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Blue Book on

Implementation of Air Monitoring System and Detection and Purification of particles present in Air using IOT

Of

BACHELOR OF ENGINEERING

In

ELECTRONICS ENGINEERING

By

Group No.08

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Year 2020-2021

CERTIFICATE

This is to certify that **Vasu V. Jivani, Shubham A. Malji, Shloka D. Rao** are bonafide students of Thakur College of Engineering and Technology, Mumbai. They have satisfactorily completed the requirements of the PROJECT-I as prescribed by University of Mumbai while working on **"Implementation of Air Monitoring System and Detection and Purification of particles present in Air using IOT"**

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Our project, '**The Implementation of air monitoring system and detection of purification of particles present in the Air using IOT**' has not been done by individual students alone, but along with the guidance and assistance of our teacher and project guide Dr. S.C. Patil who has been a key factor in the motivation and completion of the project. We are grateful to him for giving us the opportunity to create this project and guiding and supporting us in each and every way possible.

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ABSTRACT

Civilization today is moving to an amount which is completely centered upon improvement but at the same time has unnoticed the importance of our very own support system, Air. It goes without saying that in today's world because of the heightened growth in motor vehicles and industrial revolution our surrounding has become a lot more impure. The major reason for atmosphere contamination today is because of the amalgamation of various harmful gases like carbon dioxide, carbon monoxide and more emerging due to factories, vehicles and from combustion of fossil fuels. The pollution management board collects information from thousands, if not lakhs, of air observation devices which are fitted into varied industries. This results in a tedious procedure for the board to stay on track of all the assorted waste levels because each business has a totally different style of waste (like Co2, CO, NH3, etc.) that must be maintained at an optimum level. In order to provide observation and management solution to industries as per their want, a sensible pollution perspective framework is projected in this paper. This framework is often used for observing pollutants of specific territory and to find the air peculiarity or property after the examination. The obligated framework can focus on checking air poison concentrates with the help of the internet and wireless sensor systems. The investigation of air quality is to be done by computation of air-quality index (AQI). The pollution observation tool includes microcontroller and sensors that gives the availability to observe the standard of air by detecting the harmful gases present in the atmosphere the pollution level will be monitored remotely using PC or smartphones the data is stored in cloud and can be accessed remotely.

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Chapter 1
Introduction

1.1 Importance of The Project

While technological advances have generated an improvement in human being's life quality, they have also contributed to the emergence of associated issues such as exponential industrial growth and increase of transportation networks, mainly due to a fast-growing population and its centralization into urban centers. As a result, the rises of pollutant emissions towards the environmental compartments have been framed as a public health concern. Air pollution poses a serious threat worldwide. Towns and cities are choked with smog and dangerous emissions which are damaging both the environment and the health of global populations.

Detection and measurement of the contents in the atmosphere are becoming increasingly important. Careful planning of measurements is imperative as well as essential. The primary purpose of a systematic air quality monitoring network is to distinguish between areas where pollutant levels violate the ambient air quality standards and areas where they don't. The secondary purpose of systematic monitoring network is to document the success of this sophisticated endeavor, either by recording the rate of progress towards attaining the ambient air quality standard or to show that the standard has been achieved.

Our main focus for implementing such a system will be to monitor the various hazardous gases at the industry level as well as monitoring the LPG at home level and also to control the same. All the monitoring and controlling will be done with the help of IOT. An IOT system can be deployed at any location and will help in storing the measured value in our cloud database, perform pollution analysis and display the pollution level at any given location.

1.2 Motivation

Air pollution and its depletion is not a new topic and even after it been a highly spoken issue by tones of people, we are yet to reach a stage where it's balanced or improving. Then main basis of our research and its inspiration comes from the reality around us which reminds us every day, since years, that the atmosphere is depleting and we are doing nothing but being self-centered and focusing all our resources on production and manufacturing. Keeping this in mind we have come together to do an in-depth research of the same, to study the current situation, understand the already existing devices and mechanisms of air pollution control and try and suggest newer techniques to enhance and improve them. There are many motives behind selecting such a topic but our main motive in developing this project is to overcome the issues which are associated with the existing systems and to implement a more effective system for measuring and controlling the required parameters so that the processing is done efficiently. This is done using IOT which will help in reducing the manual work and increase the productivity of the industry.

