

# IOT Based Road Mapping & Air Pollution Monitoring using GPS

Nayan Dev<sup>1</sup>, Fiza Saniya<sup>1</sup>, Harshitha B V<sup>1</sup>, Varshini D<sup>1</sup>, Dileep R<sup>2</sup>

4<sup>th</sup> year BE, Dept. of Electronics and Communication Engineering, NDRK Institute of Technology, Hassan, India<sup>1</sup>

Assistant Professor, Dept. of Electronics and Communication Engineering, NDRK Institute of Technology, Hassan, India<sup>2</sup>

**ABSTRACT:** The Rapid growth of technology and infrastructure has made our lives easier. The advent of technology has also increased the traffic hazards and the road accidents take place frequently which causes huge loss of life and property because of the poor emergency facilities. Specifically, road anomalies are some of the challenges that contribute to the increase in vehicle damage and decrease in driver safety. A road surface condition monitoring system that utilizes low cost MEMS acceleration sensors and GPS receivers to detect and localize road surface anomalies. Several types of road information data were collected, analysed, and processed using statistical and time domain analysis for feature extraction of the various events. One of the most challenging issues in cities is pollution especially air pollution. From this point, IoT based efficient system that detects and monitor the outdoor air pollution level. This system monitors the pollution level if the pollution level exceeds the acceptable pollution level, it takes a decision to notify the authorities who can use this data in planning preventive actions and take measures to stop the continuous harmful air pollution effects and prevent the evolution of this phenomenon.

**KEYWORDS:** IOT, GPS, Road conditions, Air pollution.

## I.INTRODUCTION

One of the world's largest health and environmental impacts is Air Pollution. Air pollution release into atmosphere of various gases, finely divided solids, or finely dispersed liquid aerosols at rates that exceed the natural capacity of the environment to dissipate and dilute or absorb them. These substances may reach concentrations in the air that cause undesirable health, economic or aesthetic effects. The transportation sector contributes heavily to air pollution due to automobiles and unpaved roads. Air pollution is a mixture of solid particles and gases that are suspended in the air due to burning of fossil fuels like coal, petroleum products, wood: Releases carbon mono-oxides nitrogen oxides and volatile organic compounds from automobile emissions and industrial processes, electricity generation, gasoline vapours, chemical solvents are responsible for ozone depletion and greenhouse effect. In addition manufacturing plants that emits carbon particles and other harmful gases which are not occurs naturally in the environment. It causes imbalance in the quality of air and environmental parameters due to rapid urbanization. Exposure of harmful (or) Poisonous gases in hazardous to public health which leading causes of death including heart disease, stroke, lower respiratory infections, lung cancer, diabetes and chronic obstructive pulmonary disease.

Damaged and poor conditions of roads are another main disaster of transportation sector. Due to heavy weight trucks continuously travel on the road and roads are constructed by low quality materials. poor roads construction we need some strict and good quality work to improve road condition. The effects of damage roads like potholes and ditches on road: leads the

chance of many accidents. Ditches, potholes, or other wear and tear in the ground’s surface are unavoidable occurrences that develop over time. Also Kazakhstan roads are changing rapidly due to climate and the road surface may undergo various changes throughout the day [1]. It is difficult for ambulance to travel on the

damaged roads and takes more time to reach hospital during the emergency. Potholes results when a combination of heavy traffic, either of foot or vehicles, from above and water from the soil below causes asphalt to give way. Potholes are common anywhere that these two elements are present, including in crosswalks and parking lots. Similarly, ditches are formed when soil or dirt are pushed by waterfall in certain directions to form sometimes massive pits. Because of Florida’s year-round tendency for rainfall, potholes and ditches are frequently present. These hazards often involve sharp differences in height, which may not easily be detected by sight and therefore cause many trip and falls accidents also damage the vehicle conditions and consume more fuel while travelling on the roads. Indirectly increases the maintenances and service cost of vehicles. Finding correlations between different factors and road condition, driving safety will be an important task in defining critical parameters for input to the transportation system. However, a failure to fix or warn of these dangerous hazards may lead to serious injuries for people unaware of their presence. falls due to ditch or pothole may cause a great deal of harm to victim.

