Indian Journal of Science and Technology, *Vol 9(45), DOI: 10.17485/ijst/2016/v9i45/99612, December 2016*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Environment Monitoring System and Traffic Control Using Vehicular Network

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Abstract

Objectives: This paper aims at providing a feasible solution for monitoring the environment as well as to control the traffic using vehicular network. **Methods/Statistical Analysis**: The MQ-2 gas sensor and the GPS Module are interfaced with the Raspberry Pi to facilitate the vehicular network. The well integrated module helps in making the routine life of getting into traffic avoidable. **Findings:** This work effectively gives a solution to control the traffic as well as to monitor the environmental pollution. It helps to reduce the pollution along with the traffic. This can be implemented on the vehicles to provide a better communication between the vehicles. **Application/Improvement**: This lead to the implementation of a network which works on the grounds of the vehicle communication and brings out a better throughput.

Keywords: Artificially Intelligent, Automobile, GPS Module, MQ-2 Gas Sensor, Raspberry Pi¸ Traffic Congestion

1. Introduction

With the advancements in technology, many innovations have been created within the field of communications that are transiting IOT. Vehicles are a major source of pollution in urban territories. The extreme increase in number of vehicles has also resulted in a significant increase in the outflow heap of different toxins and also the activity. World Health Organization has authoritatively announced that inhaling diesel fumes can cause lung cancer. From Central Pollution Control Board, Govt. of India, i.e., 72% to aggregate contamination created by vehicles and remaining 28% by industries and other domestic[1]. As pollution being a major environmental change that causes several unsafe effects on human beings that requires to be controlled. Efficient monitoring of the gases in the environment with sensor networks will provide a continuous monitoring of the toxic gases[2]. The main purpose of a gas detection system is to alert the people about the potential danger associated with the life hazard and material injury.

Early deals with sensor systems have been focused on the advancement of empowering advances by tending to a horde of specialized difficulties, for example, communication abstractions, Operating Systems (OS) and sharing of data[3]. The obstacles for sensor network technology to become a transformational force in application areas lie in its absence of dependability, flexibility, versatility and in its challenges in long-term deployment, operation, and maintenance. In sensor systems situations, it is more helpful form the applications perspective to have hubs recognized by the of sensor device or by their geographical location[4].

The transportation infrastructure keeps on being overwhelmed by the quantity of vehicles out and about, prompting to automobile overloads and blockage in huge urban areas. Ongoing Street activity observing has gotten extensive consideration since it offers the chance to utilize relief measures such as changing the timings of movement flag lights or to take substitute routes–in real time[5]. However, it is a significant test to handle constant activity sensor information that is continuously generated

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in large cities. Traditional traffic monitoring technologies include magnetic loops, camera-based systems[6] microwave radar, laser-based frameworks, infrared indicators, and ultrasonic identifiers. These are roadside technologies that distinguish passing vehicles and give exact and stable traffic data about a septic location where they are installed. The real weakness of these technologies is the high cost of deployment and maintenance.

This technology can be classified into two major group of communication including V2V communication and Vehicle-to-Infrastructure (V2I). Both are committed short-range communications (DSRC) devices. DSRC works in 5.9 GHz band with data transfer capacity of 75 MHz and approximate range of 1000 m[7]. The V2V correspondence frameworks perhaps convey by flag of its V2V antenna and by the flag from V2V antennas of the neighbouring vehicles.

Hence, we have a tendency to deploy VSN nodes for constant watching of the pollution[8] round the town with the help of the vehicle. This methodology gives us the watching information from the stationary nodes deployed within the town to the mobile nodes on Vehicle. It'll have many advantages with regard to the long run thought of sensible Cities that will have the new technologies associated with internet of Things.

