M.KUMARASAMY
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Thalavapalayam, Karur – 639 113.

Smart Air Monitoring System

A MINOR PROJECT – II REPORT

Submitted by

SUBASH.P (927621BEC213)

SIVARAMAKRISHNAN.M (927621BEC201)

YASAR.S (927621BEC245)

VIGNESHWARAN.S (927621BEC240)

BACHELOR OF ENGINEERING

in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.KUMARASAMY COLLEGE OF ENGINEERING

(Autonomous)

KARUR – 639 113

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M.KUMARASAMY COLLEGE OF ENGINEERING, KARUR

BONAFIDE CERTIFICATE

Certified that this **18ECP104L-Minor Project II** report "SMART AIR MONITORING SYSTEM**"** is the bonafide work of " P.SUBASH (927621BEC213), SIVARAMAKRISHNAN.M (927621BEC201), YASAR.S (927621BEC245), VIGNESHWARAN.S (927621BEC240)"who carried out the project work under my supervision in the academic year **2022-2023 EVEN**.

SIGNATURE	**SIGNATURE**
Dr.S.PALANIVELRAJAN, M.E.,M.B.A., Ph.D., D.Litt (USA).,	**Mrs.B.NEETHTHI AADITHIYA, M.E.,(Ph.D)**
HEAD OF THE DEPARTMENT,	**SUPERVISOR,**
Professor, Department of Electronics and Communication Engineering, M.Kumarasamy College of Engineering, Thalavapalayam, Karur-639113.	Assistant Professor, Department of Electronics and Communication Engineering, M.Kumarasamy College of Engineering, Thalavapalayam, Karur-639113.

This Minor project-III report has been submitted for the **18ECP104L – MinorProject-II** Review held at M. Kumarasamy College of Engineering, Karur on **_______________.**

PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: **Core Competence:** Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: **Professionalism:** Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: **Lifelong Learning:** Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	**Matching with POs,PSOs**
Smart Air monitoring system	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2.**

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ABSTRACT

Air pollution is a major environmental issue that affects human health and well being. To combat this issue, a smart air monitoring system has been developed to provide real-time air quality data. The system uses various sensors to monitor the levels of pollutants in the air, such as particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO2), and ozone (O3). The collected data is processed and transmitted to a cloud-based server, where it is analyzed and displayed on a user-friendly dashboard. The system is also equipped with an alert system that sends notifications to users when the air quality reaches dangerous levels. This smart air monitoring system provides a proactive approach to air pollution and empowers individuals and communities to make informed decisions about their environment. Air pollution is a major public health concern, with significant impact on respiratory and cardiovascular diseases. In this study, we propose a smart air monitoring system that uses low-cost sensors to measure\various air quality parameters, such as particulate matter (PM), carbon monoxide(CO), and nitrogen oxides (NOx). The collected data is processed in real-time using machine learning algorithms and is displayed on a user-friendly dashboard. The system also alerts users via SMS or email when the air quality reaches unsafe levels. The proposed system provides an affordable and accessible solution for monitoring air quality and promoting public health.

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ACRONYM	ABBREVIATION
AC	Alternating Current
ADC	Application Delivery Controller
ARM	Advanced Risc Machine
ASIP	Application-Specific Instruction set Processer
ASSP	Application-Specific Standard Product
CPU	Central Processing Unit
DC	Direct Current
DSP	Digital Signal Processer
ESH	Embedded System Hardware
ESS	Embedded System Software
GND	Ground
GPIO	General Purpose Input/Output
HTML	Hyper Text Markup Language
IC	Integrated Circuit
IDE	Integrated Drive Electronics
LED	Light-Emitting Diode
MCU	Micro Controller Unit
NES	Network Embedded System
PSU	Power Supply Unit
PTOS	Peal Time Operating System
PWM	Pulse Width Modulation
RAM	Random Access Memory
ROM	Read Only Memory
RS	Register Select
RTE	Real Time Embedded

SCI	Serial Communication Interface
USB	Universal Serial Bus
VCC	Voltage Common Collector

CHAPTER 1

INTRODUCTION

Smart air monitoring system is an innovative project aimed at tackling the critical issue of air pollution, which has become a major concern for our planet. The project utilizes advanced technologies and sensors to monitor and analyze air quality in real-time, providing accurate and reliable data for decision-makers, researchers, and individuals to take proactive measures to improve air quality. The smart air monitoring system project aims to promote awareness about air pollution, enable data-driven decision-making, and empower communities to take action towards achieving cleaner and healthier air for all.Smart air monitoring systems are designed to help improve the quality of the air we breathe by providing real-time monitoring of air quality levels. These systems use a combination of sensors, wireless networks, and cloud-based analytics to collect and analyze data on a variety of air pollutants, including particulate matter, carbon monoxide, and nitrogen dioxide.

