

**SMART INDOOR AIR POLLUTION CAUTION SYSTEM**

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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## **APPROVAL**

This Project titled “**Smart Indoor Air Pollution Caution System**”, submitted by Kawsar Ahmed, ID No: 152-15-5610, Abu Rayhan, ID No: 152-15-6013, and Mohammad Saiful Alam, ID No: 152-15-5640 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 4<sup>th</sup> May, 2019.

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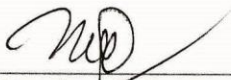


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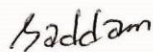


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## DECLARATION

We hereby declare that, this project has been done by us under the supervisor **Samia Nawshin, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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## **ABSTRACT**

Air pollution is not well known by people also they do not know about utile steps .As of late, peoples are suffering much from air pollution .They feel discomfort such as fatigue, headaches and more serious reactions. People breathing in air of poor quality could suffer from difficulty in breathing, wheezing and asthma. In addition to the human health, air pollution also has a major effect on the global environment and the worldwide economy. Scientific evidence has indicated that the air within homes and other buildings can be more seriously polluted than the outdoor air. Other research indicates that people spend approximately 90 percent of their time indoors. To avoid this problem, we are going to implement the project “Smart indoor air pollution caution system” for ensuring hygienic situation and making people conscious. Sensor system will detect volatile components (like Co<sub>2</sub>, benzene, alcohol, smoke etc.) of indoor air. Air quality information will be shown in live data streaming by using android application, included utile steps feature in apps for people’s consciousness. People will get their indoor air quality info from anywhere. To reduce volatile organic compounds from indoor, we used window automation in this smart system which will reduce polluted air. If indoor air quality is bad then window will open automatically until get the good air quality.

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# **CHAPTER 1**

## **Introduction**

### **1.1 Introduction**

We all face an assortment of dangers to our wellbeing as we approach our everyday lives. Driving in autos, flying in planes, taking part in recreational exercises, and being presented to natural toxins all posture changing degrees of hazard. A few dangers are basically unavoidable. Some we acknowledge on the grounds that to do generally would limit our capacity to lead our lives the manner in which we need. What's more, some are dangers we may choose to evade in the event that we had the chance to settle on educated options. Indoor air contamination is one hazard that you can take care of.

Over the most recent quite a long while, a developing assemblage of logical proof has demonstrated that the air inside homes and different structures can be more truly contaminated than the open air in even the biggest and most industrialized urban communities. Other research shows that individuals spend roughly 90 percent of their time inside. Accordingly, for some individuals, the dangers to wellbeing might be more noteworthy because of presentation to air contamination inside than outside.

Moreover, individuals who might be presented to indoor air contaminations for the longest timeframes are frequently those most powerless with the impacts of indoor air contamination. Such gatherings incorporate the youthful, the old, and the incessantly sick, particularly those experiencing respiratory or cardiovascular infection.

We are focusing on developing a system using IOT by which peoples can make hygienic situation at indoor and also make them conscious on pollution. Our sensor framework will recognize unstable segments (like Co2, benzene, liquor, smoke and so forth.) of indoor air. Air quality data will be appeared live information gushing by utilizing android application, included utile advances highlight in applications for individuals' awareness. Individuals will get their indoor air quality data from anyplace. To decrease unpredictable natural mixes from indoor, we utilized window computerization in this shrewd framework which will diminish dirtied air. In the event that indoor air quality is awful, at that point window will open consequently until get the great air quality.

## **1.2 Motivation**

People's health issue is always our main priority. Individuals feels uneasiness, for example, exhaustion, migraines and progressively genuine responses. Individuals taking in demeanor of low quality could experience the ill effects of trouble in breathing, wheezing and asthma (Disease from air toxins).With the advancement of science and technology we have to find a solution to make the situation better. In our project, we are using Internet of things (IOT) concept to make this whole indoor air pollution caution system more reliable and convincing. It will result less air pollution at indoor, tension of people's on air pollutants, health risks and make our life more efficient.

### **1.3 Rationale of the Study**

With the beginning of mechanical upheaval amidst the 19 century, carbon dioxide discharges in our climate have expanded relentlessly and significantly. It dramatically affects our atmosphere, both warming our atmosphere and modifying our climate with more dry spells and all the more exceptionally extraordinary climate occasions. To control the carbon emanation and condition contamination, carbon exchanging assumes an essential job. Carbon outflows exchanging is a market-based methodology used to control contamination by giving monetary motivations to accomplishing decreases in the emanations of pollutants .On the other hand Bangladesh can acquire US\$ 80 million every year through selling carbon as carbon credit in the universal market by utilizing current innovation encompassing Dhaka city, said a World Bank official.

Bangladesh has traversed from Least Developing Countries (LDCs) by accomplishing all the 3 conditions and going to be perceived as creating nations financially and socially [1]. The nation is flourishing through information and Communication Technology (ICT). Government and individual associations are well ordered creating with stylish innovation like Industrial computerization. Other than business and innovative improvement, our style is moreover creating. We tend to be sharing elegant advances in every part of our life for a reasonable and advantageous life.

By using smart indoor air pollution monitoring system in our home, office etc. We can contribute to the ongoing development of our technology and environment system. Besides that, it will mitigate most important problem unconsciousness on air pollution along with some common problems of all peoples as well. This study is intended to make the indoor air monitoring system smarter to escape from some unwanted situations.