The paper describes the state of art about monitoring the air pollution and road condition. In order to monitoring air pollution and road condition like potholes and while travelling we have built a project which collects the data of environmental parameters along the location and alert the related authorities to take prevention action. Using information received from all cars on the road through cellular networks and communications between vehicles it is possible to develop a prevention action for related authorities.

## II.METHODOLOGY

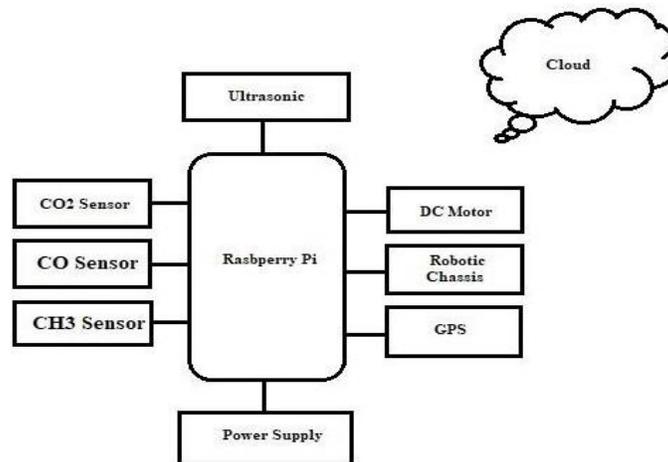


Fig.1 Proposed block diagram

Figure 1 shows the Proposed block diagram, where Raspberry Pi 3 Model B+ is used as a microcontroller which is placed robotic chassis. As air pollution monitoring is our main concern various Gas sensors is utilized for monitoring. The ultrasonic sensor measures the distance at real time which monitors the road condition. And all these sensor keeps updating the data to the Raspberry Pi which will be stored in the cloud. Road mapping is observed with the GPS module where the time and the place will be updating. An alert email/SMS is sent, if the gas concentration in air reaches above the threshold level. After particular timespan it sends detection data if any damages on road and gas concentrations of different level to the Server. Air quality data is directly stored in Repository for future use. On road mapping the GPS Module senses traffic density which will later be used for displaying traffic density to other users.

## COMPONENTS USED

### 1. RASPBERRY PI 3 MODEL B+:

Raspberry pi 3 module B+ popular credit card size single board computer. It is a low cost computer with open source linux system which supports and runs on LINUX OS. It provides dual-band 2.4GHz and 5GHz wireless LAN. It has built-in Broadcom 1.4GHz quad core 64bit processor with low energy on-board Wi-Fi Bluetooth and USB port. Raspberry pi 3 Model B+ is faster and more powerful and provide support for even more powerful devices on the USB ports, a 2.5A adapter. In our project it acts as Microcontroller collects the data of different environmental parameters using sensors.

### 2. ULTRASONIC SENSOR:

use to determine distance to an object. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. The ultrasonic sensor works on the principles as a radar system. An ultrasonic sensor convert electrical energy into acoustic waves and vice versa. The acoustic wave signal is an ultrasonic wave traveling at a frequency above 18KHz. The HC SR04 ultrasonic sensor generates ultrasonic waves at 40Kz frequency.

### 3. MQ135 AIR QUALITY SENSOR:

A low cost semiconductor sensor which can detect the presence of ammonia(NH<sub>3</sub>), Mono- nitrogen oxides(NO<sub>x</sub>), Alcohol, Benzene, smoke, carbon-dioxide(CO<sub>2</sub>). It has good sensitivity to harmful gases in a wide range. The sensitive material used for this sensor is SnO<sub>2</sub>, whose conductivity is lower in clean air. Its conductivity increases as the concentration of sensing gases increases. MQ135 gas sensor has high sensitivity to ammonia, sulphide and benzene steam, also sensitive to smoke and other harmful gases. Concentration range is 10 to 1000ppm.