2. Experimental Setup

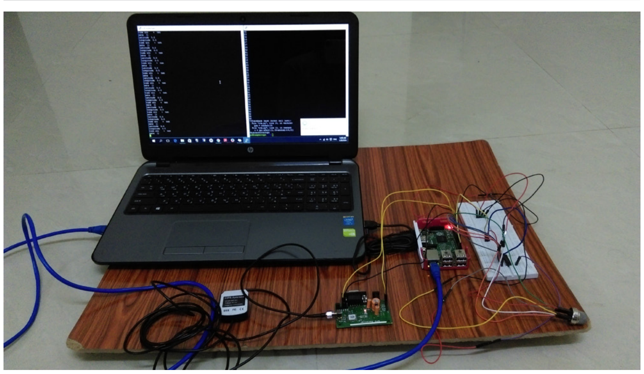


Figure 1. Experimental setup for environmental monitoring and the traffic control.

The Figure 1 shows the experimental setup for monitoring the environment and traffic control. It consists of the MQ-2 gas sensor, GPS module, MCP3008 and Raspberry Pi as shown in Figure 2. First we have to make Raspberry Pi as a Webserver which can be easily communicate with the client; the Figure 3 depicts the same. The MQ-2 gas sensor and the GPS module is interfaced with the Raspberry Pi. The MQ-2 gas sensor is used to detect the carbon dioxide gas. The GPS module is used to locate the position of the vehicle using the latitude and longitude values. The data from the gas sensor and the GPS module is uploaded to the cloud as well as into the spreadsheet. The data from the spreadsheet is imported into the map.

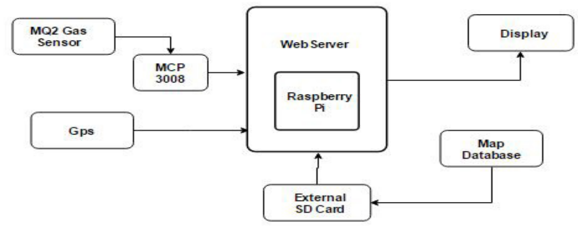


Figure 2. Node 1.

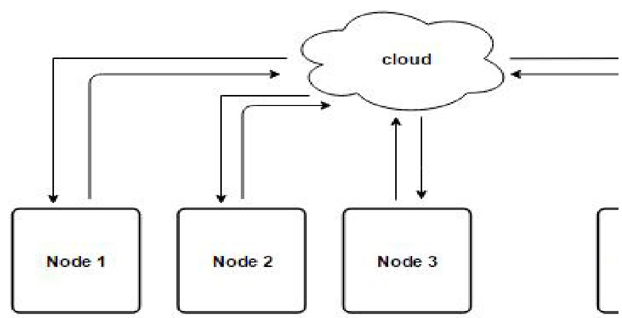


Figure 3. Block diagram.

Figure 4. Schematic of MQ 2 gas sensor.

2.1 MQ-2 Gas Sensor

The MQ-2 gas sensor, as shown in Figure 4 is interfaced with the Raspberry Pi using MCP3008. The enveloped sensor has 6 pin of which 4 of them are used to fetch signals, and the other 2 are used for providing heat current.

The 5V is connected to the Raspberry Pi from the heater. And then the continuous monitoring is performed for the gas like carbon dioxide.

Here the calibration is not possible for the MQ-2 gas sensor which can detect multiple gases. The MQ-2 gas sensor can detect CO between 20 ppm to 2000 ppm which is more harmful.

2.2 GPS Module

A Global Positioning System (GPS) is a framework intended to explore on the Earth, noticeable all around, and on water. A GPS collector demonstrates where it is. It might like wise demonstrate how fast it is moving, which course it is going, how high it is, and perhaps how quick it is going up or down.

A GPS module, as shown in Figure 5 is interfaced on the Raspberry pi. The GPS module consists of the input voltage, ground, receiver and transmitter. The input voltage is connected to the pin4 5v to the Raspberry pi. The ground is connected to the pin6 ground to the Raspberry pi. The transmitter pin in the GPS module is connected to the receiver pin in Raspberry pi. Similarly, the receiver pin in the GPS module is connected to the transmitter pin in the Raspberry pi.

Figure 5. GPS module

2.3 MCP 3008

The MCP3008 is a 10-bit Analog-to-digital converter joins high performance and low power utilization in a little bundle, making it perfect for inserted control applications. The pin diagram of MCP3008 is appeared in Figure 6. The MCP3008 features a Successive Approximation Register (SAR) and an industry-standard SPI serial interface, permitting 10-bit ADC capability to be added to any PIC microcontroller.