## **1.4 Research Questions**

Current air pollution monitoring system of our universe provides outdoor air monitoring facility most of the time, where people at indoors cannot be conscious and do not get hygienic situation cause lacking of smart indoor air monitoring system. As a state we are focusing much on indoor air than outdoor because of carbon trading or international treaty. As a result, it turns into a problematic situation for those people whose are at indoor most of the time. Our system will provide real time status of the air pollution along with live notifications of the indoors. We have to think about more safety issues considering the situation of developing countries. To balancing this air pollutions, we have to develop window computerization system which will be open automatically until get balanced situation at indoor. Using a smartphone is more reliable and user-friendly to get the information.

Likewise, there are different reasons moreover,

Applications can give better perception.

Applications can work quicker than program.

Applications likewise give better personalization.

## **1.5 Expected Output**

Our goal is to getting real time air quality information and giving message for necessary steps when indoor is covered by air pollutants. System of air pollution monitoring will help to make people more aware. Also system will provide another live notification like bad air quality or good air quality when air quality is bad or good . Green or red signal will be provided based on air quality. We will also provide window automation system to balancing air at indoor. After all the mobile app can be used by all.

## 1.6 Report Layout

This report consists of five chapters, and this section provides insight of all five chapters.

1. Chapter one provides introduction, motivation and expected outcome of the study.
2. Related research work is discussed on chapter two. It also provides problem Scopes of the research.
3. In chapter three, requirements of the proposed system, system architecture and System flow diagram is provided.
4. Chapter four of this document describe our proposed system design, implementation and testing.
5. Lastly, chapter five is on conclusion, limitations, comparison and future study.

## **CHAPTER 2**

### **Background**

#### **2.1 Introduction**

In this time of science and innovation, we are including internet with about everything from PC to cell phone. Because of intense interest and modernizing human progress, innovators and scientists are interfacing more things to the web. This inclination results another idea called Internet of things.

Correspondence is never again ensured to human to human contribution though IoT acquainted machine with machine correspondence. A machine will act with another machine while not immediate human contribution through the internet. This thought keeps on being in its underlying phase of business arrangement, anyway a few ventures e:g: home and modern computerization, transportation square measure appearing on this.

Presently multi day, we are associating home machines, other day by day need elements to the web utilizing IoT idea so why not on condition checking. This investigation expects to build up a shrewd indoor air contamination alert framework by interfacing home to the internet.

#### **2.2 Related Works**

This is neither an original nor a new idea. There are many existing implementations like this system after Introduction of Smart Air pollution caution system. However, this is a new plan for smart indoor air pollution caution system with reliability, making people conscious and volatile organic compounds reducing.

The paper [3] portrays, proposed framework comprise sensors to detect perilous gases, temperature, and mugginess tenaciously and convey results to implanted controller. It likewise continues checking air quality dimension and shows it to the online cloud server. The sensor cluster interfaced with controller for preparing information and transmits to channels of Thingspeak.com. A straightforward ringer and LEDs are interfaced to show surpass in risky gas level. This paper furnishes a financial IoT arrangement with ESP8266-01 for determined application. Watchwords Internet of Things, Indoor air contamination, Arduino, Gas Sensors.

In the paper [4], Indoor air contamination can be higher than outside focuses up to multiple times because of off base usefulness of warming, ventilation, and cooling (HVAC) framework. Web of Things can play out a continuous observing of indoor air quality by utilizing inserted gadgets, programming, sensors, and availability. One methodology that is picking up force is the Web of Things that utilizes web engineering and web models as a system for making IoT applications. In this paper, an IoT stage for checking indoor air quality is introduced. The usage depends on the Web of Things idea and utilizations CoAP convention to gather information from sensors. Equipment stage created for this undertaking is additionally introduced and execution subtleties are portrayed.

The paper [5] portrays, This paper shows a start to finish IAQM framework empowering estimation of CO<sub>2</sub>, CO, SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub>, Cl<sub>2</sub>, surrounding temperature, and relative mugginess. In IAQM frameworks, remote clients for the most part utilize a nearby entryway to interface remote sensor hubs in a given checking site to the outside world for pervasive access of information. In this work, the job of the door in preparing gathered air quality information and its dependable dispersal to end-clients through a web-server is stressed. A component for the reinforcement and the rebuilding of the gathered information on account of Internet blackout is displayed. The framework is adjusted to an open-source Internet-of-Things (IoT) web-server stage, called Emoncms, for live observing and long haul stockpiling of the gathered IAQM information. A measured IAQM engineering is received, which results in a brilliant adaptable framework that permits consistent combination of different detecting advancements, remote sensor systems (WSNs) and shrewd versatile benchmarks. The paper gives full equipment and programming subtleties of the proposed arrangement. Test IAQM results gathered in different areas are likewise exhibited to show the capacities of the framework.

In the paper [6] In the wake of this inclination, this paper proposes a novel, IoT Smart design for air quality checking. With the IoT vision, we propose a Smart worldwide AQM framework, which utilizes unique, yet reciprocal, innovations, for example, gas detecting, WSN and Smart versatile. Our proposed framework, can gather, progressively and from various urban areas, information identified with the convergences of basic gases, mugginess, and temperatures. Gathered information are conveyed to a neighborhood entryway where a propelled handling makes them simple and open by both, nearby and remote clients by means of a remote web server.



In the paper [7] This paper plans to build up a remote answer for indoor air quality checking. The proposed arrangement is to gauge the natural parameters like temperature, mugginess, vaporous toxins, vaporized/Particulate Matter to decide the ecological strength of an indoor space. It additionally speaks to that as far as Air Quality Index (AQI) and gives ecological data as contribution for controlling HVAC (Heating, Ventilation and Air Conditioning) framework in a brilliant structure. A toolbox has been created to see the live air quality information of conveyed locales as numbers and diagrams.