### 4. DUST SENSOR:

Is a simple air monitoring module .it is capable of detecting fine particle larger than 0.8um in diameter, even like the cigarette smoke. Analog voltage output of the sensor is linear with dust density, the module has embedded voltage boost circuit to support wide range of power supply.

### 5. MQ7 CO SENSOR:

It make detection by method of cycle high and low temperature, and detects carbon mono-oxide at low temperature. The sensor's conductivity gets higher along with the CO gas concentration rising. At high temperature it cleans the other gases adsorbed at low temperature. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit.

### 6. MQ5 SENSOR:

Sensor has high sensitivity to Methane, also propane and butane. The sensor could be used to detect different combustible gas, especially methane, it is with low cost and suitable for different application.

### 7. MQ2 SENSOR:

This gas sensor module is useful for gas leakage detection in home and industry. It is suitable for detecting H<sub>2</sub>, LPG, CH<sub>4</sub>, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity if the sensor can be adjusted by potentiometer.

### 8. NEO-6M GPS:

The NEO-6MV2 is a GPS module and is used for navigation. The module simply checks its location on earth and provides output data which is longitude and longitude of its position. It is from a family of stand-alone GPS receivers featuring the high performance u-blox 6 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature package. The compact architecture, power and memory options make NEO-6modules ideal for battery operated mobile devices with very strict cost and space constraints. Its innovative design gives NEO-6MV2 excellent navigation performance even in the most challenging environments.

### III.SOFTWARE REQUIREMENTS

**Python:** is an interpreted, high-level, general- purposed programming language. Python is a multi-paradigm programming language. Object -oriented programming and structured programming are fully supported. python uses dynamic typing and a combination of reference counting and a cycle-detecting garbage collector for memory management. It also features dynamic name resolution, which binds method and variable names during program execution. It has diversified application in the software development companies such as in gaming, web frameworks and application, language development, prototyping, graphic design applications.

**IOT (INTERNET OF THINGS):** Is a system of ‘connected things’ the things generally comprise of an embedded operating system and an ability to communicate with the internet or with the neighboring things. One of the key elements of a generic IOT system that bridges the various ‘things’ is an IOT service. An interesting implication from the things comprising the IOT systems is that the things by themselves cannot do anything. At a bare minimum, they should have an ability to connect to other ‘things’. But the real power of IoT is harnessed when the things connect to a ‘service’ either directly or via other ‘things’. In such systems, the service plays the role of an invisible manager by providing capabilities ranging from simple data collection and monitoring to complex data analytics.

**SmartCore:** Altair SmartCore is a cloud-native platform which offers an integrated set of services and features to help easily connect things to the digital world. It provides a framework for building powerful industry applications, which optimize efficiency, enable innovative business models, and quickly deliver value. Available as a platform as a service or on-premises, Altair SmartCore will help execute IoT projects faster in an easy- to-use, reliable and highly scalable environment.

### IV.EXPERIMENTAL RESULTS

The complete setup of the proposed system is as shown in the figure 2. Once the system is powered on, the setup of Raspberry Pi OS will be done as discussed in previous chapters. The GPS and air monitoring units initializes itself and updates on real time basis. The sensors values are as displayed on the OS. The ultrasonic sensor sends a mail to the registered mail ID with the location values of Pot holes as shown in below figure 3. Where it says pot hole is detected and its longitude and latitude values are displayed. The data that is stored in the cloud will also be updated in the twitter. Here are the results of the data updated in the twitter as shown in figure 5.

