

**IOT based air quality monitoring system using
machine learning techniques**

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

By

Faizal Rahman S (38130062)

Godwin Sanjay W (38130070)



DEPARTMENT OF ELECTRONICS AND COMMUNICATION

ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY (DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL 2022



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

www.sathyabama.ac.in

DEPARTMENT OF ELECTRONICS AND

COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafede work of FAIZAL RAHMAN S (38130062) and GODWINSANJAY W (38130070) who carried out the project entitled “**IOT based air quality monitoring system using Machine learning techniques**” under our supervision from September 2021 to April 2022.

Internal Guide

DR.K.Srilatha

Assistant Professor,

Department of Electronics and Communication Engineering.

Head of the Department

Dr. T. RAVI, M.E., Ph.D.

Department of Electronics and Communication Engineering.

Submitted for Viva voce examination held on _____

Internal Examiner

External Examiner

DECLARATION

We, FAIZAL RAHMAN S (38030062) and GODWINSANJAY W (38130070) hereby declare that the Project Report entitled “**IOT BASED AIR QUALITY MONITORING SYSTEMS USING MACHINE LEARNING TECHNIQUES**” done by us under the guidance of **DR. SRILATHA K ,M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE:

PLACE:

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

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

We would like to express our sincere and deep sense of gratitude to our Project Guide **Dr. SRILATHA K ,M.E., Ph.D.**

Department of Electronics and Communication Engineering for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of the project work.

We wish to express our 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.

We express our gratitude to our parents for their constant encouragement and support for the completion of the project.

ABSTARCT

The level of air pollution is increasing rapidly due to factors like industries, urbanization, increasing in population, vehicle use which can affect human health. Arduino Based Air Pollution Monitoring System is used to monitor the Air Quality over a web server using Internet. It will trigger an alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases present in the air like CO, smoke, alcohol, benzene, NH₃ and NO_x. It will show the air quality in PPM on the LCD and as well as on webpage so that air pollution can be monitored very easily. A prototype for an Environmental Air Pollution Monitoring System for monitoring the concentrations of major air pollutant gases has been developed. The system uses low cost air-quality monitoring nodes comprises of low cost semiconductor gas sensor with Wi-Fi modules. This system measures concentrations of gases such as CO using semiconductor sensors. The sensors will gather the data of various environmental parameters and provide it to Arduino which act as a base station. Realization of data gathered by sensors is displayed on Arduino based Webserver. These data's are moved to node MCU Through the serial communication to update the data in IOT web page. The device are going to be put in through a mobile application which is able to show the live updates of the environmental pollution level of the industries or remote space The thought of IOT helps to access knowledge from remote locations.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
1.	INTRODUCTION	
	1.1 MOTIVATION	10
	1.2 OBJECTIVE	12
	1.3AIR QUALITY PARAMETERS	13
	1.4 OVERVIEW	15
2.	LITERTATURE SURVEY	
	2.1 SMART DEVICE TO MONITOR WATER QUALITY IN IOT	21
	2.2 IOT BASED AIR POLLUTION MONITORING SYSTEM USING ARDUINO	22
	2.3 REMOTE SOIL MONITORING USING IOT	23
	2.4 AIR AND SOUND MONITORING SYSTEM USING IOT	23
	2.5 AUTOMATIC IRRIGATION SYSTEM ON SENSING SOIL MOISTURE CONTENT	24
	2.6 AN IOT BASED AUTOMATED NOISE AND AIR MONITORING SYSTEM	25

3.	SYSTEM DESIGN	
3.1	EXISTING SYSTEM	29
3.2	PROBLEM STATEMENT	30
3.3	PROPOSED SYSTEM	30
3.4	ADVANTAGE	31
3.5	BLOCK DIAGRAM	32
3.6	FLOW DIAGRAM	33
3.7	HARDWARE AND SOFTWARE REQUIREMENTS	34
4.	HARDWARE REQUIREMENTS	
4.1	ARDUINO UNO AND ITS PROGRAMMING	35
4.1.1	OVERVIEW	36
4.1.2	SUMMARY	37
4.1.3	PIN CONFIGURATION	38
4.1.4	COMMUNICATION	41
4.1.5	ARDUINO SOFTWARE	43
4.2	NODE MCU	49
4.3	NODE MCU ESP8266 SPECIFICATION & FEATURES	53
4.4	METHANE SENSOR	54
4.5	CO GAS SENSOR	58

5.	SENSOR	
	5.1 BACKGROUND	60
	5.2 MOTIVATION	61
	5.3 IOT DEFINITON	62
6.	SOFTWARE REQUIREMENTS	
	6.1 PROTEUS SOFTWARE	63
	6.2 PROTEUS SOFTWARE EXPLANATION	65
	6.3 LANGUAGE FEATURES	65
	6.4 UBIDOTS	69
7.	CONCLUSION	77
8.	REFERENCES	79

CHAPTER 1

INTRODUCTION

Traffic and power generation are the main sources of urban air pollution. The idea that outdoor air pollution can cause exacerbations of pre-existing asthma is supported by an evidence base that has been accumulating for several decades, with several studies suggesting a contribution to new-onset asthma as well. In this Series paper, we discuss the effects of particulate matter (PM), gaseous pollutants (ozone, nitrogen dioxide, and sulphur dioxide), and mixed traffic-related air pollution. We focus on clinical studies, both epidemiological and experimental, published in the previous 5 years. From a mechanistic perspective, air pollutants probably cause oxidative injury to the airways, leading to inflammation, remodelling, and increased risk of sensitisation. Although several pollutants have been linked to new-onset asthma, the strength of the evidence is variable. We also discuss clinical implications, policy issues, and research gaps relevant to air pollution and asthma.

Outdoor air pollution contributed more than 3% of the annual disability-adjusted life years lost in the 2010 Global Burden of Disease comparative risk assessment, a notable increase since the previous estimate was made in 2000. Previous assessments of global disease burden attributed to air pollution were restricted to urban areas or by coarse spatial resolution of concentration estimates.² In a study of Ten European Cities, 14% of the cases of incident asthma in children and 15% of all exacerbations of childhood asthma were attributed to exposure to pollutants related to road traffic.³ Urbanisation is an important contributor to asthma and this contribution might be partly attributed to increased outdoor air pollution because many urban centres in the developing world are undergoing rapid population growth accompanied by increased outdoor air pollution, the global burden of asthma is likely to increase. In this context, it is notable that the populations of China, India, and Southeast Asia are equal to the rest of the world combined.

In view of the burden of asthma attributed to outdoor air pollution, a better understanding of why asthmatic individuals are susceptible to this exposure should enable the design of effective preventive strategies. The idea that air pollution can cause exacerbations of pre-existing asthma is supported by an evidence base that has been accumulating for several decades,^{7–10} but evidence has emerged that suggests air pollution might cause new-onset asthma as well.^{11–21} Not all studies support a causal link between air pollution and asthma, and a recent meta-analysis²² of cross-sectional studies that compared communities with different levels of

pollution showed no effect of long-term exposure to pollution on asthma prevalence. Although outdoor air pollution almost always occurs as a mixture, air quality is regulated by most jurisdictions in terms of its individual components. Such regulation has meant that experimental studies of humans and animals have been focused on individual pollutants. Because epidemiological studies inherently involve exposure to mixtures of pollutants, substantial efforts are usually made to try to identify the individual effects of pollutants, which often obscures the health effect of the mixture as a whole.

1.1 MOTIVATION

Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where airization and growing number of vehicles leads to release of lot of gaseous pollutants. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution 50,000 to 100,000 premature deaths per year occur in the U.S. alone. Whereas in EU number reaches to 300,000 and over 3,000,000 worldwide. IOT Based Air Pollution Monitoring System monitors the Air quality over a web server using Internet and will trigger an alarm when the air quality goes down beyond a certain threshold level, means when there are sufficient amount of harmful gases present in the air like CO₂, smoke, alcohol, benzene, NH₃, LPG and NO_x. It will show the air quality in PPM on the LCD and as well as on webpage so that it can monitor it very easily. LPG sensor is added in this system which is used mostly in houses. The system will show temperature and humidity. The system can be installed anywhere but mostly in industries and houses where gases are mostly to be found and gives an alert message when the system crosses threshold limit.

With increasing attention to traffic-related air pollution (TRAP) as the exposure variable of interest, a shift has occurred away from a focus on individual components of the pollution mixture. In this Series paper, we will attempt to discuss the effects of several gaseous pollutants (ozone, nitrogen dioxide, and sulphur dioxide), the independent effects of various forms of PM, and then focus on the effects of TRAP as a mixture. We concentrate on studies published in the past 5 years that report results relevant to both exacerbation and onset of asthma.

We focus primarily, although not exclusively, on epidemiological and experimental clinical studies. Controlled exposure studies in human beings are restricted by small sample size and

an inability to study the potentially most susceptible subgroups (eg, children and adults with severe asthma) and the effects of chronic exposure. Epidemiological studies are restricted by imprecise methods of both exposure and asthma outcome assessment and often inadequate data about potentially confounding variables.

Although the potential effect of indoor air pollution on asthma is an important concern, especially in developing countries where much domestic cooking is done with solid fuels, it is outside the scope of this review.

Pollution is an important factor affecting the quality of the lives of millions. Most of the pollutants in the air are a result of emissions from vehicles, factories and natural occurrences like volcanic eruptions and forest fires. When people breathe in contaminated air, they are exposed to many health risks, such as cancer, premature death or asthma attacks. In industries, the polluted air is emitted in the atmosphere which in turn increases the temperature causing Global Warming. Also, the machines in the industries produce pollution like Noise pollution, Radiation, etc. the Radiation produced by the industries can cause cancer even for their labors. It is necessary to monitor pollution and keep it under control for a better future and healthy living for all. Due to flexibility and the low- cost Internet of things (IOT) is getting popular day by day. With the urbanization and with the increase in the industries pollution is caused. In this paper, we propose a pollution monitoring and controlling system that allows us to monitor and control pollution in different industries of an area using GSM and IOT. The system uses sensors to sense the presence of pollution in the industries and constantly transmit this data. The sensors interact with Arduino Uno which processes this data and transmits it through GSM. This allows authorities to

Monitor smoke, radiation, temperature and different types of pollution in different industries and act against it. Also, authorities can control the pollution by cutting the power supply of the polluting industry. Hence we can control pollution effectually.

As we probably are aware the mechanical development radically expanding, natural contamination related issues quickly appears . To satisfy the need of thriving observing framework, in our task we are setting up a system called Internet of Things, in which detecting gadgets are associated with remote implanted processing framework. Web of Things is an innovation that connects the sensors with installed framework and enables the information from

these sensors to go over an Internet. We are actualizing creating model which can screens the capriciousness of parameter like Air, Noise, Temperature, Humidity and Light.

Here to make an IOT Based Air Pollution Monitoring System in which we will monitor the Air quality over a web server using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO₂, smoke, alcohol, benzene and NH₃. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily. Previously we have built the LPG detector using MQ6 sensor and Smoke detector using MQ2 sensor but this time we have used MQ135 sensor which is the best choice for monitoring Air Quality as it can detects most harmful gases and can measure their amount accurately. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile. We can install this system anywhere and can also trigger some device when pollution goes beyond some level, like we can switch on the Exhaust fan or can send alert SMS or mail to the user.

1.2 Purpose of this project Air pollution occurs when harmful substances including particulates and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies or death in humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Human activity and natural processes can both generate air pollution.

The terms monitoring and assessment are frequently confused and used synonymously. The process of air quality assessment is an evaluation of the air quality in relation to standard quality set by pollution control board. Due to the complexity of factors determining air quality, large variations are found between different industries. Similarly, the response to air impacts is also highly variable. To design an Air machine control and monitoring system using IOT. Surveillance is most important security systems in home, air, office and public places. To build a robust system that can measure the air pollution and help to reduce it and to decrease human interference in monitoring the air pollution to reduce pollution and provide a healthy environment for the workers to work in. To build a robust system that evaluates the air pollution continuously and indicates when there is an increase in emission and controls it using IOT.

The main objective of IOT Air & Sound Monitoring System is that the Air and sound pollution is a growing issue these days. It is necessary to monitor air quality and keep it under control for a better future and healthy living for all. Due to flexibility and low cost Internet of things (IoT) is getting popular day by day. With the urbanization and with the increase in the vehicles

on road the atmospheric conditions have considerably affected. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be analyzed interpreted and presented. This information can then be applicable in many ways. Analysis of monitoring data allows us to assess how bad air pollution and sound pollution is from day to day

1.2 OBJECTIVES:

To build a robust system that can measure the air pollution and help to reduce it and to decrease human interference in monitoring the air pollution to reduce pollution and provide a healthy environment for the workers to work in. To make the air pollution monitoring a wireless system. To protect the environment from air pollution. To build a robust system that evaluates the air pollution continuously and indicates when there is an increase in the emissions and takes action to control it using wireless technology that is IOT. These improvements can be used to develop and implement its environmental policy and manage its environmental aspects .Furthermore, it is necessary for Nepalese industries to develop and implement those as the increase in CO₂ concentration in the atmosphere thickens the greenhouse blanket, adding to climate change with much of the heat being trapped in the earth's atmosphere.

OVERVIEW OF PROJECT:

- This project provides a combination of process of sensing several gas levels in the air and also the ambient temperature and humidity, thus sensing the quality of the air.
- The levels of the gases and the temperature is displayed in a LCD display panel , which continuously shows the real time output values of the gas sensors , temperature and humidity sensor.
- To measure and display temperature and humidity level of the environment.
- To combine advanced detection technologies to produce an air quality sensing system with advanced capabilities to provide low cost comprehensive monitoring.
- To display the sensed data in user friendly format in LCD display panel.

1.3 AIR QUALITY PARAMETERS

The important parameters that are considered in the proposed framework include:

- Carbon Dioxide (CO₂) – CO₂ is colorless, odorless gas and non-combustible gas. Moreover, it is considered under the category of asphyxiate gases that have capability of interfering the availability of oxygen for tissues. Carbon Dioxide is a gas essential to life in the planet, because it is one of the most important elements evolving photosynthesis process, which converts solar into chemical energy. The concentration of CO₂ has increased due mainly to massive fossil fuels burning. This increase makes plants grow rapidly. The rapid growth of undesirable plants leads to the increase use of chemicals to eliminate them.
- Sulphur Dioxide (SO₂) - Sulphur Dioxide is a colorless gas, detectable by the distinct odour and taste. Like CO₂, it is mainly due to fossil fuels burning and to air processes. In high concentrations may cause respiratory problems, especially in sensitive groups, like asthmatics. It contributes to acid rains.
- Nitrogen Dioxide (NO₂) – Nitrogen Dioxide is a brownish gas, easily detectable for its odour, very corrosive and highly oxidant. It is produced as the result of fossil fuels burning. Usually NO thrown to the atmosphere is converted in NO₂ by chemical processes. In high concentrations, NO₂ may lead to respiratory problems. Like SO₂, it contributes to acid rains.
- Smoke-About 1 million people are in habit of tobacco smoking globally of which majority population is from developing countries. Every year nearly 4.9 million people died due to smoking according to 2007 report. In addition, second hand smoke is serious threat to the health of people of all age's causes 41000 deaths each year.
- LPG-Liquefied petroleum gas (LPG) is an odorless and colorless liquid which evaporates readily into a gas. Leakage is normally detected by adding an odorant into it. It is considered under the category of highly flammable gases and it can be classified as a carcinogen and mutagen if Butadiene content is more than 0.1%. LPG may leak in the form of a gas or a liquid. If it leaks in the form of a liquid it evaporates quickly and will eventually form large cloud of gas in air which is relatively heavier than air thus drops to the ground. Whereas, LPG vapors travel along the ground for a long distance and gets collected in drains or basements. Gas leads to burn or explode after getting in touch with a source of ignition.
- Temperature and humidity- Measurement of temperature is important for safety of people and affects our life skills. Greenhouse effect can be monitored by measuring temperature and comparing temperature changes from historical to present time especially since the air revolution using climate data. Humidity is a type of gas that protects us from UV rays from the sun and helps trap heat on Earth, thereby making the climate on Earth, a pleasant one for living. But as humidity increases, the warmth on Earth also increases which makes our

life uncomfortable. Humidity is essential for various storage and food processing facilities. 4. AIR POLLUTION MONITORING EQUIPMENT The different components of the equipment along with their intended purpose are discussed below: • Arduino Uno R3 microcontroller It is the most flexible hardware platform used based on ATmega328P which can be programmed according to the function where it is to be used. It has 6 analog inputs, 14 digital input/output pins (6 pins of these can be used as PWM outputs), a USB Connection, a 16 MHz quartz crystal, SPI, serial interface, a reset button, a power jack and an ICSP header as shown in Fig.3. The Arduino microcontroller is not only for technical audience but is intended for designers and artists as well because of its focus to usability based on its design which helps to achieve the intended goal.