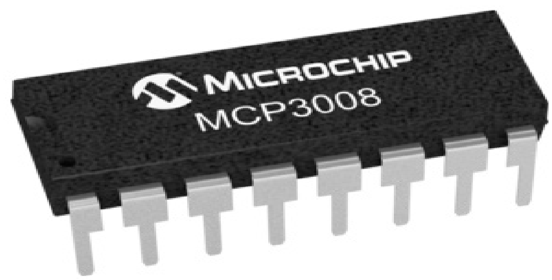


Figure 6. MCP 3008

2.4 Raspberry Pi

Raspberry Pi acts as the server for the system. Raspberry Pi is a low-cost credit card sized computer having chips and I/O connectors as shown in Figure 7.

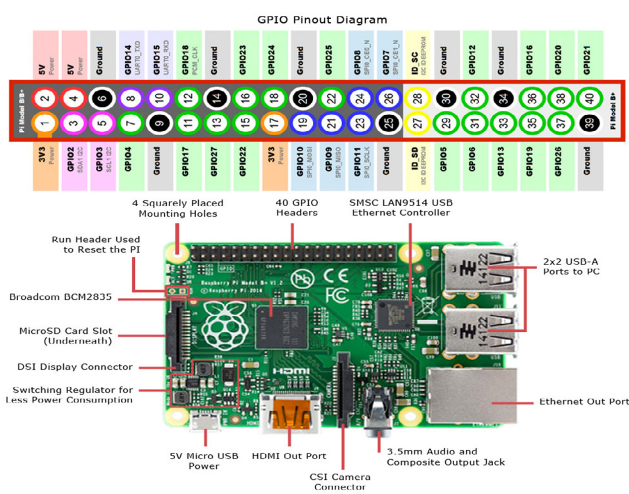


Figure 7. Raspberry Pi

The particularities which make Raspberry Pi different from other embedded boards are:

- Broadcom BCM2836 Arm7 Quad Core Processor augmented Single Board Computer at 900MHz
- 1GB RAM with 40pin extended GPIO and 4 x USB 2 ports
- 4 pole Stereo output and Composite video port output at 1080P with Full size HDMI and CSI camera port

- Micro SD port for loading your operating system and storing data
- Micro USB power source
- 10/100 Ethernet Port to rapidly associate the Raspberry Pi to Internet

The step to trigger the OS into raspberry Pi follows the under-given sequence.

Step1: Booting the OS
The OS booting follows a few steps:

Step 2: Selecting the Images
The latest image file for the OS is downloaded from raspberrypi.org/downloads.

Step 3: Unzipping the Image File
7-zip supports the unzipping of the downloaded image file.

Step 4: Writing to Micro SD Card
SD card is mounted with the image file using the Win32 Disk Imager software. The image and the device is selected for writing the image. SD card class determines the speed of the mounting process.

Step 5: Inserting SD Card into RPi
The SD card is inserted into RPi. On power on the Rpi has the OS loaded.
Step 6: Accessing RPi

There are 2 methodologies by using which the Raspberry pi can be accessed. Firstly the PUTTY terminal which is an open source emulator having a serial console with network file transfer application used to see the results and secondly by using GUI it can be launched from the boot screen by using the command stat rx.

3. Results

The deployment of the setup leads to the following results:

3.1 Raspberry as a Web Server

- Start the Raspberry pi operating system
- Run software updates
- Keep the firmware up to date
- Set up SSH
- Installing the webserver
- Install MySQL
- Install FTP

Here we are running a new version of Debian, we have to do some housecleaning, redesigning, and introducing. To start with, we are going to update the clock, redesign our sources then upgrade any pre-installed packages as shown in Figure 8.

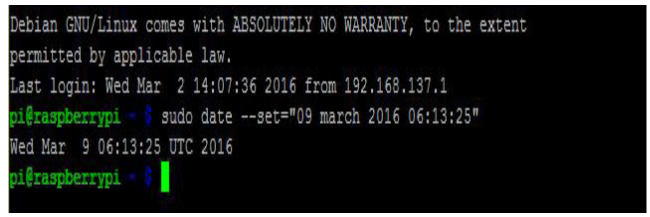


Figure 8. Update the clock.