1.3 Scope of the Project

As already mentioned before, development has been increasing on a rapid scale and not just in one sector but in every sector that exists today. This development is without a doubt taking humans forward in their business, in having a better lifestyle, variety of choices in their day-to-day life, and much more. But what good is this development if it's going to end up in the destruction of all life forms.

And in today's day and age, many have come to the realization that their very own existence and life support, the air that they breathe, is under a major threat. We can take a very recent example of the Delhi Air quality case which happened about a few months ago, when people couldn't even step outside of their house without layers of masks and protection of themselves. The air quality was so bad that many citizens of Delhi also ended up with lung diseases that could last them their whole life.

Therefore, this is where our project comes in. We're thinking small scale, and trying to make a difference in people's lives at an immediate level and that is their own homes.

Our project would work best as a home purifier.

While there are people working on making the world outside a better place to live and breathe in, we know that it's going to take its time. Thus, our whole idea is premised on the fact that if not outside, atleast people can breathe pure and fresh air at their own homes.

Chapter 2
Proposed Solution

2.1 Current Scenario

1) There's a growing need to maintain the air quality today which has fostered the demand for air quality monitors. This is due to the impure air which contains harmful pollutants that cause various health issues. These toxic pollutants are released in air through emission from various industries, vehicles and combustion of fossil fuels in residential areas.
2) Increase in level of pollution has triggered the spread of diseases such as asthma, chronic obstructive pulmonary disease, lung cancer and cardiovascular problems amongst people. The rise in awareness towards the adverse effects of polluted air on health has propelled the growth of air quality monitoring market. In addition the support of government regulations pertaining to the monitoring and control of air-pollution and the increase in public-private partnership for air quality monitoring have supplemented the demand for air quality devices. However, the high prices and technical complexities of air quality monitors restrict the market growth.
3) All the current projects that are in use are focusing more on monitoring the pollutant levels and sending a message on the user's or the concerned person's phone. After which the user has to manually control the changes of the pollutant level. For instance, if there's an increase of hazardous gas in an industry then the user has to manually turn on the air purifier in order to reduce the gas and bring it back under safety levels. Also, there are a few systems that have limited range which cannot be expanded as per company needs.

To summarize the current scenario of this topic, we can say that at present industries have implemented systems which can only sense the gas and send intimations or alerts.

2.2 Proposed Technology Solution

In this project, IOT will be used for monitoring and controlling of the pollutant levels. This means, the manual work is reduced because a change in the pollutant levels will automatically turn the controlling device on/off. As a result, there's no need for the user to personally go and turn the controlling device on/off. Also, this device which we're proposing through our project is made user friendly i.e. the safety levels of the pollutant can be changed depending on the requirements of each industry. Sensors are used here for sensing the levels of various hazardous gases such as benzene, LPG, smoke, etc. The Wi-Fi module in the device is used for sending data to and from the cloud into the user's device as and when required. Our project then, tries to implement a system which will monitor and control the levels of pollutants in an easy, cost- effective and efficient manner.

Chapter 3
Analysis, Planning & Requirement

3.1 Software & Hardware Requirement

The hardware of the project comprises of the following:

1. The sensor used for detection Benzene, alcohol, smoke is MQ-135. It has a detection range between 10-1000ppm for benzene and 10-300ppm for alcohol. It can only work in areas with humidity less than 95%.

Fig 3.1.1 MQ-135 Sensor Module

2. The MQ-137 Gas sensor is used to detect the amount of ammonia in the air. It can detect ammonia from 5 – 500 ppm. A preheat period of over 24 hours is required before the senor can actually be used.