Now a days, many people are suffering from number of diseases which is only because of impure/unsafe drinking water. The traditional method of testing Temperature and humidity is to collect samples manually and then send them to laboratory for analysis. However, it has been unable to meet the demands of water quality monitoring today. Air and sound pollution is growing issue these days. It is necessary to monitor air quality for a better future and healthy living for all. We propose an air quality as well as sound pollution monitoring system that allows us to monitor and check air quality as well as sound pollution in particular area through IoT.

Soil moisture is the amount of water in the soil. Soil moisture monitoring system that helps the government authorities to know the information about dry soil areas in the agricultural lands within a village, town or even a state so that the necessary precautionary steps can be taken to make such lands fertile. Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. Here we design and develop a low cost system for real time monitoring of the water quality in IOT(internet of things).The system consist of several sensors used to measuring physical and chemical parameters of the water. The parameters such as temperature, PH, humidity sensor of the water can be measured.

Air pollution is both an environmental and a social problem, as it leads to a multitude of adverse effects on human health, ecosystems and the climate. Quality of the air in city and urban areas is the most important factor that directly influences the incidence of diseases and decreases the quality of life. Appropriate soil water level is a necessary prerequisite for optimum plant

growth. Also, water being an essential element for life sustenance, there is the necessity to avoid its undue usage. Irrigation is a dominant consumer of water.

1.4 Overview

An Air contamination is a substance noticeable all around that can effect affect people and eco framework. The substance can be strong particles, fluid beads, or gases. A poison can be of common beginning or man-made. Toxins are named essential or optional. Air contamination developed in numerous parts of the world because of touchy modern development. Street transport is additionally one of the real supporters of air contamination which add to environmental change that has risky residential and worldwide results. Age and transport of contamination materials are represented by the dispersions of their sources as well as by the elements of the climate. Poison mists are in some cases watched going along the breeze headings. To comprehend the included procedures in more detail we require more careful information on the spreads of finegrain contaminations and their varieties with time. An air contamination observing framework that is thorough regarding spatial and toxin scope and is moderately economical and self-ruling is the need.

On the planet 20% individuals does not have safe drinking water. One of the explanation for it is different molecule blended in the water, absence of water quality checking framework, its reality in various zone. Another reason drinking water isn't obviously sifted, in blustery season more often than not turbid water is supply yet this water not useful for drinking reason. That time not very many individuals doing objection to officer however they won't make a move on these protestation, consequently individuals confronting medical issue. We are select these venture in light of the fact that everybody

CHAPTER 2

LITERATURE SURVEY

AIRPOLLUTION AND ASTHMA

The role of air pollution in the increased prevalence and morbidity of asthma has been widely debated, but results to date indicate that the normally encountered levels of air pollution are unlikely to contribute to a worsening of asthma. When the levels of sulphur dioxide (SO₂) are exceptionally high it is possible that asthmatic patients may have increased symptoms after exertion, since this irritant gas acts as a trigger to bronchoconstriction. There is also evidence that suspended particles may also act as an inciter of asthma symptoms when concentrations are high. Experimentally, ozone in high concentrations may increase airway responsiveness in both normal and asthmatic subjects by inducing airway inflammation, but asthmatic individuals show the same responses as normal subjects and there is little or no evidence to link increases in ambient ozone with an increase in asthma. There is little evidence that nitrogen dioxide (NO₂), even at the peak levels recorded, has any significant effect on airway function in normal or asthmatic individuals. Other air pollutants which are present in lower concentrations have not been studied as extensively, but there is no convincing evidence that they cause significant respiratory symptoms in asthmatic patients. It is still possible that combinations of air pollutants may have greater effects on airway function than exposure to a single pollutant, although there is little evidence to support this. Epidemiological evidence provides little support for the idea that atmospheric pollution levels are related to the frequency of asthma symptoms or the frequency of attacks. More importantly, there is no evidence that asthma prevalence or aetiology is related to the level of air pollution. A review of currently available information therefore provides little evidence for the widely expressed view that atmospheric pollution is related to increased prevalence or morbidity of asthma or is related to the causation of asthma.

AIR POLLUTION CAN MAKE ASTHMA:

If you or your child has asthma, have you ever noticed symptoms get worse when the air is polluted? Air pollution can make it harder to breathe. It can also cause other symptoms, like coughing, wheezing, chest discomfort, and a burning feeling in the lungs. Two key air pollutants can affect asthma. One is ozone(found in smog). The other is particle pollution (found in haze, smoke, and dust). When ozone and particle pollution are in the air, adults and children with asthma are more likely to have symptoms

AIR POLLUTION MONITORING SYSTEM:

The hazards affecting environment have grown through the ages. Environmental condition changes from time to time, this lead to invention to environmental monitoring and controlling system. The study of environment initiated by implementation of wired communication and till the date resting on wireless technology. The paper calculates energy consumption by the Cluster Head deployed in an area which monitors air pollution through wireless sensor network using Matlab tool. The results mentioned proved how effective a sensor can work to monitor air pollution Index Terms—Wireless sensor Network, Cluster Head, Matlab

RESEARCH ON AN IOT BASED AIR POLLUTION MONITORING SYSTEM

Humankind, moving to a period centered upon improvement has overlooked the significance of supportability and has been the real guilty party behind the rising Pollution levels in the world's air among all other living life forms. The Pollution levels at certain spots have come to such high degrees that they have begun hurting our very own It will being. An IoT based Air Pollution observing framework incorporates a MQ Series sensor interfaced to a Node MCU outfitted with an ESP8266 WLAN connector to send the sensor perusing to a Thing Speak cloud. Further extent of this work incorporates an appropriate AI model to foresee the air Pollution level and an anticipating model, which is fundamentally a subset of prescient displaying. As age of poisonous gases from ventures, vehicles and different sources is immensely expanding step by step, it winds up hard to control the dangerous gases from dirtying the unadulterated air. In this paper a practical air Pollution observing framework is proposed. This framework can be utilized for observing Pollutions in demeanour of specific territory and to discover the air peculiarity or property examination. The obligated framework will concentrate on the checking of air poisons concentrate with the assistance of mix of Internet of things with wireless sensor systems. The investigation of air quality should be possible by figuring air quality index (AQI).

AIR POLLUTION MONITORING SYSTEMFOR SMART CITY:

Where pollution has become a major problem around the world, air pollution is the most dangerous, shocking and severe pollution among other pollutions e.g. water pollution, soil

pollution, noise pollution, light pollution, thermal pollution etc. Air pollution is the major cause of diseases like asthma, cancer, bronchitis, birth defects and immune system like diseases. This system implements the combination of an android app, server, gas sensors (CO₂, CO, LPG, and CH₄) to sense the air quality of the environment and shows the real condition of air. Solving the draw backs of existing air quality sensors this device can be used to monitor various gasses at a time. The most demanding thing would be this system will give the real time data and will show the quality of the air based on the standard air quality. The system will give the user the indication of the air quality and based on given parameters it will let the user know how much the environmental air is polluted or safe. This system will do everything on behalf of human in such a way that for a smart city when people will have less time for spending and there will be more industry and air will be more polluted this device will let people know how safe the air is. The goal is to make the system as reasonable as possible so that people from every society background can use this and if some research organization wants to do further research then if some nominal amount of money is invested then it would be a great solution to install a weather station thus air quality monitoring system

A WiFi-enabled indoor air quality monitoring and control system:-

Published in: Control & Automation (ICCA), 2017 13th IEEE International Conference
Authors: Xiaoke Yang, Lingyu Yang, Jing Zhang (School of Automation Science and Electrical Engineering, Beihang University, Beijing, 100191, China)

This paper proposes an open platform of a WiFi-enabled indoor air quality monitoring and control system, which could be incorporated into such a ‘smart building’ structure. The complete software and hardware design of this system is presented, along with a series of control experiments. The proposed system operates over an existing WiFi wireless network utilizing the MQTT protocol. It is capable of monitoring the indoor air quality as well as controlling an air purifier to regulate the particulate matters concentration. Experiment results under a real world office environment demonstrate the effectiveness of the proposed design.

A low-power real-time air quality monitoring system using LPWAN based on LoRa:-
Published in: Solid-State and Integrated Circuit Technology (ICSICT), 2016 13th IEEE International Conference
Authors: Sujuan Liu, Chuyu Xia, Zhenzhen Zhao (College of Electronic Information and Control Engineering, Beijing University of Technology, 100124, China)

This paper presents a low-power real-time air quality monitoring system based on the LoRa Wireless Communication technology. The proposed system can be laid out in a large number in the monitoring area to form sensor network. The system integrates a single-chip microcontroller, several air pollution sensors (NO₂, SO₂, O₃, CO, PM₁, PM₁₀, PM_{2.5}), LongRange (LoRa) - Modem, a solar PV-battery part and graphical user interface (GUI). As communication module LoRa sends the data to the central monitoring unit and then the data would be saved in the cloud. The range tests at an outdoor area show that LoRa is able to reach to approximately 2Km. The TX power is only about 110mA which is lower compared with other used wireless technology. An easy to use GUI was designed in the system. Based on LoRa technology, GUI, and Solar PV- Air quality sensing and monitoring 9 battery part the system has several progressive features such as low cost, long distance, high coverage, long device battery life, easy to operate.

IoT enabled proactive indoor air quality monitoring system for sustainable health management:- Published in: Computing and Communications Technologies (ICCCT), 2017 2nd International Conference Authors: M.F.M Firdhous, B.H Sudantha, P.M Karunaratne (Dept. of Information Technology, University of Moratuwa, Sri Lanka)

This paper proposes an IoT based indoor air quality monitoring system for tracking the ozone concentrations near a photocopy machine. The experimental system with a semiconductor sensor capable of monitoring ozone concentrations was installed near a high volume photocopier. The IoT device has been programmed to collect and transmit data at an interval of five minutes over blue tooth connection to a gateway node that in turn communicates with the processing node via the WiFi local area network. The sensor was calibrated using the standard calibration methods. As an additional capability, the proposed air pollution monitoring system can generate warnings when the pollution level exceeds beyond a predetermined threshold value.

A wireless system for indoor air quality monitoring:- Published in: Air Electronics Society , IECON 2016 - 42nd Annual Conference of the IEEE Authors: R du Plessis, A Kumar, GP Hancke (Department of Electrical, Electronic and Computer Engineering, University of Pretoria, South Africa)

This paper describes the development of a wireless monitoring system which can be deployed in a building. The system measures carbon dioxide, carbon monoxide and temperature. The

system developed in this paper can serve as the monitoring component of a HVAC control system and function as an indoor air quality monitor independently.

An embedded system model for air quality monitoring:- Published in: Computing for Sustainable Global Development (INDIACom), 2016 3rd International Conference
Authors: Sneha Jangid, Sandeep Sharma (School of ICT, Gautam Buddha University, Greater Noida, India)

Objective of the paper is to present a system model which can facilitate the assessment of health impacts caused due to indoor air pollutant as well as outdoor and can intimate the human prior about the risk he/she going to have, here we are focusing our work in context to allergic patients as they will be informed by this tool such that they can secure themselves without actually experiencing the risk factors, here a sensing network based microcontroller equipped with gas sensors, optical dust particle sensor, humidity and temperature sensor has been used for air quality monitoring. The design included various units mainly: sensing unit, processing unit, power unit, display unit, communication unit. This work will apply the techniques of electrical engineering with the knowledge of environmental engineering by using sensor networks to measure Air Quality Parameters. Air quality sensing and monitoring 11

A real-time ambient air quality monitoring wireless sensor network for schools in smart cities:- Published in: Smart Cities Conference (ISC2), 2015 IEEE First International
Authors: H. Ali, J. K. Soe, Steven. R. Wel (School of Electrical Engineering & Computer Science, The University of Newcastle, Callaghan, NSW 2308, Australia)

In this paper, a low-cost solar-powered air quality monitoring system based on ZigBee wireless network system technology is presented. The solar powered network sensor nodes can be deployed by schools to collect and report real-time data on carbon monoxide (CO), nitrogen dioxide (NO₂), dust particles, temperature, and relative humidity. The proposed system allows schools to monitor air quality conditions on a desktop/laptop computer through an application designed using LabVIEW and provides an alert if the air quality characteristics exceed acceptable levels. They tested the sensor network successfully at the Singapore campus of the University of Newcastle, Australia. The experimental results obtained by them demonstrated that the sensor network can provide high-quality air quality measurements over a wide range of CO, NO₂ and dust concentrations. A smart sensor system for air quality monitoring and massive data collection:- Published in: Information and Communication Technology Convergence (ICTC), 2015 International Conference Authors: Yonggao Yang, Lin Li

(Department of Computer Science, Prairie View A&M University, Prairie View, TX 77446, U.S.A) Air pollution has been a global challenge for environment protection. Effectively collecting and scientifically visualizing the air quality data can better help us monitor the environment and address related issues. This article presents a smart sensor system for air quality monitoring which consists of three units: the smart sensor unit, the smartphone, and a server.\

2.1 Pandian D R “Smart Device to monitor water quality to avoid pollution in IoT” January 2015

Internet of Things (IoT) is an integrated part of future internet and could be defined as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘things’ have identities, physical attributes and virtual personalities and use intelligent interfaces which are seamlessly integrated into the information network. In the IoT, ‘things’ are expected to become active participants in business, information and social processes where they are enabled to interact and communicate among themselves and with the environment by exchanging data and information ‘sensed’ about the environment, while reacting autonomously to the ‘real/physical world’ events and influencing it by running processes that trigger actions and create services with or without direct human intervention. Interfaces in the form of services facilitate interactions with these ‘smart things’ over the Internet, query and change their state and any information associated with them, taking into account security and privacy issues. The water quality monitoring is the essential need for the human life. There are huge numbers of diseases which cause through the polluted drinking water. The water will be polluted by the human being, animals, natural disasters and seasonal changes. So, people have to aware of their own locality water bodies conditions. To enable this, a prototype is proposed to monitor water quality in IoT environment.

