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by Vandana Rao

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"Mobile Air Pollution Monitoring & Vehicle Tracking" for Metropolitan Ares Using Internet of Things and Thingspeak Cloud

ABSTRACT

The need for a smart and portable management system which provides us with an efficient method to track the current location of a vehicle and help the stakeholders with efficient time management is crucial. And also, air pollution levels are constantly on rise. Even rural areas are affected by the overall increase in vehicle emissions, which is one of the big causes for the pollution increase in day by day. So, a system is needed where we can constantly monitor the surrounding pollution levels. Instead of an inert system, we are proposing a more flexible one. With an idea of jointly presenting technology with the requirement of information transmission also, planned for a creative approach to track a vehicle and monitor the pollution levels at the same time using GPS and PM sensors. The system modelled can also be used for Detection of Accident and to Alert people in wide areas of applications such as in tracking college/school buses, Taxis /Cabs, theft vehicles, etc.

Keywords- *Tracking, GPS, Air Pollution, PM Sensor, Monitoring, Thing speak cloud.*

INTRODUCTION

The term "air pollution" refers to the contamination of the atmosphere's constituents by substances that are hazardous to human health and the health of other living things, or that harm the environment's resources or climate. Gases (including ammonia, carbon monoxide, sulphur dioxide, nitrous oxides, methane, carbon dioxide, and chlorofluorocarbons), particles (both organic and inorganic), and living molecules are only a few examples of the many different types of air pollution. Air pollution can damage other living things like animals and food crops, as well as the built environment (owing to factors like habitat degradation, ozone depletion, and climate change), in addition to damaging humans, animals, and food crops (for example, acid rain). Animals and humans both contribute to air pollution.

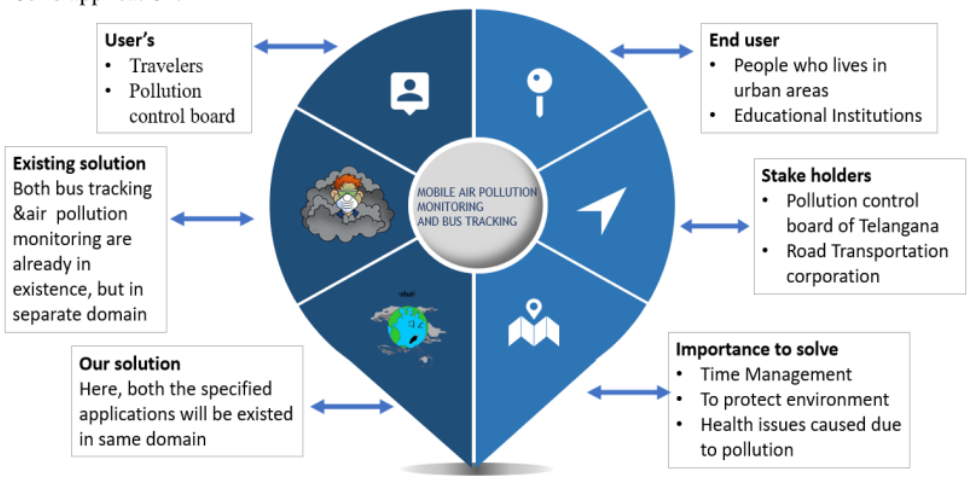
Air pollution poses a serious danger for a number of pollution-related diseases, such as lung cancer, heart disease, COPD, and respiratory infections. According to a growing body of evidence, being exposed to air pollution may be associated with cognitive decline, worse IQ scores, a higher risk of developing psychiatric conditions including depression, and poor perinatal outcomes. Although there are many effects of poor air quality on human health, the respiratory and cardiovascular systems are the main targets. The type of pollutant, the amount of exposure, the individual's health, and heredity all have an impact on how each person reacts to air pollutants.

