Portable Air-Pollution Monitoring and Alerting System for Traffic Policeman Using IOT

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***Abstract*—** The level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it. The worst affected by this are the traffic policeman who stay outside breathing the toxic gases and bearing the strong heat to maintain a constant traffic flow. Studies and surveys show that they suffer from Respiratory diseases, Photo sensitivity, skin infections, nausea, high blood pressure and many more problems.

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.Governments and Citizens are looking for scientific intellect to challenge the common threat pollution in its many procedures. Currently mobile apps are able to accomplish functions like reporting status of air quality, air quality forecasts, air quality monitoring in a particular area, and risks highlighting. But these applications do not provide the user with data of a local area where the user is currently located.

***Index Terms*—**IOT , ESP8266 , NodeMCU, ThinkSpeak

I. INTRODUCTION

One of the basic requirements of human health and well-being is clean air. However, the World Health Organization (WHO) estimates that around 1.4 billion urban residents worldwide are living in areas with air pollution above recommended air quality guidelines, and reports that air pollution kills about 7 million people a year. Chronic exposure to air pollution increases the risk of cardiovascular and respiratory mortality and morbidity, while acute short-term inhalation of pollutants can induce changes in lung function and the cardiovascular system exacerbating existing conditions such as asthma, and ischemic heart disease. Monitoring and controlling air pollution is high on the public consciousness in both developing and developed countries.

Several governments operate air quality monitoring stations and publish the data. These stations are generally outfitted with several high-quality monitoring devices that can measure a wide range of air pollutants (such as CO, NOx, SO2, ozone, particulate matter, etc.). However, the high costs of installing and maintaining these sites limits their number.

Existing monitoring systems have inferior precision, low sensitivity, and require laboratory analysis. Therefore, improved monitoring systems is needed. To overcome the problems of existing systems, we will develop an economical and portable air pollution monitoring system. An IoT kit was prepared using gas sensors, Arduino IDE (Integrated Development Environment), and a Wi-Fi module. This kit can be physically placed in various cities to monitoring air pollution. The gas sensors gather data from air and forward the data to the Arduino IDE. The Arduino IDE transmits the data to the cloud via the Wi-Fi module.

II. METHODOLOGY

The paper discusses methods to notify traffic policemen or general public about the air quality of a particular area. The paper proposes a smart city product will can rise awareness about the ever increasing pollution.

Base sensor which are reliable and sensor to high degree of correctness are used to capture data using a microcontroller NodeMCU.

NodeMCU having an added advantage to the Arduino Uno is the Wifi Capability can be used to connect to the internet. Conducting research and experiments a threshold value is determined beyond which the air quality is consider to be unhealthy.

Users collect and contribute air pollution data obtained from personal sensing units, and the greater spatial density of data thus obtained from many users in turn gives each user more accurate estimates of their pollution exposure.

The alert to the user is sent via mail or indicators.

1. portable sensor units that monitor air pollution,

2. applications on the driver's mobile phone that harvests the data from the sensor unit, tags it with location and time information, and uploads it in real- time to our server,
3. the cloud-based server that stores the data, and applies interpolationmodels to generate spatio-temporal estimates, and
4. visualization tools that map pollution levels and personalize theinformation for the individual user. The first two steps constitute data collection, while the latter two steps comprise data consumption.

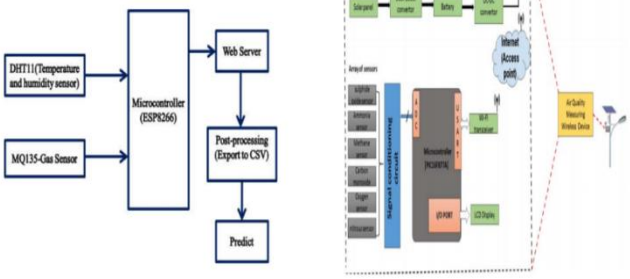
III. LITERATURE SURVEY

Some previous works like Smart environment monitoring system [9] on vehicles was introduced on 2015. It basically figured out the emission rate of poisonous gasses which are Responsible for air pollution. Industrial air pollution [12] monitoring system for safety and health enhancement was introduced to know the hazardous gasses and their impact. Low cost air quality system [13] was discussed on 2008 as because at that time the sensors were quiet expensive and also the system. By using mobile GPRS [8] system air pollution could be detected. Wireless sensor network based pollution monitoring system in metropolitan cities was introduced to know the air quality [5].Pollution Dynamic Monitoring System [6] is also done previously.
By reviewing the future researches which has done before we can say that air pollution has increased in an alarming rate. If it is not stopped immediately the whole world is going to face a filthy and extreme weather for the future. There are more pollutions e.g. water pollution, noise pollution, plastic pollution, soil contamination but from the future studies we can say that air pollution is the most alarming issue and this should be studied for the sake of saving the world.

