

AN ALERT SYSTEM FOR THE ALERT OF ALLERGENS TRIGGERING ASTHMA ATTACK

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering Degree in Electronics and Communication Engineering

By

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SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

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

CATEGORY -1 UNIVERSITY BY UGC

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APRIL- 2024



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ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this project Report is the bona-fide work of **PANDIYARAJAN R (40130706) THANGA TAMIL SELVAN P (40130285)** who carried out the project entitled **"AN ALERT SYSTEM FOR THE ALERT OF ALLERGENS TRIGGERING ASTHMA ATTACK"** under my supervision from November 2023 to April 2024

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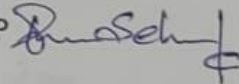
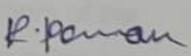
DECLARATION

We PANDIYARAJAN R (40130706) THANGA TAMIL SELVAN P (40130285) hereby declare that the Project Report entitled "AN ALERT SYSTEM FOR THE ALERT OF ALLERENS TRIGGERING ASTHMA ATTACK" done by us under the guidance of Dr. M SUGADEV, Associate professor at SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY is submitted in partial fulfillment of the requirements for the award Bachelor of Engineering Degree in ELECTRONICS AND COMMUNICATION ENGINEERING.

DATE: 16.04.2024

PLACE: Chennai

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ACKNOWLEDGEMENT

I am pleased to acknowledge our sincere thanks to the **Board of Management of SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr.N.M.Nandhitha M.E.,Ph.D.**, Dean, School of Electrical and Electronics and **Dr.T.Ravi, M.E., Ph.D**, Head of the Department, Dept. of Electronics and Communication Engineering for providing us necessary support and details at the right time during the progressive reviews.

I would like to express our sincere and deep sense of gratitude to our Project Guide **Dr.SUGADEV.M**, for his valuable guidance, suggestions and constant encouragement paved the way for the successful completion of our projectwork.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of **Electronics and Communication Engineering** who were helpful in many ways for the completion of the Project.

ABSTRACT

The human body uses air in several ways. Without it we wouldn't be able to live. Breathing in Oxygen - Air supplies the oxygen to our lungs which circulates through our bodies to combine with sugars in the food we eat to give us energy and to build tissues. Exhaling Waste - Oxygen is primarily combined with carbon in our bodies to produce Carbon Dioxide which is exhaled. Other trace gases are exhaled including a little methane and water vapor. The water vapor is not really a waste product like CO₂ or methane. Regulating Temperature - The air around us helps to keep us warm. In the absence of any heat in the air, our bodies lose heat quickly. If we are working hard or exercising, we generate excess heat. The air provides some cooling to help the body maintain an ideal temperature of 37° C.

Air quality affects your health. Ozone and particulate matter, also known as PM, are two pollutants of significant concern in the Bay Area. Ozone is primarily a health problem in the summertime, and PM in the winter. Poor air quality affects your health. When pollution is bad, it can irritate your eyes, nose, and throat, cause shortness of breath, aggravate asthma and other respiratory conditions, and even affect your heart and cardiovascular system. Breathing polluted air for long periods of time can cause more serious health problems. Two primary causes of poor air quality in the Bay Area are ozone and particulate matter, also called PM or soot. Cars and trucks and other mobile sources are the major sources of ozone in the summertime. In the winter, wood smoke from woodstoves and fireplaces is the major source of PM pollution.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	v
	LIST OF ABBREVIATIONS	ix
	LIST OF FIGURES	x
1	INTRODUCTION	1
2	LITERATURE SURVEY	3
3	SYSTEM ANALYSIS	9
	3.1 EXISTING SYSTEM	9
	3.1.1 DISADVANTAGES	9
	3.2 BLOCK DIAGRAM OF PROPOSED SYSTEM	9
	3.2.1 OBJECTIVE	10
	3.2.2 SCOPE	10
	3.2.3 NOVELTY	10
	3.3 MQ135 AND DHT11	11
	3.3.1 FEATURES	11
	3.3.2 APPLICATIONS	11
	3.3.3 SENSOR AND MODULES	12
	3.3.4 MQ135 GAS SENSOR	12
	3.4 DHT11 SENSOR	13
	3.4.1 WORKING PRINCIPLE	13
	3.4.2 APPLICATIONS	14
	3.5 GSM MODEM	15
	3.5.1 FEATURES	15
	3.5.2 HARDWARE DESCRIPTION	16

3.5.3 SIMcomSIM900AGSM MODULE	16
3.5.4 MAX232 IC	16
3.5.5 SERIAL PORT / DB9 CONNECTOR	17
3.5.6 POWER SUPPLY SOCKET	17
3.5.7 POWER ON/OFF AND ON SWITCH	18
3.5.8 SIM CARD SLOT	18
3.5.9 RXD,TXD AND GND PINS	19
3.5.10 INSERTING SIM CARD INTO SIM SLOT/HOLDER	20
3.6 POWER SUPPLY	20
3.6.1 TRANSFORMER	21
3.7 ARDUINO	22
3.7.1 PIN DIAGRAM	23
3.7.2 ANALOG INPUT	25
3.7.3DIGITAL INPUT	25
3.7.4 POWER JACK CABLE/ USB PORT	26
3.7.5 POER SUPPLY	26
3.7.6 ARCHITECTURDE DIAGRAM	26
3.8 NODE MCU ESP8266	28
3.9 ARDUINO SOFTWARE	30
3.9.1 WRITING SKETCHES	30
3.10 PROTEUS DESIGN	32
3.10.1 PRODUCT MODULES	32
3.10.2 SCHEMATIC CAPTURE	33
3.10.3 MICROCONTROLLER SIMULATION	33
3.10.4 PCB DESIGN	34

	3.10.5 3D VERIFICATION	34
	3.11 EMBEDDED C	34
	3.11.1 INTRODUCTION TO EMBEDDED C	35
	3.11.2 EMBEDDED SYSTEMS PROGRAMMING	35
	3.11.3 USE OF C IN EMBEDDED SYSTEMS	36
4	RESULTS AND DISCUSSIONS	38
5	CONCLUSION	41
	5.1 IEEE STANDARDS	43
	5.2 TRADE-OFFS	44
	REFERENCES	45

LIST OF ABBREVIATIONS

GSM	GLOBAL SYSTEM FOR MOBILE COMMUNICATION
SIM	SUBSCRIBER IDENTITY MODULE
WSN	WIRELESS SENSOR NETWORK
GIS	GEOGRAPHIC INFORMATION SYSTEMS
IAQ	INDOOR AIR QUALITY
OAQ	OUTDOOR AIR QUALITY
ALU	ARITHMETIC LOGIC UNIT
SRAM	STATIC RANDOM ACCESS MEMORY
TWI	TEO EIRS INTERFACE
SPI	SERIAL PERIPHERAL INTERFACE
USART	UNIVERSAL SYNCHRONOUS ASYNCHRONOUS RECEIVER TRANSMITTER
SDK	SOFTWARE DEVELOPMENT KIT
DSR	DATA SET READY
RI	RING INDICATOR
DCD	DATA CARRIER DETECT
DTR	DATA TERMINAL READY
CTS	CLEAR TO SEND

LIST OF FIGURES

FIGURE NO.	FIGURE NAME	PAGE NO.
3.1	BLOCK DIAGRAM	9
3.2	MQ135 SENSOR	11
3.3	DHT11 SENSOR	14
3.4	GSM MODEM	16
3.5	SIMCOM SIM900AGSM MODULE	16
3.6	MAX232 IC	17
3.7	SERIAL PORT /DB9 CONNECTOR	17
3.8	POWER SUPPLY SOCKET	18
3.9	POWER ON/OFF AND GSM ON SWITCH	18
3.10	SIM CARD SLOT	19
3.11	RXD,TXD AND GND PIN	19
3.12	SIM CARD UNSERTING	20
3.13	POWER SUPPLY	21
3.14	BLOCK DIAGRAM	21
3.14	TRANSFORMER	21
3.16	PIN DIAGRAM	23
3.17	ARCHITECTURE DIAGRAM	26
3.18	NODE MCUESP8266(IOT)	29
3.19	NODE MCUESP8266 PIN DIAGRAM	30
3.20	PRODUCT MOULE	33
4.1	WORKING MODEL	38
4.2	VALUES FROM APP	38
4.3	USER LOGIN	38
4.4	ARDUINO IDE ALGORITHM	39

CHAPTER 1

INTRODUCTION

Air plays a very important part in our life, we will talk about just a few of them today. Air contains oxygen, which is essential for life on Earth. We inhaled air, taking the out oxygen and other gases our bodies need, then air we exhaled is made up of the gases useless to us - mainly carbon dioxide. Moving air, called wind, has great force. It enables the movement of sailboats and gliders. It runs windmills, which are used to generate electricity. Wind also helps in the dispersal of seeds. Water, air, and soil are three natural resources that we cannot live without. The Forest Service strives to protect, maintain, and restore these valuable assets now and into the future. Water is one of the most important natural resources flowing from forests. The organisms living in the soil respire through oxygen present in this air. Hence plants and animals are interdependent and they maintain a balance between carbon dioxide and oxygen in the atmosphere. The article briefly describes the importance of air for survival. Moving air (wind) is also important for some plants to pollinate. Animals including humans need oxygen to live. We breathe in oxygen and breathe out Carbon Dioxide. There are also air pockets in soils and water that help tiny living things survive in water and beneath the soils. The human body uses air in several ways. Without it we wouldn't be able to live. Breathing in Oxygen - Air supplies the oxygen to our lungs which circulates through our bodies to combine with sugars in the food we eat to give us energy and to build tissues. Exhaling Waste - Oxygen is primarily combined with carbon in our bodies to produce Carbon Dioxide which is exhaled. Other trace gases are exhaled including a little methane and water vapor. The water vapor is not really a waste product like CO₂ or methane. Regulating Temperature - The air around us helps to keep us warm. In the absence of any heat in the air, our bodies lose heat quickly. If we are working hard or exercising we generate excess heat. The air provides some cooling to help the body maintain an ideal temperature of 37° C.