Fig 3.1.2 MQ-137 Sensor Module

3. The sensor used for sensing Carbon-Dioxide (CO_2) is MG-811. It can detect CO_2 up to 10000 ppm as the gas detecting chip inside the sensor is highly sensitive to Carbon-Dioxide.

Fig 3.1.3 MG-811 Sensor Module

4. To detect the amount of natural gas or smoke present in our house we are using the MQ-5 sensor module. It can sense the gas from 100ppm to 3000ppm.

Fig 3.1.4 MQ-5 Sensor Module

5. The hardware of the project comprises of NodeMCU, which uses 128kB of memory and has a storage capacity of 4Mbytes.

Fig 3.1.5 NodeMCU Board

6. For display of the values liquid crystal display (LCD) of outline size 80*36 mm is used.

Fig 3.1.6 16x2 LCD Display

7. To extend the analog pins on NodeMCU we are using an analog extender of ADS series: ADS1015. It is a 12-bit I2C compatible ADC which is being offered in an ultra-small package.

Fig 3.1.7 ADS-1015

8. To purify the presence of LPG and smoke in the house we will be using an Air Filter which is a High Output Air Ionizer or Negative Ion Generator. It works on 220V AC it purifies an area of $11m^2$ to $20m^2$ and it can purify $50m^3/h$ volume of LPG or smoke at a time.

Fig 3.1.8 Air Ionizer

9. The device used for alerting the user is a piezo-electric buzzer. It works on 2300Hz frequency and it can provide various tone to represent various levels of alert by adjusting its frequency.

Fig 3.1.9 Buzzer

10. A relay module of 5V and 12V input voltage is used.

Fig 3.1.10 Relay Module

The software comprises of the following:

1. The software used for writing Code of the project is Arduino IDE version: 1.8.1. The Arduino Integrated Development Environment or the Arduino IDE is a cross-platform application for Windows, macOS, Linux that is written in functions from C and C++. It is primarily used to write and upload programs to Arduino compatible boards, but with the help of 3rd party cores, the code can also be deployed to other vendor boards such as NodeMCU, etc.

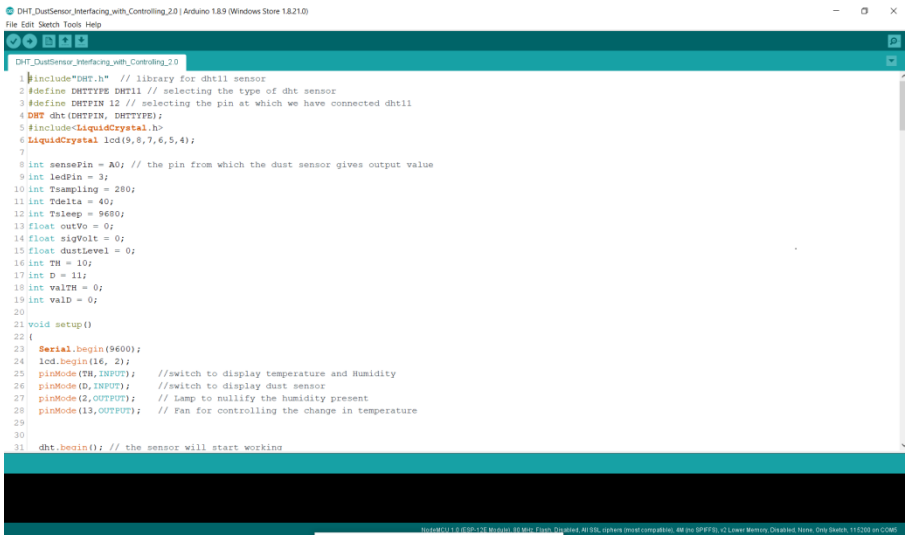

Fig 3.1.11 Sample Arduino Sketch of the Project Code

2. The second software which we will be using is BLYNK. BLYNK is a new platform that allows one to quickly build interfaces for controlling and monitoring one's hardware projects from your IOS, Android device.

