proposed to enhance nature of air. Utilization of IOT innovation upgrades the way toward observing different parts of condition, for example, air quality checking issue. Utilizing of MQ135 gas sensor gives the feeling of various kind of perilous gas and Node MCU is the core of this undertaking which control the whole procedure. Wi-Fi module associates the entire procedure to web and yield is shown on the website page.

It is particularly important to mindful the general population with Air Pollution data. It is effectively conceivable by IOT applications. The present hardware and software engineering innovation makes conceivable to build up a few IOT applications. By utilizing these Air Pollution Monitoring IOT applications individuals can lead glad life. These applications give the air contamination data as well as make the general population to consider the air contamination lessening.

The different information and specialized particular of segments required for the framework are talked about with the guide of pseudo-code and framework outline work process. The proposed framework encourages the worry contamination board specialists to take important choice and impart the deliberate PPM esteems to different government and non-legislative associations in a quick and effective way for the advantages of open to have a contamination free life.

5.1) FUTURE SCOPE:

- This could be further improved by designing for global server and designing apps for the real time monitoring.
- To make more advancements by testing the gas sensor with harmful gases and to portray the constituents of the gases.
- To make attempts to measure Noise Pollution and to detect the safe level of sound in decibels.

REFERENCES

[1]Navreetinder Kaur, Rita Mahajan, Deepak Bagai,"Air Quality Monitoring System based on Arduino Microcontroller," International Journal
Innovative Research in Science, Engineering and Technology (IJIRSET),Vol 5, Issue 6- June 2016.

[2]Shadrach Tunde,Akinkaude, kowawole, Peter Fasae, "A Survey of Noise Pollution in Ado-Ekiti Metropolis Using Mobile Phone," Science
Technology Department, Science Research Publishing, October-2015.

[3] Jiong Jin, Jayavardhana Gubbi, Slaven Marusic, Marimuthu Palaniswami, "An Information Framework for Creating a Smart City Through Internet of Things,"Published in: IEEE Internet of Things Journal (Volume: 1, Issue: 2, April 2014)DOI:10.1109/JIOT.2013.22965168.

[4] P.Vijnatha Raju, R.V.R.S.Aravind, Sangeeth Kumar,"Pollution Monitoring System using Wireless Sensor Network," International Journal of Engineering Trends and Technology (IJETT),Vol 4, Issue 4 - April 2013.

[5] A. R. Al-Ali, Imran Zualkernan and Fadi Aloul, ―A Mobile GPRS-Sensors Array for Air Pollution Monitoring‖ IEEE SENSORS JOURNAL,
VOL. 10, NO. 10, OCTOBER 2010

[6] Grzegorz Lehmann, Andreas Rieger, Marco Blumendorf, SahinAlbayrakDAI, "A 3-Layer Architecture for Smart Environment Models"/A model-based approach/Labor Technische University Berlin, Germany 978-1-4244-5328-3/10 © IEEE,2010

[7] " ZigBee for Building Control Wireless Sensor Networks" Fabio L. Zucatto, Clecio A. Biscassi IEEE 2007

[8] *Robokits* World *RF Modules* (Tx + Rx Pair) 433 MHz ASK [RKI-1064] - The   RX   ASK is an

ASK Hybrid receiver module, Online, 15 August 2008

< **http://www.robokitsindia.com** >

Books

1.   Author: Muhammad Ali Mazidi & Janice Gillispie Mazidi

The 8051 Microcontroller and Embedded system

Publisher: PEARSON, Prentice Hall, 1990

2.   *RS components* , Catalog book, 2008