Air quality affects your health. Ozone and particulate matter, also known as PM, are two pollutants of significant concern in the Bay Area. Ozone is primarily a health problem in the summertime, and PM in the winter. Poor air quality affects your health. When pollution is bad, it can irritate your eyes, nose, and throat, cause shortness of breath, aggravate asthma and other respiratory conditions, and even

affect your heart and cardiovascular system. Breathing polluted air for long periods of time can cause more serious health problems. Two primary causes of poor air quality in the Bay Area are ozone and particulate matter, also called PM or soot. Cars and trucks and other mobile sources are the major sources of ozone in the summertime. In the winter, wood smoke from woodstoves and fireplaces is the major source of PM pollution.

CHAPTER 2

LITERATURE SURVEY

Related work similar to the proposed work has been studied and briefly described in this chapter

Jason Alanya Villanueva et al. (2022) present an article on Development of an IoT system using ESP8266 for the detection of asthma triggering allergens in children. Asthma, a chronic respiratory condition, pervades all corners of the globe and poses a significant challenge, particularly in nations with limited healthcare resources. Shockingly, it accounts for 80% of deaths among patients who aren't receiving adequate treatment. Extensive research underscores the profound impact of environmental factors, especially on pediatric asthma cases. In Peru, where environmental pollution looms large, Lima stands out as a hotspot, grappling with elevated levels of PM2.5 and PM10 pollutants, notorious for triggering asthma exacerbations. Recognizing this pressing issue, the imperative arises to develop a robust system capable of pinpointing asthma triggers to avert potentially life-threatening attacks. The proposed system, detailed in this discourse, aims to gauge air quality within the confines of asthmatic children's homes and beyond, thereby assuaging the concerns of parents or caregivers and proactively notifying them of any impending hazards. Central to this endeavor is the deployment of sensors strategically positioned to capture pertinent air quality data. These sensors relay real-time readings to a cloud-based database for storage and analysis, facilitating the creation of a Progressive Web Application (PWA). This application serves as a conduit for comparing and monitoring air quality metrics, enabling stakeholders to conduct comprehensive environmental assessments and institute requisite precautions.

In operationalizing the system, an intricate network of sensors continuously monitors air quality parameters, swiftly detecting deviations from established norms. Leveraging the versatility of the "If This, Then That" (IFTTT) platform, the system promptly dispatches alerts to designated recipients via the IFTTT application upon detecting anomalies indicative of potential asthma triggers. This proactive notification mechanism empowers caregivers to promptly intervene and mitigate risks, safeguarding the well-being of asthmatic individuals.

Related work similar to the proposed work has been studied and briefly described in this chapter

Agrippina Mwangi et al (2020) present an article on an IoT-alert System for Chronic Asthma Patients. Asthma remains a significant public health concern, with thousands of lives lost each year, particularly exacerbated during colder seasons due to delayed access to first-aid and inadequate medical care. However, many of these fatalities are preventable through a combination of home remedies, prescribed treatments, exercises, and most crucially, rapid response and care during asthma attacks. Given the unpredictable nature of asthma attacks, especially for those unable to forecast them, this research introduces an IoT-alert system aimed at providing timely notification to emergency contacts in the event of a sudden asthma attack, with a particular focus on reducing asthma-related deaths in Rwanda. Conducted in Rwanda, this study aims to alert emergency contacts promptly, enabling a rapid response and potentially saving lives. The proposed system utilizes a keypad unit as the primary interaction point for users. When triggered, either manually by the asthma patient or automatically in response to certain physiological indicators, the system sends SMS messages to pre-registered emergency contacts while simultaneously sounding a buzzer to alert nearby neighbors. This dual notification system aims to ensure that asthma patients, particularly those living alone, receive the necessary medical assistance within a critical five-minute window following an attack.

The keypad interaction unit, designed for easy accessibility, can be wall-mounted in any room frequented by the patient. A functional prototype of the system has been successfully tested in Kigali, demonstrating its effectiveness in providing timely assistance to asthma patients during emergencies.

By leveraging IoT technology, this innovative alert system seeks to bridge the gap in emergency response for asthma patients, potentially saving lives and improving overall outcomes. With further development and implementation, it holds the promise of significantly reducing the burden of asthma-related mortality in Rwanda and beyond.

Related work similar to the proposed work has been studied and briefly described in this chapter

Tabarek G et al (2017) present an article on an Internet of Things Based Cloud Smart Monitoring for Asthma Patient. The Internet of Things (IoT) stands as a cornerstone of present and future technological advancements, offering the potential to greatly simplify human life through the connectivity of smart devices. Exploiting this connectivity opens avenues to address various societal issues, including chronic diseases such as asthma. This paper presents an IoT-based remote monitoring system tailored for asthma patients, designed to enhance monitoring and control of the condition.

The research begins with a comprehensive survey on asthma chronic disease, consulting specialists in the field to understand its nuances and challenges. Subsequently, the focus shifts towards leveraging IoT technology for monitoring and managing asthma effectively. The prototype IoT Asthma monitoring system is devised, featuring a heart pulse sensor integrated with an ESP8266 microcontroller. Real-time data collected by the sensor is wirelessly transmitted to the ESP8266, which then communicates with the cloud infrastructure using the HTTP protocol.

In the cloud, a MySQL database is employed to store the incoming sensor readings, facilitating easy access and retrieval. Authorized entities such as monitoring facilities, hospitals, doctors, or even the patients themselves can access a dedicated webpage written in PHP to monitor live updates of the patient's condition. This remote accessibility ensures timely intervention and proactive management of asthma symptoms.

To validate the system's functionality, network simulation using packet tracer is conducted, verifying its seamless operation and data transmission capabilities. Titled "Research and Development of an IoT-Based Remote Asthma Patient Monitoring System," this endeavor underscores the potential of IoT technology in revolutionizing healthcare delivery, particularly in the realm of chronic disease management. Through continuous refinement and implementation, such systems hold the promise of significantly improving patient outcomes and quality of life.

Related work similar to the proposed work has been studied and briefly described in this chapter

Waruna Premachandra et al.(2019) present an article on an Early Warning System for Asthma Patients based on IoT and AI. In today's digital age, technological advancements, particularly those revolving around the Internet of Things (IoT), are revolutionizing how we interact with the world around us. IoT serves as a cornerstone of the modern digital landscape, facilitating connectivity and communication between various devices and systems. This paper delves into the development of an IoT-based early warning system tailored for asthma patients, aiming to enhance their quality of life and mitigate potential health risks

Asthma sufferers, alongside individuals with similar respiratory conditions, often require optimal air quality for respiratory comfort and well-being. The quality of the air we breathe is influenced by numerous factors, including smoke, dust, humidity, oxygen, carbon dioxide, and carbon monoxide concentrations. Recognizing the critical importance of air quality monitoring, the proposed system employs Raspberry Pi-based computing and an array of sensors to measure key air quality parameters.

The system utilizes a Queuing Telemetry Transport (MQTT) server to facilitate seamless message transfers between devices and actuators. Actuators such as the SIM900A GSM Module are integrated into the system to enable timely alerts to be sent to asthma patients and relevant stakeholders. Upon detecting air quality parameters surpassing pre-defined threshold values, the system triggers alerts, prompting asthma patients and other concerned parties to take necessary emergency precautions. By leveraging IoT technology, this early warning system empowers asthma patients with real-time air quality monitoring and proactive risk management capabilities. Through continuous monitoring and alerting, potential asthma triggers can be identified and mitigated swiftly, thereby reducing the likelihood of asthma attacks and enhancing overall health outcomes.