** Because of the increased burden on public transportation like buses, we need a smart and portable management system for the purpose of location tracking of a vehicle. With the increase in pollution levels in the atmosphere, a system is needed where we can constantly monitor the surrounding pollution levels. Instead of an inert system, where it must be fixed in a single place, a mobile system, which has more flexibility, is suggested. The current existing methods only either track the bus location or just monitor the air pollution levels at a particular designated area separately. Which may not be that useful on its own. It also becomes useless if any precautionary measures are not taken based on the high-risk levels. So here, the mobile application comes into play.

As we have collected information from our campus students and faculty, we came to know that the students are facing some difficulties in the regular period of college bus transport system, the main reason is that the college buses and the movement of the vehicles is affected by the different unexpected conditions such as unexpected bus delays due to traffic congestion leads to waste of our valuable time.

The students and faculty who are travelling to college via urban routes, expose themselves to pollution air which could affect everyone's health. When air pollutants are entered in to our body through breathe in, the particles dust and harmful gases can enter into our respiratory system and result in , respiratory disorders like coughing, itchy eyes and lung diseases, which leads to hospitalisation.

We are currently making the sensors take real-time data by placing it on one of the college buses. Connecting the air pollution monitoring sensors to the GSM module along with a GPS sensor, we can easily track the current location of the vehicle along with the PM sensor data. There would also be an DHT11 sensor which measure humidity and temperature. The PM sensor takes in data on the particles under 2.5 and 10 µm. It shows us the pollution levels in the atmosphere. It updates at rapid time intervals. This system is accurate and cost-effective. It helps for better time management, safety and on-time response in case of emergencies by viewing the graphical and locational data displayed on the mobile application.



Figre:2. Problem analysis and scoping for the work to be done

LITERATURE STUDY

Payali Das, [1] proposed system is a pocket friendly, innovational Air Pollution Monitoring Device (APMD) with advanced features of rating. A Particulate Matter sensor is intended to measure PM 2.5 and PM 10. Air Pollution Monitoring Device also includes sensors for measuring carbon monoxide Sulphur dioxide, nitrogen dioxide, ozone, (CO, SO2, NO2, O2, O3) and temperature and humidity. To recharge the module, the node is having a solar energy harvesting system and a rechargeable battery. Air Pollution Monitoring Device uses an on-board Global positioning system (GPS) subsystem to package all of the collected air quality (AQ) data into some proportions which includes the time, date, location and sends it into a cloud server. Wi-Fi and IOT connectivity are available to the node. The developed Air Pollution Monitoring Device was co-located with an actual reference sensor node to check the valid sensing quality, and a succession of field data will be collected for 7-days. The given PM sensor saves up to 90-94% of energy. To control the fan speed by sending a pulse width modulated signal to a switch connected to the fan's power supply a power control technique is also being used on the PM sensor. PM sensor is 97% more energy reliable & efficient than a materialistic sensor at 100 milliseconds switching period & 30% duty cycle, Maintaining the sensing error as low as 0.7 for Particulate Matter 2.5 and 2.7 for Particulate Matter 10. the research background deployment studies show that the designed Air Pollution Monitoring Device uses 90% less power than the reference power while providing a notable coverage range with an allowable range of the sensing error.

Muhammad Fareez Mohd Ainul Kakeem, [2] proposed system is a simple Internet of Things module that allows the users to watch the activity of bus through the mobile application which displays the available seats in the bus ,timings of bus, and bus pursuits. The Node MCU ESP32 controller, which communicates through Wi-Fi, which is used in the design prototype. The given input sensors are an infrared sensor & a GPS module. The data survey is presented on the mobile apps using the Blynk and cloud applications. For viewing the number of passengers on the bus as well as its location a mobile application was developed. The database which is deliberated to collect the records of the passengers entering and exiting the bus. Thus, the GPS module can determine the exact location of the bus and also, its latitude and longitude. These activities can be monitored by authorities of respected institutions, which intended in providing good services, managing time &managing bus transportation services.

Yuhan Huang, [3] The proposed system employs on-road remote sensing technology for fast, accurate, and cost-effective identification of high-emitting vehicles as part of an implementation program to improve air quality mainly in urban areas. they discovered that a notable percentage of in-use petrol and liquefied petroleum gas vehicles failed emission standards, particularly in high-mileage bus,By Developing more accurate and vertical remote sensing systems will improve and expand their applications in the respective domain.