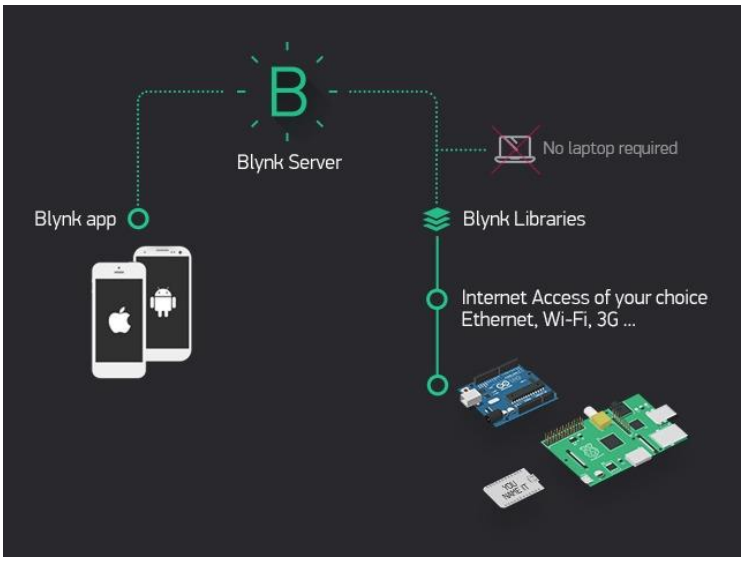

Fig 3.1.12 Blynk Interface screen

Table 3.1 (a) Hardware Component List

Sr. No	Name of Component	Specification	Quantity
1	MQ 135	Detection Range: 10 - 300 ppm NH3, 10 - 1000 ppm Benzene, 10 - 300 Alcohol	1
2	MQ-137	Preheat duration over 24 hours. Can be used as a Digital or analog sensor. The Sensitivity of Digital pin can be varied using the potentiometer.	1
3	MG 811	Operating Voltage: +5V Signal output indication Size: 32mm X22mm X30mm Working Voltage: DC 6V	1
4	MQ 5	Power: 2.5V ~ 5.0V Dimension: 40.0mm * 21.0mm Mounting holes size: 2.0m	1
5	NodeMCU	128KBytes of Memory, Storage of 4MBytes	1
6	LCD	Works on I2C communication protocol. Libraries Required to control: Liquid Crystals	1
7	ADS 1015	Supply Range: 2,0V to 5,5V Continuous Mode: 150µA, Single-Shot Mode: Auto Shut-Down Data Rate: 128SPS to 3,3kSPS, program labile	1
8	Air Filter	Input voltage: AC 220V Output voltage: DC-3.5KV0.5KV Applicable Area: $11m^2$ -$20m^2$ Air Purifier Volume: $50m^3/h$ Coverage area: an effective coverage area of about 15 square meters.	1
9	Jumper Wires M-M, M-F, F-F	It is used for connecting purposes.	1
10	Buzzer	Operating Voltage Range: 4V-8V DC Resonant Frequency: 2300Hz Rated Current: <30mA	1
11	Relay Module .	High Impedance controller pin can switch current up to 10A or voltage up to 250V.	1

Table 3.1 (b) Software List

Sr. No.	Name of Program	Software Version
1	Arduino IDE	1.8.1
2	BLYNK	2.27.12

3.2 Project Planning

Table 3.2 Planning of the Project

Sr. No.	Date	Work Plan	Work Progress
1.	15th July 2020	BE Project Title Finalization w.r.to Domain & category & GNATT Chart Preparation	Finalization of topic and domain. GANTT Chart prepared
2.	16th July 2020	Literature Survey -1	Found research papers related to our project
3.	17th July 2020	Literature Survey -2	Research related to various possible solutions to our project
4.	18th July 2020	Block Diagram of project. List of-Hardware – Software/ With all Specification Quantity and Cost with proper Estimate. Work layout Finalization. PCB Layout design as per Layout.	Design of block diagram and hardware/software specifications list submitted.
5.	20th July 2020	Evaluation I PPT Presentation	Project presentation evaluated by guide
6.	21st July 2020	Preparation of Synopsis Report	Preparation of Synopsis Chapter
7.	22nd July 2020	Preparation of PPTS of Presentation –II	PPT presentation