This paper [8], proposes an IoT based indoor air quality checking framework for following the ozone fixations close to a photocopy machine. The trial framework with a semiconductor sensor fit for observing ozone focuses was introduced almost a high volume scanner. The IoT gadget has been modified to gather and transmit information at an interim of five minutes over blue tooth association with a passage hub that thus speaks with the preparing hub by means of the WiFi neighborhood. The sensor was aligned utilizing the standard adjustment techniques. As an extra ability, the proposed air contamination checking framework can produce alerts when the contamination level surpasses past a foreordained limit esteem.

### **2.3 Research Summary**

In our study, we are intended to find a feasible solution of indoor air pollution caution system for under developed and developing city considering current system available so that current system can accommodate it easily. We will also be focused on economical and overall condition of our country. It is slightly time consuming to implement. We will use existing analog windows to replace them as automated system. Providing for keep balancing over air pollution interfacing with air sensors, and microcontroller.

For internet connection, GSM, 3G or 4G will not be efficient because of high cost equipment's as well as data charge. We are going to be use Wi-Fi network for connectivity considering availability through the city. Equipment's for Wi-Fi is comparatively less expensive than cellular network.

We are using servo motor for window automated system in based of air pollution level which have never used before. This will keep balanced in indoor system. As we believe that “prevention is better than cure”. So hereby we are planning for peoples of developing cities which don’t lead elegant life so will provide smart notification system which’ll keep people stay away from doing or emitting any volatile organic compounds.

## **2.4 Scope of the Problem**

This study focuses on finding a way to develop a smart indoor air pollution caution system to reduce overall risks on health, problems of the peoples as well as it will be less costly.

### **No tension in safety purpose:**

This study aimed to ensure no tension in safety reason of indoor as peoples will always be notified about indoor air quality from anyplace.

### **Health issues:**

This study also works to ensure hygienic situation at indoor either there is probability to suffer from many air pollution related diseases. Probabilities of getting headaches or any serious reaction will be reduce.

### **Easy to notifying:**

In our system, we will provide android application with user friendly interface to authorized people only. Getting live updates of their indoor will make their consciousness. They can also see the necessary steps by mobile apps.

### **Air pollution reducing:**

Our window automation system will put impact on reducing air pollution. Window automatically will be opened at bad situation and do not get shut down until getting good situation of air.

## **2.5 Challenges**

### **Network Connectivity**

Lacking's of internet service provider in developing cities is challenging for connection to our system.

### **Getting efficient data**

The situations in room can be changed any time. Sometimes sensor may not works properly. Sensor might not read efficient data always. This kind of loop hole is one of the main challenge to properly run the system.

### **Awareness**

Proper awareness of the peoples when using the system is also a challenge. Indoor air and anent necessary steps have to well known by people. Otherwise the system may not work properly.

## CHAPTER 3

### Requirements analysis for the Proposed System

#### 3.1 Introduction

Requirement analysis is consisting of some approaches taken to work out specific options, demands, expectation by communication with the system users. It needs combination of hardware, software.

#### 3.2 Proposed System Architecture

In this proposed system, at first MQ135 sensor attached with Microcontroller for the air reading and then measured data will be shown as live in android apps through wifi module. This data will be sent to firebase server. By the condition of bad and good air quality window will be control by servo motor.

In figure 3.1, smart indoor air caution system consists of MQ135 sensor, firebase server, servo motor, microcontroller and Wi-Fi module is a single board development board.