Water quality monitoring can be used to protect source waters by identifying pollutant levels and locations in a source water. Water quality monitoring is commonly done multiple times a year because water quality may change with season and with weather events. Water quality can be monitored by measuring physical, chemical, or biological characteristics of the water. Shruti Sridharan et al. addressed in their project about developing an efficient wireless sensor network (WSN) based water quality monitoring system, that examines water quality, an important factor as far as, irrigation, domestic purposes, industries, etc are concerned. R.Karthik Kumar et al.

investigated Underwater wireless sensor network to monitor the quality of water using wireless sensor network (WSN) technology powered by solar panel. Through WSN various data collected by various sensors at the node side such as pH, Turbidity and oxygen level are sent to base station. At the base station collected data is displayed as visual and is analysed using different simulation tools. Marco Zennaro, Athanasios Floros, Gokhan Dogan, Tao Sun, Zhichao Cao, Chen Huang, Manzoor Bahader, Herve' Ntareme et al. proposed the design of a water quality monitoring system and, building upon the SunSPOT technology, a prototype implementation of a water quality wireless sensor network(WQWSN) as a solution to the water quality monitoring problem

2.2 Poonam Pal¹, Ritik Gupta², Sanjana Tiwari³, Ashutosh Sharma⁴ “IOT Based Air Pollution Monitoring System Using

Arduino” Oct -2017

The level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, airization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it. In order to monitor In this project we are going to make an IOT Based Air Pollution Monitoring System in which we will monitor the Air Quality over a web server using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO₂, smoke, alcohol, benzene and NH₃. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile. The main objective of IOT Air & Sound Monitoring System is that the Air and sound pollution is a growing issue these days. It is necessary to monitor air quality and keep it under control for a better future and healthy living for all. Due to flexibility and low cost Internet of things (IoT) is getting popular day by day. With the urbanization and with the increase in the vehicles on road the atmospheric conditions have considerably affected. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be analyzed interpreted and presented. This information can then be applicable in many ways. Analysis of monitoring data allows us to assess how bad air pollution and sound pollution is from day to day.

2.3 L.Rama Devi D.Srivalli Satya Sri N.S D.Badhru SSRG “Remote Soil Moisture Monitor Using IoT” – April 2017

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners. Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors and include tension meters and gypsum blocks. Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently. Knowing the exact soil moisture conditions on their fields, not only are farmers able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages. Soil moisture sensors are used in numerous research applications, e.g. in agricultural science and horticulture including irrigation planning, climate research, or environmental science including solute transport studies and as auxiliary sensors for soil respiration measurements.

2.4 Ms. Sarika Deshmukh Mr. Saurabh Surendran Prof M.P. Sardey “Air and Sound Pollution Monitoring System using IoT”

As modernization is growing rapidly internet technologies and wireless sensor networks are advanced, a new trend in the era of omnipresence is being realized. The increase in the number of internet users and application on the internet working technologies enable networking of everyday objects requiring human-to-human or human-to-computer communication. Internet of Things allows an exchange of information to and from a device or thing. It can be anything

such as refrigerators, watches, fans, air conditioner, automobiles, or anything. It is a communication between human and machine or machine and machine. Due to flexibility and low-cost Internet of things (IoT) is getting popular day by day. With the urbanization and with the increase in the vehicles on road the atmospheric conditions have considerably affected. Also, there has been the growth of industries and infrastructure which has caused increase in pollution in atmosphere like air and sound pollution. Air pollution and sound pollution are major constituents for having adverse and harmful effects on environment as well on human beings. To monitor this pollution is a very difficult task. Traditionally, authorities like data loggers were used to collect the data of the site to be analyzed. They had to visit the site to be analyzed every time they wanted the data. This was a lengthy, time consuming and expensive task. Due the use of sensors collaborated with internet can make pollution monitoring less complex, less time consuming and flexible. The data can be obtained from remote location without having to visit the location due the internet.

Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be analyzed interpreted and presented. This information can then be applicable in many ways. Analysis of monitoring data allows us to assess how bad air pollution and sound pollution is from day to day.

To design an IoT based Air and Sound pollution monitoring system which can be accessed with the help of Wi-Fi module and to analyse the pollution level of a particular place or site. To pick up the data from the atmosphere or contents of atmosphere various sensors are used. In this system air pollutants will be measured are carbon monoxide, carbon dioxide, cooking fumes, smoke and temperature.

2.5 Nagarajapandian M, Ram Prasanth U, Selva Kumar G, Tamil Selvan S, “Automatic irrigation system on sensing soil moisture content”, 2015

The continuous increasing demand of food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming

slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes to waste.

In modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation techniques in India through manual control in which farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which crops Get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use automatic micro controller based drip irrigation system in which the irrigation will take place only when there will be acute requirement of water.

2.6 Palaghat Yaswanth Sai “An IoT Based Automated Noise and Air Pollution Monitoring System” March 2017

This project we are going to make an IOT Based Air Pollution Monitoring System in which we will monitor the Air Quality over a webserver using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO₂, smoke, alcohol, benzene and NH₃. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily.

We have used MQ135 sensor which is the best choice for monitoring Air Quality as it can detects most harmful gases and can measure their amount accurately. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile. We can install this system anywhere and can also trigger some device when pollution goes beyond some level, like we can switch on the Exhaust fan or can send alert SMS/mail to the user. Some of the research works carried out for monitoring the pollution parameters in a particular area of interest for making the environment smart in that area, different techniques and methods which were used in the past discussed in this section.

Smart Environment Monitoring using Wireless Sensor networks. In this work they are mainly focus on the making the city environment smart, by deploying wireless sensor networks in all over the city and moving public transportation system buses and cars.

A WiFi-enabled indoor air quality monitoring and control system:-

Published in: Control & Automation (ICCA), 2017 13th IEEE International Conference

Authors: Xiaoke Yang, Lingyu Yang, Jing Zhang

(School of Automation Science and Electrical Engineering, Beihang University, Beijing, 100191, China)

This paper proposes an open platform of a WiFi-enabled indoor air quality monitoring and control system, which could be incorporated into such a ‘smart building’ structure. The complete software and hardware design of this system is presented, along with a series of control experiments. The proposed system operates over an existing WiFi wireless network utilizing the MQTT protocol. It is capable of monitoring the indoor air quality as well as controlling an air purifier to regulate the particulate matters concentration. Experiment results under a real world office environment demonstrate the effectiveness of the proposed design.

A low-power real-time air quality monitoring system using LPWAN based on LoRa:-

Published in: Solid-State and Integrated Circuit Technology (ICSICT), 2016 13th IEEE International Conference

Authors: Sujuan Liu, Chuyu Xia, Zhenzhen Zhao

(College of Electronic Information and Control Engineering, Beijing University of Technology, 100124, China)

This paper presents a low-power real-time air quality monitoring system based on the LoRa Wireless Communication technology. The proposed system can be laid out in a large number in the monitoring area to form sensor network. The system integrates a single-chip

microcontroller, several air pollution sensors (NO₂, SO₂, O₃, CO, PM₁, PM₁₀, PM_{2.5}), LongRange (LoRa) Modem, a solar PV-battery part and graphical user interface (GUI). As communication module LoRa sends the data to the central monitoring unit and then the data would be saved in the cloud. The range tests at an outdoor area show that LoRa is able to reach to approximately 2Km. The TX power is only about 110mA which is lower compared with other used wireless technology.

An easy to use GUI was designed in the system. Based on LoRa technology, GUI, and Solar PVbattery part the system has several progressive features such as low cost, long distance, high coverage, long device battery life, easy to operate.

IoT enabled proactive indoor air quality monitoring system for sustainable health management:-

Published in: Computing and Communications Technologies (ICCCT), 2017 2nd International Conference

Authors: M.F.M Firdhous, B.H Sudantha, P.M Karunaratne (Dept. of Information Technology, University of Moratuwa, Sri Lanka)

This paper proposes an IoT based indoor air quality monitoring system for tracking the ozone concentrations near a photocopier machine. The experimental system with a semiconductor sensor capable of monitoring ozone concentrations was installed near a high volume photocopier. The IoT device has been programmed to collect and transmit data at an interval of five minutes over blue tooth connection to a gateway node that in turn communicates with the processing node via the WiFi local area network. The sensor was calibrated using the standard calibration methods. As an additional capability, the proposed air pollution monitoring system can generate warnings when the pollution level exceeds beyond a predetermined threshold value.

A wireless system for indoor air quality monitoring:-

Published in: Air Electronics Society , IECON 2016 - 42nd Annual Conference of the IEEE

Authors: R du Plessis, A Kumar, GP Hancke

(Department of Electrical, Electronic and Computer Engineering, University of Pretoria, South Africa)

This paper describes the development of a wireless monitoring system which can be deployed in a building. The system measures carbon dioxide, carbon monoxide and temperature. The system developed in this paper can serve as the monitoring component of a HVAC control system and function as an indoor air quality monitor independently.

Pollution: An efficient cloud-based management of IoT devices for air quality monitoring:-

Published in: Research and Technologies for Society and Industry Leveraging a better tomorrow (RTSI), 2016 IEEE 2nd International Forum

The Internet of Things paradigm originates from the proliferation of intelligent devices that can sense, compute and communicate data streams in a ubiquitous information and communication network. The great amounts of data coming from these devices introduce some challenges related to the storage and processing capabilities of the information. This strengthens the novel paradigm known as Big Data. In such a complex scenario, the Cloud computing is an efficient solution for the managing of sensor data. This paper presents Polluino, a system for monitoring the air pollution via Arduino. Moreover, a Cloud-based platform that manages data coming from air quality sensors is developed.

An embedded system model for air quality monitoring:-

Published in: Computing for Sustainable Global Development (INDIACom), 2016 3rd International Conference

Authors: Sneha Jangid, Sandeep Sharma (School of ICT, Gautam Buddha University, Greater Noida, India)

Objective of the paper is to present a system model which can facilitate the assessment of health impacts caused due to indoor air pollutant as well as outdoor and can intimate the human prior about the risk he/she going to have, here we are focusing our work in context to allergic patients as they will be informed by this tool such that they can secure themselves without actually

experiencing the risk factors, here a sensing network based microcontroller equipped with gas sensors, optical dust particle sensor, humidity and temperature sensor has been used for air quality monitoring. The design included various units mainly: sensing unit, processing unit, power unit, display unit, communication unit. This work will apply the techniques of electrical engineering with the knowledge of environmental engineering by using sensor networks to measure Air Quality Parameters.

A real-time ambient air quality monitoring wireless sensor network for schools in smart cities:-

Published in: Smart Cities Conference (ISC2), 2015 IEEE First International

Authors: H. Ali, J. K. Soe, Steven. R. Wel

(School of Electrical Engineering & Computer Science, The University of Newcastle, Callaghan, NSW 2308, Australia)

In this paper, a low-cost solar-powered air quality monitoring system based on ZigBee wireless network system technology is presented. The solar powered network sensor nodes can be deployed by schools to collect and report real-time data on carbon monoxide (CO), nitrogen dioxide (NO₂), dust particles, temperature, and relative humidity. The proposed system allows schools to monitor air quality conditions on a desktop/laptop computer through an application designed using LabVIEW and provides an alert if the air quality characteristics exceed acceptable levels. They tested the sensor network successfully at the Singapore campus of the University of Newcastle, Australia. The experimental results obtained by them demonstrated that the sensor network can provide high-quality air quality measurements over a wide range of CO, NO₂ and dust concentrations.

A smart sensor system for air quality monitoring and massive data collection:-

Published in: Information and Communication Technology Convergence (ICTC), 2015 International Conference

Authors: Yonggao Yang, Lin Li

(Department of Computer Science, Prairie View A&M University, Prairie View, TX 77446, U.S.A)

Air pollution has been a global challenge for environment protection. Effectively collecting and scientifically visualizing the air quality data can better help us monitor the environment and address related issues. This article presents a smart sensor system for air quality monitoring which consists of three units: the smart sensor unit, the smartphone, and a server. The smart

CHAPTER 3

SYSTEM DESIGN

EXISTING SYSTEM:

- The classical way to detect air pollution is LabVIEW and SCADA. Air Pollution in India has become an alarming problem in current day scenario. The pollution levels have increased to such an extent that it has already started showing adverse effects on the human life and other living organisms.
- We have developed Pollution Monitoring System based on two strategies that will measure the level of harmful gases such as CO₂, CO, smoke along with humidity and temperature of the surrounding environment. One of the two methods involves use of GSM which enables the user to monitor the pollution levels remotely.
- The system includes essential components to measure the parameters such as carbon monoxide, carbon dioxide, smoke level, humidity and temperature in the surrounding area of the system.
- Another method developed uses LabVIEW, where the pollution levels can be monitored automatically with the help of sensors.

PROBLEM STATEMENT

- The relative cost of SCADA systems can be substantial if not used in air plants.
- Data acquisition services can rely on PC with direct connection to PLC through RS232, Modbus, CAN or any other protocol. The service can run directly on modern PLC.
- The service that presents the data can be on any PC that has an internet connection with service on the PLC, and acquired data can be accessed through the web interface.
- Process monitoring and management is not done.
- More man power.
- High maintenance.
- High Cost.
- Wired communication.

PROPOSED SYSTEM:

The air pollution monitoring includes ecological parameters like methane Gas, carbon monoxide sensor and other poisonous sensor. The sensors data are giving to the Arduino microcontroller for observe analyze the environmental situation.

- The framework is utilizing a model usage comprises of detecting gadgets, Arduino uno board, ESP8266 as Wi-Fi module. A prototype for an Environmental Air Pollution Monitoring System for monitoring the concentrations of major air pollutant gases has been developed.
- The system uses low cost air-quality monitoring nodes comprises of low cost semiconductor gas sensor with Wi-Fi modules. This system measures concentrations of gases such as CO, CO₂, Methane using semiconductor sensors. Once voice of that particular animal recognized, The GPS location of that animal will be send to the IOT Cloud web page.
- The sensors will gather the data of various environmental parameters and provide it to node MCU which act as a base station. Realization of data gathered by sensors is displayed on LCD.
- The animal's condition is sent to authorize persons as a sms and mail. Then the particular person will rescue the animal easily.
- All the sensors data are collected via IOT to ubidots web page. Then location and sms will be send to the particulate person via IOT module.

ADVANTAGES:

- Remote monitoring applications present a range of challenges.
- The variety and complexity of applications has driven a need for an equal variety of features. End-users want feature-rich solutions that they can configure to meet their unique needs, with the configurability to apply them as needed.
- The need to accommodate legacy systems as well as new installations has underlined the necessity of compatibility and configurability.
- End-users want products that incorporate as many useful features as possible to keep capital and maintenance costs at a minimum.
- We can monitor the Temperature, Gas detection in our proposed system and control via IOT.