Baichoo Bibi Humaira, [4] The proposed system is to have an efficient and reliable Android Bus Tracking Application, it needs to implementation of tracking the real-time location of the bus using Global Positioning System and Global System for Mobile Communication / General Packet Radio Service technology. Google Map Application Program Interface which is used in the developed application to display the bus on the map. As a result, using this application, the users will be easily able to keep track the buses at any given time. Distance and time required to reach the destination by users, as well as the time required for the bus to arrive at the user location, will be displayed on the available screen. An Internet connection, whether Wi-Fi or mobile data, is required for the user to receive this information as well as the map markers. SMS will be used as a backup communication method if there is no Internet access.

Temesegan Walelign Ayele, [5] proposed system is an Internet of Things (i.e IOT) based air pollution monitoring and forecasting module. This proposed system can be used to monitor air pollutants in each specific area, perform air quality analysis, and forecast air quality. By combining IoT with a machine learning algorithm known as Recurrent Neural Network the proposed system will monitor air pollutants. Vladimir Shakhov, [6] The given proposed system is a monitoring system, where sensors embedded on vehicles. They offer the right approach for monitoring the air pollution levels. Thus, the results help the users to optimize and manage the given systems for monitoring of air pollution levels in environment.

R. Santhana Krishnan, [7] For guiding the passengers in booking the bus tickets the proposed system Application-based Smart Bus Transportation System is helpful. Which also keeps them updated on bus location based on their request. This proposed system also sends the important messages to the passengers within a few minutes before the bus arrives at the user's destination point. This system will also send the provisional instructions to passengers ahead of time, which should be followed while travelling in the bus. To provide reliable and extra safety for the passengers, the temperature of the users in the bus will be monitored and communicated to the bus before they are allowed to board in their respective destination.

Siti Asma, [8] Two applications are proposed for the convenience of those who want to plan their

journey with shuttle buses. One application will track the bus's location, while the other will be used by the students. Both proposed applications will be used in conjunction with an Android phone, which is commonly used by students. The primary goals of creating this application are to inform users of the current bus location and estimated arrival time. This application also offers users a real-time forum where they can initiate conversations with other users of the same application. Additionally, the driver's profile is included for the user's future reference.

Hina Gull, [9] The given System is incorporated with a tracking website as well as an mobile application for college transport administrators, bus drivers, and passenger's parents. The given system will charge the transport administrator by adding new bus drivers & students to the given list. Furthermore, the application will generate a unique QR code for each student, which will be printed on a identity card with the student's information. In addition, the system will track the bus's location via the driver's mobile phone. Following that, the parent's mobile application will display a map displaying the live bus location, which will be updated for every modification or change in bus position. Furthermore, different types of notifications will be received by the college transport administration and for parents.

S. Vigneshwaran, [10] The "Plan of Bus Tracking and Fuel Monitoring System" by combining current innovation with the new requirement of data transmission. To overcome the drawbacks of previous paper-based techniques, we inform a task with tracking a vehicle using GPS and GSM. The transport framework is very useful and fruitful framework. which will be used to create the applications. The first application is to establish communication between the college server and the transport incharge framework, which is required to provide constant information about the current or live state of the bus. The second application is sending a message, for example, ready messages to understudies like waiting at the prior stop, changes in current situation, transport vehicle number and so on. Saving understudies' time. Period is the third application. There is no need for a plastic vehicle timer. The final application is developing a crisis management framework that will send ready messages to the college, police, and rescue vehicles in the event of an incident in the given location.

Rezowana Akter, [11] The proposed system is designed to provide convenient transportation by reducing the problems encountered by users, drivers, and relevant authorities(college) through the use of a handy Android application. For a satisfying bus fare calculation, our system employs Radio Frequency Identification, Global Positioning System, and a mobile Android application for passenger management and real-time tracking features.