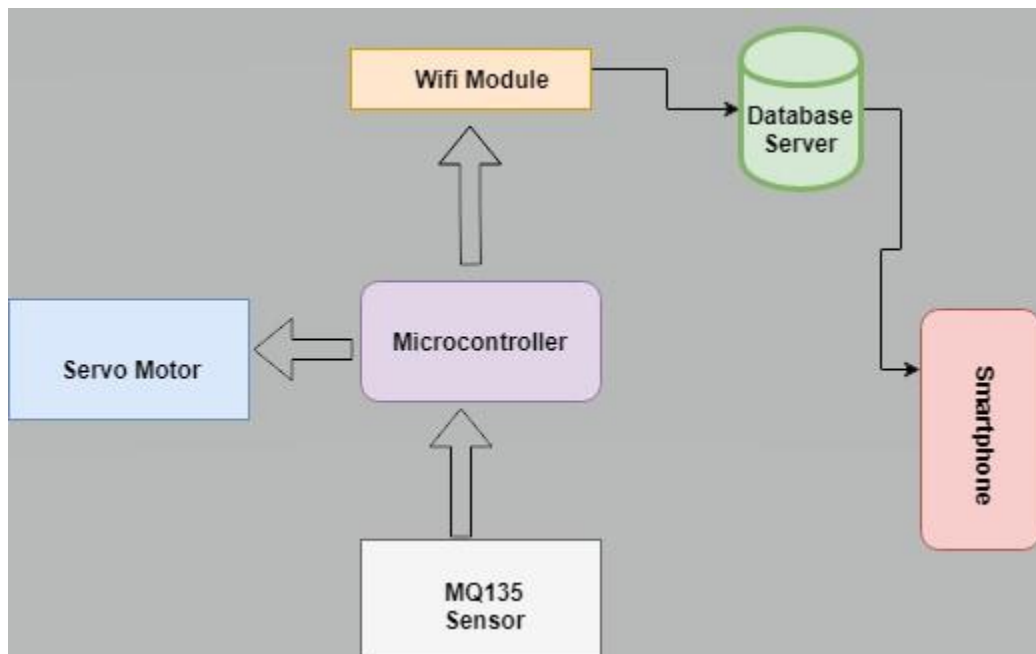


Figure 3.1: Proposed System Architecture

### 3.3 Program flow Diagram for the Proposed System

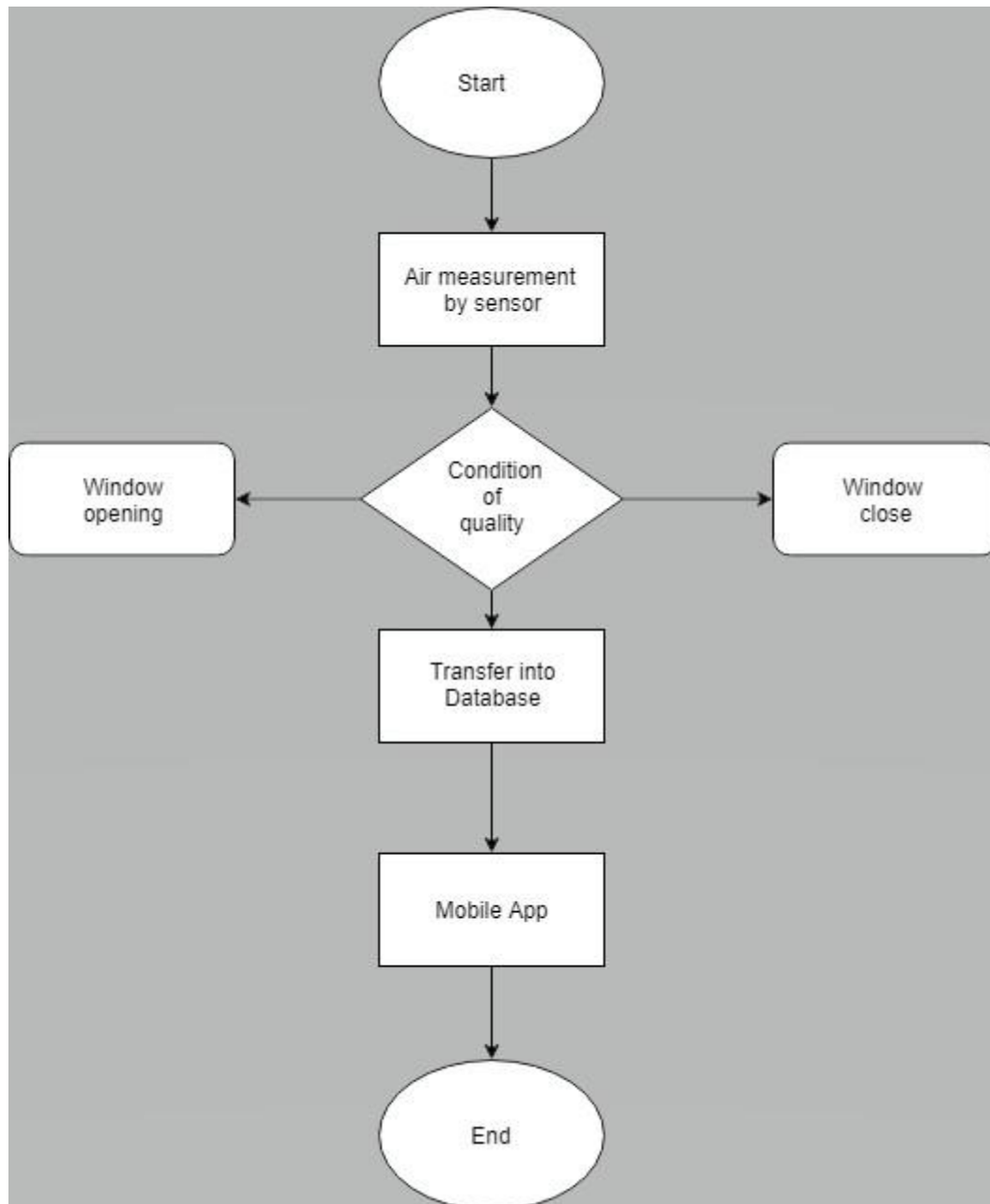


Figure 3.2: Flow Chart Diagram

In figure3.2, flowchart of this system is shown. Sensor will detect the indoor air at first. Window will be control like if air is bad then window will be open automatically until get the normal situation of air, data will be sent to the database. Result will be shown in live by android apps. In apps there is another option which is, what should be done by us or not at indoor in the perspective of air pollution.

### 3.4 Use case diagram

The following figure 3.3 shows use case diagram for mobile application.