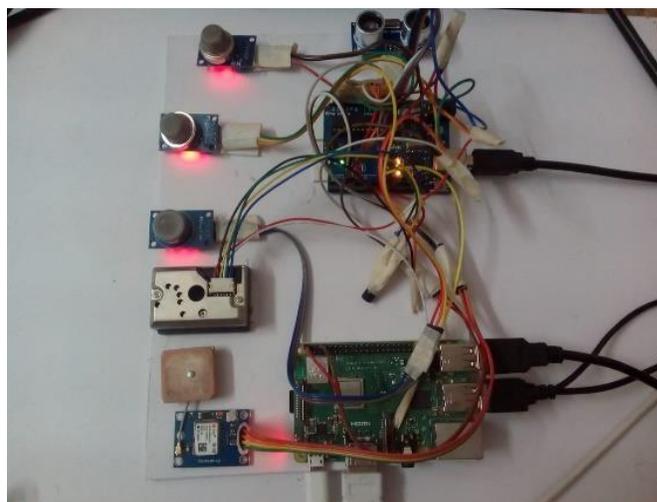


Fig.2 snapshot of the project

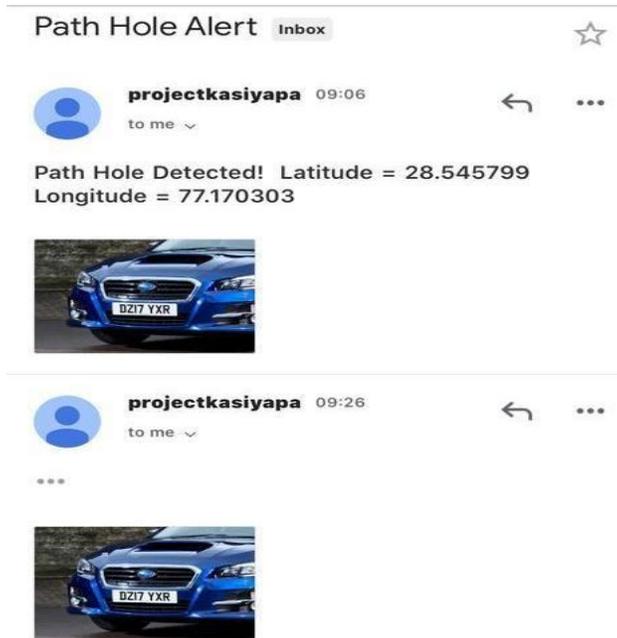
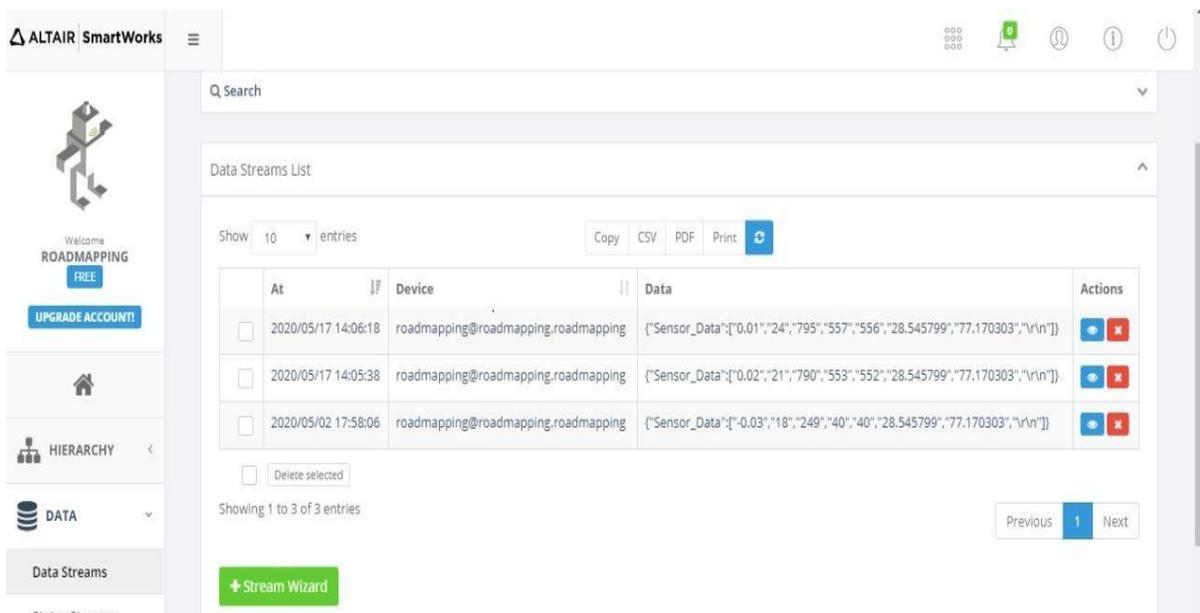


Fig.3 pothole is detected and its latitude and longitude value.