Hongjie Liu, [12] The proposed system is a long short-term memory and Artificial neural networks comprehensive forecasting model based on the spatial-temporal features vectors to concatenate the advantages of the two prediction models. The bus station forecast is realized from the dimension of time feature, and the long-distance arrival to the station prediction is realized from the dimension of spatial feature. Thus, most of the experiments were being carried out and tested based on the entire entity datasets, and then the results show that the proposed method has a high accuracy in bus arrival prediction problems for the users.

Pau Ferrer-Cid, [13] By To comparing the techniques of the transportation, the sensor signal is rebuild ed using a method in machine learning which is supervised linear regression method(SLRM) and a semi-supervised Laplacian interpolation method(SSLIM). which allows reconstruction even when data is missing. The results on data sets measuring O3, NO2, and PM 10 show that the signal smoothness-based technique performs better than the other two and, when combined with the mathematical analysis like Laplacian interpolation (LI), is nearly optimal in comparison to the linear regression method (LRM).

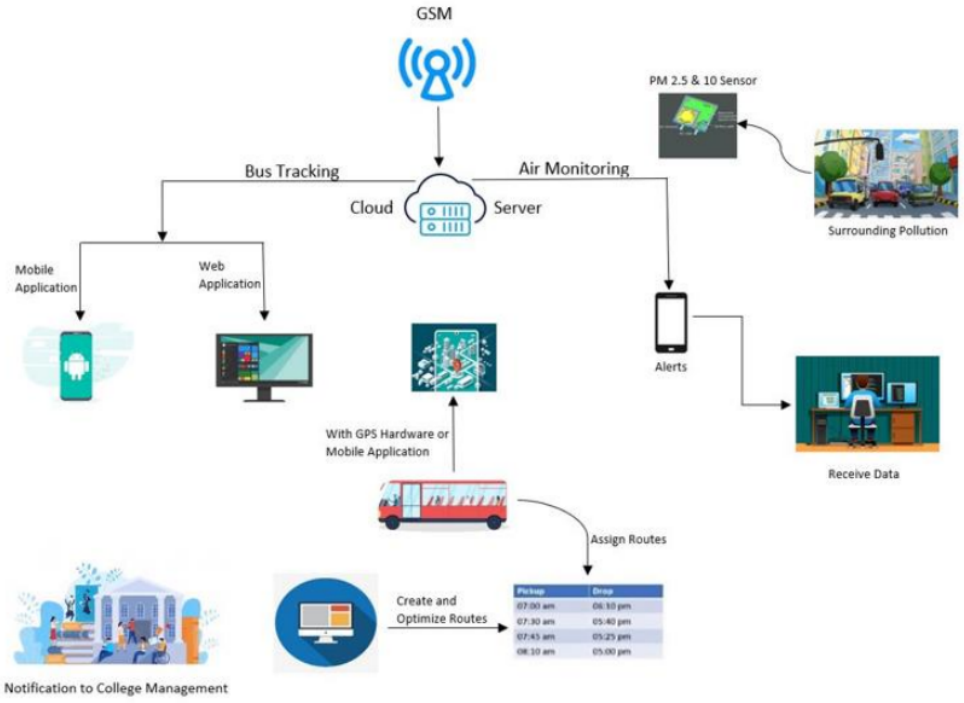
Ditsuhi Iskandaryan [14] Given proposed system revises studies on air pollution prediction based on sensor data using machine learning algorithms in the context of smart cities. The most relevant papers

were chosen using the most popular databases and the corresponding filtration. After thoroughly reviewing those papers, the main features have been extracted and used as a foundation to link and compare them. As a result, we can conclude that: 1. By Using simple machine learning techniques is a simple level whereas authors now use advanced and sophisticated levels of techniques; 2. China was the leading country in terms of a case study, 3. The Particulate matter (PM) will be having a diameter of 2.5 micrometres was the main prediction target; 4. in 41% of the publications.

Zena A. Aziz, [15] Given proposed system is based on Wireless Sensor Networks, a thoroughgoing system which is updated version in the current technology that can detect, calculate, monitor, and gather the information from the real time and relay data to the consumer based on the gathered data. One of the major important aspects of modern networks is the ability to evaluate the world at high resolutions. This report contains research on air pollution monitoring sensors and monitoring systems.