Next, we need to install Hexxeh's RPI upgrade instrument to stay up with the latest. The accompanying as appeared in Figure 9 is accomplished for this to work.

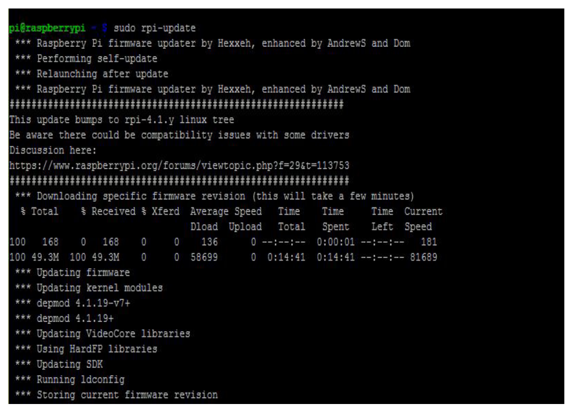


Figure 9. Firmware updation.

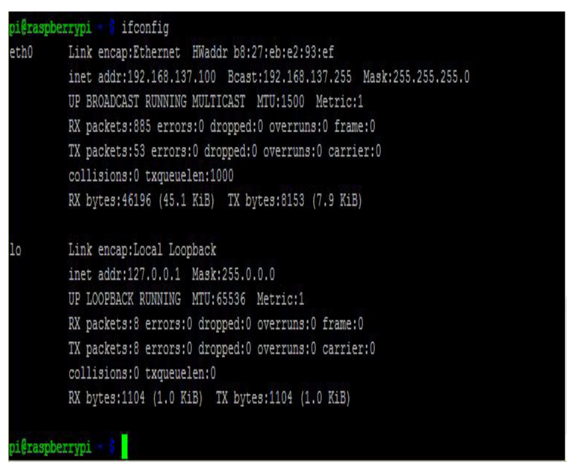


Figure 10. Ifconfig

We will set up SSH so we can do everything else from a alternative PC. To do this, first note the I.P. address of the Raspberry Pi: ifconfig delineated in Figure 10. Now enable SSH and reboot.

The Figure 11 shows the Installation of the Apache and PHP. Figure 12 shows the IP address of the Raspberry Pi on the Web Browser.

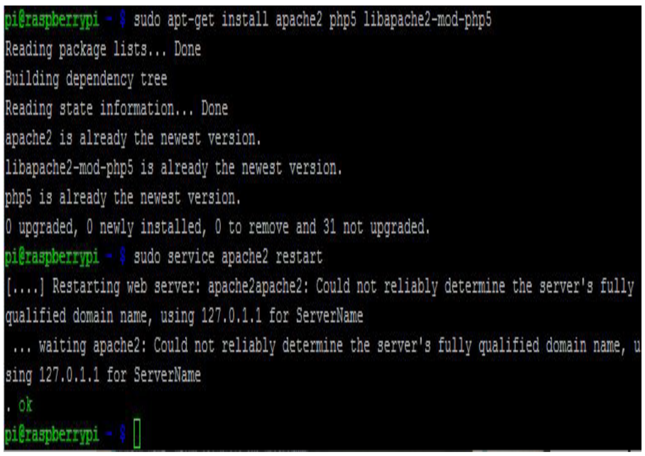


Figure 11. Apache and PHP installation.

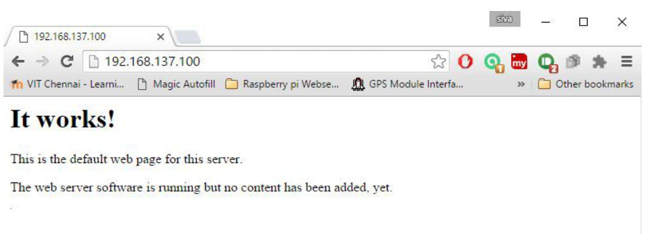


Figure 12. IP address on web browser.

The Figure 13 shows the installation of the My SQL which is used for creating our own data base.