8.	23rd July 2020	Evaluation-II	Project presentation evaluation by guide
9.	24th July 2020	To prepare MRG and Grant Proposal	Preparation of proposals.
10.	25th July 2020	Submission of Proposal	Proposals submission.

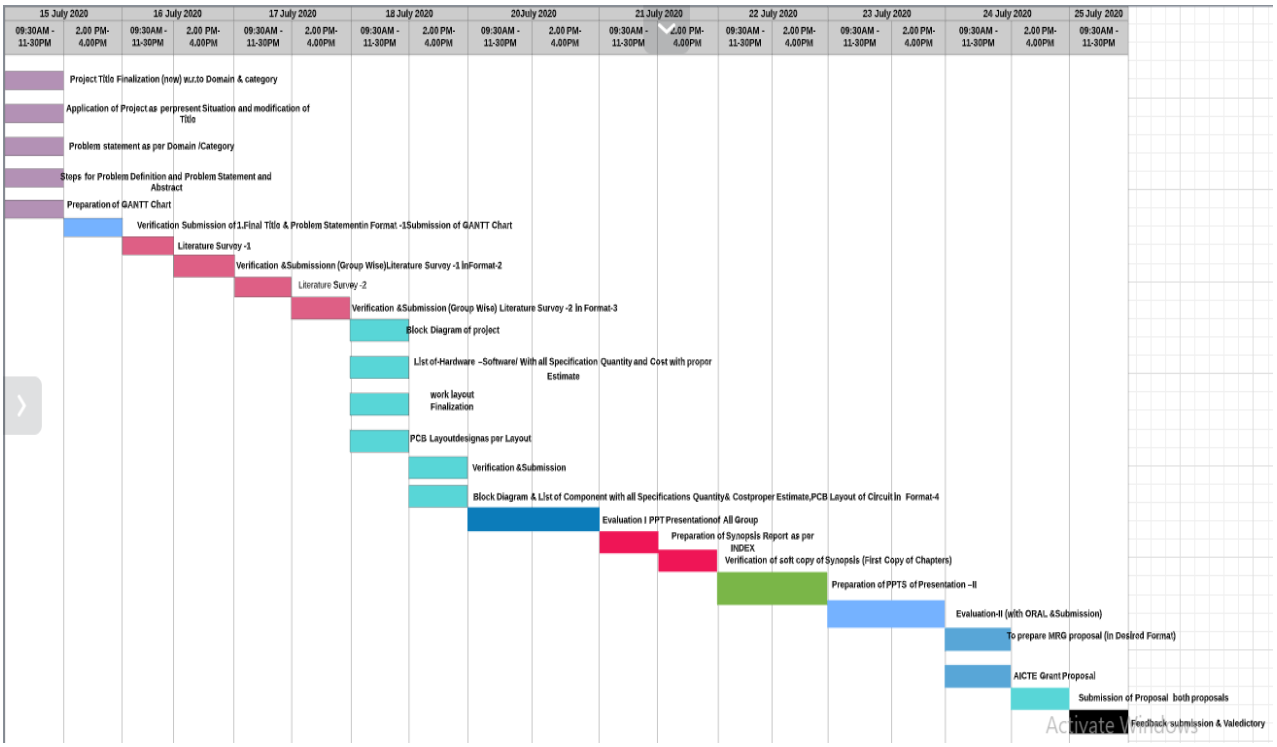

Table 3.3 Gantt Chart

Chapter 4
Design Phase

4.1 Designing of Block Diagram

The planning of the diagram plays a really vital role because it visually describes the system as a whole displaying the significant elements of the system. The diagram below is the block diagram of the project.