B. Perumal. [16] proposed system is a basic structure for tracking an air pollution. An Arduino mini is used to control the proposed model. The air pollution monitoring system is designed to track and correct the air quality in real time using data retrieved from the main server and also from the saved online server. The components of air quality are measured in Million Metrics and analysed in Microsoft Excel. The established system Air quality measurements were also accurate in the nature.

METHODOLOGY



Figre:3. Working Model of Air pollution monitoring and bus tracking system

A bus-tracking application developed to form part of the system of a real time bus management and it helps as a convenient point of access when installed onto the handheld device of the users. The vehicle-

tracking app provides a map view of the current position of the vehicle with information to parents and transport authorities where the currently location of vehicle is. To start and work with, modern GPS technology-based bus-tracking app have been used. Thus, a device installed GPS within a vehicle can transmit its real time location which can be displayed on a map.

As we could imagine, a situation where students travel on a regular basis forms an important segment of vehicle travel. When there is a sudden repair in the bus or the bus has diverged from the current route, it creates a dilemma for the passengers on the bus. They get confused whether to board another bus or to wait until the current bus gets repaired.

As discussed earlier, the buses with a GPS sensor are installed that and is connected to an application. The College management/concern authorities (Transport Incharge) can track it from their respective places, meanwhile parents can track it on their mobile phones. If there is any unplanned delay or a repair in the bus, this system also conveniently facilitates the driver in communicating directly with the college management and with the parents. Within the bus tracking application, we are adding another feature to monitor air pollution.

Nowadays, air pollution is one of the major risk factors which harms the environment. Several studies have shown the detrimental effects of air pollution on human health and wellbeing among all the air pollutants, the particulate matter (PM) is one of the particular concerns of pollution to worry about. Particulate matter is classified into PM 2.5 and PM10, based upon their particle diameter. Existing networks of PM 2.5 and PM 10 monitors have shown that Particulate Matter concentrations have been increased. Due to their tiny size, they can penetrate deep into the lungs and mix with the blood stream. Which leads to cardiovascular and pulmonary diseases. Here the main objective of our project is to increase time efficiency, safety and with air pollution monitoring we are trying to create awareness on personal health safety.

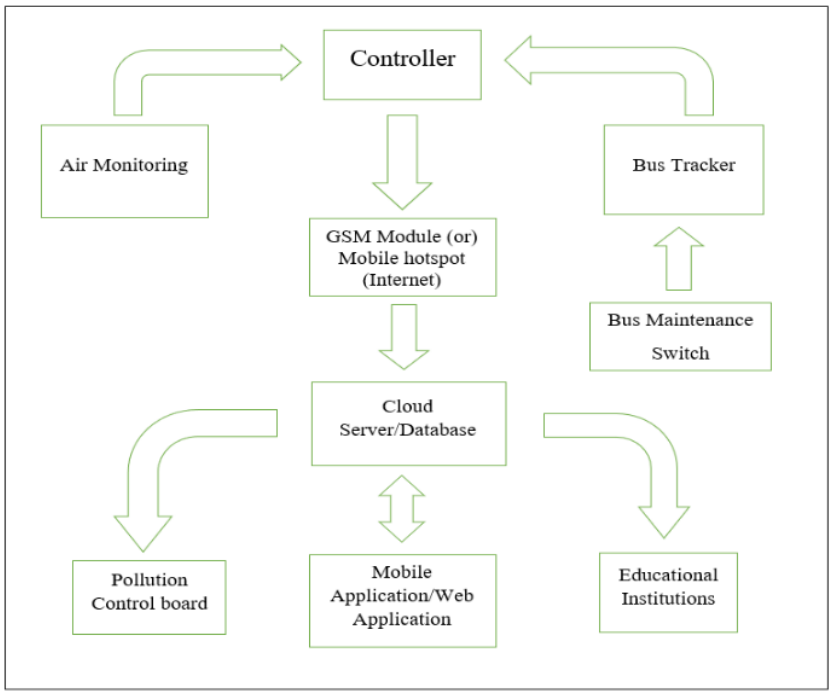


Figure:4. Functional diagram of monitoring air pollution and vehicle tracking system