1.1 Impacts of air pollution

Poor air quality can have detrimental effects on human health, including respiratory problems, cardiovascular issues, and other health conditions. Without proper monitoring, individuals may be exposed to harmful pollutants without being aware of the risks, leading to health problems and reduced quality of life.Air pollution contributes to environmental degradation, including damage to ecosystems, soil, water bodies, and vegetation. Without monitoring, the extent of pollution and its impacts on the environment may go unnoticed, leading to further degradation and loss of biodiversity.Air pollution can result in significant economic costs, including increased healthcare expenses, loss of productivity due to illnesses, and damage to infrastructure and property. Without monitoring, these costs may be underestimated or overlooked, leading to economic losses and reduced socio-economic development.Monitoring air quality provides data and insights that are crucial for informed decision-making. Without accurate and up-to-date information, policymakers may not have a clear understanding of the severity and sources of air pollution, hindering the development and implementation of effective pollution control strategies and policies.Monitoring air quality provides data that can help identify areas or communities with poor air quality, enabling targeted mitigation measures. Without monitoring, opportunities for timely interventions and mitigation efforts may be missed, resulting in prolonged exposure to harmful pollutants.not monitoring air quality can result in various issues, including health risks, environmental degradation, lack of informed decision-making, economic costs, limited accountability, missed opportunities for mitigation, and reduced public awareness and engagement. Monitoring air quality is essential for understanding the state of our environment and taking effective measures to protect air quality and public health.

1.2 Benefits of smart air monitoring system

The impact of the Smart Air Monitoring System is far-reaching and significant. By providing real-time, accurate, and comprehensive data on air quality, this system enables decision-makers to make informed policy decisions to mitigate air pollution. It empowers communities and individuals to take proactive measures to protect their health and well-being, by providing them with actionable insights to reduce exposure to pollutants. The system also facilitates research and analysis, leading to a better understanding of the sources and patterns of air pollution, and informing the development of effective strategies for pollution reduction. Additionally, the Smart Air Monitoring System creates a platform for public awareness and engagement, encouraging active participation in environmental protection efforts. Overall, the implementation of this innovative system has the potential to drive positive change, promoting cleaner air and healthier communities for the present and future generations.By continuously monitoring air quality levels, smart air monitoring systems can provide valuable insights into the sources of pollution, as well as the long-term trends and patterns in air quality. This information can be used to inform public policy decisions, including the implementation of targeted interventions to improve air quality in areas that are most affected by pollution.

In addition to their environmental benefits, smart air monitoring systems can also be used to enhance public health by providing early warning systems for dangerous levels of air pollution. By alerting individuals and authorities to these risks in real-time, it is possible to take proactive steps to reduce exposure and mitigate the negative health effects of pollution.

Overall, smart air monitoring systems are an essential tool in the fight against air pollution and will play an increasingly important role in ensuring that our cities and communities remain healthy and livable for years to come.

The system utilizes advanced sensors and technologies to provide real-time and accurate data on air quality parameters such as PM2.5, PM10, VOCs, and more. This enables decision-makers, researchers, and individuals to have up-to-date information to understand the current state of air quality and take timely actions.

By monitoring air quality and providing insights on pollutant levels, the system helps individuals and communities take proactive measures to reduce exposure to harmful pollutants. This can have a direct positive impact on public health by minimizing respiratory illnesses, cardiovascular issues, and other health problems associated with poor air quality.

By raising awareness about air pollution and encouraging active engagement from communities, the system promotes environmental protection efforts. It enables stakeholders to monitor the impact of pollution reduction initiatives, track progress, and make informed decisions for a cleaner and healthier environment.

The Smart Air Monitoring System offers numerous benefits, including improved public health by providing timely information to individuals and communities, facilitating informed decision-making for policymakers, promoting environmental protection efforts, fostering technological innovation, and empowering public engagement. The system provides actionable insights that can support the development and implementation of effective pollution control strategies, policies, and interventions.

The Smart Air Monitoring System plays a crucial role in addressing the global challenge of air pollution, which is a major environmental and public health concern. By providing accurate and real-time data, the system enables stakeholders to monitor air quality, understand the sources and impacts of pollution, and take proactive measures to protect public health and the environment. It is a vital tool in promoting cleaner air, healthier communities, and sustainable development for present and future generations.

CHAPTER 2
HARDWARE

2.1 ARDUINO

I was surprised to see a twelve-year-old boy giving life to his electronic gadgets. He was trying his hands on building his own creative toys which involved hard electronics and software skills. My zeal was on its peak to know the magical power inside the young chap. How did he understand the concepts of electronics so early? How did he develop the software? Anxiously I went down and asked him about the magic he was doing. The answer was “ARDUINO”.