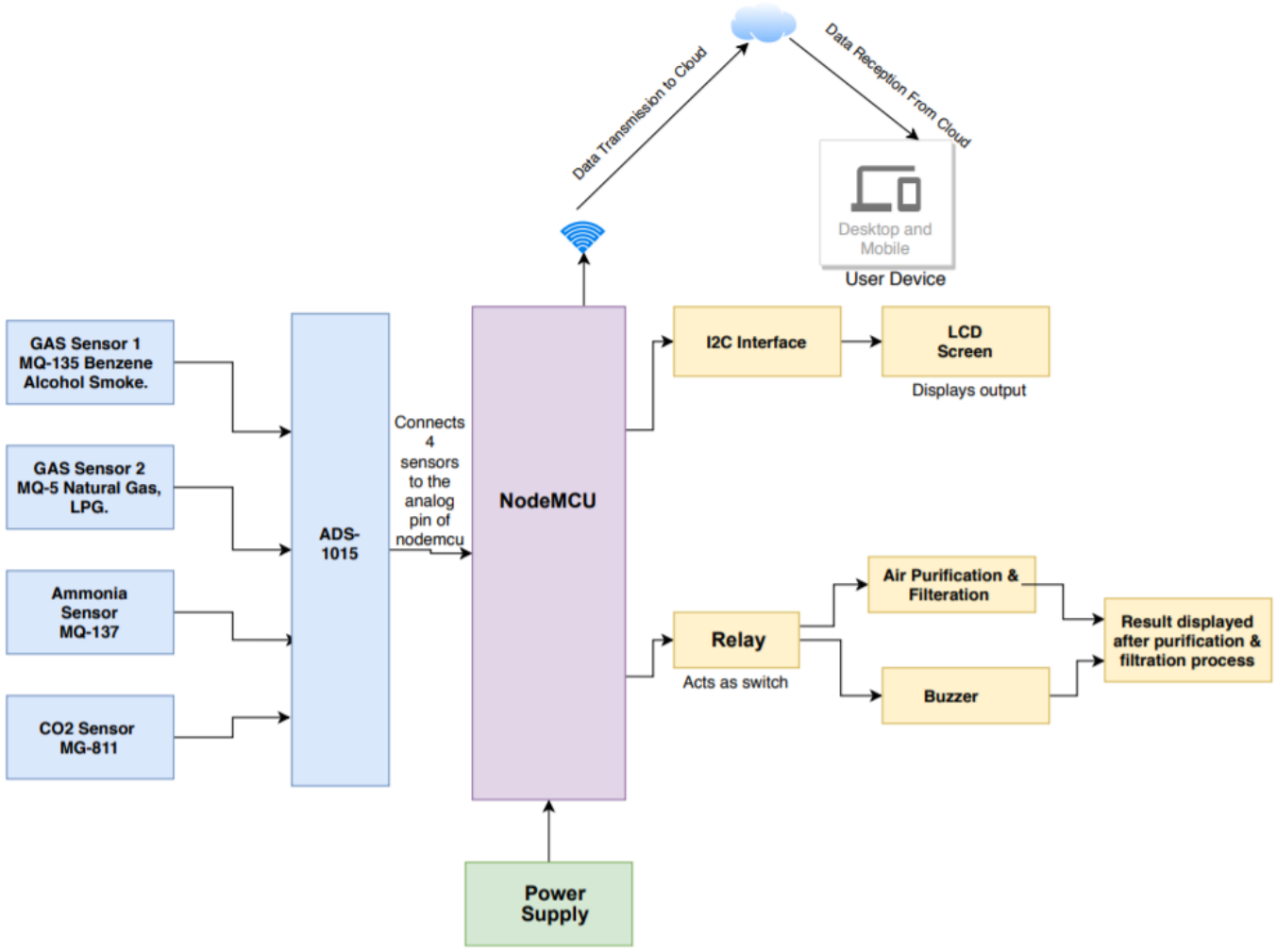

Figure 4.1 Block Diagram of Air monitoring, Detection, Purification and Filtration process of pollutants.