The air monitoring unit i.e., gas sensors values are updated on the cloud Smart core as shown in the below figure 4. The data can be saved or viewed anytime needed by the users.

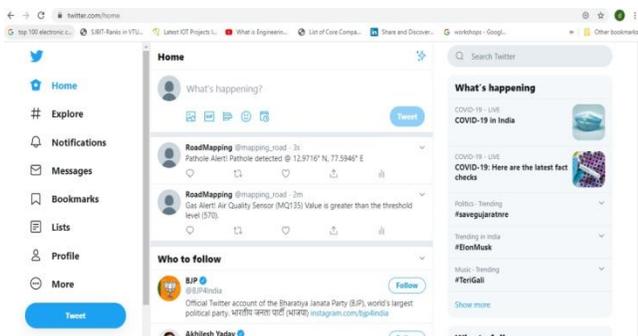
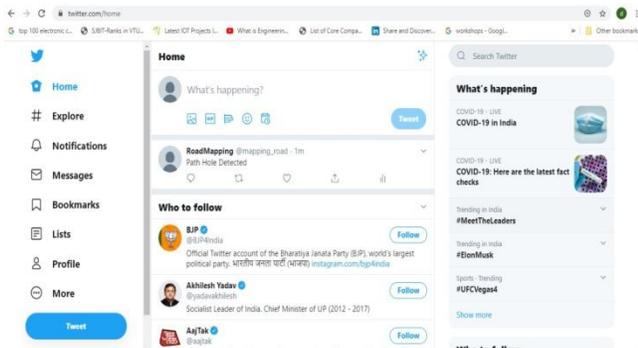


### Application & Advantages Application:

- Roadside pollution monitoring.
- Industrial perimeter monitoring.
- Potholes and ditches detection on roads.
- Data can be made available for common man.
- Consumes less time and fuel for travelling.

### Advantages:

- Sensors are easily available
- Detection of wide range of gases like  $CO_2$ ,  $CO$  etc.
- Continuous update of change in location and air quality.
- Real time potholes detection and location update.
- Low operating costs and high-quality data



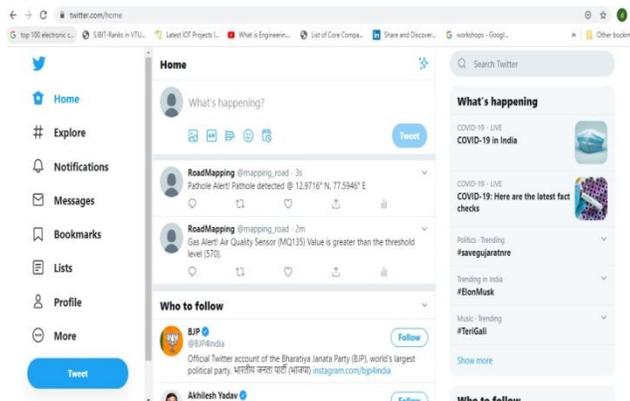


Fig.5 The data updated on the social media such as twitter.

## V.CONCLUSION

The purpose of the proposed system is to monitoring the Air pollution and roads condition like potholes, ditches and alerting the related authorities through email along with the location. As we all know Air pollution is harmful for all living beings. The major source of air pollution includes the inefficient use of energy by households, industry, the agriculture, coal-fired power plant and transport sectors.

Our proposed system is use to monitoring the concentration of pollutant gases in present in environment while travelling using various gas sensor place in vehicle. If the concentration of gas exceeds the threshold value email is sent to pollution control board along with location. Similarly another main disaster of transport sector is poor road condition our proposed system also monitors the potholes, ditches present on the road using ultrasonic sensor which count the number potholes. If count increases more than the threshold level setted then email is sent to PWD department. By using this data related authorities can take proper prevention actions. This methodology constitutes a major advance to track progress towards air quality and road condition using for development goals, and to expand the evidence base on the impact of air pollution on health and poor road condition on public.

## REFERENCES

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