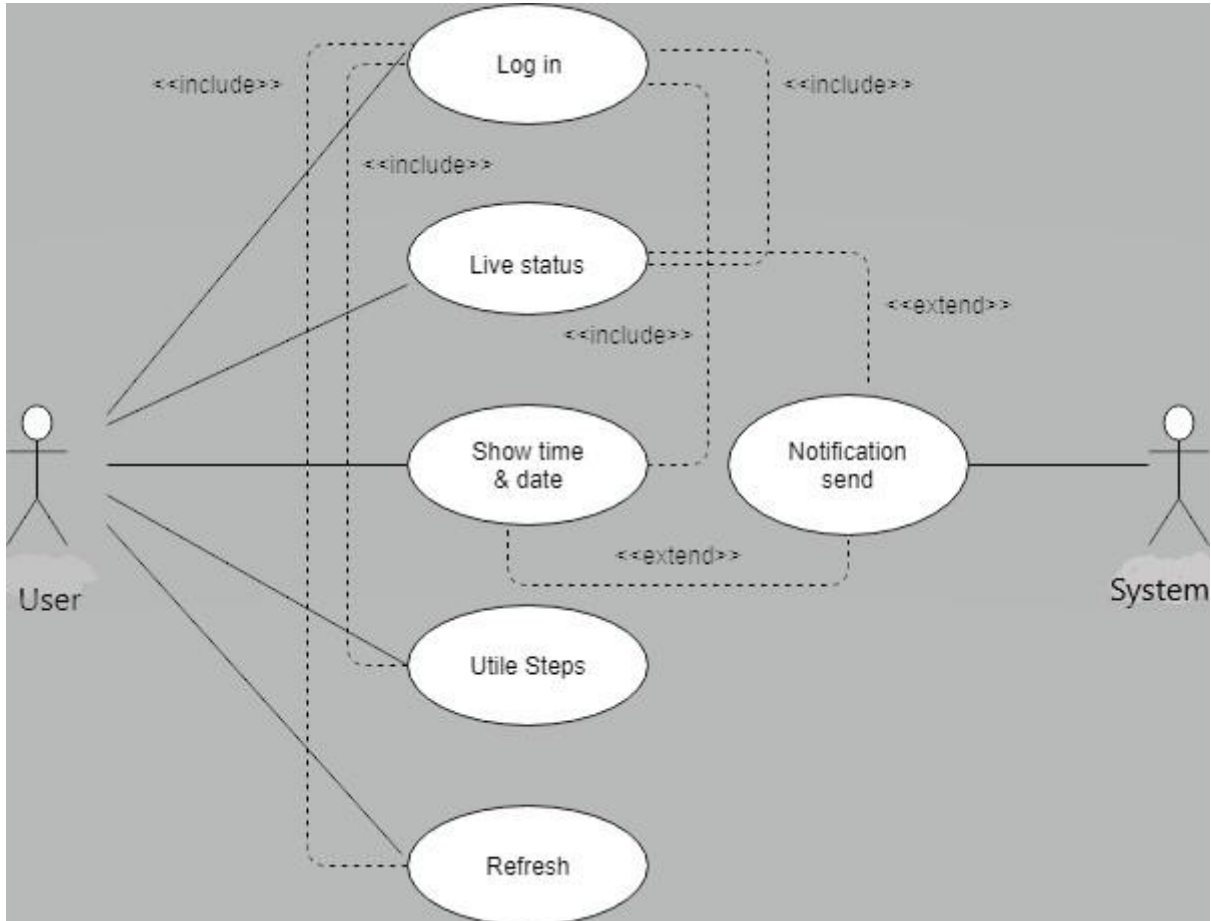


Figure 3.3: Use case diagram

### 3.5 USE CASE DESCRIPTION

#### FOR INDOOR AIR POLLUTION MONITORING SYSTEM

##### **Sending Update to Cloud**

Table 3.1 shows use case description sending data from sensor with trigger, pre-condition, and post condition and exception path. This case will be triggered whenever data sending is done.

TABLE 3.1: SENDING UPDATE TO CLOUD

<b>Use Case Name</b>	Sending update to Cloud
<b>Trigger</b>	When the amount of waste in a indoor become changed.
<b>Pre-Condition</b>	Smart device must be connected to the cloud.
<b>Basic Path</b>	Microcontroller processes data and send it to the cloud.
<b>Post Condition</b>	Successfully updated.
<b>Exception Path</b>	Fails to update

## For Mobile Application

### User Login

Table 3.2 shows use case description for user login. Exception may occur upon invalid input.

TABLE 3.2: USER LOGIN

<b>Use Case Name</b>	User Login
<b>Trigger</b>	User Clicks on Start button
<b>Pre-Condition</b>	User must be connected to the internet and must have a Pin code.
<b>Basic Path</b>	Application will show a field for pin code for user input.
<b>Post Condition</b>	User Must click on Login button.
<b>Exception Path</b>	If the field contains invalid input, application will show a warning message to fix that.
<b>Others</b>	If the user is logged in already, application will not show login page and redirect to main page.



## Edit Profile

Table 3.3 shows use case description profile management. In this case, user must be logged in to his account. Exception will occur upon invalid input.

TABLE 3.3: EDIT PROFILE

<b>Use Case Name</b>	Edit Profile
<b>Trigger</b>	User Clicks on Edit profile button.
<b>Pre-Condition</b>	User must be logged in and have active connection.
<b>Basic Path</b>	Application will show a page with all editable fields.
<b>Post Condition</b>	User has to click on update button.
<b>Exception Path</b>	Application will show warning message for invalid field input.

## Logout

Table 3.4 shows use case description for log out option. In this case, user must be logged in to his account. System will sign that user out from application and there is no exception path for this case.

TABLE 3.4: LOGOUT

<b>Use Case Name</b>	Sign Out From the Application
<b>Trigger</b>	User clicks on sign-out button
<b>Pre-Condition</b>	Must be logged in to the system
<b>Basic Path</b>	System sign out current user from application
<b>Exception Path</b>	Not Applicable

## 3.6 Equipment's for Proposed System

- ESP 8266 (ESP-12E) Wi-Fi IoT Development Board
- MQ135 Sensor
- Buzzer
- Servo motor
- LED

### 3.6.1 ESP8266 (ESP-12E) Wi-Fi Development Board

It is a microcontroller and Wi-Fi module in-manufactured one board stage that is frightfully clear to use to frame accompanies Wi-Fi and IoT (Internet of Things) applications. The board is predicated on the amazingly in style ESP8266 Wi-Fi Module chip with the ESP-12 SMD impression. This Wi-Fi advancement board as of now implants in its board all the required components for the ESP8266 (ESP-12E) to program and exchange code. It's an inborn USB to sequential chip exchange codes, 3.3V controller and rationale level gadget circuit in this manner you'll straightaway exchange codes and associate your circuits. This board contains the ESP-12E chip with a 4MB nonvolatile capacity hence no stresses for long venture codes. This microcontroller board will basically be customized abuse the Arduino IDE programming bundle.