RESULTS AND DISCUSSION

After all the connections made, the results of how each sensor is working and uploading the data to the cloud server and the outputs are generated are as shown below:

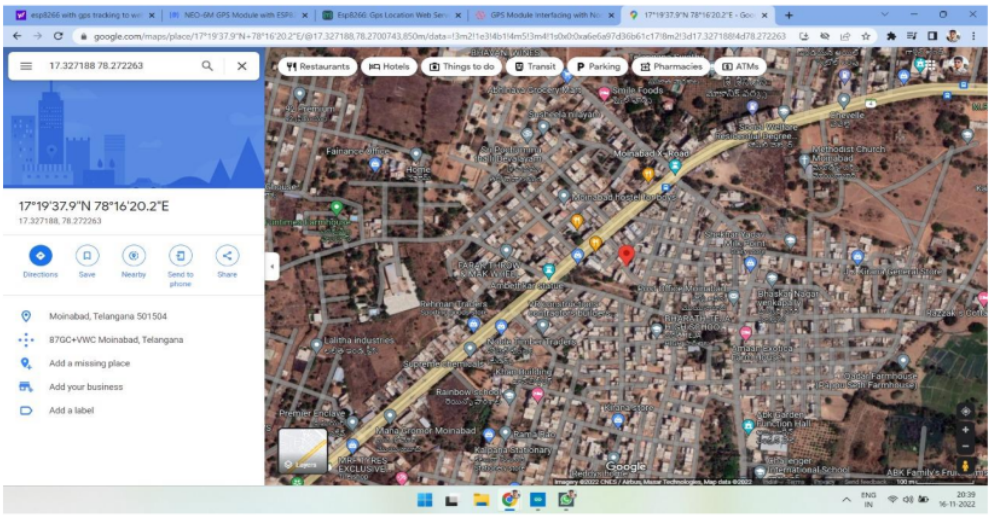


Figure:6. Redirect page of location from thing speak server

Firstly, sensor readings in the form of analog data are sent to ESP8266, then it converts it into digital data and feds it to ThingSpeak server, then readings will be displayed on ThingSpeak server console. When the server IP address is searched in a browser it opens up the information tab, which consists of latitude, longitude data along with date and time. Clicking on the generated hypertext link will redirect us to the location coordinates mentioned above and it will display on the google maps as shown in Figure:6.

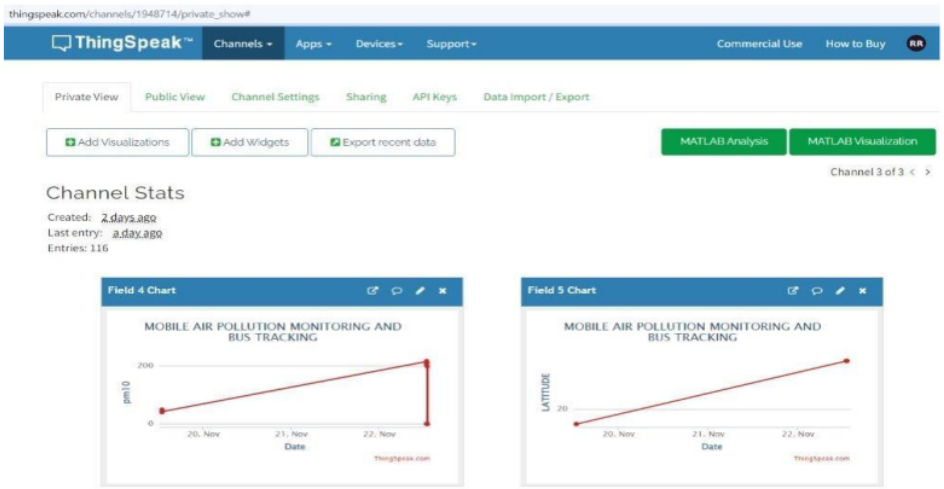


Figure:7. Thingspeak Graph Particulate Matter sensor readings

Here, SDS011 Sensor displays the readings of PM10 and PM 2.5 present in the atmosphere at any given time interval. The tolerable range is from 0.3-10 μm.