IV. CHALLENGES AND ISSUES

Most of the works lack the functionality to provide a user with instantaneous air quality updates. Knowing about the current quality to air in the environment will help in rising awareness and taking action. Also I huge investment cost is required to establish nodes in various places to get the most accurate result. The cost of microcontroller, knowledge and maintenance is a very big issue as the concept of IOT is not well-known among general public.

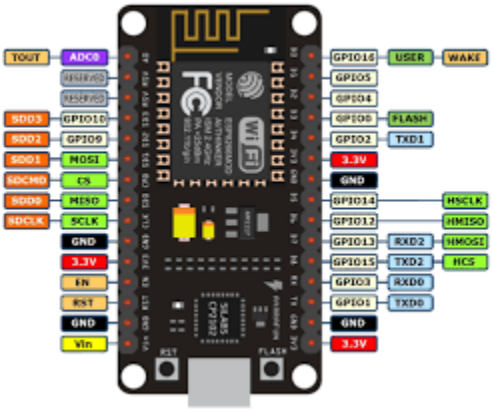
V. ARCHITECTURE



VI. COMPONENTS USED

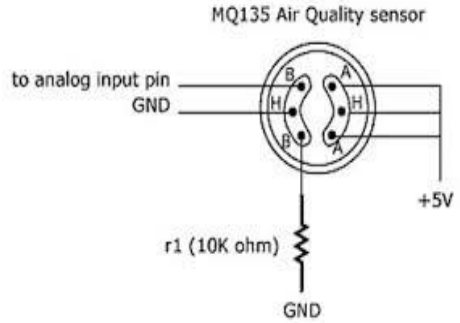
A. Hardware-

1. NodeMCU- NodeMCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with ESP8266 Development board/kit i.e. NodeMCU Developmentboard.



2. MQ-135 Gas Sensor

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

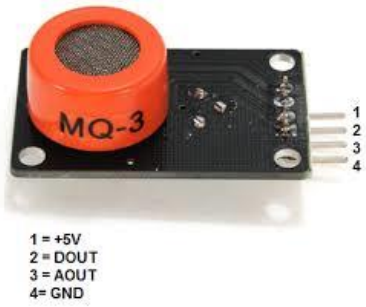


3. DHT 11

The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

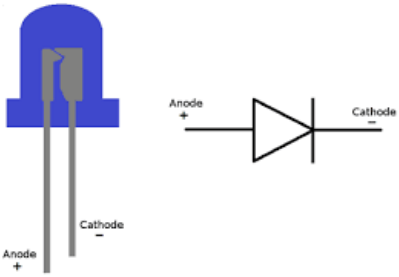
4. MQ3 Sensor-

The Grove - Gas Sensor (MQ3) module is useful for gas leakage detection (in home and industry). It is suitable for detecting Alcohol, Benzene, CH4, Hexane, LPG, CO. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.



5. LED

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.



B. SOFTWARE-

Arduino IDE

The Arduino board is connected to a computer via USB, where it connects with the Arduino development environment (IDE). The user writes the Arduino code in the IDE, then uploads it to the microcontroller which executes the code, interacting with inputs and outputs such as sensors, motors, and lights.

Thing-Speak

Thing-Speak is an IoT analytics platform service that allows you to aggregate, visualize and analyse live data streams in the cloud.

Thing-Speak allows you can perform online analysis and processing of the data as it comes in.

Blynk App

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.

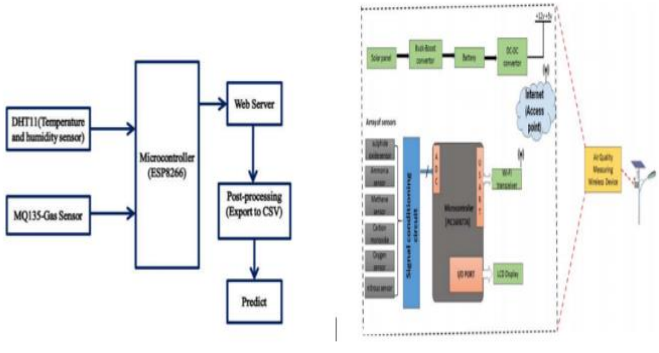
VII. PROPOSED METHOD AND ALGORITHM

The design of the air pollution monitoring system involves three main phases:

Phase 1: detect the concentration of air pollutants in the area of interest via sensors.