In figure 3.3, ESP-12E Wi-Fi Development Board. Microcontroller, Wi-Fi module, flash chip and logic level converter are integrated in a single board.



Figure 3.4: ESP8266 (ESP-12E) Wi-Fi Development Board

### 3.6.2 Buzzer

A bell or beeper is a sound flagging gadget, which encourages us to make any caution and might be mechanical, electromechanical, or piezoelectric (piezo for short)[12]. Run of the mill employments of signals and beepers incorporate alert gadgets, clocks, and affirmation of client info, for example, a mouse snap or keystroke



Figure 3.5: Buzzer

### 3.6.3 LED

A light-emanating diode (LED) is a semiconductor light source that produces light when current moves through it. Electrons in the semiconductor recombine with electron gaps, discharging vitality as photons. This impact is called electroluminescence. The shade of the light (relating to the vitality of the photons) is dictated by the vitality required for electrons to cross the band hole of the semiconductor. White light is gotten by utilizing different semiconductors or a layer of light-emanating phosphor on the semiconductor gadget [13].



Figure 3.6: LED

### 3.6.4 SERVO MOTOR

Servo Motor are likewise called Control engines. They are utilized in criticism control frameworks as yield actuators and does not use for ceaseless vitality change. The guideline of the Servomotor is like that of the other electromagnetic engine, yet the development and the task are unique. Their capacity rating differs from a small amount of a watt to a couple of hundred watts. The rotor dormancy of the engines is low and have a fast of reaction. The rotor of the Motor has the long length and littler measurement. They work at extremely low speed and now and again even at the zero speed [17].



Figure 3.7: Servo Motor

### 3.6.5 MQ135 GAS SENSOR

Delicate material of MQ135 gas sensor is  $\text{SnO}_2$ , which with lower conductivity in clean air. At the point when the objective flammable gas exist, The sensors conductivity is increasingly higher alongside the gas focus rising. If you don't mind utilize straightforward electrocircuit, Convert change of conductivity to relate yield flag of gas fixation. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam, additionally delicate to smoke and other destructive gases. It is with minimal effort and appropriate for various application. Used for family, Surrounding condition toxic gas location gadget, Apply to alkali, aromatics, sulfur, benzene vapor, and other hurtful gases/smoke, gas recognition, tried fixation extend: 10 to 1000ppm [19].



Figure 3.8: MQ135 gas sensor

### Platform used for Smart Indoor Air Monitoring

- Platform: Arduino
- Language: C++
- Tools: Arduino IDE

### Arduino IDE

In our project, we have used Arduino IDE to program microcontroller that is used on smart indoor air monitoring system.



Figure 3.9: Arduino IDE

Arduino is an open-source platform which consists of both programmable circuit board and a piece of software that is known as Arduino IDE (Integrated Development Environment). This IDE runs on computer and used to writing, compiling and uploading program to many varieties of physical board.

The Arduino Platform has become very popular among hobbyist and developers.

Arduino products are distributed as open-source hardware and software and are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL) [18].

Here are some reasons of using Arduino IDE:

It is open-source and extensible software.

It has a large community all over the world.

It is a cross-platform IDE and very popular

## **Platform used for Android Application**

Platform: Android

Language: Java

Tools: Android Studio, Java SDK, Android Mobile Phone, Firebase App Platform.

## Android Studio

In our project, we have used Android Studio IDE to develop Android Application



Figure 3.10: Android Studio

Android studio is an authority IDE (Integrated Development Environment) given by Google to its working framework Android. It is a substitution of Eclipse Android Development Tool (ADT) as essential IDE for Android Development.



## **CHAPTER 4**

### **System Design, Implementation and Testing**

#### **4.1 Introduction**

In this section, we discuss our approach has been taken to solve the problem. Here, our proposed system shows the expected output. When room is polluted sensor will detect the situation of air pollution and this detected result will be shown in app through database. When the process is completed properly, a notification will be sent through app which will tell air quality is good or bad. In the room, there will be window automation system where if air quality is bad then window will open until get balance of air quality. Some features will be added later.

There is a caution system in mobile apps which will say necessary steps which means what would be our measured steps when we are in room or when households cooking.

#### **4.2 System Design**

This study is focused on creating an environment where the reliability of the people in at indoor in developing city. MQ135 gas sensor is used to detect the indoor air. Servo motor is used to control window while air at indoor is cross the limit of good air. Apps will provide air quality notification and will give live data updates after a certain amount of time.

### 4.3 Implementation of the Proposed System

Figure 4.1 shows the interfaces of the android application of users.