Related work similar to the proposed work has been studied and briefly described in this chapter

A. Raji et al (2017) present an article on a Respiratory monitoring system for asthma patients based on IoT. In the contemporary landscape, respiratory ailments such as sleep apnea, chronic obstructive pulmonary disease (COPD), and asthma afflict a significant portion of the population, particularly impacting elderly individuals and often leading to hospitalization. Managing chronic diseases necessitates regular monitoring of vital signs, fundamental indicators of bodily functions crucial for assessing health status. Among these vital signs, respiratory rate monitoring holds particular importance, especially for patients in critical care settings like Intensive Care Units (ICUs).

This paper introduces a respiratory rate monitoring system designed to continuously assess patients' respiration rates using an LM35 temperature sensor. By measuring the temperature variance between inhaled and exhaled air, the system calculates the respiratory rate, providing real-time data on patients' breathing patterns. Utilizing NRF24L01 for wireless transmission, sensor data is relayed from the patient's home to a medical center, where it is published on a web server via Ethernet connectivity. This enables healthcare professionals to remotely monitor patients' respiratory statuses and make informed decisions about their care.

In addition to remote monitoring, the system features a Liquid Crystal Display (LCD) for local display of vital sign data. Furthermore, it incorporates alarm functionalities triggered when respiratory rate thresholds are exceeded, promptly notifying medical personnel of potential respiratory distress. These alerts are also propagated to a dedicated webpage, ensuring timely awareness of patients' conditions.

Moreover, leveraging data mining techniques enhances self-awareness of health conditions for individuals, allowing them to monitor their respiratory health independently of medical professionals. This integration of technology not only facilitates early detection of respiratory abnormalities but also empowers individuals to proactively manage their health.

Related work similar to the proposed work has been studied and briefly described in this chapter

Sreeja Gundu. (2020) presents an article on A Novel IoT based Solution for Monitoring and Alerting Bronchial Asthma Patients. Asthma is a prevalent respiratory condition affecting individuals of all ages worldwide. It is characterized by inflammation and swelling of the airways, leading to breathing difficulties, coughing, and wheezing. In severe cases, asthma can necessitate nebulization for relief. Symptoms such as wheezing, coughing, and shortness of breath signify an asthma attack, highlighting the urgent need for effective management strategies.

In response to this need, IoT-based electronic devices have been developed to detect asthma triggers and provide timely alerts to patients. The proposed device not only identifies triggers in the surrounding environment but also advises the patient on the appropriate dosage of inhaler medication. By continuously monitoring atmospheric parameters that could exacerbate asthma symptoms, such as air quality and allergen levels, the device offers real-time insights to patients, enabling them to take proactive measures to safeguard their health.

Moreover, the device goes beyond mere detection by issuing alerts prompting patients to relocate to a safer environment when potentially harmful conditions are detected. This proactive approach not only helps prevent asthma attacks but also reduces the risk of severe illness and complications.

In essence, the proposed IoT-based electronic device represents a significant advancement in asthma management, offering personalized monitoring and intervention capabilities to enhance patient well-being and quality of life. By leveraging technology to detect triggers and provide timely alerts, the device empowers individuals with asthma to better manage their condition and minimize health risks associated with environmental factors.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

- Natural disasters have become a major concern throughout the world especially for the developing countries.
- The commercial meters available in the market are Fluke CO-220 carbon monoxide meter for CO, Amprobe CO2 meter for CO2, Forbix Semicon LPG gas leakage sensor alarm for LPG leakage detection.
- The researchers in this field have proposed various air quality monitoring systems based on WSN, GSM and GIS. Now each technology has limited uses according to the intended function, as Zigbee is meant for users with Zigbee trans-receiver, Bluetooth

3.1.1 Disadvantages

- Lack of communication
- No Alert System

3.2 BLOCK DIAGRAM PROPOSED SYSTEM

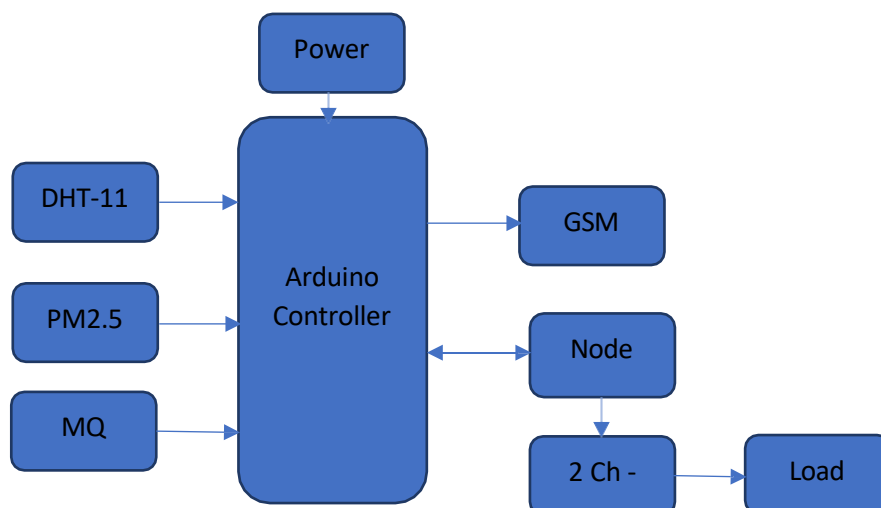


Fig:3.1: Block Diagram Proposed System

3.2.1 Objective of work

- Design and implement an integrated air quality monitoring system using air quality sensors, GSM communication.
- IoT technology to continuously assess air quality in real-time and optimize energy consumption in buildings.
- To enhance air quality monitoring, ensure occupant safety, optimize energy consumption, and contribute to a sustainable and healthy indoor and outdoor environment.

3.2.2 Scope of work

- Develop an IoT-based air quality monitoring system using Arduino and Integrate GSM connectivity for real-time data transmission and alerts.
- IoT-based energy management is continually expanding as technology evolves and organizations seek to reduce energy costs, minimize environmental impact, and improve energy sustainability.
- Create a user-friendly interface for monitoring air quality remotely.

3.2.3 Novelty of work

- Advanced Sensor Integration: Use state-of-the-art sensors for monitoring indoor air quality (IAQ) and outdoor air quality (OAQ). This might include sensors for pollutants like PM2.5, MQ Sensors. Additionally, consider integrating environmental sensors for factors like temperature, humidity.
- Develop a user-friendly web application that provides real-time air quality information, and iot based energy consumption device control with gsm alert system for pollution warning using Arduino.

3.3 MQ135 AND DHT11

Air quality sensor for detecting a wide range of gases, including NH₃, NO_x, alcohol, benzene, smoke and CO₂. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application.



Fig:3.2: MQ135 and DHT11

3.3.1 Features

- High Sensitivity
- High sensitivity to Ammonia, Sulfide and Benze
- Stable and Long Life
- Detection Range: 10 - 300 ppm NH₃, 10 - 1000 ppm Benzene, 10 - 300 Alcohol
- Heater Voltage: 5.0V
- Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High
- Long life and low cost

3.3.2 Applications

- Domestic air pollution detector
- Industrial air pollution detector
- Portable air pollution detector

3.3.3 Sensor and Module

When it comes to measuring or detecting a particular Gas, the MQ series Gas sensors are the most inexpensive and commonly used ones. MQ135 is available as a module or as just the sensor alone. If you are trying to only detect (not measuring PPM) the presence of a gas, then you can buy it as a module since it comes with an op-amp comparator and a digital output pin. But if you planning to measure the PPM of a gas it is recommend buying the sensor alone without module.

3.3.4 MQ-135 Gas sensor

The MQ-135 Gas sensors are used in air quality control equipment's and are suitable for detecting or measuring of NH₃, NO_x, Alcohol, Benzene, Smoke, CO₂. The MQ-135 sensor module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. If you need to measure the gases in PPM, the analog pin need to be used. The analog pin is TTL driven and works on 5V and so can be used with most common microcontrollers.

If you are looking for a sensor to detect or measure common air quality gases such as CO₂, Smoke, NH₃, NO_x, Alcohol, Benzene then this sensor might be the right choice for you.

MQ-135 Sensors to detect gases

You can either use the digital pin or the analog pin to do this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre-heating time (mentioned in features above) before you can actually work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V).

You can also use the analog pin to achieve the same thing. Read the analog values (0-5V) using a microcontroller, this value will be directly proportional to the concentration of the gas to which the sensor detects. You can experiment with this values and check how the sensor reacts to different concentration of gas and develop your program accordingly.

MQ-135 gas sensor applies SnO₂ which has a higher resistance in the clear air as a gas-sensing material. When there is an increase in polluting gases, the resistance of the gas sensor decreases along with that.

3.4 DHT11 SENSOR

Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc... Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc... to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

3.4.1 Working Principle

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in

the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.