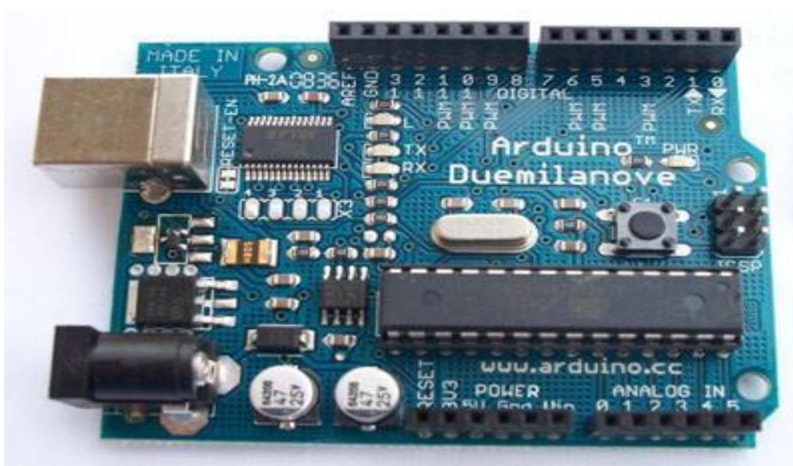

Fig.2.1 Arduino UNO Board

Arduino is an open source electronics platform accompanied with a hardware and software to design, develop and test complex electronics prototypes and products. The hardware consists of a microcontroller with other electronic components which can be programmed using the software to do almost any task. The simplicity of the Arduino language makes it very easy for almost everyone who has an interest in electronics to write programs without the understanding of complex algorithms or codes. Arduino is intended for an artist, tinker, designer or anyone, interested in playing with electronics without the knowhow of complex electronics and programming skills. Arduino is an excellent designed open source platform. It has specially designed boards which can be programmed using the Ardunio Programming Language (APL). The presence of Arduino is not only spreading between hobbyists, but it has also expanded its roots in industries and used by experts for making prototypes of commercial products. Arduino takes off the efforts required in complex coding and designing hardware. The open source nature of Arduino has been the main reason for its rapid horizontal growth. Since it is an Open Source project, all the files related to hardware and software is available for personal or commercial use. The development cost of the hardware is very small as against the costly similar proprietary products by the industrial giants. The open source nature doesn't require any licenses to develop, use, redistribute or even sell the product. But the Arduino name is trade mark protected (Arduino™) i.e., you are free to sell the Arduino board under any other name however in order to sell it under the name "Arduino" you need to take permission from the founders and follow their quality terms. The Software files which includes all the source code library are also open sourced. A user can modify them to make the project more versatile and improve its capabilities. This provides a strong online community support.

2.2 Concept of Arduino

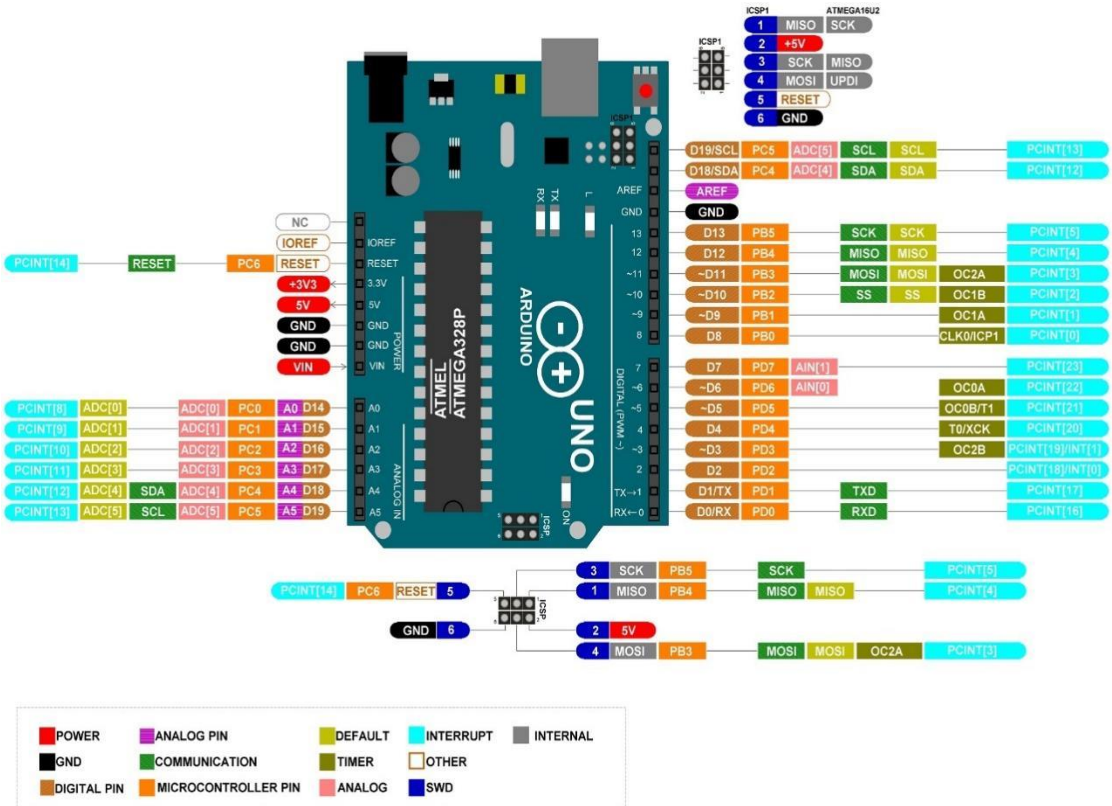

Fig 2.2 Pin Configuration

LED: There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it is off.

VIN: The input voltage to the Arduino/Genuino board when itis using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack,access it through this pin.

5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V),or the VINpin of the board(7-20V).Supplyingvoltageviathe5Vor3.3Vpinsbypassestheregulator,and can damage the board.

The root of Arduino goes deep down to the development of Processing Language by MIT researchers. Processing language is an open source language designed to introduce the software development environment for the artistic people without the need of deep knowledge of programming of algorithms. Processing is based on java.