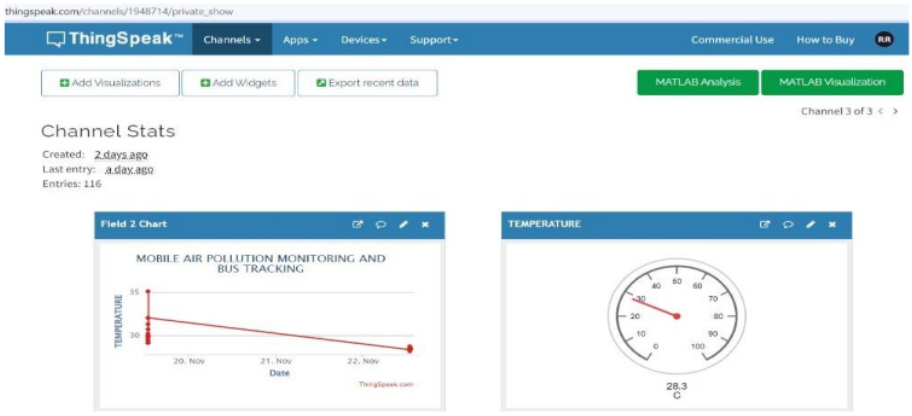


Figure:8. Thing Speak Graph of Temperature and Humidity

DHT11 Sensor measures the temperature and humidity of the surroundings. The output is shown in ThingSpeak Fig 8 and Fig 9.

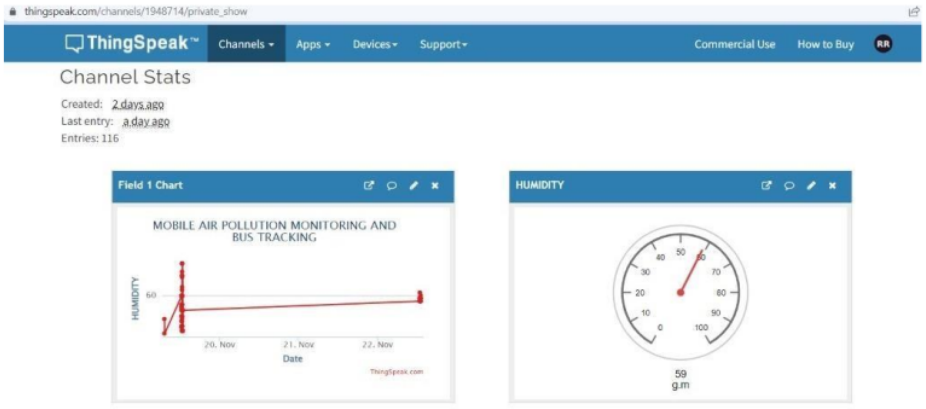


Figure:9. Thing Speak Graph of Temperature and Humidity

The readings are displayed on graph and in gauge format as shown above. It also includes date in it. The overall advantage with cloud is that, to analyze and visualize data and the past data can also be stored and accessed at any given time.

CONCLUSION

The work done titled "Mobile Air Pollution Monitoring and Vehicle Tracking" is a model for vehicle tracking unit with the help of GSM modem and GPS receivers and it is better scheduling or route planning can enable the end users and the concern authorities handle larger jobs loads within a stipulated time. Mobile air pollution monitoring helps people who travels through areas where heavy pollution

leads to contamination of air we breathe and causes unexpected respiratory issues. The system developed provide a live data of respective area where the vehicle is running with, which intern alert the travelers about levels of pollution. Vehicle tracking both in case of personal as well as business purpose improves security and safety, communication medium, performance monitoring and increases productivity. As well as the air pollution monitoring will be done parallelly, the different areas have different levels of air quality at different times it is important for us to monitor what is happening. So, in the near future, this type of system is going to play a major role in our day-to-day living.

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