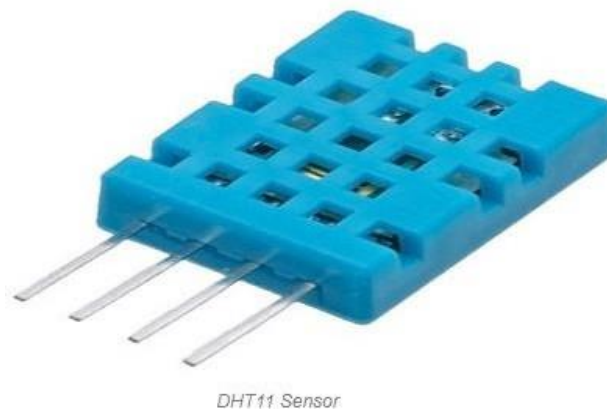


Fig:3.3: DHT11 Sensor

DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller.

3.4.2 Applications

This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by

humidity. Offices, cars, museums, greenhouses and industries use this sensor for measuring humidity values and as a safety measure.

3.5 GSM MODEM

GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL-Modem is SIM900 Quad-band GSM /GPRS device, works on frequencies 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5VDC TTL interfacing circuitry, which allows User to directly interface with 5V Microcontrollers (PIC, AVR, Arduino, 8051, etc.) as well as 3V3 Microcontrollers (ARM, ARM Cortex XX, etc.). The baud rate can be configurable from 9600-115200 bps through AT(Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable User to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface

3.5.1 Features

- Quad Band GSM/GPRS : 850 / 900 / 1800 / 1900 MHz
- Built in SIM (Subscriber Identity Module) Card holder
- Built in Network Status LED
- Inbuilt Powerful TCP/ IP(Transfer Control Protocol / Internet Protocol) stack for internet data transfer through GPRS (General Packet Radio Service)
- Audio Interface Connectors (Audio in and Audio out)
- Most Status and Controlling pins are available
- Normal Operation Temperature : -20 °C to +55 °C
- Input Voltage : 5V to 12VDC
- LDB9 connector (Serial Port) provided for easy interfacing

3.5.2 Hardware Description

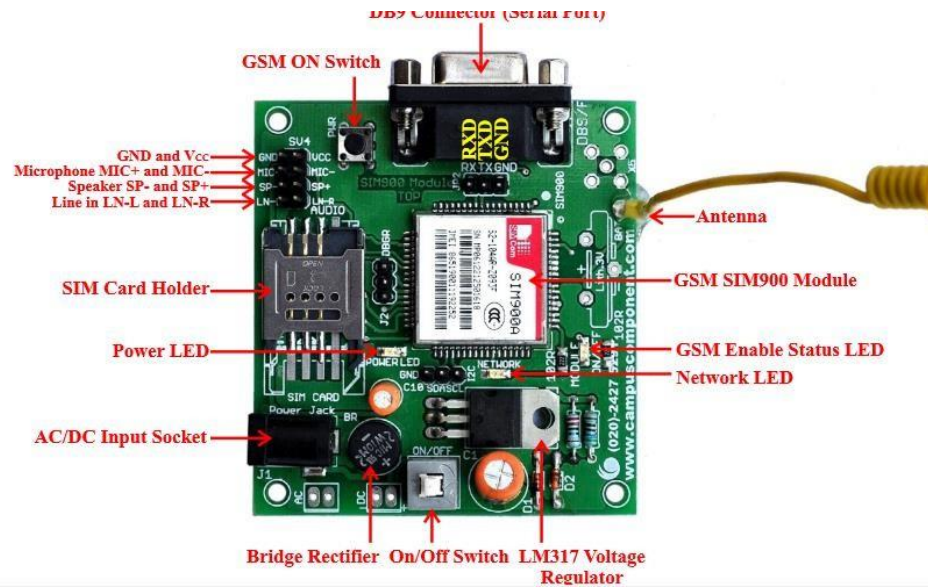


Fig:3.4: GSM Hardware Description

3.5.3 SIMCom SIM900AGSM Module

This is actual SIM900 GSM module which is manufactured by SIMCom. Designed for global market, SIM900 is a quad-band GSM/GPRS engine that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz.



Fig 3.5 SIMCom SIM900AGSM Module

3.5.4 Max232 Ic

The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits, so that devices works on TTL logic can share the data with devices connected through Serial port (DB9 Connector).

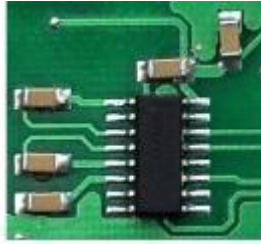


Fig:3.6: MAX232 IC

3.5.5 Serial port / DB9 connector

User just needs to attach RS232 cable here so that it can be connected to devices which has Serial port / DB9 Connector



Fig:3.7: Serial port / DB9 Connector

- Pin 1 : DCD (Data Carrier Detect)**
- Pin 2 : RxD (Receive Data)**
- Pin 3 : TxD (Transmit Data)**
- Pin 4 : DTR (Data Terminal Ready)**
- Pin 5 : Signal Ground (SG)**
- Pin 6 : Data Set Ready (DSR)**
- Pin 7 : Request To Send (RTS)**
- Pin 8 : Clear To Send (CTS)**
- Pin 9 : Ring Indicator (RI)**

3.5.6 Power Supply Socket

This power supply socket which actually named as AC/DC Socket provides the functionality to user to connect external power supply from Transformer, Battery or Adapter through DC jack. User can provide maximum of 12VAC/DC power supply through AC/DC socket.

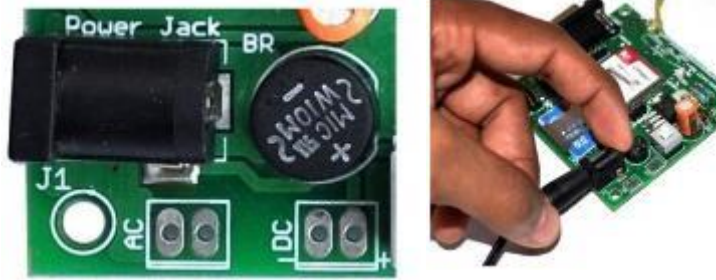


Fig:3.8: Power supply socket

3.5.7 Power On/Off and GSM On Switch

Power On/Off switch is type of push-on push-off DPDT switch which is used for only make power supply on/off provided through AC/DC Socket indicated by 'Power LED'. GSM On Switch is type of Push on DPST tactile switch which is used for only to make GSM module 'On 'indicated by 'Module On/Off LED' while initiating with Network indicated by 'Network Indication LED'

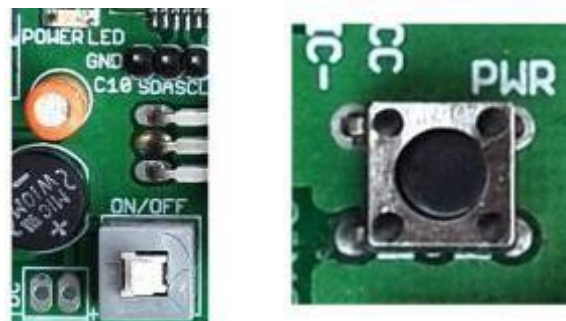


Fig:3.9: power on/off and GSM switch

3.5 8 SIM (Subscriber Identity Module) Card Slot

This onboard SIM card slot provide User functionality of insert a SIM (GSM only) card of any service provider. Process of inserting and locking SIM card into SIM card slot is given in this manual. While inserting in and removing out SIM card from SIM card slot, User needs to take precaution that power supply should be OFF so that after making Power supply ON it will be easy to reinitialize with SIM for this module.



Fig:3.10: SIM card slot

3.5.9 RXD, TXD and GND pins (JP2)

These pins are used to connect devices which needs to be connected to GSM module through USART communication. Devices may be like Desktop or Laptop Computer System, Microcontrollers, etc. RXD (Receive Data) should be connected to TXD (Transmit Data) of other device and viceversa, whereas GND (Ground) should be connected to other device's GND pin to make ground common for both systems



Fig:3.11: RXD ,TXD AND GND pins

3.5.10 Inserting SIM card into SIM card Slot/Holder

Here is the process how to insert SIM card into SIM card slot. User just need to unlock SIM card cover by sliding back. Then user need to open this cover and insert SIM card according to slot. Put down cover on SIM card and then lock by sliding forward.