In year 2003 Hernando Barragan, a programmer developed an open source electronics development platform with software IDE, where anyone with a small knowledge in electronics and programming could use his project to give wings to their creativity. His focus was to reduce the burden of complexity in designing electronics hardware and software. The project was named as Wiring. The software IDE of the Wiring used processing language to write the codes.

As the program written in C\C++ is named as Project, in the same way the code written in Wiring (even in Processing and Arduino) is termed as Sketch. The name sketch gives a familiar look for an artist.

Wiring has predefined libraries to make the programming language easy. Arduino uses these libraries. The predefined libraries are written in C and C++. One can even write his software in C\C++ and use them on Wiring boards. The difference between writing a program in C/C++ and Wiring is that the Wiring Application Programmable Interface (API) has simplified programming style and the user doesn’t require detailed knowledge of the concepts like classes, objects, pointers, etc. While sketching hardware you need to call the predefined functions and rest will be handled by the Wiring software.

The basic difference between the Processing and the Wiring is that the Processing is use to write the program which can be used on other computers while Wiring program is used on microcontrollers.

2.3 BUZZER

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. When current is applied to the buzzer it causes the ceramic disk to contract or expand. Changing the This then causes the surrounding disc to vibrate. That's the sound that you hear. By changing the frequency of the buzzer, the speed of the vibration's changes, which changes the pitch of the resulting sound.

Fig 2.3 Buzzer

There are many ways to communicate between the user and a product. One of the best ways is audio communication using a buzzer IC. So, during the design process, understanding some technologies with configurations is very helpful. So, this article discusses an overview of an audio signalling device like a beeper or a buzzer. An audio signalling device like a beeper or buzzer may be Electromechanical or piezoelectric or mechanical type.

The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren. The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the ‘+’ symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the ‘- ‘symbol or short terminal and it is connected to the GND terminal.

2.4 Working Of MQ 135 Sensor

Fig 2.4 MQ 135 Sensor

What is MQ-135 gas sensor and how does it work? The gas sensor module consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it. Fig 2.4

2.4.1 Pin Configuration MQ-135 gas sensor

From left to right first pins are as follows:

- A0 Analog output
- D0 Digital output
- GND Ground Vcc
- Supply

Fig 2.5Pin Configuration MQ-135 gas sensor

2.4.2 Specifications of MQ-135 gas sensor

• Wide detecting scope

• Fast response and High sensitivity

• Stable and long-life Simple drive circuit

• Used in air quality control equipment for buildings/offices, is suitable for detecting of NH3, NOx, alcohol, Benzene, smoke, CO2, etc.

• Size: 35mm x 22mm x 23mm (length x width x height)

• Working voltage: DC 5 V

• Signal output instruction.

• Dual signal output (analog output, and high/low digital output)

• 0 ~ 4.2V analog output voltage, the higher the concentration the higher the voltage.

2.4.3 Interfacing of MQ-135 gas sensor with Arduino

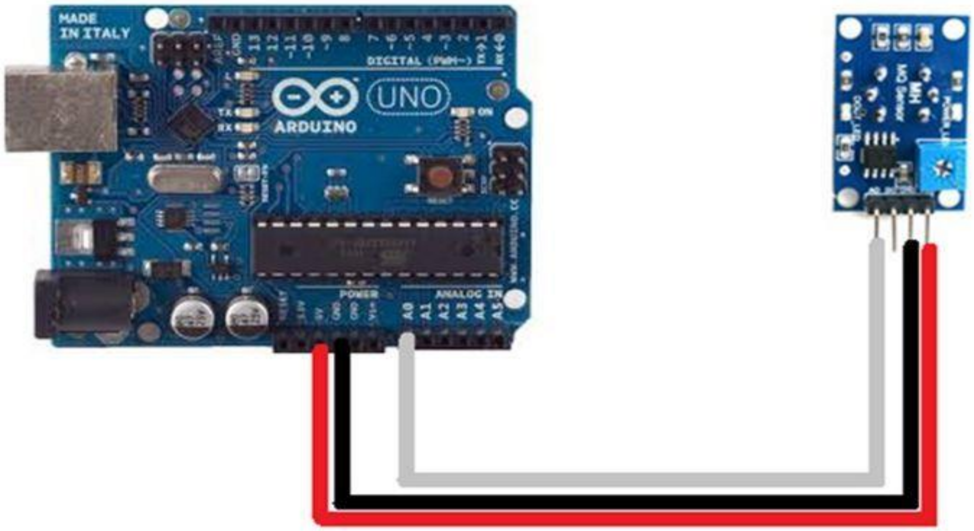

Fig 2.6 Interfacing of MQ-135 gas sensor with Arduino

When no gas digital output is 1 and analog output gives 1023 max value. When gas is present digital output is 0 and analogue output is much less than 1023. Using potentiometer on chip we control the turning OFF point of digital pin at some value of analog pin. The sensor needs a load resistor at the output to ground. Its value could be from 2kOhm to 47kOhm. The lower the value, the less sensitive is the sensor. The higher the value, the less accurate is sensor for higher concentrations of gas. If only one specific gas is measured, the load-resistor can be calibrated by applying a known concentration of that gas. If the sensor is used to measure any gas (like in a air quality detector) the load-resistor could be set for a value of about 1V output with clean air. Choosing a good value for the load-resistor is only valid after the burn-in. Fig 2.7

2.5 POWER SUPPLY

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Power supplies for electronic devices can be broadly divided into linear and switching power supplies. The linear supply is a relatively simple design that becomes increasingly bulky and heavy for high current devices; voltage regulation in a linear supply can result in low efficiency. A switched-mode supply of the same rating as a linear supply will be smaller, is usually more efficient, but will be more complex.