1. The Input side consists of 4 sensors i.e. MQ-135, MQ-135 MQ-5 and MG-811 which are designed to sense the amount of gas and give a reading to the NodeMCU which is Proportional to those values.
2. All those 4 sensors are interfaced to the NodeMCU via an Analog extender ADS1015 which is an I2C 12-bit ADC.
3. The NodeMCU is given power either from a Laptop or an external power supply.
4. The output side consists of an LCD and a Relay module. The LCD uses separate I2C interface in order to make its integration with NodeMCU easy.

These values given to the NodeMCU by the various sensors are displayed on a 16x2 LCD screen.

5. The values sensed by the sensor are given to the CLOUD via a Wireless-Fidelity (Wi-Fi) module (which in our case is already integrated with NodeMCU board) at an interval of the choice of user.
6. When the parameter value of the sensor used to detect gas at home level exceeds threshold, the controlling device (Air Ionizer) is automatically turned ON with the help of NodeMCU.

4.2 Designing of Model

The following model explains the design of Air monitoring, Detection, Purification and Filtration process of pollutants.

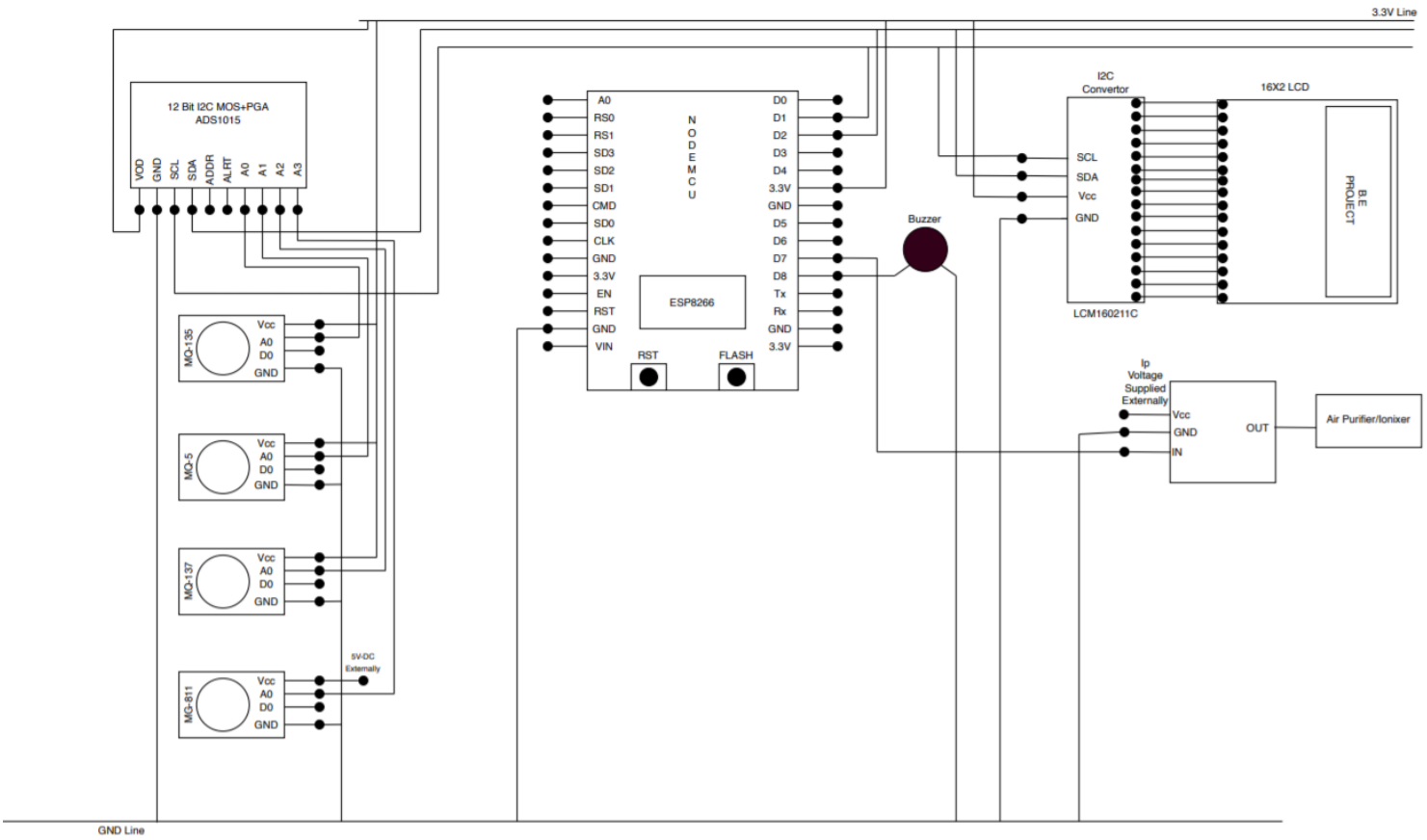

Figure 4.2 Model of the Air monitoring, Detection, Purification and Filtration process of pollutants.

1. Sensing of desired parameter via sensors

This process involves making use of sensors as a sensing element to sense the desired gases such as the sensor MQ137 detects mainly Ammonia, MQ135 detects gases like Benzene, alcohol, smoke, and NO2, MQ5 detects natural gases like LPG and MG811 detects CO2 as it is highly sensitive to it.

2. Conversion of the IP signal coming from the sensors into voltage/value.

This step involves conversion of the given input signal coming from the output of 4 sensors and converting it into desired value which can be used to display on the LCD screen.

3. **Setting the Alert system ON once parameter value crosses threshold value.**

In order to ensure that there is no high emission of harmful gases in industries or even there is no damage to the house, as soon as the level of gas at home or emission of harmful gases goes beyond its threshold value, the buzzer will be turned ON and an alert will be sent to the user's device.