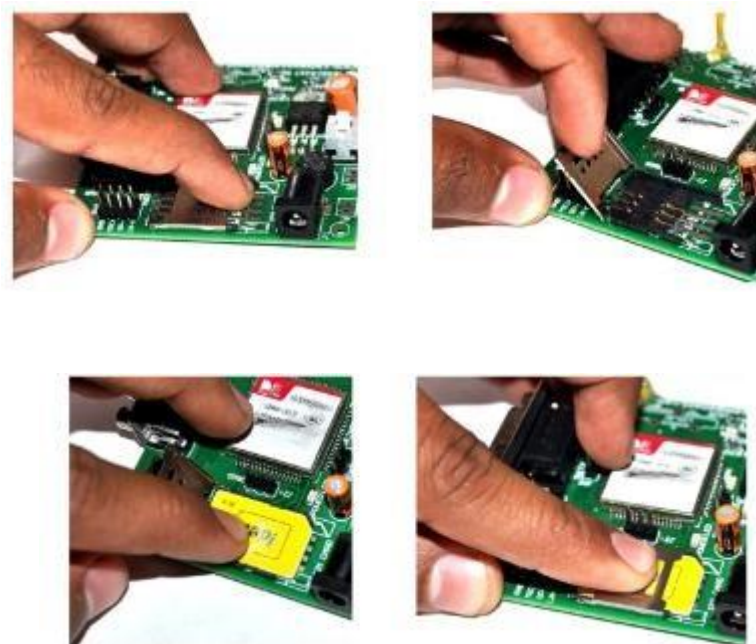


Fig: 3.12: SIM card inserting

3.6 POWER SUPPLY

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:

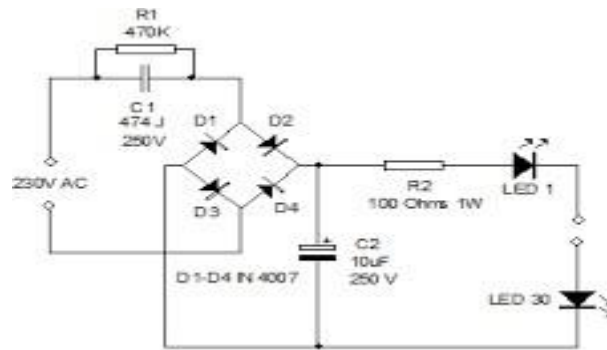


Fig: 3.13: Power supply

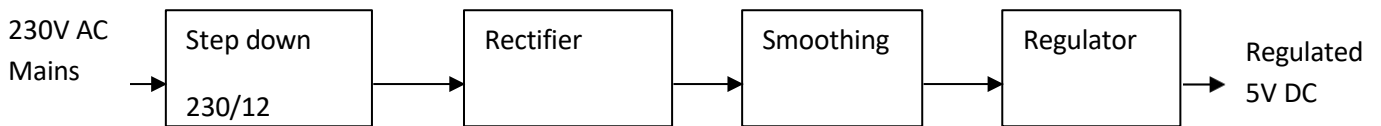


Fig: 3.14: Block diagram

Each of the blocks is described in more detail below:

- 230V-12V Adaptor - steps down high voltage AC mains to low voltage AC
- Rectifier - converts AC to DC, but the DC output is varying.
- Smoothing - smooth's the DC from varying greatly to a small ripple.
- Regulator - eliminates ripple by setting DC output to a fixed voltage

3.6.1 Transformer

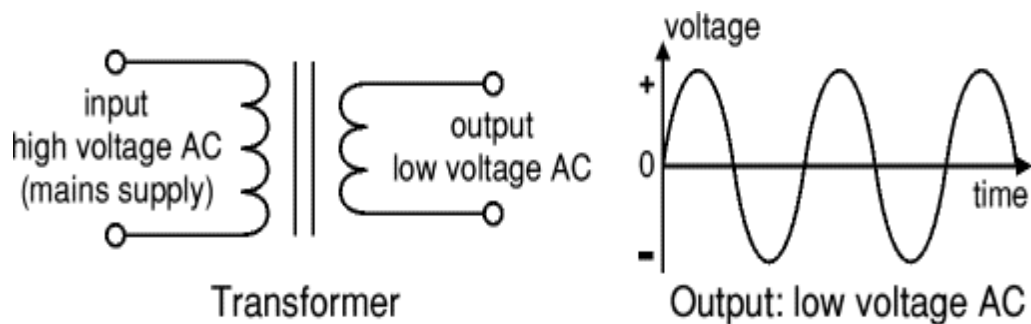


Fig:3.15: Transformer

The low voltage AC output is suitable for lamps, heaters and special AC motors. It is not suitable for electronic circuits unless they include a rectifier and a smoothing capacitor. The varying DC output is suitable for lamps, heaters and standard motors. It is not suitable for electronic circuits unless they include a smoothing capacitor. The smooth DC output has a small ripple. It is suitable for most electronic circuits. The output is very smooth with no ripple. It is suitable for all electronic circuits. Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in UK) to a safer low voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core.

3.7 ARDUINO

Arduino ATMEGA-328 microcontroller consist of 14 input and output analog and digital pins (from this 6 pins are considered to be a PWM pins), 6 analog inputs and remaining digital inputs. Power jack cable is used to connect arduino board with the computer. Externally battery is connected with the arduino microcontroller for the power supply. Arduino is an open source microcontroller from which there is no feedback present in the microcontroller. This arduino board consist of I2C bus that can be able to transfer the data from arduino board to the output devices. These arduino boards are programmed over RS232 serial interface connections with ATmega arduino microcontrollers. The operating volt ranges from 5v. The input voltage recommended for arduino microcontroller is from 7v and the maximum of 12v. The DC input current given to the arduino board is in the range of 40mA.

It consists of different types of memories such as flash memory, EEPROM, SRAM. The length of the arduino board is nearly about 68.64mm and the width of the microcontroller is about 53.4mm. The weight of the arduino microcontroller is about 20g. We can use various types of microcontroller such as 8 bit AVR Atmel microcontroller and 32 bit Atmel arm microprocessor. From these different kinds of

processors, we can use those processors for various engineering projects as well as industrial applications. Some of the examples of using the arduino in the industrial applications are controlling the actuators and sensors. Some of the examples of arduino microcontrollers are Arduino Duemilanove, Arduino UNO, Arduino Leonardo, Arduino Mega, and Arduino MEGA 2560 R3, Arduino MEGA 2560 R3, Arduino Nano, Arduino Due, LilyPad Arduino, micro arduino. We have already mentioned, arduino has been programmed by using c and c++ programming language. These c and c++ are high level languages. Normally it has 18 number of input and output pins. Among those 6 pins are considered to be an analog inputs. From these analog inputs, we can be able to work the arduino microcontroller using analog inputs supply. Normally analog inputs can be in the range of 0-5V. Similar to that digital inputs are present in the microcontroller which can act the use of microcontroller using digital inputs. Digital inputs can be in the range of 5V.

3.7.1 Pin diagram

ATMEGA 328 microcontroller, which acts as a processor for the arduino board. Nearly it consists of 28 pins. From these 28 pins, the inputs can be controlled by transmitting and receiving the inputs to the external device. It also consists of pulse width modulation (PWM). These PWM are used to transmit the entire signal in a pulse modulation. Input power supply such as Vcc and Gnd are used. These IC mainly consists of analog and digital inputs. These analog and digital inputs are used for the process of certain applications.

The power pins are as follows:

- VIN: The input voltage to the Arduino board when it's 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: The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- 3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

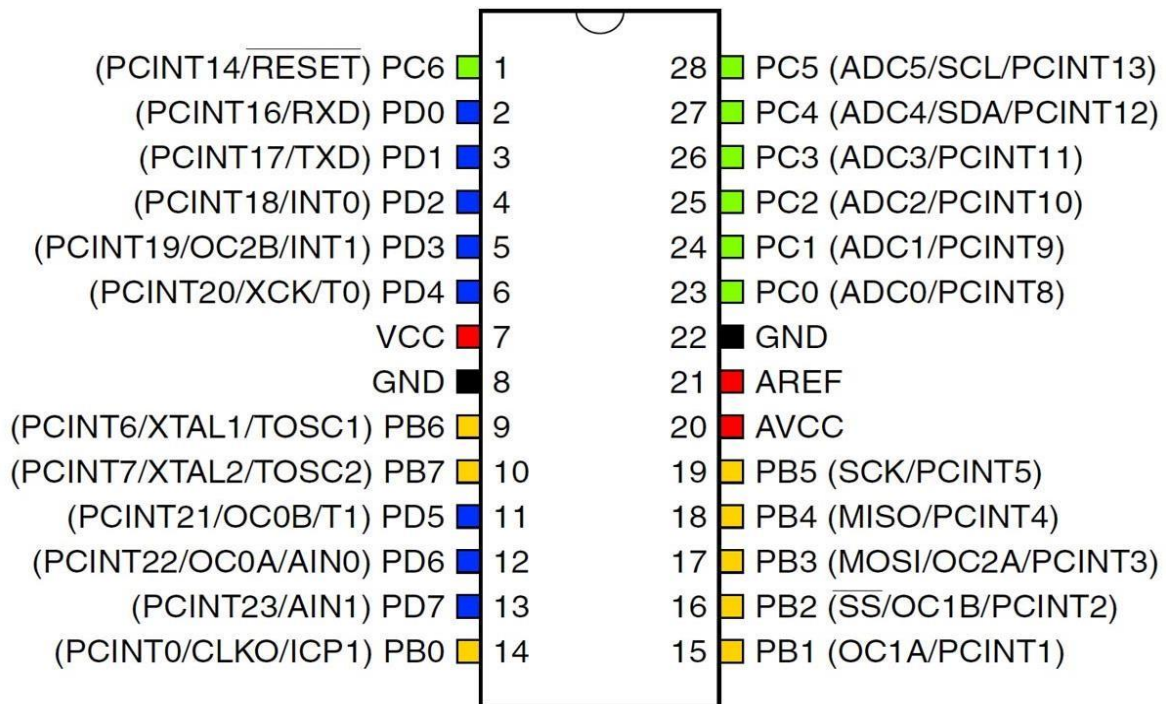


Fig: 3.15: Pin diagram

Each of the 14 digital pins on the Uno can be used as an input or output, using `pinMode()`, `digitalWrite()`, and `digitalRead()` functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- **Serial:** 0 (RX) and 1 (TX): Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts:** 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the `attachInterrupt()` function for details.
- **PWM:** 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the `analogWrite()` function.
- **SPI:** 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- 2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.
- AREF. Reference voltage for the analog inputs. Used with analog Reference.
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