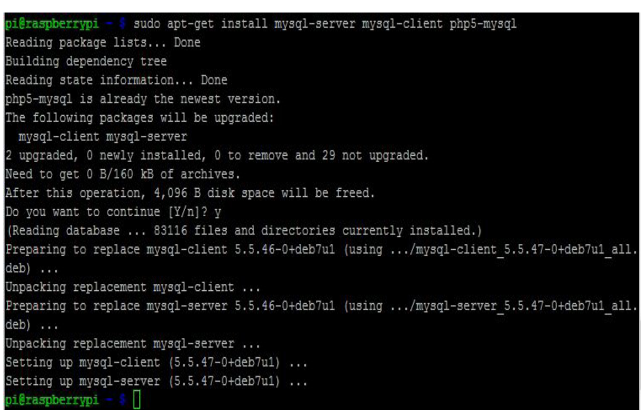


Figure 13. Installation of my SQL.

The to and fro file transfer is facilitated using FTP and for the same the installation of FTP on Raspberry Pi is done shown in Figure 14.

Figure 14. Installation of FTP.

3.2 Interfaced Gas Sensor and GPS Module with Raspberry Pi

The Figure 15 shows the output of the sensor values on the Putty terminal. Figure 16 shows the values of the latitude and longitude values on the terminal.