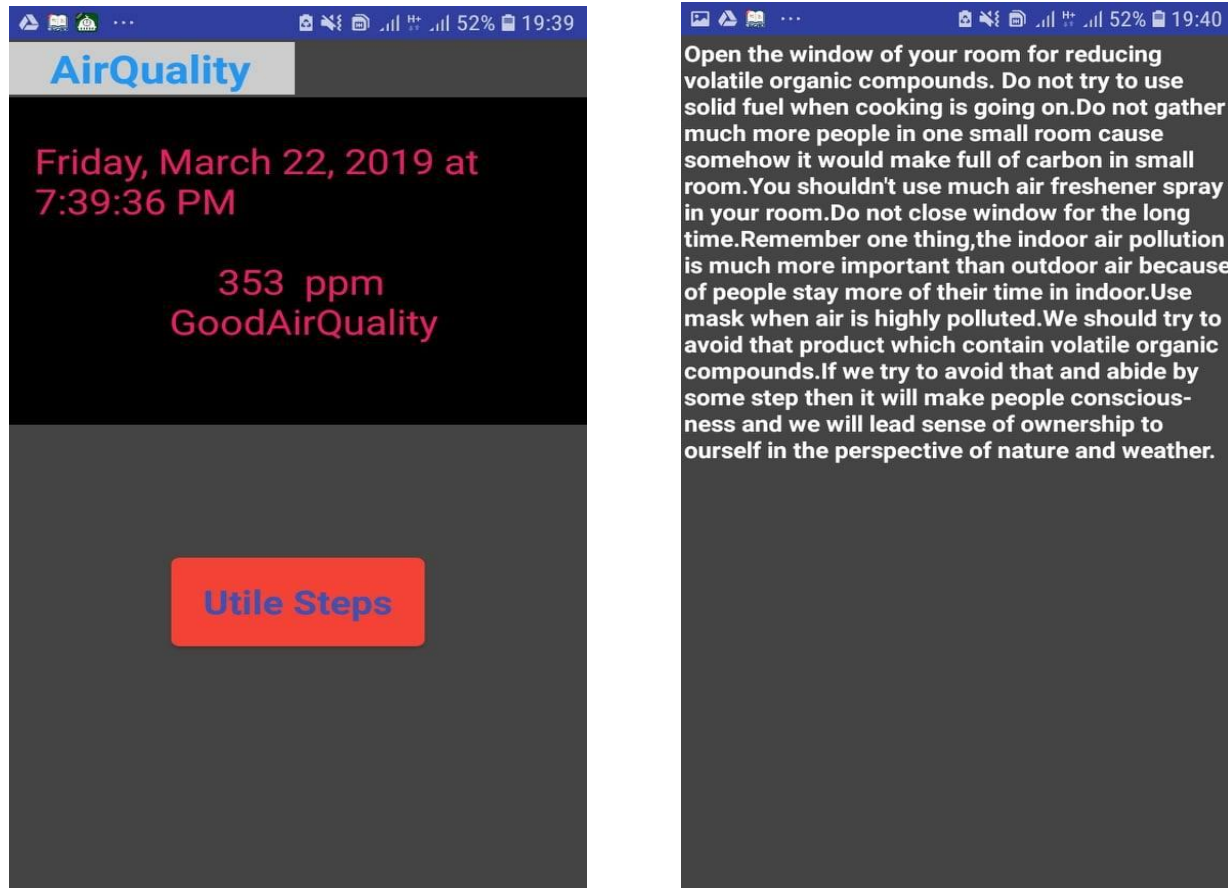


Figure 4.1: Android Application

Figure 4.2 Shows the design of Smart indoor air caution system where the system will be implemented.

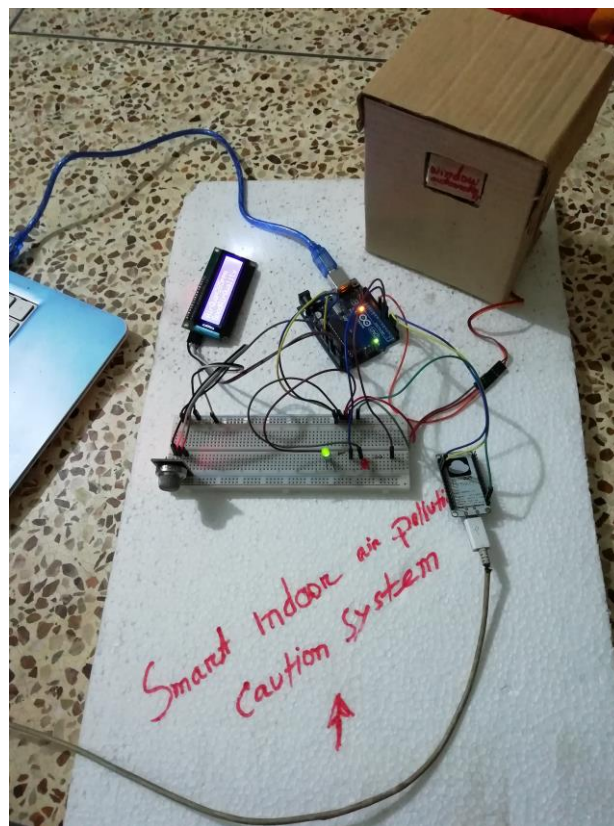
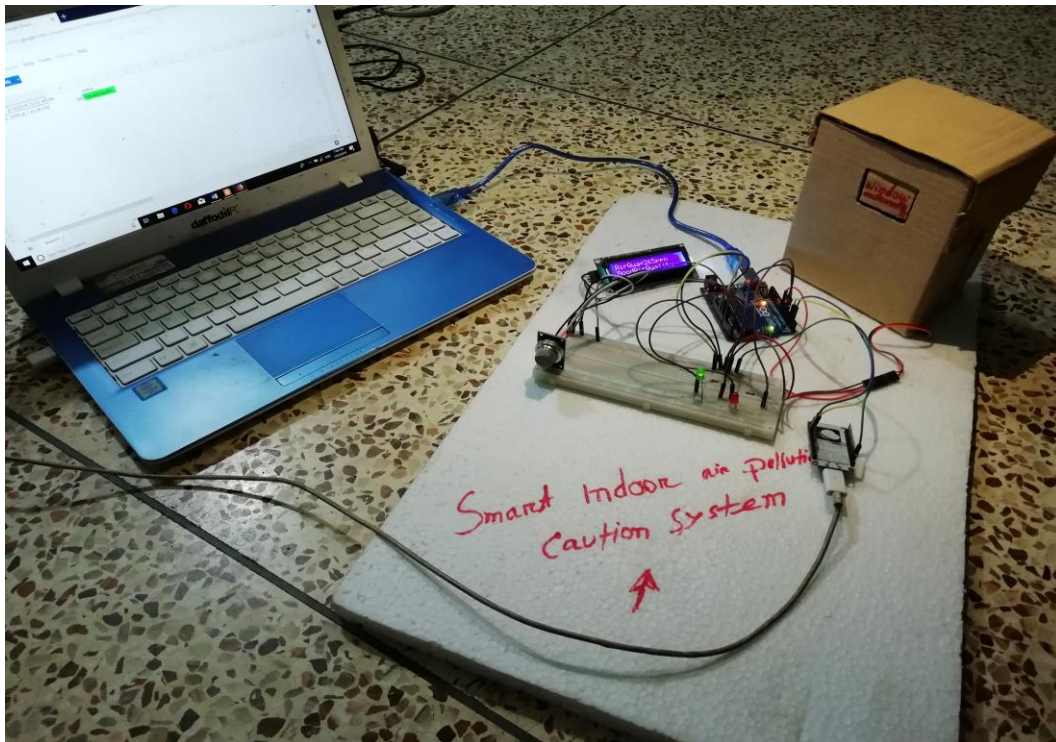