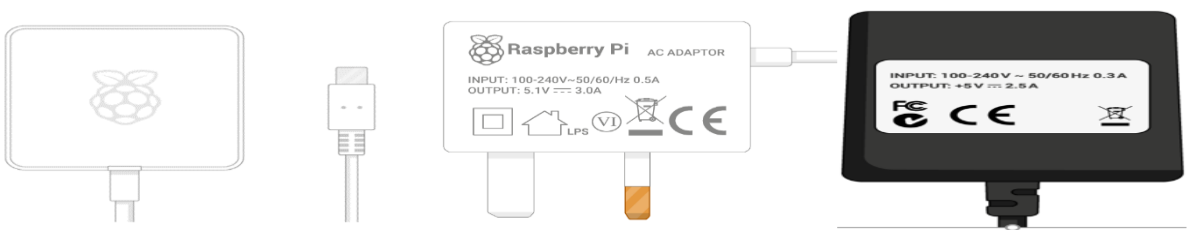

Fig 2.7 Power Supply

You need a power supply that provides:

- At least 3.0 amps for raspberry pi 4
- At least 2.5 amps for raspberry pi 3

2.5.1 Linear Power supply

An AC powered linear power supply usually uses a transformer to convert the voltage from the wall outlet (mains) to a different, usually a lower voltage. If it is used to produce DC, a rectifier is used. A capacitor is used to smooth the pulsating current from the rectifier. Some small periodic deviations from smooth direct current will remain, which is known as ripple. These pulsations occur at a frequency related to the AC power frequency (for example, a multiple of 50 or 60 Hz).

The voltage produced by an unregulated power supply will vary depending on the load and on variations in the AC supply voltage. For critical electronics applications a linear regulator will be used to stabilize and adjust the voltage. This regulator will also greatly reduce the ripple and noise in the output direct current. Linear regulators often provide current limiting, protecting the power supply and attached circuit from over current.

Adjustable linear power supplies are common laboratory and service shop test equipment, allowing the output voltage to be set over a wide range.

For example, a bench power supply used by circuit designers may be adjustable up to 30 volts and up to 5 amperes output. Some can be driven by an external signal, for example, for applications requiring a pulsed output.

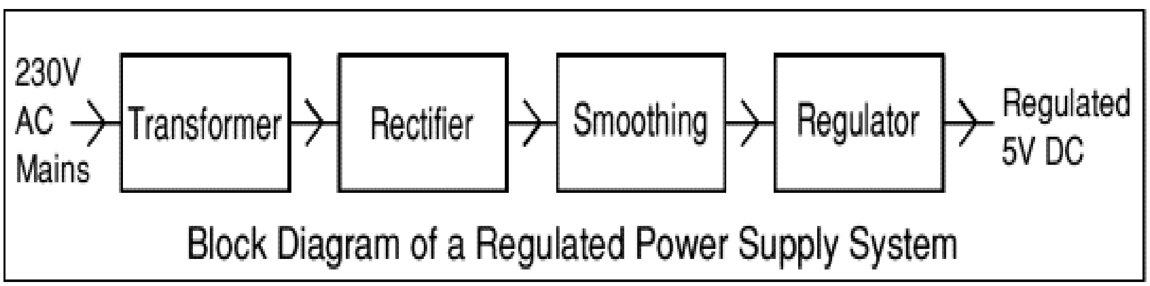

Fig 2.8 Block Diagram of a Regulated Power Supply

CHAPTER 3

SOFTWARE REQUIREMENTS

3.ARDUINO SOFTWARE (IDE)

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

3.1 Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

 Verify

Checks your code for errors compiling it.

 Upload

Compiles your code and uploads it to the configured board.

See uploading below for details.

Note: If you are using an external programmer with your board, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"


New

Creates a new sketch.


Open

Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.

Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the File | Sketch book menu instead.


Save

Saves your sketch.


Serial Monitor

Opens the serial monitor.

Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

3.2 File

- **New**
  Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.
- **Open**
  Allows to load a sketch file browsing through the computer drives and folders.
- **Open Recent**
  Provides a short list of the most recent sketches, ready to be opened.

- **Sketchbook**

  Shows the current sketches within the sketchbook folder structure; clicking on any name opens the corresponding sketch in a new editor instance.

- **Examples**

  Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.

- **Close**

  Closes the instance of the Arduino Software from which it is clicked.

- **Save**

  Saves the sketch with the current name. If the file hasn't been named before, a name will be provided in a "Save as.." window.

- **Save as...**

  Allows to save the current sketch with a different name.

- **Page Setup**

  It shows the Page Setup window for printing.

- **Print**

  Sends the current sketch to the printer according to the settings defined in Page Setup.