BLOCK DIAGRAM:

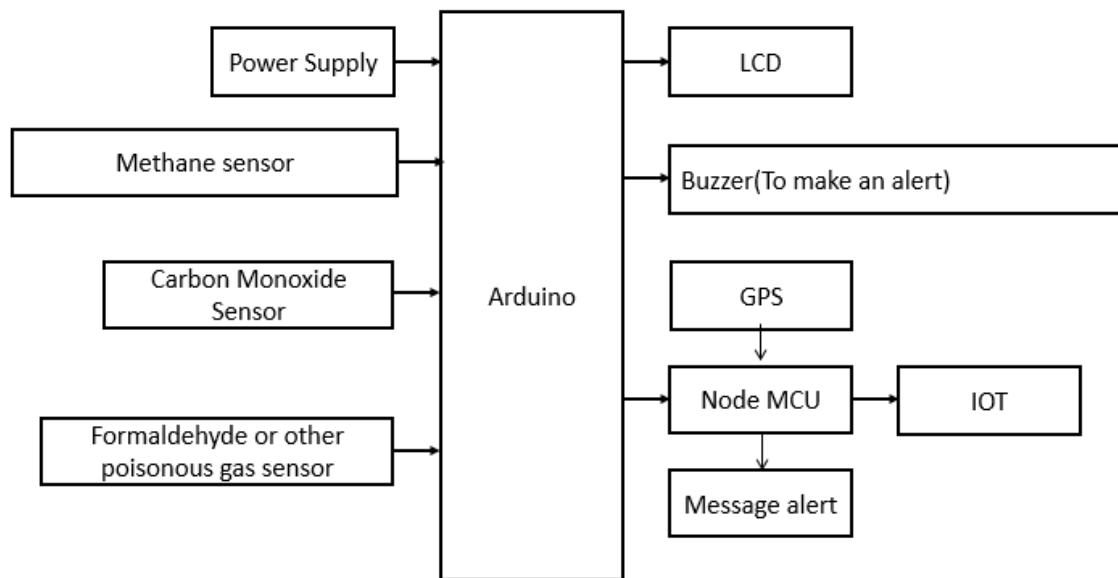


Fig 3.1 block diagram

OBJECTIVES

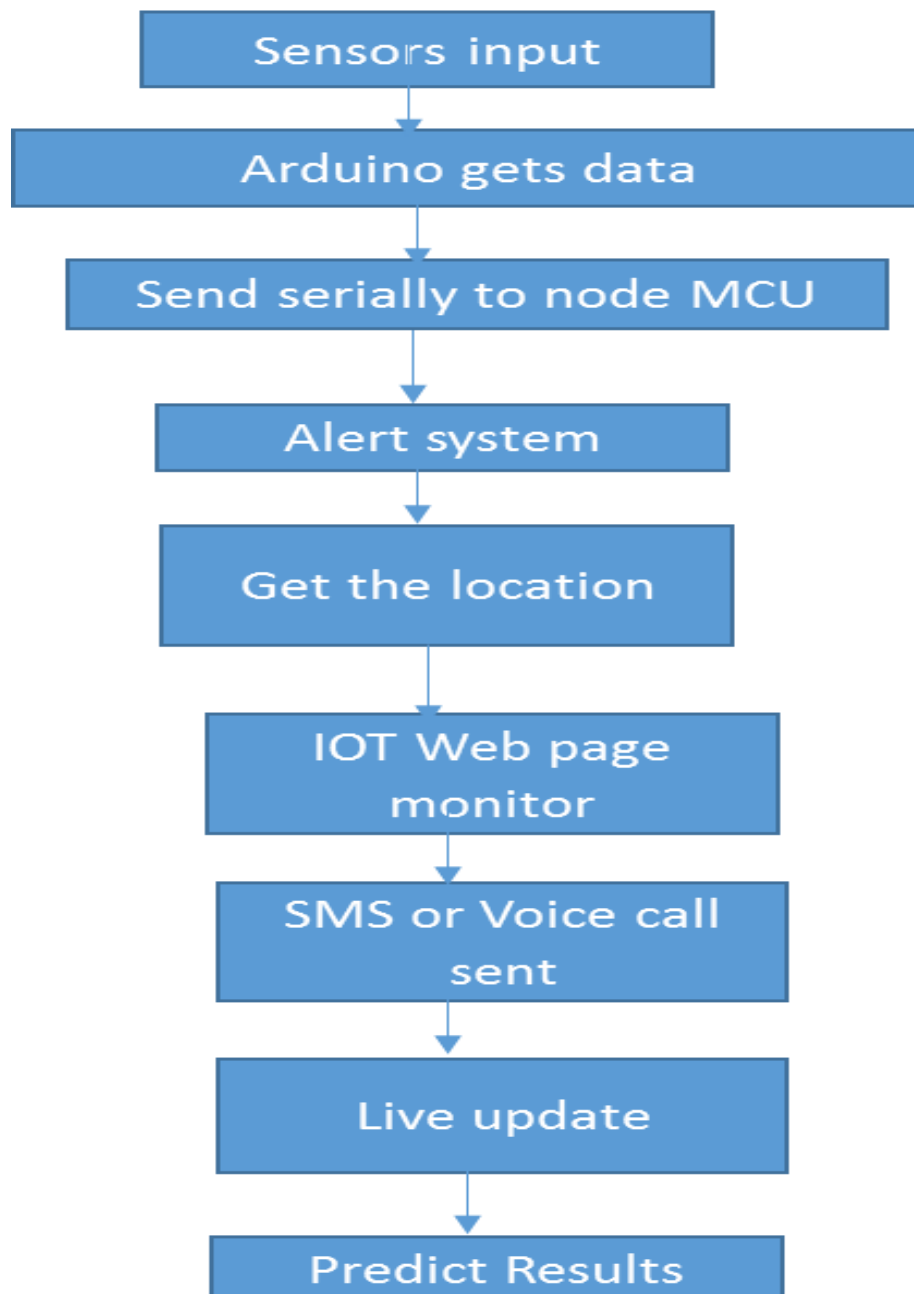
Determination of Air pollutants.

Air pollution monitoring and notification system - harmful gases such as CO, Smoke, LPG etc.

Water pollution monitoring and notification system - temperature and humidity of the water.

Soil pollution monitoring and notification system - soil moisture level.

Flow diagram:



Sensors module:

- CO, Methane and other poisonous gas sensors are connected with the Arduino controller. Through the analog to digital conversion we are getting the data.

Arduino:

- ATmega328p microcontroller is used to get the sensors data.

IOT Module:

- **The node MCU is used to the upload the data to directly IOT cloud update.**

HARDWARE REQUIREMENTS

- Arduino Uno
- Node MCU
- Methane Gas sensor
- Carbon monoxide sensor
- Other poisonous gas sensor
- LCD Display
- Buzzer
- GPS Module

SOFTWARE REQUIREMENTS

- Arduino IDE
 - Embedded c Programming language
 - Proteus simulation tool.
- Cloud storage application software

CHAPTER 4

HARDWARE REQUIREMENTS

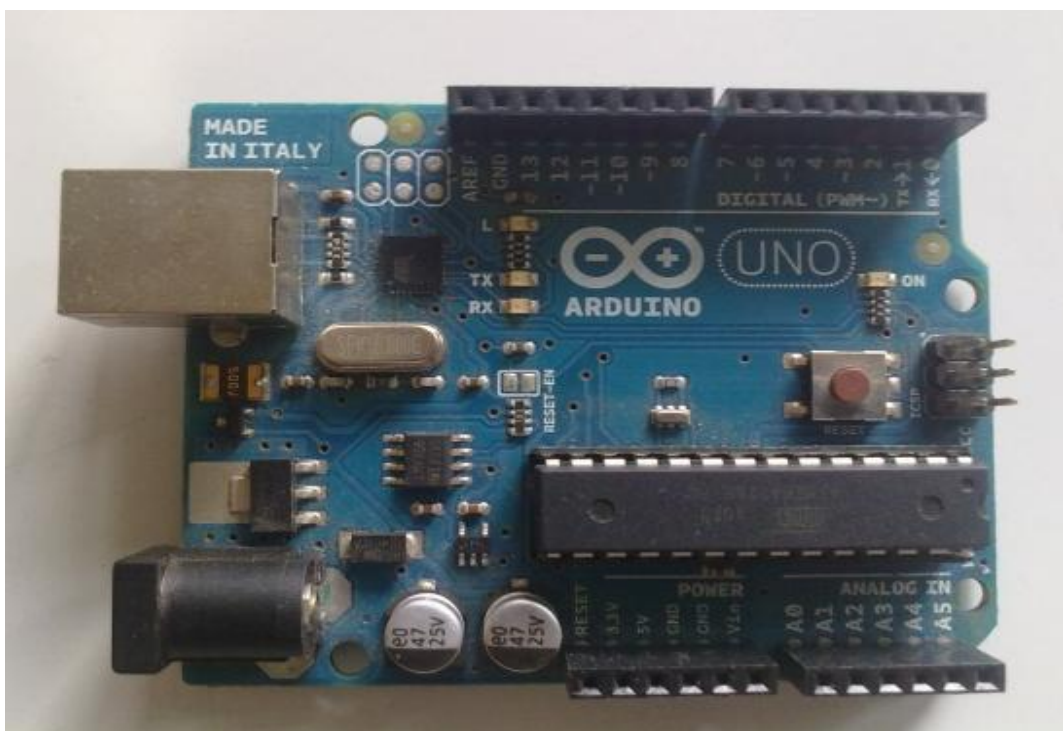
ARDUINO UNO AND ITS PROGRAMMING

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

Arduino Uno:



4.1 Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

This guide covers the Arduino Uno board (Spark fun DEV-09950, \$29.95), a good choice for students and educators. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort.

This is what the Arduino board looks like.



The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

4.2 Summary:

Microcontroller ATmega328

Operating Voltage 5V

Input Voltage (recommended) 7-12V

Input Voltage (limits) 6-20V

Digital I/O Pins 14 (of which 6 provide PWM output)

Analog Input Pins 6

DC Current per I/O Pin 40 mA

DC Current for 3.3V Pin 50 mA

Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader

SRAM 2 KB (ATmega328)

EEPROM 1 KB (ATmega328)

Clock Speed 16 MHz

4.3 Pin Configuration

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall- wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using

more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

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.** 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 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.
- **IOREF.** This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader).

It also has 2 KB of SRAM and 1 KB of EEPROM.

Input and Output

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 using the SPI library.
- **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.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin and the `analogReference()` function. Additionally, some pins have specialized functionality:

- **I2C: A4 or SDA pin and A5 or SCL pin.** Support I2C communication using the Wire library.

There are a couple of other pins on the board:

- **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.

2.4 Communication

Microcontrollers depend on a host computer for developing and compiling programs. The software used on the host computer is known as an integrated development environment, or IDE. For the Arduino, the development environment is based on the open source Processing platform (www.processing.org) which is described by its creators as a “programming language and environment for people who want to program images, animation, and interactions.” The Arduino programming language leverages an open source project known as Wiring (wiring.org.co). The Arduino language is based on good old- fashioned C. If you are unfamiliar with this language, don’t worry; it’s not hard to learn, and the Arduino IDE provides some feedback when you make mistakes in your programs.

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 ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a 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 Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

As you go through the list of programming statements available in the Arduino IDE (choose Help->Reference), you might think there isn't much power for doing things like running servos, operating stepper motors, reading potentiometers, or displaying text on an LCD. Like most any language based on C, the Arduino supports the notion of "libraries" code

Repositories that extend core programming functionality. Libraries let you re-use code without having to physically copy and paste it into all your programs. The standard Arduino software installation comes with several libraries you may use, and you can download others from the Arduino support pages and from third-party websites that publish Arduino library code. A good example of a library you'll use with the Robot and likely many other robot projects is Servo. This library allows you to connect one or more hobby R/C servos to the Arduino's digital I/O pins. The Servo library comes with the standard Arduino installation package Library->Servo. This adds the line

```
#include <Servo.h>
```

Which tells the Arduino IDE that you wish to include the Servo library in your sketch. With the functionality of the library now available to you, you can use its various functions to control one or more servos. For example, you can use the write function to rotate a servo to a specific position, from 0 to 180 degrees. The following code

```
myServo.write(90);
```

Moves a servo to its midpoint, or 90 degree position. Structurally, Arduino sketches are very straightforward and are pretty easy to read and understand. The Arduino program

contains two main parts: `setup ()` and `loop ()`. These are programming functions that do what their names suggest: `setup ()` sets up the Arduino hardware, such as specifying which I/O lines you plan to use, and whether

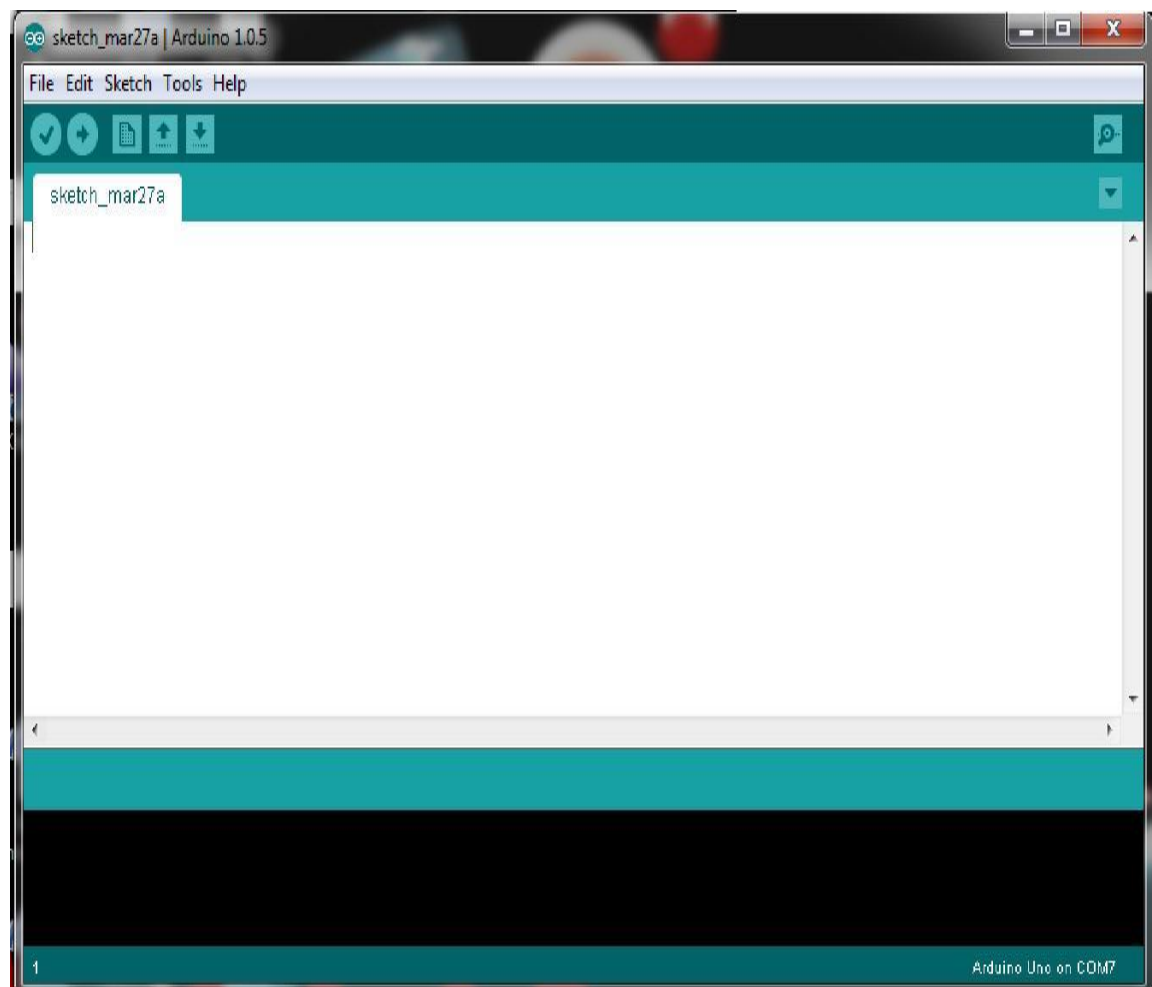
They are inputs or outputs. The `loop ()` function is repeated endlessly when the Arduino is operating.