3.7.2 Analog Input

Arduino atmega-328 microcontroller board consist of 6 analog inputs pins. These analog inputs can be named from A0 to A5. From these 6 analog inputs pins, we can do the process by using analog inputs. Analog inputs can be used in the operating range of 0 to 5V. Analog signal is considered as the continuous time signal, from which these analog signal can be used for certain applications. These are also called as non-discrete time signal. Inputs such as voltage, current etc., are considered to be either analog signal or digital signal only by analyzing the time signal properties. Various applications of arduino microcontroller can use only an analog input instead of digital inputs. For these applications, analog input ports or pins can be used.

3.7.3 Digital Input

Digital inputs can be defined as the non-continuous time signal with discrete input pulses. It can be represented as 0's and 1's. These digital inputs can be either on state or in off state. Arduino atmega328 microcontroller also consists of 12 digital input pins. It can be stated as D0 to D11. Nearly 12 inputs can be used for digital input/output applications. The working of the digital input ports is where the discrete input pulses can be triggered and supplied to the ports. These ports receive the input and therefore the port can be used for both input and output process. These digital pins can access only the digital inputs.

3.7.4 Power Jack Cable / USB PORT

This Arduino atmega-328 microcontroller can be interfaced with the other electronic devices such as computer by using USB port or power jack cable from these power jack cable, we can upload the program of Arduino for their applications. At first, the program can be initialized or can be edited by using Arduino software tools. Then these programs can be transferred through arduino microcontroller board by using USB cable or power jack cable.

3.7.5 Power Supply

There is an additional power supply source present in Arduino microcontroller. Power supply port is present at the corner of the arduino microcontroller. Either we can use this power supply port by connecting with external power supply.(i.e., ac power supply), or by connecting an dc power supply through input pins. These power supplies produce an active form to the arduino microcontroller. These arduino microcontrollers can accept a range of power supply. When the power supply voltage range exceeds, the microcontroller gets damaged. Hence, only the particular range of power supply should be given to the arduino microcontroller.

3.7.6 Architecture Diagram

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega48PA/88PA/168PA/328P provides the following features: 4/8/16/32K bytes of In System Programmable Flash with Read-While-Write capabilities, 256/512/512/1K bytes EEPROM, 512/1K/1K/2K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning.

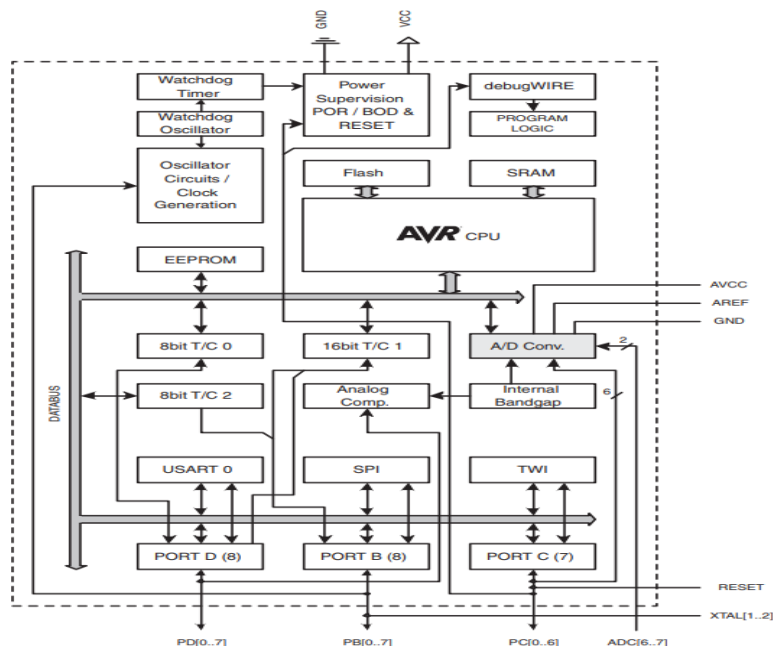


Fig: 3.16: Architecture Diagram

The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on monolithic chip, the Atmel ATmega48PA/88PA/168PA/328P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an *.inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. To use the SPI communication, please see the ATmega328 datasheet.

3.8 NODE MCU ESP8266 (IOT)

Node MCU is an open source IoT stage. It incorporates firmware which keeps running on the ESP8266 Wi-Fi SoC from Expressive Systems, and equipment which depends on the ESP-12 module. The term NodeMCU typically refers to the firmware, whereas the board is termed Devkit. NodeMCU Devkit 1.0 consists of associate ESP-12E on a board that facilitates its use. It additionally contains a transformer, a USB interface. The expression "NodeMCU" of course alludes to the firmware as opposed to the improvement units. The firmware utilizes the Lua scripting dialect

The NodeMCU (Node Micro Controller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266 is designed and manufactured by Express, contains all crucial elements of the modern computer: CPU, RAM, networking (wi-fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only \$2 USD a piece. That makes it an excellent choice for this system design. The NodeMCU aims to simplify ESP8266 development. It has two key components.

- i. An open source ESP8266 firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming

environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn. And to add on NodeMCU can be programmed with the Android IDE too.

- ii. A development kit board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. Figure 2 below shows the NodeMCU development board.



Fig: 3.17: Node MCU ESP8266 (IoT)

There are various platforms for IoT system one of them is NodeMCU. It provides lower level control on devices which is known as firmware. These control runs on ESP8266 Wi-Fi SoC, which hardware is based on ESP-12 module. Esp8266 is a Wi-Fi based communication system's microchip. It uses TCP/IP protocol for communicating with internet through router. It uses 802.11b/g/n slandered technology for Wi-Fi communication. It is a Tensilica L106 32-bit RISC instruction unite microprocessor with 32 KB instruction RAM, 32KB instruction Cache RAM, 80KB Data memory.ESP8266 (Pin) and Arduino Mega's (Pin) common pins are GND TX (0)-3.3V, RX (0), 3.3V. For running the ESP8266 on Arduino platform we need to install ESP8266 package in Arduino IDE. As a board is using, we need to give the additional board manager.

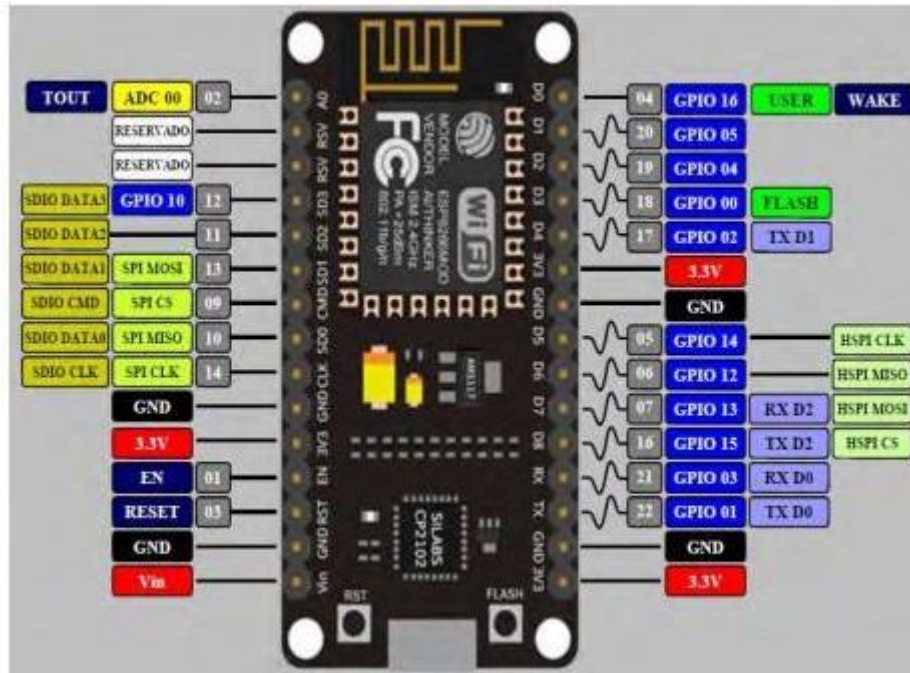


Fig: 3.18: Node MCU ESP8266 (IoT) Pin Diagram

As shown in Fig it has 12 GPIO pins. One ADC pin. For this project 7 GPIO pins have been used. They are D0 to D6 which delivers digital outputs.