- **Preferences**

  Opens the Preferences window where some settings of the IDE may be customized, as the language of the IDE interface.

- **Quit**

  Closes all IDE windows. The same sketches open when Quit was chosen will be automatically reopened the next time you start the IDE.

3.3 Edit

- **Undo/Redo**

  Goes back of one or more steps you did while editing; when you go back, you may go forward with Redo.

- **Cut**

  Removes the selected text from the editor and places it into the clipboard.

- **Copy**

  Duplicates the selected text in the editor and places it into the clipboard.

- **Copy for Forum**

  Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax coloring.

- **Copy as HTML**

  Copies the code of your sketch to the clipboard as HTML, suitable for embedding in web pages.

- **Paste**

  Puts the contents of the clipboard at the cursor position, in the editor.

- **Select All**

  Selects and highlights the whole content of the editor.

- **Comment/Uncomment**

  Puts or removes the // comment marker at the beginning of each selected line.

- **Increase/Decrease Indent**

  Adds or subtracts a space at the beginning of each selected line, moving the text one space on the right or eliminating a space at the beginning.

- **Find**

  Opens the Find and Replace window where you can specify text to search inside the current sketch according to several options.

- **Find Next**

  Highlights the next occurrence - if any - of the string specified as the search item in the Find window, relative to the cursor position.

- **Find Previous**

  Highlights the previous occurrence - if any - of the string specified as the search item in the Find window relative to the cursor position.

3.4 Sketch

- **Verify/Compile**

  Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.

- **Upload**

  Compiles and loads the binary file onto the configured board through the configured Port.

- **Upload Using Programmer**

  This will overwrite the bootloader on the board; you will need to use Tools > Burn Bootloader to restore it and be able to Upload to USB serial port again. However, it allows you to use the full capacity of the Flash memory for your sketch. Please note that this command will NOT burn the fuses. To do so a Tools -> Burn Bootloader command must be executed.

- **Export Compiled Binary**

  Saves a .hex file that may be kept as archive or sent to the board using other tools.

- **Show Sketch Folder**

  Opens the current sketch folder.

- **Include Library**

  Adds a library to your sketch by inserting #include statements at the start of your code. For more details, see libraries below. Additionally, from this menu item you can access the Library Manager and import new libraries from .zip files.

- **Add File...**

  Adds a source file to the sketch (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using the tab menu accessible clicking on the small triangle icon below the serial monitor one on the right side o the toolbar.

3.5 Tools

- **Auto Format**

  This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.

- **Archive Sketch**

  Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.

- **Fix Encoding & Reload**

  Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

- **Serial Monitor**

  Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

- **Board**

  Select the board that you're using. See below for descriptions of the various boards.

- **Port**

  This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.

- **Programmer**

  For selecting a hardware programmer when programming a board or chip and not using the onboard USB-serial connection. Normally you won't need this, but if you're burning a bootloader to a new microcontroller, you will use this.

- **Burn Bootloader**

  The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino or Genuino board but is useful if you purchase a new ATmega microcontroller (which normally come without a bootloader).

- Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

3.6 Help

Here you find easy access to a number of documents that come with the Arduino Software (IDE). You have access to Getting Started, Reference, this guide to the IDE and other documents locally, without an internet connection. The documents are a local copy of the online ones and may link back to our online website.

- **Find in Reference**

  This is the only interactive function of the Help menu: it directly selects the relevant page in the local copy of the Reference for the function or command under the cursor.

3.7 Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. You may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

3.7.1 Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

3.8 Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or/dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB- to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx ,/dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the File menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

3.9 Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include<statements> from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

3.10 Third-Party Hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

3.11 Serial Monitor

Displays serial data being sent from the Arduino or Genuino board (USB or serial board). To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down that matches the rate passed to serial.begin in your sketch. Note that on Windows, Mac or Linux, the Arduino or Genuino board will reset (rerun your sketch execution to the beginning) when you connect with the serial monitor.

3.12 EMBEDDED C

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today.

Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP).The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processor since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Peripherals

Embedded Systems talk with the outside world via peripherals, such as:

- Serial Communication Interfaces (SCI): RS-232, RS-422, RS-485 etc.
- Synchronous Serial Communication Interface: I2C, SPI, SSC and ESSI

(Enhanced Synchronous Serial Interface)

- Universal Serial Bus (USB)
- Analog to Digital/Digital to Analog (ADC/DAC)

Advantages

- Reliability
- Simple control loop
- Interrupt controlled system

CHAPTER 4

EXISTING SYSTEM

Title : Smart Air Quality Monitoring System with LoRaWAN Features:

- Tracks pollution levels and environmental factors in real-time , including temperature, humidity, carbon dioxide, and volatile organic compounds (VOCs)
- Uses a Low-Power, Wide-Area Network (LoRaWAN) to connect smart devices across long distances.
- Provides real-time air quality data visualization and analysis through a web portal or mobile app.
- Can send alerts and notifications to users when air quality levels exceed safe thresholds.
- Enables users to take action to improve air quality, such as by adjusting ventilation systems or air purifiers.
- This system has been proposed in a paper titled "Smart Air Quality Monitoring System with LoRaWAN" published in the IEEE Xplore digital library . It could be a good option if you are looking for a smart air quality monitoring system that uses low-power , wide-area network technology to connect devices and provides real-time data visualization and alerts.