Arduino IDE (Integrated development environment) is used to write the program and dump into the Arduino board

4.5 ARDUINO SOFTWARE:

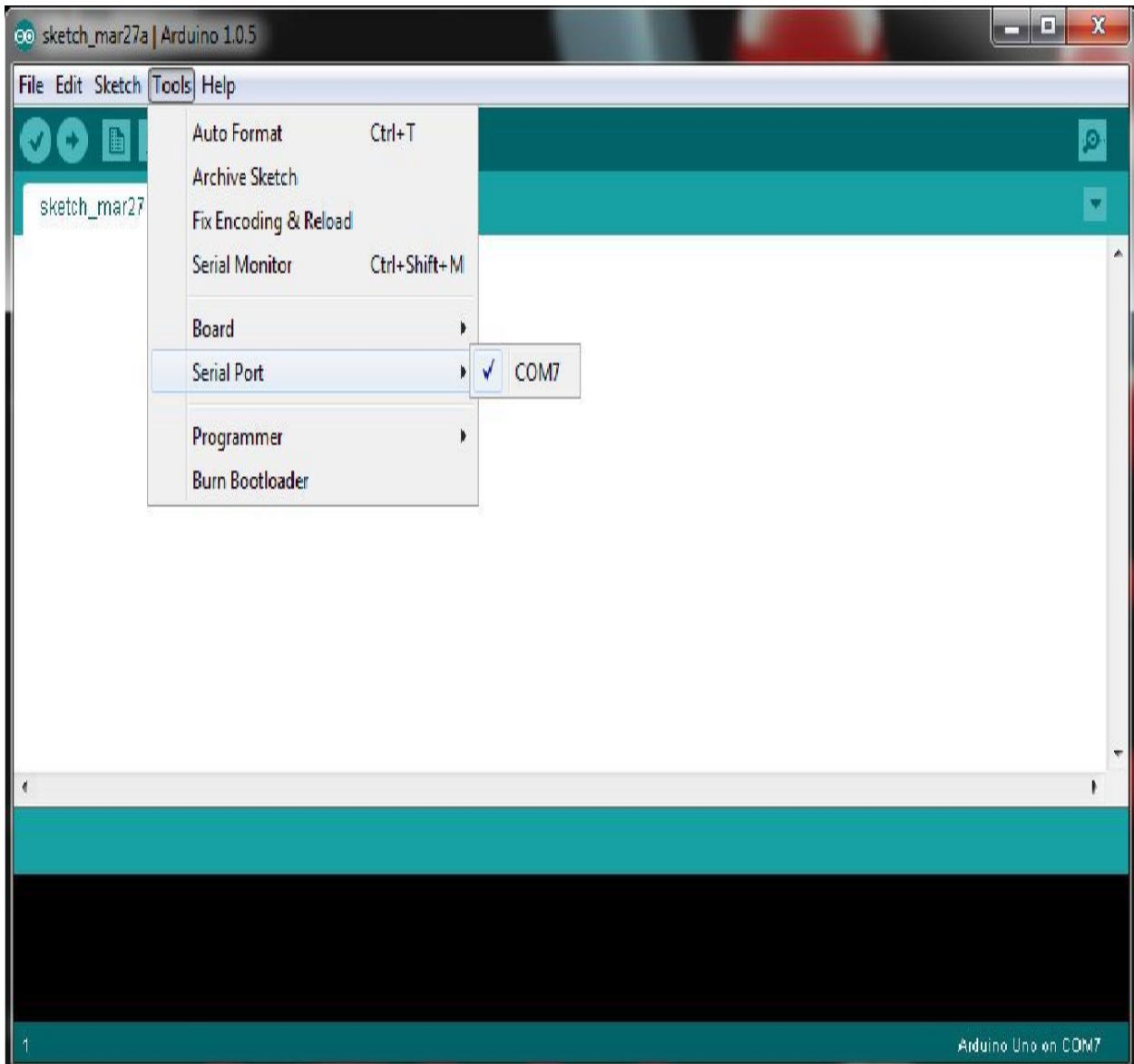
1. Open Arduino IDE as shown below

Open Arduino IDE



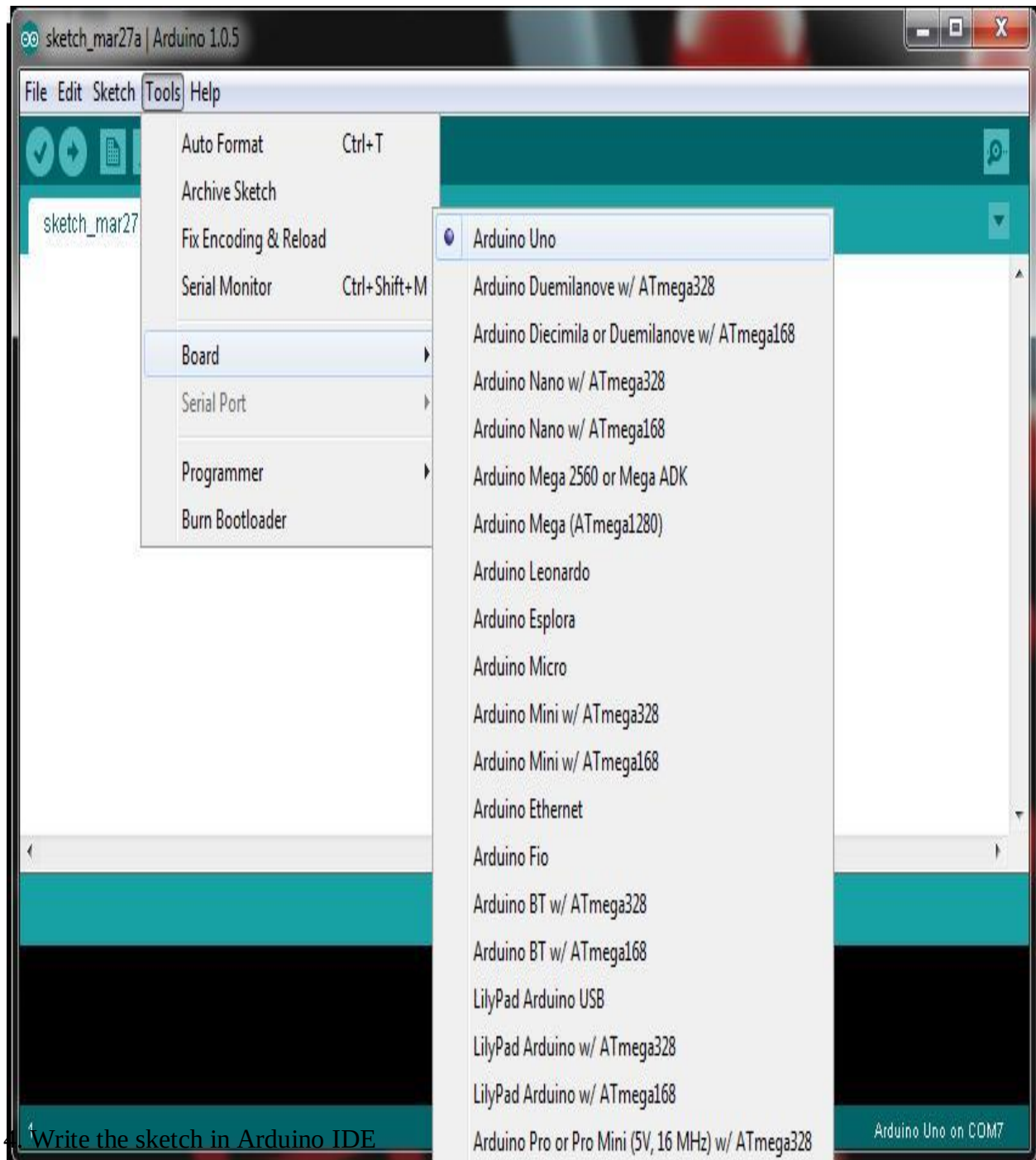
2. Select the COM Port from tool

Select the COM Port

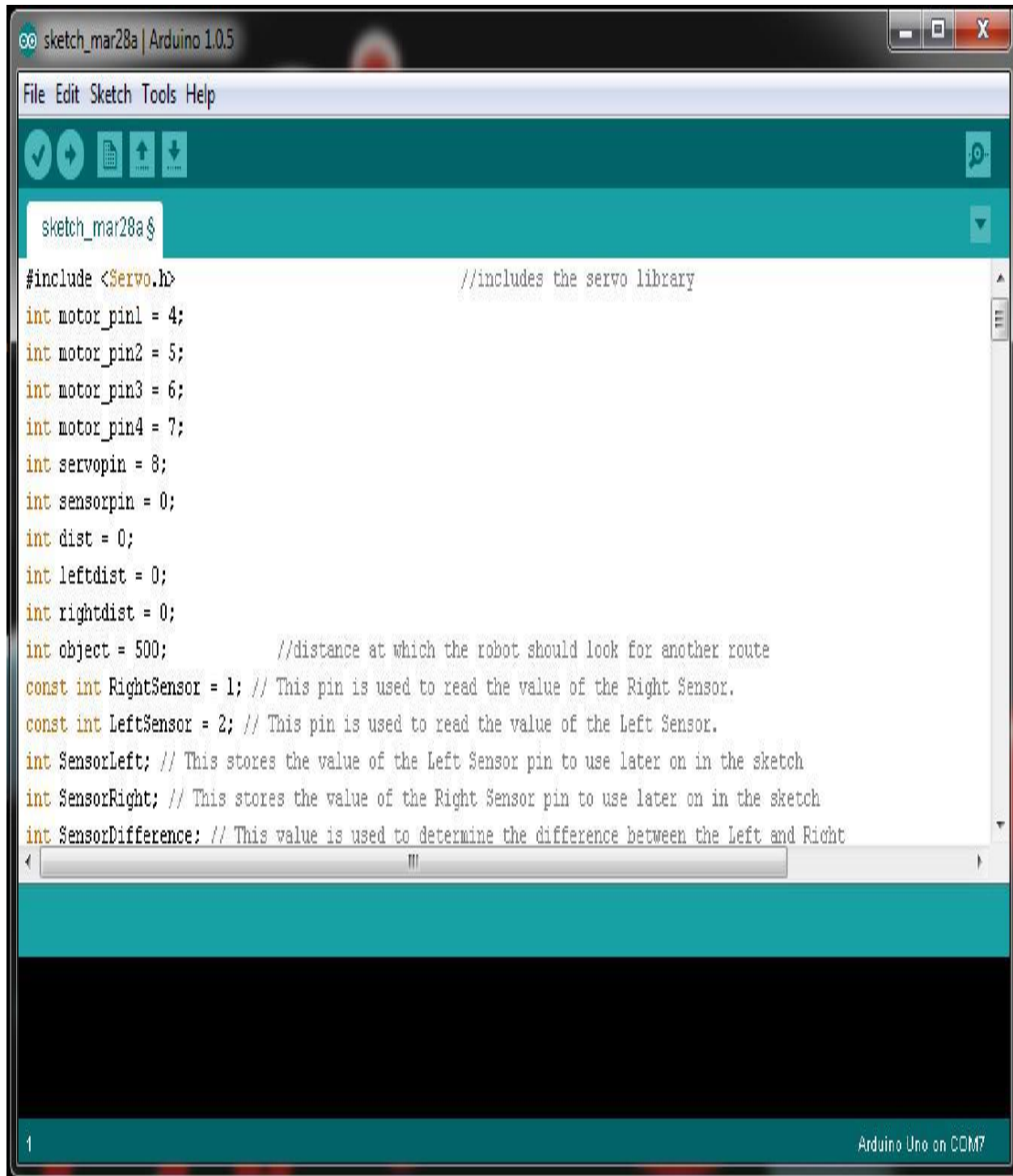


3. Select the required Arduino board from Tools as shown below

Select the required Arduino board



Sketch in Arduino DE



The screenshot shows the Arduino IDE interface. The title bar indicates the sketch is named 'sketch_mar28a' and the IDE version is 'Arduino 1.0.5'. The menu bar includes 'File', 'Edit', 'Sketch', 'Tools', and 'Help'. Below the menu bar is a toolbar with icons for saving, undo, redo, and other functions. The main text area contains the following code:

```
sketch_mar28a$  
#include <Servo.h> //includes the servo library  
int motor_pin1 = 4;  
int motor_pin2 = 5;  
int motor_pin3 = 6;  
int motor_pin4 = 7;  
int servopin = 8;  
int sensorpin = 0;  
int dist = 0;  
int leftdist = 0;  
int rightdist = 0;  
int object = 500; //distance at which the robot should look for another route  
const int RightSensor = 1; // This pin is used to read the value of the Right Sensor.  
const int LeftSensor = 2; // This pin is used to read the value of the Left Sensor.  
int SensorLeft; // This stores the value of the Left Sensor pin to use later on in the sketch  
int SensorRight; // This stores the value of the Right Sensor pin to use later on in the sketch  
int SensorDifference; // This value is used to determine the difference between the Left and Right
```

The status bar at the bottom shows '1' on the left and 'Arduino Uno on COM7' on the right.

5. Compile and upload the Sketch to Arduino board upload the Sketch to Arduino board



NODE MCU

NodeMCU is an open-source Lua based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module

Programming NodeMCU ESP8266 with Arduino IDE

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use.

Programming NodeMCU with the Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the NodeMCU board itself. You can check this [Getting Started Tutorial for NodeMCU](#) to prepare your Arduino IDE for NodeMCU.

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).^[8] The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.^[citation needed]

Both the firmware and prototyping board designs are open source.^[8]

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson^[9] and SPIFFS.^[10] Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications (see related projects).

History

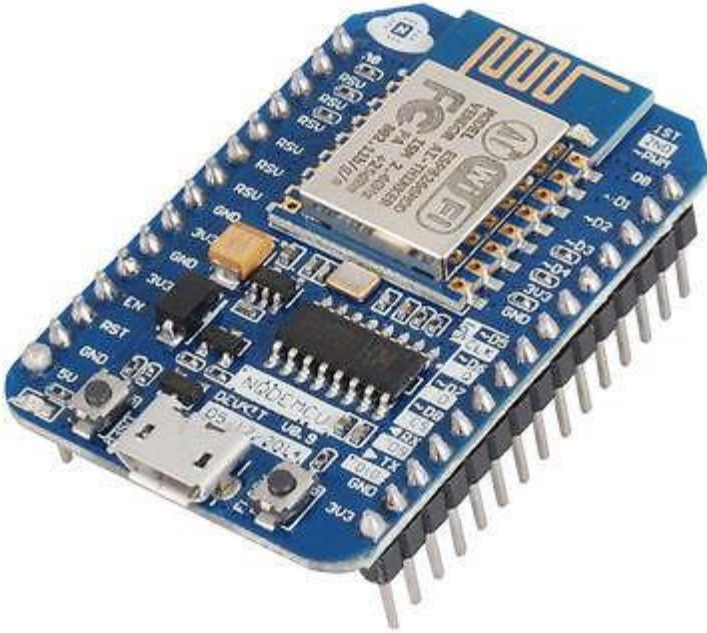
NodeMCU was created shortly after the [ESP8266](#) came out. On December 30, 2013, [Espressif Systems](#)^[6] began production of the ESP8266.^[11] NodeMCU started on 13 Oct 2015, when Hong committed the first file of nodemcu-firmware to GitHub.^[12] Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the [gerber](#) file of an ESP8266 board, named devkit v0.9.^[13] Later that month, Tuan PM ported [MQTT](#) client library from [Contiki](#) to the ESP8266 SoC platform,^[14] and committed to NodeMCU project, then NodeMCU was able to support the MQTT IoT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the [u8glib](#)^[15] to the NodeMCU project,^[16] enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

In the summer of 2015 the original creators abandoned the firmware project and a group of independent contributors took over. By the summer of 2016 the NodeMCU included more than 40 different modules.