3.9 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.

3.9.1 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 right-hand 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 | Sketchbook menu instead.

Save: Saves your sketch.

Serial Monitor: Opens the serial monitor.

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

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.

3.10 PROTEUS DESIGN

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

3.10.1 Product Modules

The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for

microcontroller simulation. All PCB Design products include an auto router and basic mixed mode SPICE simulation capabilities.

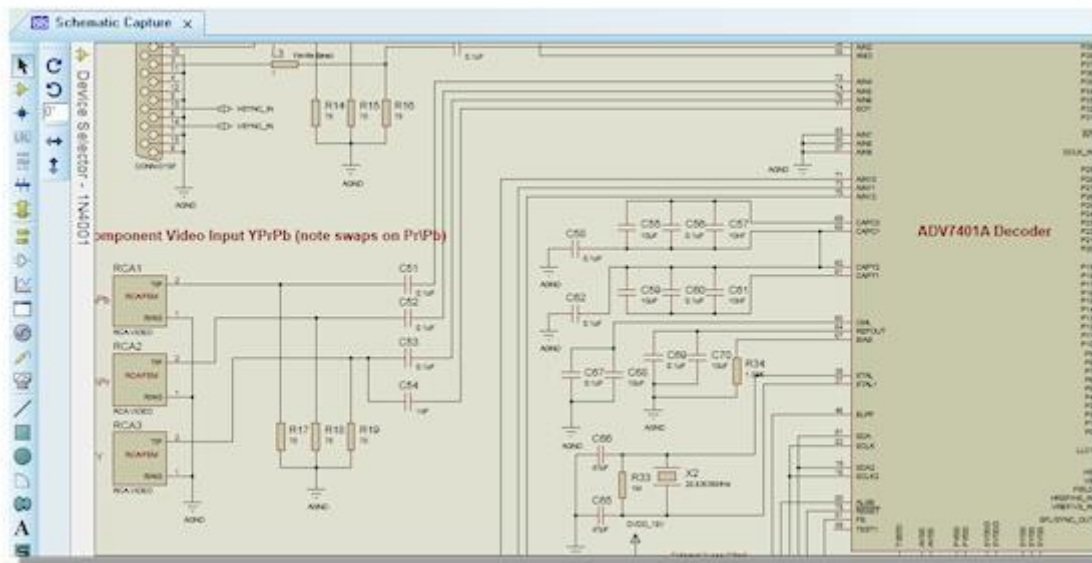


Fig: 3.19: Product Modules

3.10.2 Schematic Capture

Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations.

3.10.3 Microcontroller Simulation

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control,[2][3] temperature control [4][5] and user interface design.[6] It also finds use in the general hobbyist community[7][8] and, since no hardware is required, is convenient to use as a training[9][10] or teaching tool.[11][12] Support is available for co-simulation of:

Microchip Technologies PIC10, PIC12, PIC16, PIC18, PIC24, dsPIC33 Microcontrollers.

Atmel AVR (and Arduino), 8051 and ARM Cortex-M3 Microcontrollers

NXP 8051, ARM7, ARM Cortex-M0 and ARM Cortex-M3 Microcontrollers.

Texas Instruments MSP430, PICCOLO DSP and ARM Cortex-M3 Microcontrollers.

Parallax Basic Stamp, Free scale HC11, 8086 Microcontrollers.

3.10.4 PCB Design

The PCB Layout module is automatically given connectivity information in the form of a net list from the schematic capture module. It applies this information, together with the user specified design rules and various design automation tools, to assist with error free board design. PCB's of up to 16 copper layers can be produced with design size limited by product configuration.

3.10.5 3D Verification

The 3D Viewer module allows the board under development to be viewed in 3D together with a semi-transparent height plane that represents the board's enclosure. STEP output can then be used to transfer to mechanical CAD software such as Solid works or Autodesk for accurate mounting and positioning of the board.

3.11 EMBEDDED C

Embedded C is a set of language extensions for the C Programming the C standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed point arithmetic, multiple distinct memory banks and basic input output operations. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing. Embedded C use most of the syntax and semantics of standard C, e.g., main () function, variable definition, data type declaration, conditional statements (if, switch. case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, unions, etc.

3.11.1 Introduction to embedded c

Looking around, we find ourselves to be surrounded by various types of embedded systems. Be it a digital camera or a mobile phone or a washing machine, all of them has some kind of processor functioning inside it. Associated with each processor is the embedded software. If hardware forms the body of an embedded system, embedded processor acts as the brain, and embedded software forms its soul. It is the embedded software which primarily governs the functioning of embedded systems. During infancy years of microprocessor based systems, programs were developed using assemblers and fused into the EPROMs. There used to be no mechanism to find what the program was doing. LEDs, switches, etc. were used to check correct execution of the program. Some 'very fortunate' developers had In-circuit Simulators (ICEs), but they were too costly and were not quite reliable as well.

As time progressed, use of microprocessor-specific assembly-only as the programming language reduced and embedded systems moved onto C as the embedded programming language of choice. C is the most widely used programming language for embedded processors/controllers. Assembly is also used but mainly to implement those portions of the code where very high timing accuracy, code size efficiency, eltc. are prime requirements.

Initially C was developed by Kernighan and Ritchie to fit into the space of 8K and to write (portable) operating systems. Originally it was implemented on UNIX operating systems. As it was intended for operating systems development, it can manipulate memory addresses. Also, it allowed programmers to write very compact codes. This has given it the reputation as the language of choice for hackers too.

3.11.2 Embedded systems programming

Embedded systems programming is different from developing applications on a desktop computers. Key characteristics of an embedded system, when compared to PCs, are as follows:

- Embedded devices have resource constraints (limited ROM, limited RAM, limited stack space, less processing power)
- Components used in embedded system and PCs are different; embedded systems typically use smaller, less power consuming components.
- Embedded systems are more tied to the hardware.

Two salient features of Embedded Programming are code speed and code size. Code speed is governed by the processing power, timing constraints, whereas code size is governed by available program memory and use of programming language. Goal of embedded system programming is to get maximum features in minimum space and minimum time.

Embedded systems are programmed using different type of languages:

- Machine Code
- Low level language, i.e., assembly
- High level language like C, C++, Java, Ada, etc.
- Application level language like Visual Basic, scripts, Access, etc.

Assembly language maps mnemonic words with the binary machine codes that the processor uses to code the instructions. Assembly language seems to be an obvious choice for programming embedded devices. However, use of assembly language is restricted to developing efficient codes in terms of size and speed. Also, assembly codes lead to higher software development costs and code portability is not there. Developing small codes are not much of a problem, but large programs/projects become increasingly difficult to manage in assembly language. Finding good assembly programmers has also become difficult nowadays. Hence high level languages are preferred for embedded systems programming.

3.11.3 Use of c in embedded systems

- It is small and reasonably simpler to learn, understand, program and debug.
- C Compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers.
- Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/ microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems.
- As C combines functionality of assembly language and features of high level languages, C is treated as a 'middle-level computer language' or 'high level assembly language'
- It is fairly efficient
- It supports access to I/O and provides ease of management of large embedded projects.

Many of these advantages are offered by other languages also, but what sets C apart from others like Pascal, FORTRAN, etc. is the fact that it is a middle level language; it provides direct hardware control without sacrificing benefits of high level languages. Compared to other high level languages, C offers more flexibility because C is relatively small, structured language; it supports low-level bit-wise data manipulation. Compared to assembly language, C Code written is more reliable and scalable, more portable between different platforms (with some changes). It is easier to write good code in C & convert it to an efficient assembly code rather than writing an efficient code in assembly itself. Benefits of assembly language programming over C are negligible when we compare the ease with which C programs are developed by programmers.

CHAPTER 4

RESULTS AND DISCUSSIONS

The Alert System for Asthma-triggering Allergens Model encompasses a sophisticated array of sensors, including two MQ135 sensors, a DHT11 sensor, and a Dust Sensor, each calibrated to detect critical levels of carbon dioxide, ammonia, humidity, temperature, and airborne particulate matter. Upon surpassing predefined thresholds, these sensors emit signals triggering the Arduino microcontroller, thereby initiating a cascade of responses tailored to mitigate risks and ensure timely intervention.