CHAPTER 5

PROBLEM STATEMENT

- Poor air quality a threat to the lives of all living things, including people and plants.
- Simple asphyxiants cause death by excluding oxygen from the lung. Examples include carbon dioxide, nitrogen, aliphatic hydrocarbon gases.
- Inhaling the non flammable noxious gas causes dizziness, drowsiness, lack of concentration, confusion, headaches, coma and death.

CHAPTER 6

PROPOSED SYSTEM

- We have proposed a model that can detect the presence of Noxious gas like CO2,Natural gas.
- MQ135 Gas Detector is used to find the presence of gas.
- Both a buzzer and an LED will be used to signal the presence of gas.
- After the discovery of gas,a 12 volt exhaust fan and air filter are used to purify the contaminated air.
- program Link https://drive.google.com/drive/folders/1p5Z9HF0Ay-mZsaockH7LKWlf8N47rmd3?usp=share_link
- Video link https://youtu.be/13XU3od-UY4

6.1Block Diagram

Fig 6.1 Block Diagram of the Proposed Air Pollution Measuring System

6.2 Software Requirements

- Programming language - C
- Operating system - Windows 11
- Editor - notepad++
- IDE - Arduino 2.3.2

6.3 Project kit

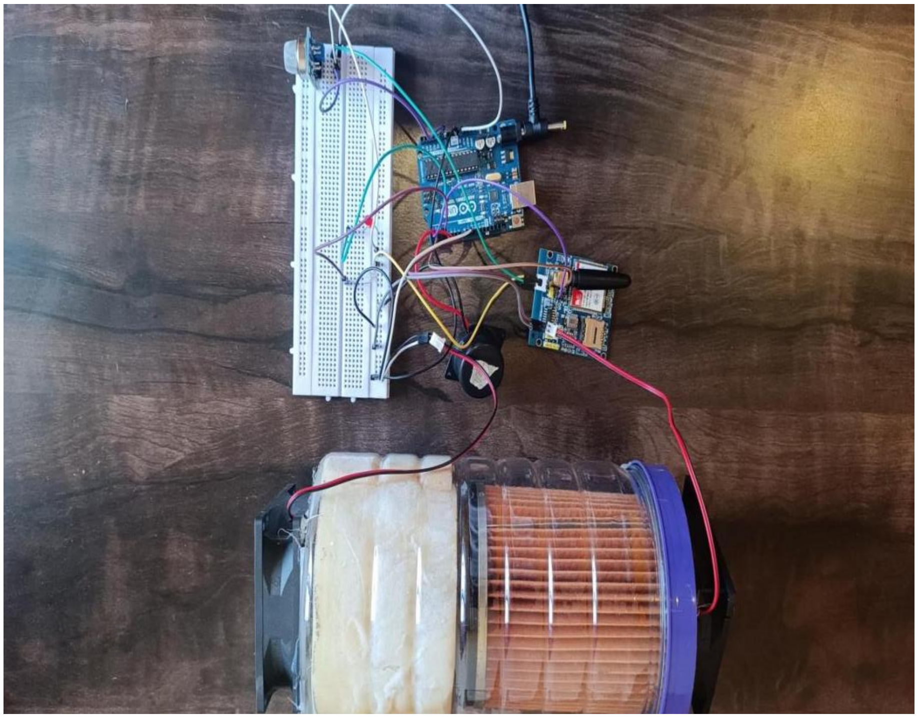

Fig 6.2 project kit

6.4 Working Principle

As described by Figure 3, the library in the Arduino was loaded and a message was sent to the LCD. Air quality data was collected using the MQ135sensor. The calibrated sensor made the analog output voltage proportional to the concentration of polluting gases in Parts per Million (ppm).

The online application provides global access to measured data via any device that has internet connection capabilities. Data collected from the sensor was converted into a string and used to update the information sent to the remote server.

6.5 Mathematical Analysis of Proposed Model

The level concentration of pollutants in the air is measured in parts per million(ppm)or percentage.

Conversion factors include the following:

1 ppm = 1.145 mg/m3

1mg/m3 =0.873 ppm

1%=1/100

1 ppm = 1/1000000

1 ppm = 0.0001%

Table1showsPPMtopercentageconversion

Parts per Million (ppm)	Percent(%)
0	0
5	0.005
50	0.005
500	0.05
1000	0.1

Table 6.1 PPM to Percentage conversion

CHAPTER 7

CODING

```
// scientist BENIEL'S LAB
// GAS DETECTOR

int Input = A0;
int R_LED = 2;
int G_LED = 3;
int Buzzer = 4;
int fan2 = 8;
int fan1 = 9;
// VAL INTEGER
int val;
int MAX = 400;


voidsetup()
{
  Serial.begin(9600);
   Serial.begin(9600);    // Setting the baud rate of Serial Monitor (Arduino)
  delay(100);
  pinMode(Input ,INPUT);
  pinMode(R_LED ,OUTPUT);
  pinMode(G_LED ,OUTPUT);
  pinMode(Buzzer ,OUTPUT);
  pinMode(fan1 ,OUTPUT);
  pinMode(fan2 ,OUTPUT);
}

voidloop(){
  val = analogRead(A0);
  if(val >= MAX){
    digitalWrite(R_LED ,HIGH);
    digitalWrite(Buzzer ,HIGH);
   digitalWrite(fan1 ,HIGH);
   digitalWrite(fan2 ,HIGH);
   digitalWrite(G_LED ,LOW);
      Serial.println("GAS LEAKING");
```

```
     Serial.println("ATD+CMGF=1");
     delay(1000);
     Serial.println("ATD+CMGS=\"+919943249595\"\r");// Replace x with mobile
number
   delay(1000);
     //Wait forever


   Serial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
   delay(1000);  // Delay of 1000 milli seconds or 1 second
   Serial.println("AT+CMGS=\"+919943249595\"\r");// Replace x with mobile
number
   delay(1000);
   Serial.println(" dust partical is founded keep safe side");// The SMS text you
want to send
   delay(100);
   Serial.println((char)26);// ASCII code of CTRL+Z
   delay(1000);
   while(1);  //Wait forever

  }
  else{
    digitalWrite(R_LED ,LOW);
    digitalWrite(Buzzer ,LOW);
   digitalWrite(fan1 ,LOW);
   digitalWrite(fan2 ,LOW);
   digitalWrite(G_LED ,HIGH);
   Serial.println("NORMAL");
  }
}
```

CHAPTER 8

CONCLUSION

Monitoring the environmental parameters especially with respect air plays very important role to ensure healthy environment for living beings. The proposed application works on the principle of IOT, data read from sensor are processed by the processor (ESP8266) then uploaded to database .This research proposed a smart air pollution monitoring system that constantly keeps track of air quality in an area and displays the air quality measured on an LCD screen. It also sends data measured to the “Thing speak” platform. The system helps to create awareness of the quality of air that one breathes daily. This monitoring device can deliver real-time measurements of air quality.In this paper, the development of an IoT-based indoor air quality monitoring platform is presented. Experiments were performed to verify the air quality measurement device used in the platform based a method suggested by the Ministry of Environment, Korea.We verified the accuracy of indoor air quality monitoring and the desirable performance of the device. Also, experiments making use of the platform were conducted and demonstrated suitable performance and convenience of the air quality monitoring platform. Several achievements of the platform were accomplished, including the following: (1) indoor air quality can be efficiently monitored anywhere and in real time by using an IoT and a cloud computing technologies; (2) the platform used Amazon Web Services as a certified web server for security of the platform and the data; (3) the Smart-Air device has an expandable interface, and the web server is also easily extendable, allowing easy application to various environments through the addition of appropriate sensors to the device or installing more Smart-Air devices to appropriate monitoring locations. Future work will involve further testing of the device and the platform.

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SMART AIR MONITORING SYSTEM BASE DON IOT

Mrs.B.Neethia adithya
Assistant Professor

P Subash
UG Scholar

M Sivaramakrishnan
UG Scholar

S Yasar
UG Scholar

S Vigneshwaran
UG Scholar

Department of Electronics and Communication Engineering
M.Kumarasamy College of Engineering, Karur

Abstract- Bad air quality can aggravate asthma and other respiratory disorders, irritate the eyes, nose, and throat, induce shortness of breath, and have negative effects on the heart and cardiovascular system. Long-term exposure to contaminated air can result in more severe issues. The smart air quality monitoring equipment from Smarter Technologies can identify noxious gases, contaminants, and carbon dioxide levels while transmitting real-time data to a management dashboard. This offers better situational awareness, increased visibility, and earlier warnings about pollution hotspots. A web server and the Internet are utilized to monitor the air quality using an IOT-based air pollution monitoring system. When the amount of dangerous chemicals including CO2, smoking, alcohol, benzene, NH3, and NOx is high enough, it will sound an alarm when the air quality drops below a specified threshold. An essential instrument for enhancing air quality, safeguarding public health, and ensuring rules arefollowedisairqualitymonitoring.Itcanalsobeusedtolocatetheoriginsofpollutants.So, installing an air quality monitoring system aids in detecting the presence of pollutants, improving the living environment for people. By maintaining a calm atmosphere or as necessary, this has an effect on their health as well as lowering the likelihood of any health

Keywords- IOT,Smartairmonitoring,CO2,NH3,NOx.

M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 & ISO 14001:2015 Certified Institution
Thalavapalayam, Karur-639 113, Tamilnadu.

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Organizing Chair

Dr.S.Palanivel Rajan
HoD / ECE

l

M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 & ISO 14001:2015 Certified Institution
Thalavapalayam, Karur-639 113, Tamilnadu.

ICSPCS 2023

CERTIFICATE OF PARTICIPATION

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Organizing Chair

Dr.S.Palanivel Rajan
HoD / ECE

M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 & ISO 14001:2015 Certified Institution
Thalavapalayam, Karur-639 113, Tamilnadu.

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Organizing Chair

Dr.S.Palanivel Rajan
HoD / ECE

M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 & ISO 14001:2015 Certified Institution
Thalavapalayam, Karur-639 113, Tamilnadu.

INSERB INDIA

KR

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Organizing Chair

Dr.S.Palanivel Rajan
HoD / ECE