ESP8266 Arduino Core[[edit](#)]

As [Arduino.cc](#) began developing new MCU boards based on non-[AVR](#) processors like the ARM/SAM MCU and used in the Arduino Due, they needed to modify the [Arduino IDE](#) so that it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors. They did this with the introduction of the Board Manager and the SAM Core. A "core" is the collection of software components required by the Board Manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language. Some ESP8266 enthusiasts developed an Arduino core for the ESP8266 WiFi SoC, popularly called the "ESP8266 Core for the Arduino IDE".^[17] This has become a leading software development platform for the various ESP8266-based modules and development boards, including NodeMCUs.

NodeMCU is an open-source [LUA](#) based firmware developed for the ESP8266 wifi chip. By exploring functionality with the ESP8266 chip, NodeMCU firmware comes with the ESP8266 Development board/kit i.e. NodeMCU Development board.

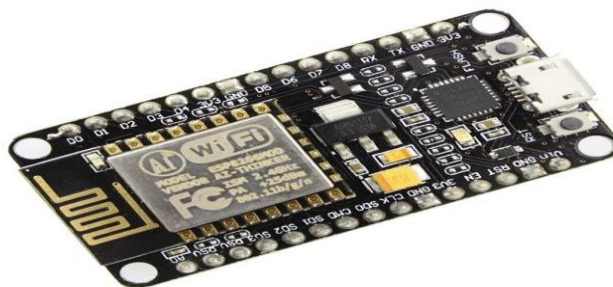


NodeMCU Development Board/kit v0.9 (Version1)

Since NodeMCU is an open-source platform, its hardware design is open for edit/modify/build.

NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The **ESP8266** is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer to the ESP8266 WiFi Module.

There is Version2 (V2) available for NodeMCU Dev Kit i.e. **NodeMCU Development Board v1.0 (Version2)**, which usually comes in black colored PCB.



NodeMCU Development Board/kit v1.0 (Version2)

For more information about NodeMCU Boards available in the market refer to [NodeMCU Development Boards](#)

NodeMCU Dev Kit has **Arduino like** Analog (i.e. A0) and Digital (D0-D8) pins on its board.

It supports serial communication protocols i.e. UART, SPI, I2C, etc.

Using such serial protocols we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards, etc.

How to start with NodeMCU?

NodeMCU Development board is featured with wifi capability, analog pin, digital pins, and serial communication protocols.

To get started with using NodeMCU for IoT applications first we need to know about how to write/download NodeMCU firmware in NodeMCU Development Boards. And before that where this NodeMCU firmware will get as per our requirement.

There are online NodeMCU custom builds available using which we can easily get our custom NodeMCU firmware as per our requirement.

To know more about how to build custom NodeMCU firmware online and download it refer to [Getting started with NodeMCU](#)

How to write codes for NodeMCU?

After setting up ESP8266 with Node-MCU firmware, let's see the IDE (Integrated Development Environment) required for the development of NodeMCU.

NodeMCU with ESPlorer IDE

[Lua](#) scripts are generally used to code the NodeMCU. Lua is an open-source, lightweight, embeddable scripting language built on top of C programming language.

For more information about how to write Lua script for NodeMCU refer to [Getting started with NodeMCU using ESPlorerIDE](#)

NodeMCU with Arduino IDE

Here is another way of developing NodeMCU with a well-known IDE i.e. Arduino IDE. We can also develop applications on NodeMCU using the Arduino development environment. This makes it easy for Arduino developers than learning a new language and IDE for NodeMCU.

For more information about how to write Arduino sketch for NodeMCU refer to [Getting started with NodeMCU using Arduino IDE](#)

The difference in using ESPlorer and Arduino IDE

Well, there is a programming language difference we can say while developing an application for NodeMCU using ESPlorer IDE and Arduino IDE.

We need to code in C\C++ programming language if we are using Arduino IDE for developing NodeMCU applications and Lua language if we are using ESPlorer IDE.

Basically, NodeMCU is Lua Interpreter, so it can understand Lua script easily. When we write Lua scripts for NodeMCU and send/upload it to NodeMCU, then they will get executes sequentially. It will not build a binary firmware file of code for NodeMCU to write. It will send Lua script as it is to NodeMCU to get executed.

In Arduino IDE when we write and compile code, the ESP8266 toolchain in the background creates a binary firmware file of code we wrote. And when we upload it to NodeMCU then it will flash all NodeMCU firmware with newly generated binary firmware code. In fact, it writes the complete firmware.

That's the reason why NodeMCU not accept further Lua scripts/code after it is getting flashed by Arduino IDE. After getting flashed by Arduino sketch/code it will be no more Lua interpreter and we got an error if we try to upload Lua scripts. To again start with Lua script, we need to flash it with NodeMCU firmware.

Since Arduino IDE compiles and upload/writes complete firmware, it takes more time than ESPlorer IDE.

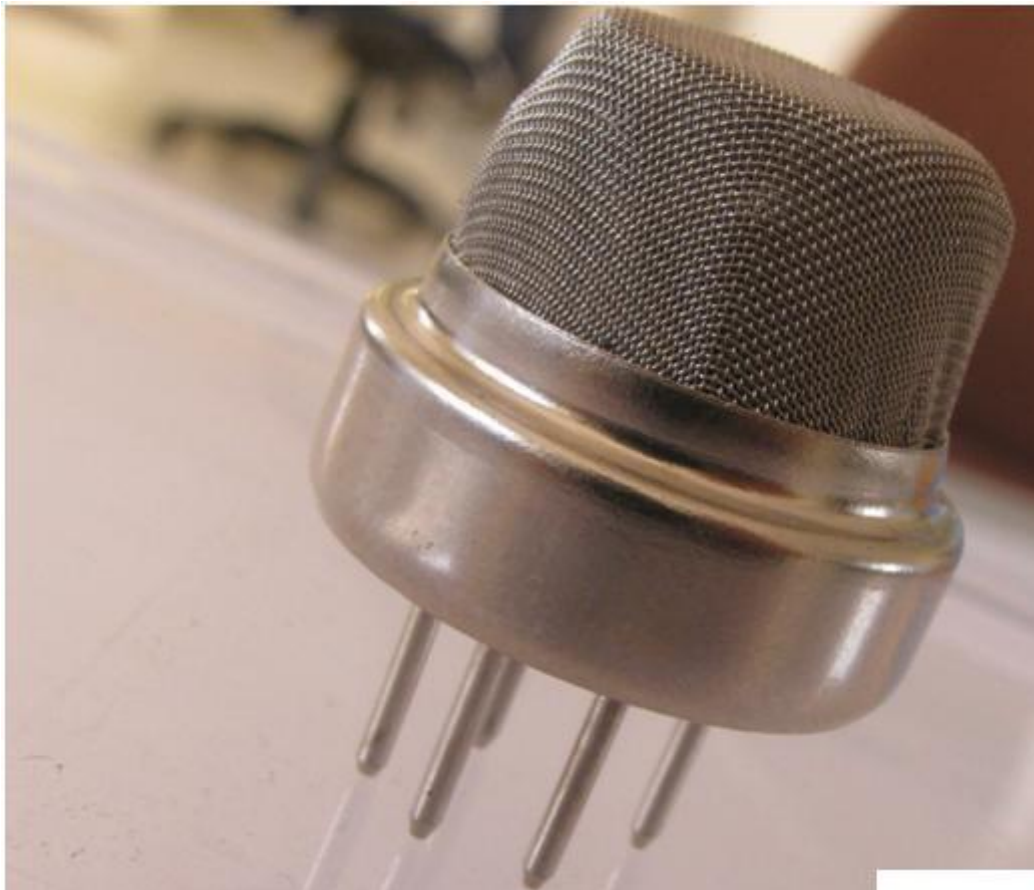
NodeMCU ESP8266 Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

METHANE Gas sensor

In current technology scenario, monitoring of gases produced is very important. From home appliances such as air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial. Gas sensors are very important part of such systems. Small like a nose, gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state.

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. What is this sensing element? Is it kept in some chamber or is kept exposed? How does it get current and how it is taken out? Let's find out in this Insight!!!



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.

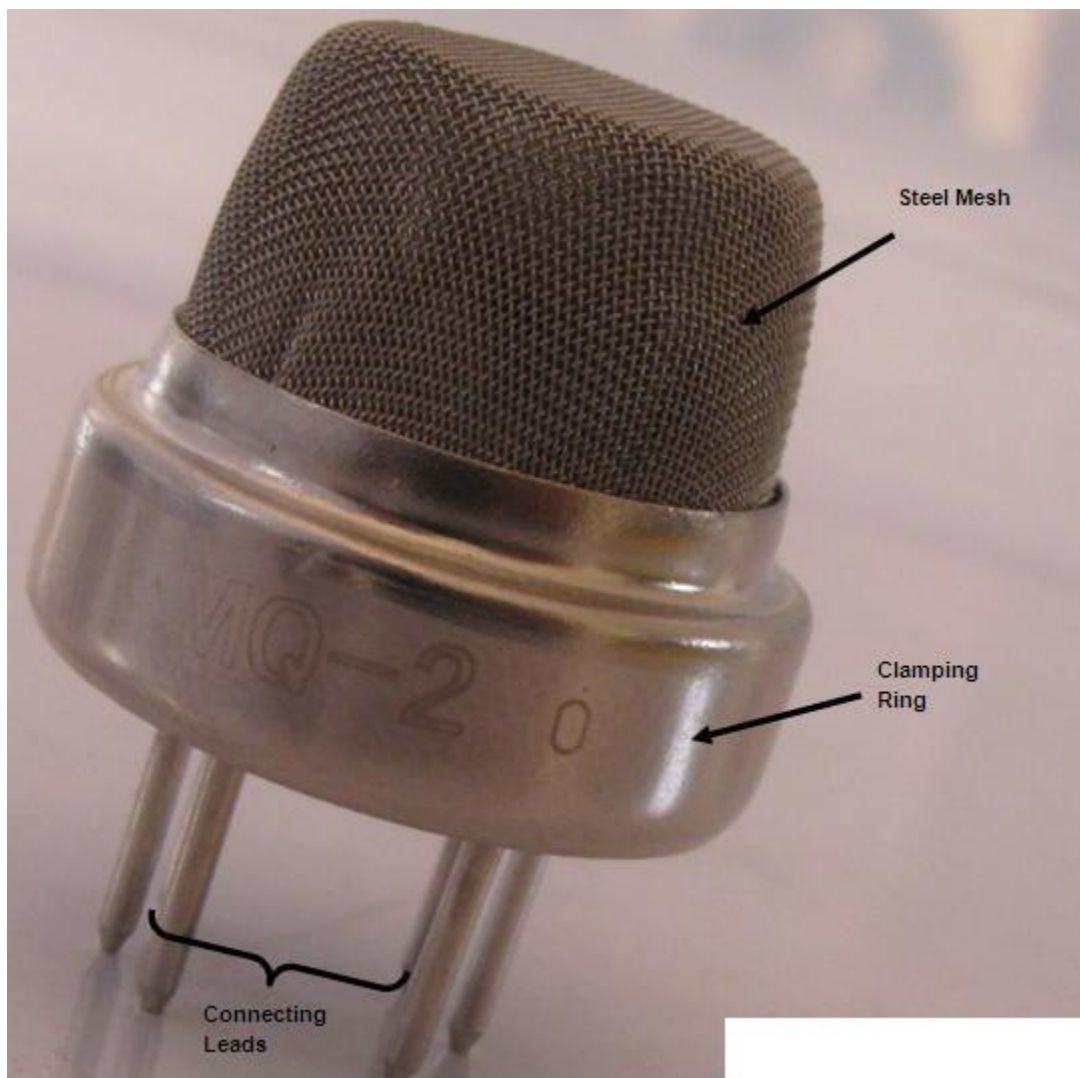


Image shows externals of a standard gas sensor module: a steel mesh, copper clamping ring and connecting leads. The top part is a stainless steel mesh which takes care of the following:

- ✓ Protecting the insides of the sensor.
- ✓ Exhibits an anti-explosion network that keeps the sensor module intact at high temperatures and gas pressures.

In order to manage above listed functions efficiently, the steel mesh is made into two layers. The mesh is bound to rest of the body via a copper plated clamping ring.

The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part. They are casted from copper and have tin plating over them. Four of the six leads (A, B, C, D) are for signal fetching while two (1, 2) are used to provide sufficient heat to the sensing element.

The pins are placed on a Bakelite base which is a good insulator and provides firm gripping to the connecting leads of the sensor. The top of the gas sensor is removed off to see the internals parts of the sensor: sensing element and connection wiring. The hexapod structure is constituted by the sensing element and six connecting legs that extend beyond the Bakelite base.

Image shows the hollow sensing element which is made up from Aluminium Oxide based ceramic and has a coating of tin oxide. Using a ceramic substrate increases the heating efficiency and tin oxide, being sensitive towards adsorbing desired gas' components (in this case methane and its products) suffices as sensing coating.

The leads responsible for heating the sensing element are connected through Nickel-Chromium, well known conductive alloy. Leads responsible for output signals are connected using platinum wires which convey small changes in the current that passes through the sensing element. The platinum wires are connected to the body of the sensing element while Nickel-Chromium wires pass through its hollow structure. While other wires are attached to the outer body of the element,

Nickel-Chromium wires are placed inside the element in a spring shaped. Image shows coiled part of the wire which is placed on the inside of the hollow ceramic.

Image shows the ceramic with tin dioxide on the top coating that has good adsorbing property. Any gas to be monitored has specific temperature at which it ionizes. The task of the sensor is to work at the desired temperature so that gas molecules get ionized. Through Nickel-chromium wire, the ceramic region of the sensing element is subjected to heating current. The heat is radiated by the element in the nearby region where gases interact with it and get ionized. Once, ionized, they are absorbed by the tin dioxide. Adsorbed molecules change the resistance of the tin dioxide layer. This changes the current flowing through the sensing element and is conveyed through the output leads to the unit that controls the working of the gas sensor.

CO GAS SENSOR

A **carbon monoxide detector** or **CO detector** is a device that detects the presence of the carbon monoxide (CO) gas to prevent carbon monoxide poisoning. In the late 1990s Underwriters Laboratories changed the definition of a single station CO detector with a sound device to **carbon monoxide (CO) alarm**. This applies to all CO safety alarms that meet UL 2034 standard;^[1] however for passive indicators and system devices that meet UL 2075, UL refers to these as *carbon monoxide detectors*.