The orchestration of this system yields three distinct outputs, each designed to address specific exigencies with precision and efficacy:

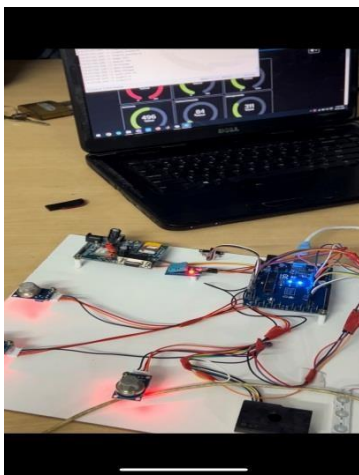


Fig:4.1: Working Model



Fig 4.2: Values from App

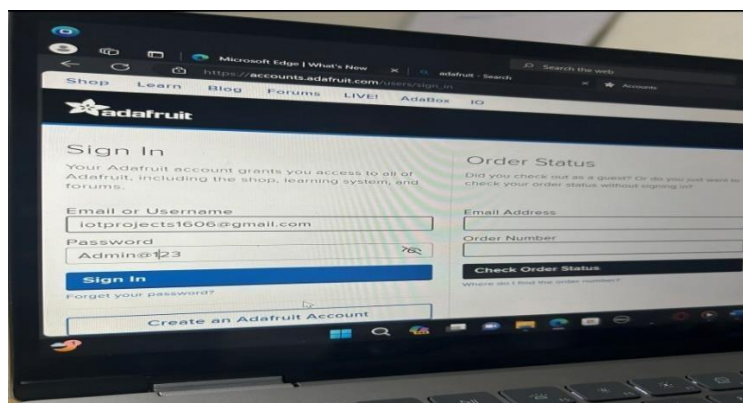


Fig:4.3:User Login

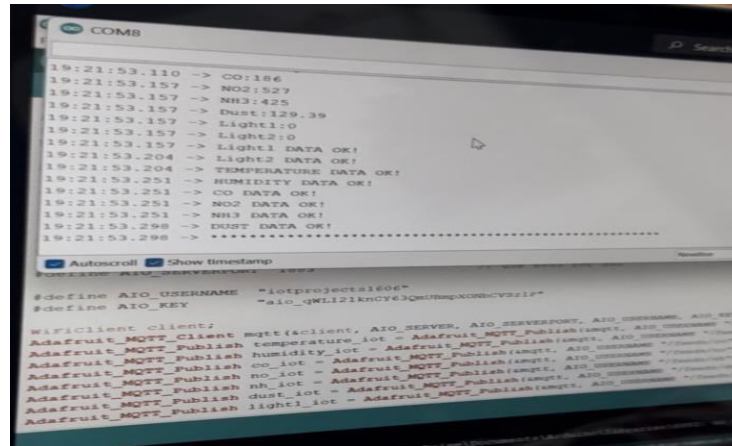


Fig: 4.4: Arduino Ide algorithm

1. **GSM Alert Mechanism:** Integrated within the system is a GSM module equipped with a SIM card, enabling the transmission of alert messages to designated mobile phone numbers. This communication conduit serves as a vital lifeline, swiftly notifying caregivers or relevant authorities of emergent conditions, thus facilitating prompt intervention and amelioration of potential health hazards.
2. **Relay and LED Indicators:** Central to the system's functionality are dual-purpose LED indicators, strategically positioned to provide visual cues in response to detected anomalies. In instances of heightened urgency, patients can activate a designated light source within their vicinity, thereby alerting caregivers or support personnel to the emergent situation. Subsequently, caregivers are prompted to activate a corresponding indicator, signaling acknowledgment and mobilization of assistance, thus fostering a streamlined and coordinated response mechanism.
3. **ESP8266 Data Management:** Complementing the real-time alerting mechanisms is the integration of an ESP8266 Wi-Fi module, tasked with aggregating and storing sensor data within a cloud-based repository. This feature affords longitudinal insights into environmental trends and facilitates retrospective analysis, empowering stakeholders with actionable intelligence for proactive decision-making and refinement of preventive measures.

By harnessing the synergistic capabilities of advanced sensor technologies and communication protocols, the Alert System for Asthma-triggering Allergens Model

exemplifies a paradigm shift in personalized healthcare management and environmental monitoring. Its robust architecture, fortified by redundant fail-safes and comprehensive data handling mechanisms, epitomizes a proactive approach to mitigating health risks and safeguarding vulnerable populations against the deleterious effects of air pollution and allergen exposure.

CHAPTER 5

CONCLUSION

The integration of an air quality monitoring project featuring an alert system utilizing GSM and Arduino IoT technology represents a pivotal stride towards enhancing environmental surveillance and fostering public health awareness. This undertaking necessitates meticulous strategizing encompassing sensor optimization, data analytics, and intuitive interface development to maximize its efficacy and accessibility. Moreover, it is imperative to contemplate the prospects for scalability and enduring maintenance protocols, thereby fortifying the project's longevity and impact in the ever-evolving landscape of environmental stewardship and technological.

The amalgamation of cutting-edge IoT capabilities with real-time data dissemination not only augments the precision of environmental monitoring but also empowers communities with actionable insights into air quality dynamics. By leveraging GSM connectivity and Arduino's versatile framework, this initiative holds the promise of democratizing access to crucial environmental data, thereby engendering informed decision-making and proactive engagement with air quality management.

Furthermore, the project's success hinges upon a multifaceted approach encompassing not only technological proficiency but also interdisciplinary collaboration and stakeholder engagement. Incorporating diverse perspectives from environmental science, engineering, and public health domains ensures the project's alignment with prevailing environmental standards and public health imperatives, thereby amplifying its societal relevance and utility.

Additionally, cognizance of the project's potential scalability underscores its capacity to transcend localized applications and catalyze broader systemic transformations in environmental monitoring infrastructure. By delineating robust scalability frameworks and fostering partnerships with relevant stakeholders, the project can transcend geographical confines and catalyze a paradigm shift towards ubiquitous environmental surveillance networks.

In essence, the envisioned air quality monitoring project epitomizes the synergy between technological innovation and environmental stewardship, heralding a new era of participatory environmental monitoring and public health advocacy. Through concerted efforts in planning, implementation, and sustainability, this initiative has the potential to catalyze tangible advancements in air quality management, thereby safeguarding human health and environmental integrity for generations to come.

5.1 IEEE STANDARDS

Creating an alert system for allergens triggering asthma attacks involves adherence to several IEEE standards to ensure its effectiveness and reliability. One key standard to consider is IEEE 802.15.4, which addresses low-rate wireless personal area networks (LR-WPANs) suitable for short-range communication. This standard could be utilized for the wireless transmission of allergen detection data to a centralized monitoring system.

Additionally, IEEE 11073 defines standards for health informatics, including protocols for the exchange of health-related information between medical devices and information systems. Integration of these protocols could facilitate communication between the allergen detection sensors and healthcare providers, enabling timely intervention in the event of an asthma trigger.

Moreover, IEEE 2410 provides guidelines for designing wearable devices for healthcare applications. Compliance with this standard can ensure that wearable allergen detection devices are ergonomic, comfortable, and capable of accurately detecting asthma triggers in real-time.

By incorporating these IEEE standards into the design and implementation of the alert system, it can effectively mitigate the risk of asthma attacks triggered by allergens and provide timely alerts to individuals with asthma and their healthcare providers.

5.2 TRADE-OFFS

When designing an alert system for allergens triggering asthma attacks, there are several trade-offs to consider to balance effectiveness, cost, and practicality.

Sensitivity and Specificity: A trade-off exists between the system's sensitivity to detect allergens and its specificity to avoid false alarms. Increasing sensitivity may lead to more accurate detection but could also result in false positives, causing unnecessary alerts and anxiety for users. Finding the right balance is crucial to ensure that genuine asthma triggers are identified without overwhelming users with false alarms.

Cost and Performance: Implementing advanced sensor technologies and communication protocols can enhance the system's performance but may also increase costs. Balancing cost-effectiveness with performance is essential to ensure the system is accessible to a wide range of users, including those with limited financial resources.

Battery life and Sensor accuracy: Power consumption is a critical consideration, especially for wearable or portable alert systems. Opting for high-accuracy sensors may drain the battery more quickly, necessitating frequent recharging or battery replacement. Designing energy-efficient sensor algorithms and optimizing power management can extend battery life without compromising accuracy.

Privacy and Data collection: Collecting and storing data about allergen exposure raises privacy concerns, particularly regarding sensitive health information. Striking a balance between collecting sufficient data for effective alerting and preserving user privacy is essential. Implementing robust encryption protocols and anonymizing data whenever possible can help mitigate privacy risks.

User interface complexity and Ease of use: The user interface plays a crucial role in the system's usability. While a complex interface may offer more customization options and features, it can also be overwhelming for users, especially those with limited technical proficiency. Simplifying the user interface while retaining essential functionality ensures that the system is intuitive and easy to use for individuals of all backgrounds.

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