Also, as soon as the gas level at home crosses the threshold value a signal is sent to the controlling device from NodeMCU so that the gas level can be brought down to a value below their respective threshold.

4. **Sending the Data over the CLOUD via Wi-Fi module**

In this process the NodeMCU will keep on sending data which is made available to it via sensors to the cloud at an interval rate which is set/defined by the user.

5. **Display of Output of the sensors on LCD screen**

The output of the sensor is displayed on the LCD screen so that in case of a network issue the user can look into the LCD screen to check out the current value.

Chapter 5
Applications

5.1 Possible Application of the Project

1. **Indoor air quality measurement and purification for health and safety purposes.**

The health effects of indoor air pollutants can range from short-term effects like eye and throat irritation to long-term effects such as respiratory conditions, lung cancer, heart disease, stroke etc. So, to avoid, what our project does is it detects pollutants indoor and purifies it to give us fresh air to breathe. This improves our health and protects us from harmful pollutants.

2. **Fugitive emissions monitoring on industrial sites**

Fugitive emissions are accidental emissions of vapors or gases from pressurized apparatus, either due to faulty equipment, leakage or other unforeseen mishaps. So, to avoid this and keep it under-control, our project can measure fugitive emissions from really low concentration to high concentration so that we can take necessary steps to control it.

3. **Consultancy firms.**

Our project can also be used by some of the small Air Consultancy firms which cannot afford as well as accommodate big machines to do the process of Air monitoring and purification. It can give them idea about the process.

4. **Ambient air monitoring.**

It is the systematic, long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air. We can look over long-term assessment of such pollutants and prepare charts and can make out how safe and healthy an area is looking at these charts.

Chapter 6
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