CO is a colorless, tasteless and odorless gas produced by incomplete combustion of carbon-containing materials. It is often referred to as the "silent killer" because it is virtually undetectable by humans. In a study by Underwriters Laboratories, "Sixty percent of Americans could not identify any potential signs of a CO leak in the home".^[2] Elevated levels of CO can be dangerous to humans depending on the amount present and length of exposure. Smaller concentrations can be harmful over longer periods of time while increasing concentrations require diminishing exposure times to be harmful.^[3]

CO detectors are designed to measure CO levels over time and sound an alarm before dangerous levels of CO accumulate in an environment, giving people adequate warning to safely ventilate the area or evacuate. Some system-connected detectors also alert a monitoring service that can dispatch emergency services if necessary.

While CO detectors do not serve as smoke detectors and vice versa, combined smoke/CO detectors are also sold.^[4] In the home, some common sources of CO include open flames, space heaters, water heaters, blocked chimneys or running a car or grill inside a garage.^[5]

The devices, which retail for \$15–\$60 USD and are widely available, can either be battery-operated or AC powered (with or without a battery backup). Battery lifetimes have been increasing as the technology has developed and certain battery-powered devices now advertise a battery lifetime of up to 10 years. All CO detectors have "test" buttons like smoke detectors but the Test Button on a CO alarm only tests the battery, electronic circuit and buzzer, not the alarm's ability to sense gas.

CO detectors can be placed near the ceiling or near the floor because CO has nearly the same density as air,^{[6][7]} but the National Fire Protection Association (NFPA) states: "Follow the manufacturer's instructions for placement and mounting height".^[8]

Since CO is colorless, tasteless, and odorless (unlike smoke from a fire), detection in a home environment is impossible without such a warning device. It is a highly toxic inhalant and attaches to the hemoglobin in the blood stream with an affinity 200x stronger than oxygen,^[9] producing inadequate amounts of oxygen traveling through the body.

When carbon monoxide detectors were introduced into the market, they had a limited lifespan of 2 years. However as battery technology developments have increased this and many now advertise up to 10 years however the sensor components can fail at any time for many reasons and failure may not be detected by the test button. Newer models are designed to signal a need to be replaced after a set time-span but the sensor could still fail at any time.

According to the 2005 edition of the carbon monoxide guidelines, NFPA 720,^[10] published by the National Fire Protection Association, sections 5.1.1.1 and 5.1.1.2, all CO detectors "shall be centrally located outside of each separate sleeping area in the immediate vicinity of the bedrooms," and each detector "shall be located on the wall, ceiling or other location as specified in the installation instructions that accompany the unit."

According to the 2009 edition of the IRC,^[11] published by the International Code Council, section R315.1, "For new construction, an approved carbon monoxide alarm shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within

which fuel-fired appliances are installed and in dwelling units that have attached garages", and section 315.2, "Where work requiring a permit occurs in existing dwellings that have attached garages or in existing dwellings within which fuel-fired appliances exist, carbon monoxide alarms shall be provided in accordance with Section R315.1."

Installation locations vary by manufacturer. Manufacturers' recommendations differ to a certain degree based on research conducted with each one's specific detector. Therefore, make sure to read the provided installation manual for each detector before installing.

CO detectors are available as stand-alone models or system-connected, monitored devices.^[12] System-connected detectors, which can be wired to either a security or fire panel, are monitored by a central station. In case the residence is empty, the residents are sleeping or occupants are already suffering from the effects of CO, the central station can be alerted to the high concentrations of CO gas and can send the proper authorities to investigate.

The gas sensors in CO alarms have a limited and indeterminable life span, typically two to five years. The test button on a CO alarm only tests the battery and circuitry, not the sensor. CO alarms should be tested with an external source of calibrated test gas, as recommended by the latest version of NFPA 720. Alarms over five years old should be replaced but they should be checked on installation and at least annually during the manufacturers warranty period. Most alarm manufacturers now recommend sensor inclusive testing on installation and at least annually.

Sensors

Early designs used a chemical detector consisting of a white pad that faded to a brownish or blackish color in the presence of carbon monoxide. Such detectors are cheap, but only give a visual warning. As carbon monoxide related deaths increased during the 1990s, audible alarms became standard.

The alarm points on carbon monoxide detectors are not a simple alarm level (as in smoke detectors) but are a concentration-time function. At lower concentrations, e.g. 100 parts per million (PPM), the detector does not sound an alarm for many tens of minutes. At 400 PPM, the alarm sounds within a few minutes. This concentration-time function is intended to mimic the uptake of carbon

monoxide in the body while also preventing false alarms due to brief bursts of carbon monoxide from relatively common sources such as cigarette smoke.

Four types of sensors are available, varying in cost, accuracy and speed of response.^[13] Most detectors do not have replaceable sensors.

SOFTWARE REQUIREMENTS:

PROTEUS

PROTEUS SOFTWARE:

Proteus 8 is a best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. You can simulate your programming of microcontroller in Proteus 8 Simulation Software. After simulating your circuit in Proteus 8 Software you can directly make PCB design with it so it could be a all in one package for students and hobbyists. So I think now you have a little bit idea about what is proteus software.

Proteus is a Virtual System Modelling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs. This is the perfect tool for engineers to test their microcontroller designs before constructing a physical prototype in real time. This program allows users to interact with the design using on-screen indicators and LED and LCD displays and, if attached to the PC, switches and buttons.

Proteus comes with extensive debugging features, single stepping and variable display for a neat design prior to hardware prototyping. Proteus is the program to use when you want to simulate the interaction between software running on a microcontroller and any analog or digital electronic device connected to it.

Proteus was initially created as a multiplatform (DOS, Windows, Unix) system utility, to manipulate text and binary files and to create CGI scripts. The language was later focused on Windows, by adding hundreds of specialized functions for: network and serial communication, database interrogation, system service creation, console applications, keyboard emulation, ISAPI scripting (for IIS). Most of these additional functions are only available in the Windows flavour of the interpreter, even though a Linux version is still available.

Proteus was designed to be practical (easy to use, efficient, complete), readable and consistent.

Its strongest points are:

- powerful string manipulation;
- comprehensibility of Proteus scripts;
- Availability of advanced data structures: arrays, queues (single or double), stacks, bit maps, sets, AVL trees.
- The language can be extended by adding user functions written in Proteus or DLLs created in C/C++.

GET PROTEUS 8 SOFTWARE?

After getting introduction about what is proteus software if you wish to download and give a try to proteus 8 software then labcenter is giving latest version of proteus, proteus 8 demo version for free of cost. The latest Proteus Software version is Proteus 8. You can download it from here.

EXPLANATION:

If you have clear idea about what is proteus 8 simulation software then you can start proteus 8 simulations at this point of time. I am sure that you have your proteus 8. If you don't have then download from above link. To learn Proteus 8 You can start with a series of video tutorials or you can download a Proteus 8 Software Tutorial PDF. But main and most important thing with this software is hands on experiments. the more you work the better you become There is no shortcut.

After making your Schematic you have to do PCB designing so here is the video tutorial which describes Single layer auto routing.

At first sight, Proteus may appear similar to Basic because of its straight syntax, but similarities are limited to the surface:

LANGUAGE FEATURES:

Proteus has a fully functional, procedural approach; variables are untyped, do not need to be declared, can be local or public and can be passed by value or by reference; all the typical control structures are available (if-then-else; for-next; while-loop; repeat-until; switch-case); new functions can be defined and used as native functions.

Data types supported by Proteus are only three: integer numbers, floating point numbers and strings. Access to advanced data structures (files, arrays, queues, stacks, AVL trees, sets and so on) takes place by using handles, i.e. integer numbers returned by item creation functions.

Type declaration is unnecessary: variable type is determined by the function applied – Proteus converts on the fly every variable when needed and holds previous data renderings, to avoid performance degradation caused by repeated conversions.

There is no need to add parenthesis in expressions to determine the evaluation order, because the language is fully functional (there are no operators).

Proteus includes hundreds of functions for:

- accessing file system;
- sorting data;

- manipulating dates and strings;
- interacting with the user (console functions)
- Calculating logical and mathematical expressions.

Proteus supports associative arrays (called sets) and AVL trees, which are very useful and powerful to quickly sort and lookup values.

The functional approach and the extensive library of built-in functions allow to write very short but powerful scripts; to keep them comprehensible, medium-length keywords were adopted. The user, besides writing new high-level functions in Proteus, can add new functions in C/C++ by following the guidelines and using the templates available in the software development kit; the new functions can be invoked exactly the same way as the predefined ones, passing expressions by value or variables by reference. Proteus is an interpreted language: programs are loaded into memory, pre-compiled and run; since the number of built-in functions is large, execution speed is usually very good and often comparable to that of compiled programs. One of the most interesting features of Proteus is the possibility of running scripts as services or ISAPI scripts. Running a Proteus script as a service, started as soon as the operating system has finished loading, gives many advantages: no user needs to login to start the script; a service can be run with different privileges so that it cannot be stopped by a user. This is very useful to protect critical processes in air environments (data collection, device monitoring), or to avoid that the operator inadvertently closes a utility (keyboard emulation). The ISAPI version of Proteus can be used to create scripts run through Internet Information Services and is equipped with specific functions to cooperate with the web server.

For intellectual property protection Proteus provides:

digital signature of the scripts, by using the development key (which is unique); the option to enable or disable the execution of a script (or part of it) by using the key of the customer. Proteus is appreciated because it is relatively easy to write short, powerful and comprehensible scripts; the large number of built-in functions, together with the examples in the manual, keep low the learning curve.

The development environment includes a source code editor with syntax highlighting and a context-sensitive guide. Proteus does not need to be installed: the interpreter is a single executable (below 400 Kb) that does not require additional DLLs to be run on recent Windows systems.

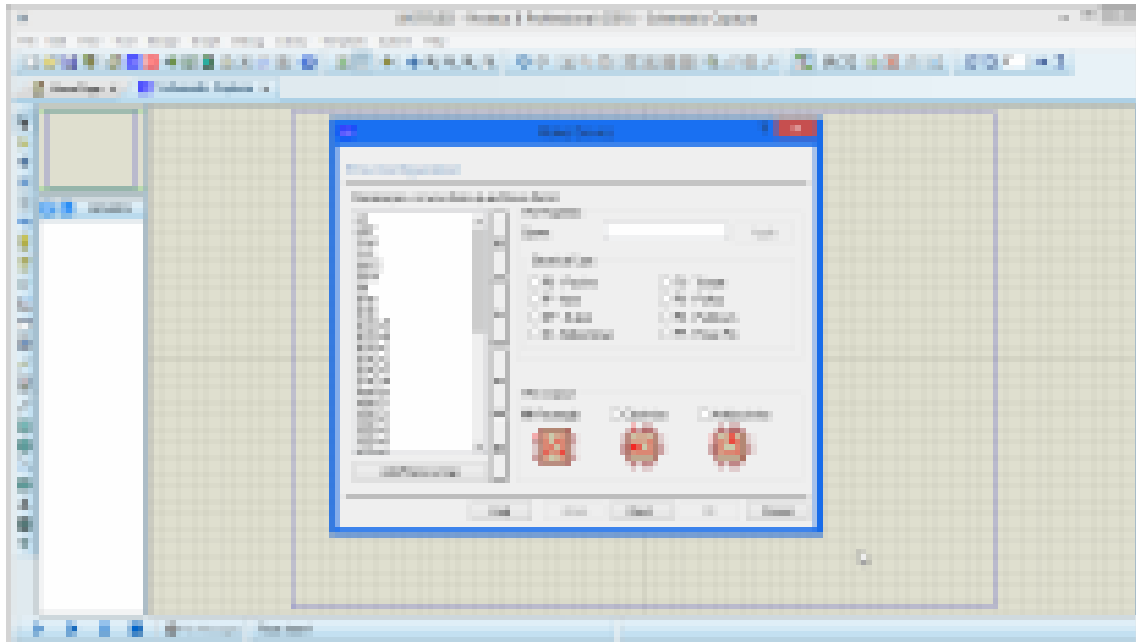
HOW TO SETUP PROTEUS?

1. Start-up the Microsoft Windows.
2. Place the ECOM 4315 CD into CD ROM drive.
3. Double click on the software tools folder and then choose Proteus Simulator after that double click Proteus 7.1 folder and run the setup.
4. Press next until you reach the window which ask for the key.
5. From browse for key; browse until you reach the same folder where the setup exists, and then open the second folder and chose the MAXIM_LICENCE folder.
6. Then click on the top icon which is MAXIM and then press install.
7. Then choose yes and then close the window, after that browse and install the program.
8. After that run the patch which exist in the same folder where the MAXIM_LICENCE exists.
9. Then browse for c:\Program files\Labcenter electronics \Proteus.
10. Finally chose next, and then finish.

GET STARTED TO PROTEUS

1. From start menu chose the PROTEUS, and then chose ISIS(blue).
2. To get a part click on Devices (P).
3. Write the name of the PIC16F84A.
4. To get LED write led then chose green led.
5. To get a resistor write 1k and chose the first part. Device Libraries

Proteus capture comes with pre-supplied libraries for TTL, CMOS, ECL, Microprocessor, Memory and Analogue ICs plus libraries with hundreds of named Bipolar, FET and Diode discrete semiconductors. Also included are manufacturer specific libraries from National Semiconductor, Philips, Motorols, Teccor, Texas Instruments, Dallas and Zetex amongst others - an expanding total, currently over 10,000 parts.

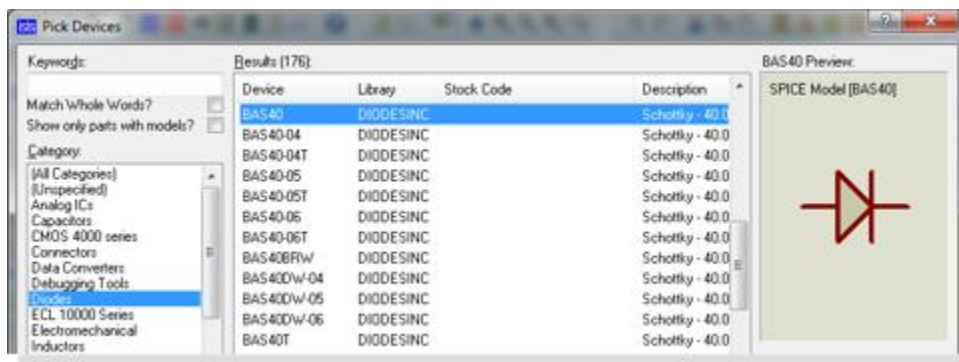


Importing Components from BSDL

Direct import of BSDL (Boundary Scan Description Library) files provides a semi-automatic way to quickly create and package larger components.

Libraries provided with Proteus also contain default properties for PCB packaging and/or simulator models. Both homogenous and heterogeneous multi-element devices are supported so you can place a relay's coil and contacts on separate parts of the drawing. Connector pins can also be distributed. Device editing is performed directly on the drawing using the general editing tools. Devices may be constructed from lines, boxes, circles, arcs, text and special pin objects. Non-electrical symbols may also be created for use in small mechanical or block diagrams.

A summary listing of included embedded peripheral libraries can be found [here](#).



UBIDOTS:

Ubidots is an IoT Platform empowering innovators and industries to prototype and scale IoT projects to production. Use the Ubidots platform to send data to the cloud from any Internet-enabled device. You can then configure actions and alerts based on your real-time data and unlock the value of your data through visual tools. Ubidots offers a REST API that allows you to read and write data to the resources available: data sources, variables, values, events and insights. The API supports both HTTP and HTTPS and an API Key is required.