Figure 4.2: System Design

## 4.4 Testing

### Integration test

Integration testing is a level of testing where individual modules are combined and tested as a group. It occurs after unit testing phase. Purpose of integrated testing is to expose faults in the interaction between integrated units [14].

table 4.1 shows test cases, expected result and observed result for individual module of the system.

TABLE 4.1: INTEGRATION TEST

Test Case	Expected Result	Observed Result	Test result
MQ135 gas sensor have to detect volatile compounds which connected with Arduino UNO	Can detect properly.	Can detect properly.	Pass
Window will be control by servo motor	Can open/close Properly	Can open/close Properly	Pass
Beside apps also result will be displayed by LCD screen	Can display properly	Can display Properly	Pass
Microcontroller should be able Tos send data to server using Wi-Fi module.	Can send data to the server.	Can send	Pass
Application should be able to retrieve data from the server.	Can retrieve data.	Can retrieve data.	Pass

## System test

System testing of software or hardware is conducted in complete and integrated system to evaluate its compliance with its the specified requirements. System testing takes all integrated modules that have passed integrated testing as its input. System testing aims to detect any inconsistency between the units integrated together [15].

Table 4.2 shows test cases, expected result and observed result of system testing.

TABLE 4.2: SYSTEM TESTING

<b>Test Case</b>	<b>Expected Result</b>	<b>Observed Result</b>	<b>Test result</b>
Users should be able to login To the system successfully.	Login to system.	Can log in.	Pass
User should see current air quality	Current air quality should be shown.	Current air quality should be shown.	Pass
User should be able to Update profile information.	Profile information can be updated.	Can update Profile information.	Pass
Application Provides Real time notifications of air quality in indoor	Should notify To users	Notify Properly	Pass
Application shows the utile steps to prevent air pollution.	Show steps properly	Show steps properly	Pass

## **CHAPTER 5**

### **Conclusion, Implication for Future Research**

#### **5.1 Conclusions**

In this study, we proposed and implemented a smart indoor air pollution caution system for developing city. This system will ensure safety from pollution, erase tension on pollution, will save from physical diseases. It will also provide an easy pick up system by providing notification. People will get notifications through an app and they can see the current status of the indoor air in phone thus it will be easy to being conscious, it will earn the relaxation of the peoples. After all, we may hope for a better solution of indoor air monitoring system.

#### **5.2 Limitations**

Firstly this proposed system requires correct data reading by gas sensor where is some probability to get misreading by sensor. Sometimes window open is risky for home in the time of natural disaster but automation system may open it that time. As a result it could be problem for peoples. Need proper internet where most of the developing city have less internet supply. These are the limitations of our work.

#### **5.3 Comparison with Existing Systems**

There are few basic differences which make our system unique and more efficient. Implementing these extra features will help a lot to earn the reliability and make consciousness of peoples into smart indoor air caution system in developing country.

## **5.4 Implication for Further Study**

In our present work, we have tried to making the system reliable to peoples. Our plan for future is to make it more reliable. We have plan for outdoor air pollution monitoring system with reducing the volatile organic compounds from both indoor and outdoor air.

We have another plan for world climate change where will contain a website and also we can be apply data mining to this website. Our main goal is to make the system more user friendly and helpful.

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## APPENDIX

### Appendix A: MQ135

The MQ-135 alcohol sensor consists of 6 things which is given below [14].

- a tin dioxide ( $\text{SnO}_2$ )
- a perspective layer inside aluminum oxide micro tubes (measuring electrodes)
- a heating element inside a tubular casing
- The end face of the sensor is enclosed by a stainless steel net and the back side holds the connection terminals
- Ethyl alcohol present in the breath is oxidized into acetic acid passing through the heat element
- ethyl alcohol cascade on the tin dioxide sensing layer

## Appendix B: Plagiarism Report

[Document Viewer](#)

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Figure A1: Plagiarism Report