Phase 2: develop a user-friendly and portable interface – a Web Application, which the user can use to know the pollution level in his/her particular area. Using 3rd party software like Blynk app, instant result and email based notification is possible.

Phase 3: connect to internet via the esp8266 module and send the data. Conducting research determine the conditions for unhealthy air quality and alert the user.



THRESHOLD VALUE

The AQI is an index for reporting daily air quality. It tells you how clean or unhealthy your air is, and what associated health effects might be a concern. The AQI focuses on health effects you may experience within a few hours or days after breathing unhealthy air.

The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value

of 50 represents good air quality with little or no potential to affect public health, while an AQI value over 300 represents air quality so hazardous that everyone may experience serious effects.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 - 50	Good	Green
51 - 100	Moderate	Yellow
101 - 150	Unhealthy for Sensitive Groups	Orange
151 - 200	Unhealthy	Red
201 - 300	Very Unhealthy	Purple
301 - 500	Hazardous	Maroon

The AQI is calculated and reported by monitoring record concentrations of the major pollutants at more than a thousand locations across the country. These raw measurements are converted into a separate AQI value for each pollutant (ground-level ozone, particle pollution, carbon monoxide, and sulfur dioxide) using standard formulas developed by EPA.

VIII. EXISTING METHODS

The existing monitoring and sensing system receive, store the data, preprocess and convert the data into useful information. Using the sensors such as MQ7 (CO detector), MQ9, MQ135(Air Quality detector), MQ3(Alcohol and Smoke detector) and Arduino Uno. But the information cannot be monitored by a person far away from the sensor.

Wifi module ESP 8266 which gives the system access to the internet. Being very cheap it makes the project more powerful. It can be used to send the data to the cloud like ThinkSpeak on which the user can perform various analytics.

IX. FUTURE WORK

The model is currently able to collect and process data through the sensors. Later work involves performing Machine Learning algorithm to predict the Air Quality.

The proposed system can be further optimized to consume less power as this will be a battery or solar powered module. This module can be deployed in all cities selected for the smart city project in our country. This will make our smart cities places where people can live a healthier life.

X. IMPLEMENTATION

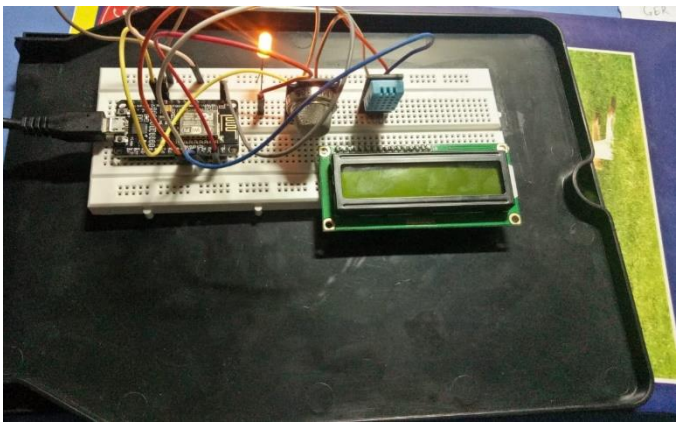


Figure Hardware Connection

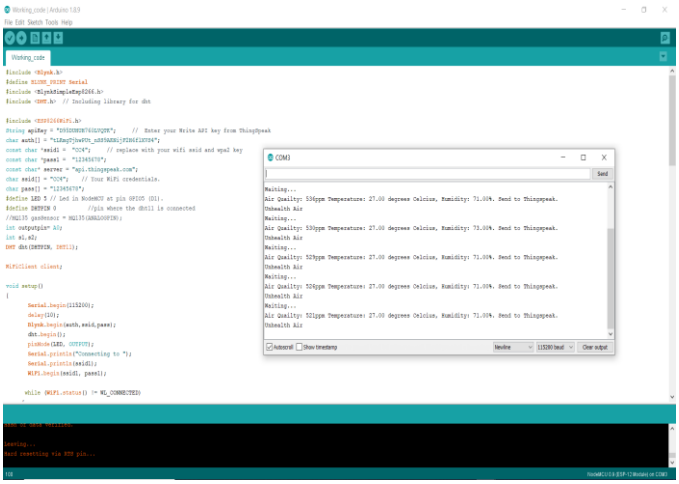


Figure Serial Monitor

XI. CONCLUSION

This research proposed a smart air pollution monitoring system that constantly keeps track of air quality in an area and displays the air quality measured on an LCD screen. It also sends data measured to the “Thing speak” platform. The system helps to create awareness of the quality of air that one breathes daily. This monitoring device can deliver real-time measurements of air quality.

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