Your data will be protected with two more replication, encrypted storage and optional TLS/SSL data support. You can also customize permission groups to each module of the platform, making sure the right information is shown to the right user.

Born as an engineering services firm in 2012, Ubidots delivered end-to-end IoT solutions in tandem with its partner and co-founding company Netux, to remotely monitor, control, and automate processes for healthcare clients as well funded startups and Fortune 1,000s in the American Southeast and across Latin America.

Between 2012 and 2014, Ubidots accomplished countless internet connected projects across Healthcare, Energy / Utilities, Manufacturing, Transportation, and Retail – learning the many small characteristics of IoT and Cloud enablement that digital transformation experts cannot speak to unless they have gotten their hands dirty in the field.

With a strong backbone and a steadfast determination to become a product-led company, Ubidots joined the Boston MassChallenge Accelerator in 2013, pivoting into a global tech startup, gaining US venture and support, and leaving behind the local services business.

Since Ubidots pivot in 2014, Ubidots has become known within hardware, software, embedded engineering, and maker circles as the affordable, reliable, and most usable platform in the IoT Application Enablement ecosystem.

In line with Ubidots guiding principles, in 2018 Ubidots spun out and repurposed its first ever cloud version as Ubidots STEM. Rather than retiring this shared-resources platform, Ubidots instead empowers 60,000+ students, makers and researchers to explore and develop technology and solutions, giving all users their first 3 devices free, always!

Ubidots Basics: Devices, Variables, Dashboards, and Alerts

The basics components of any Internet of Things application powered by Ubidots are: **Devices, Variables, Synthetic Variables Engine, Dashboards, and Events**. Within this article we will

address each of these concepts as they relate to Ubidots IoT Development and Deployment Platform and how you can better organize your Ubidots Apps to best connect with the users.

Once your devices, variables, and general Application is assembled, give your App some layers with Ubidots Device Management to learn more about Ubidots internal architecture and how you can use Apps, Organizations, and Users to efficiently connect your data with those who should be using it.

1. Devices
2. Variables
3. Synthetic Variables Engine
4. Dashboard and Visualizations
5. Events.

1. Devices

A Ubidots' device is a virtual representation of a data-source or simply, an asset taking sensor data and transmitting said data through a connection protocol to Ubidots' cloud. [Click here](#) for current firmware examples and tutorials for connecting your device to Ubidots.

All devices are different, but the standard setup on any device entails:

- A library that should be installed in the device's IDE. (not required)
- Filling parameters for authentication and connection such as a TOKEN (i.e. the unique ID for each account or user), device and variable labels (i.e. devices and variables unique identifiers in Ubidots), Wi-Fi SSID and Password, depending on the device and the requirements.
- Making API request (i.e. a call from a device to the web server). Ubidots' libraries spare the need to manually make these requests. However, if you're working with a device not

currently in the list of supported hardware, you can choose a connectivity protocol such as MQTT or HTTP and make a request using the API accordingly.

Creating devices: there are three ways to create devices:

1. Devices are created automatically in Ubidots the first time a dot is received to a user's private TOKEN or an Organizational TOKEN.
2. Clicking the "+" icon in the top right corner of any single device's screen.
3. Creating a Device Type which then creates a new device with pre-determined device properties, appearance, and variables and automate the on-boarding of thousands of devices.

ubidots

Device Management ▾Users ▾AppsReports

Devices

All organizations

Search Devices

Devices

☐	NAME	LAST ACTIVITY ▾	CREATED AT	ORGANIZATION	ACTIONS
	Elays Device	a few seconds ago	2018-04-13 13:47:07 -05:00	---	
	Currencies	5 minutes ago	2018-05-09 00:42:46 -05:00	---	
	Speed Test	a day ago	2017-11-04 11:04:57 -05:00	Manny Machines, Inc.	
	Tank	8 days ago	2018-02-12 16:28:05 -05:00	Manny Machines, Inc.	
	My Device	9 days ago	2018-07-12 17:42:37 -05:00	Manny Machines, Inc.	
	LoRaWAN T1	10 days ago	2018-07-16 00:01:00 -05:00	Nuevo Cliente	
	Run time	12 days ago	2018-07-13 11:45:23 -05:00	---	

2. Variables

Once a device is created and receiving data from your hardware or another 3rd party data-source, the data will be presented in its raw or calculated form as a **variable**.

Types of Variables:

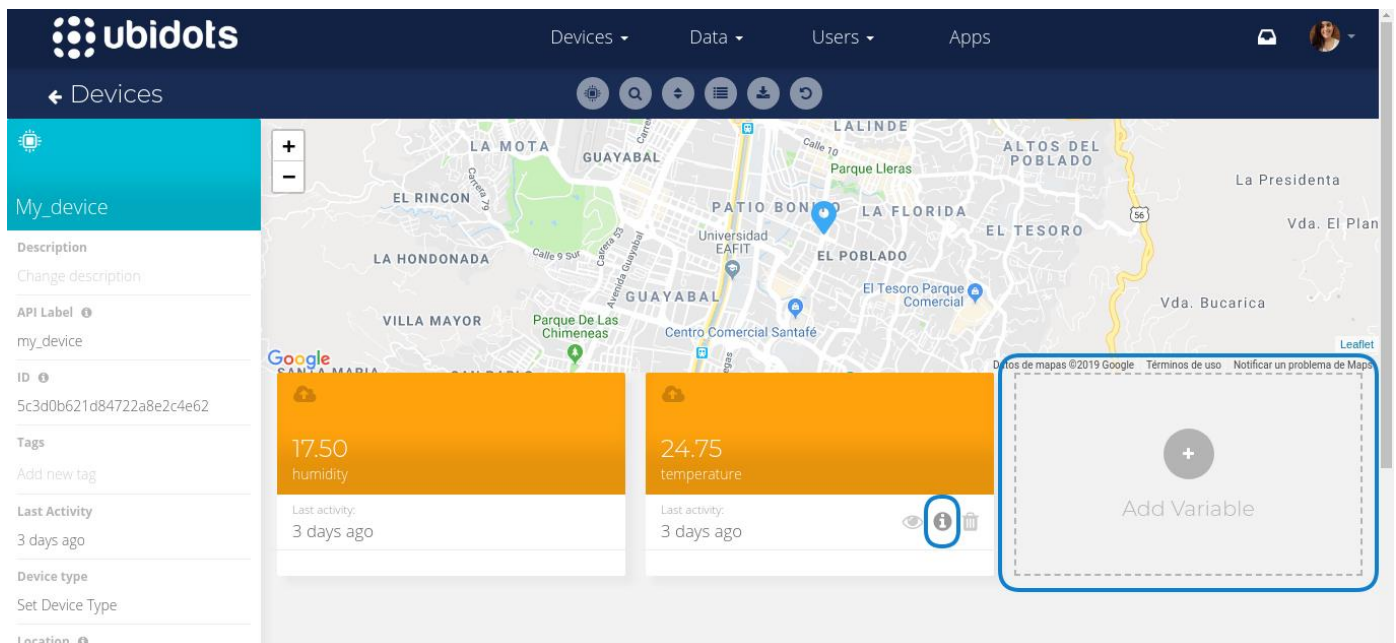
– **Default** - raw data coming from devices (people counted).

- **Synthetic** - correspond to statistical or arithmetical operations of default variables in a determined time-frame (e.g. average daily traffic this month).

Below you can read more about synthetic variable setups.

Creating variables: there are two ways to create variables.

1. Assigning a label as a variable within your hardware's code.
2. Clicking the "+" icon found in any single device screen and assign a name which will also correspond to the variable's label. By default, Ubidots assigns an additional unique identifier to the variable called Variable ID. To find both the variable's ID and variable's label, select the "i" icon from the variables card.



3. Synthetic Variables Engine

Ubidots Synthetic Variables (SV) Engine is a simple and effective way to create insights from the raw data stored in Ubidots' Cloud. Using Ubidots SV Engine, users can create **Synthetic Variables** that calculate and enhance data to give data-driven decision to user of an Ubidots powered application.

For example, to calculate Average (mean) Energy consumed this week, we will need to create a synthetic variable called Energy to calculate the product of Current and Voltage ($P=C*V$): the **default variable Current is multiplied by Voltage**. Then average the product every week with built-in function *mean()*.

Synthetic Variables Analytics

Energy

Synthetic Variable

Enter your synthetic variable expression. [Learn more about synthetic variables.](#)

1 mean(**current** * **voltage** , "W")

Timezone:

America/Bogota

Click on a variable to add it to your expression:

Current

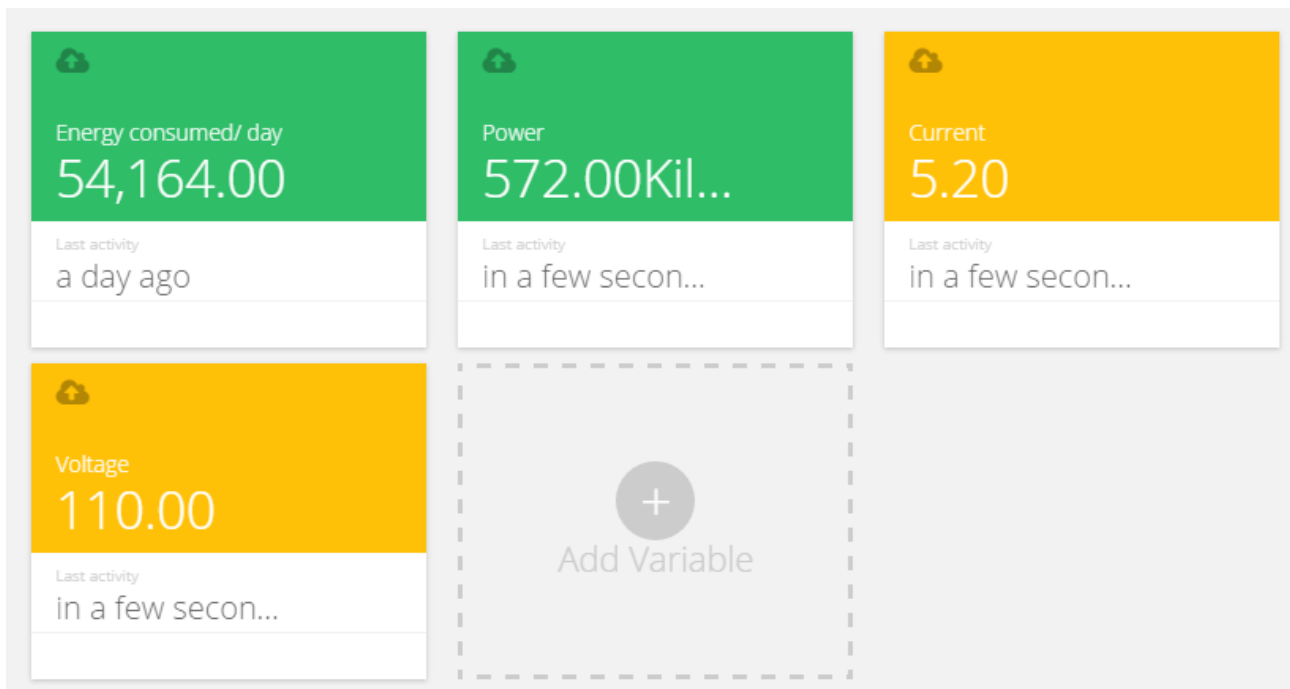
Voltage

✓

Cancel

Accept

Here is a complete list of available functions, such as **cos(x)** or **ceil(x)** functions, and more!



Note that default variables are yellow, and Synthetic Variables are green.

4. Dashboards and Visualizations

Dashboards are the human-machine interfaces where data is easily visualized. Your Ubidots account will let you create as many dashboards as needed, containing widgets and data-visualizations to comprehend your data at a glance. For additional details on your dashboard's construction, check out this tutorial.

5. Events

In Ubidots, Events are messages triggered and delivered through Email, SMS, Telegrams, Slack, Voice Call or webhook messages based on a customized design rule created in the application. If you wish to create alerts for your IoT application, check out this tutorial for additional support.

3 Event types:

- When sensor readings reach a specific value:

If triggers

then actions

demo

+

Value

✓

is

Equal to

Equal to

Greater than

Greater than or equal to

Less than

Less than or equal to

Not equal to

10

for

0

minutes

- Variable is inactive during a specific amount of time:

If triggers

then actions

demo

+

Has been inactive

✓

for

10

minutes

✓

+ And

+ Or

- When a device enters or exits a specific area (geofence):

Add Geofence



Please add a geofence



You can also determine the format of alerts by choosing between emails, SMS, Telegrams or Webhook.

CHAPTER 5

RESULT & DISCUSSION

The system to monitor the air of environment using Arduino microcontroller, IOT Technology is proposed to improve quality of air. With the use of IOT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. Here, using the MQ135 and MQ6 gas sensor gives the sense of different type of dangerous gas and Arduino is the heart of this project. Which control the entire process. Wi-Fi module connects the whole process to internet used for the visual Output. The IOT based pollution monitoring and controlling using the Arduino system is designed to sense the smoke, temperature, and radiation. If any pollution is detected then the power supply of that industry will cut off. This will prevent further emissions of pollution.

CONCLUSION

The proposed system which is designed shows the simulation output of sensing the carbon dioxide gas, methane gas . Certain actions are taken when the authority does not take any steps to control the emissions even after the alarm is given. The sensor output is pushed to cloud and can be viewed through internet. This is a robust system which is very useful in industries because of the increasing pollution due to increase in industries. This system is user friendly and cost of the product is affordable. The results of the project are accurate and hence can be implemented in any industries for the safety of workers and the environment. Each and every industry whether small scale or large scale should and must have this system to monitor the emissions. This project is done keeping in mind the small scale industries and hence it is affordable.



REFERENCES

- [1]. Chandana, P. Sai, K. Sreelekha, A. Muni Likith Reddy, M. Anil Kumar Reddy, and R. Senthamilselvan. "IOT
- [2]. Dr. A. Sumithra, P.J. Jane Ida, PK. Karthika, Dr. S. AIR AND SOUND POLLUTION MONITORING SYSTEM." International Journal on Applications in Engineering and Technology, Volume 3, Issue 1-March 2017.
- [3]. Gavaskar, "A brilliant ecological checking framework utilizing web of things", International Journal of Scientific Engineering and Applied Science, Volume 2, Issue 3-March 2016.
- [4]. Muhammad SaqibJamil, Muhammad AtifJamil, AnamMazhar, AhsanIkram, Abdullah Ahmed, and UsmanMunawar (2015). "Shrewd Environment Monitoring Framework by utilizing Wireless Sensor Networks on Vehicles for Pollution Free Smart Cities" - Humanitarian Technology: Science, Systems and Global Impact 2015, HumTech.
- [5]. SushmaMaithare, Dr. Vijaya Kumar B P, "Implanted System for Noise Pollution Monitoring utilizing IoT Platform to make Smart Environment", International Journal of Advanced Research (2015), Volume 3, Issue 8, 658-666. 6. Mr. NerellaOme, Mr. G. SomeswaraRao. "Web of Things (IoT) based Sensors to Cloud framework utilizing ESP8266 and Arduino Due", Vol. 5, Issue 10, October 2016.