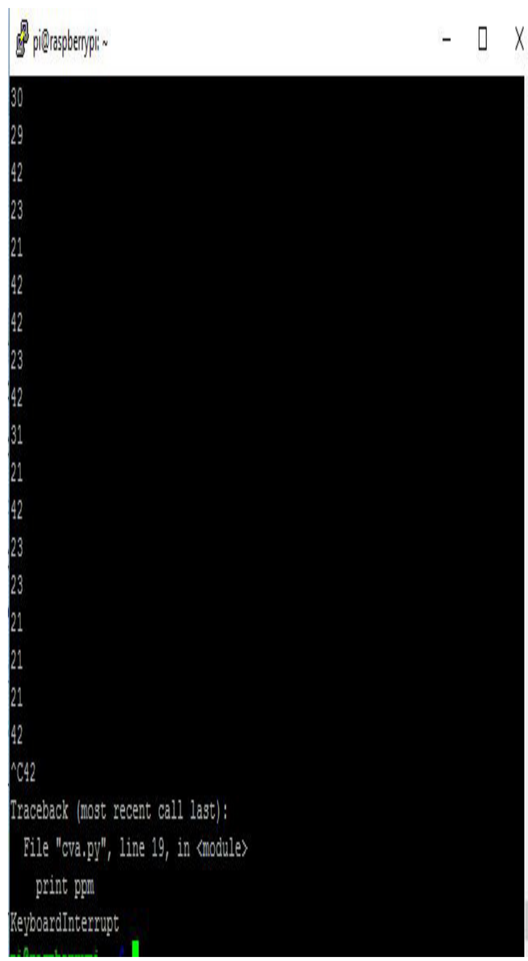


Figure 15. Output of the sensor data

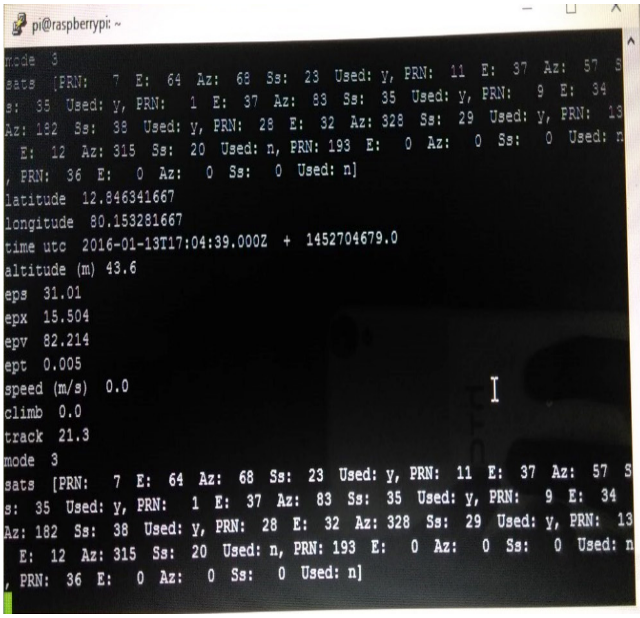
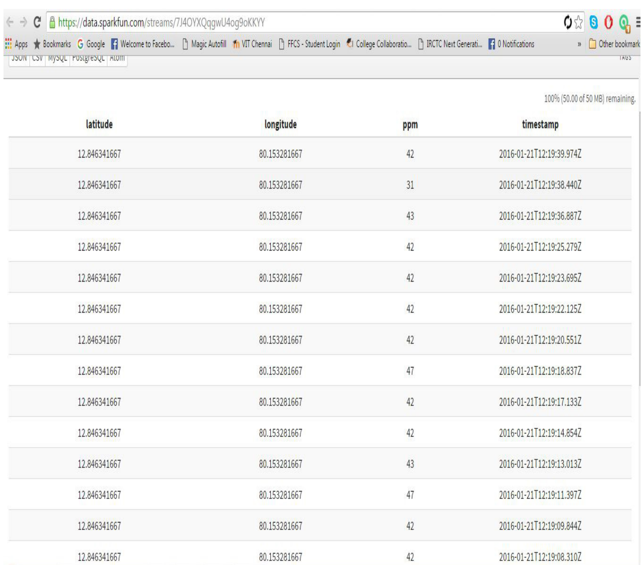


Figure 16. Latitude and longitude values.

3.3 Uploaded the Data into Cloud

For the content to be accessible all over the globe the acquired data is uploaded to the cloud server as shown in Figure 17.


https://data.sparkfun.com/streams/7J4OYXQqgwU4og9oKKYY

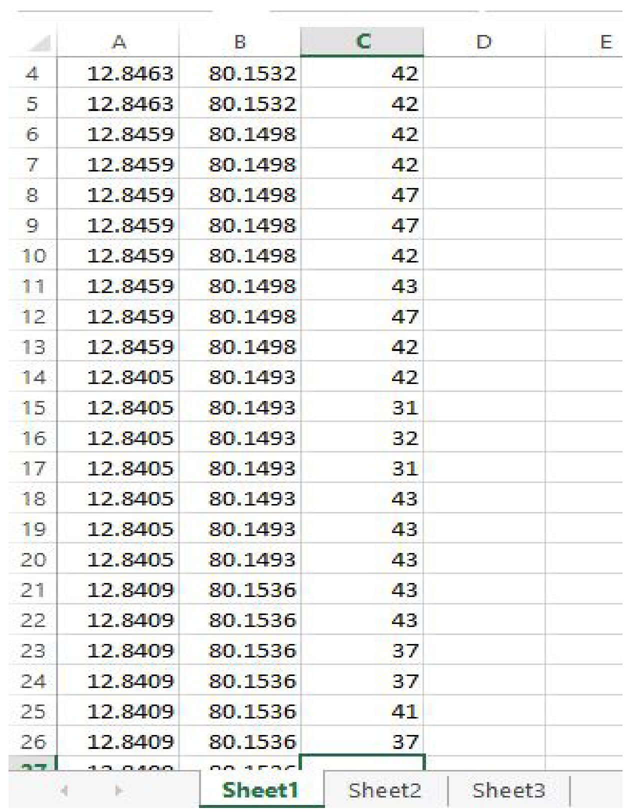
100% (50.00 of 50 MB) remaining.

latitude	longitude	ppm	timestamp
12.846341667	80.153281667	42	2016-01-21T12:19:39.974Z
12.846341667	80.153281667	31	2016-01-21T12:19:38.440Z
12.846341667	80.153281667	43	2016-01-21T12:19:36.887Z
12.846341667	80.153281667	42	2016-01-21T12:19:25.279Z
12.846341667	80.153281667	42	2016-01-21T12:19:23.695Z
12.846341667	80.153281667	42	2016-01-21T12:19:22.125Z
12.846341667	80.153281667	42	2016-01-21T12:19:20.551Z
12.846341667	80.153281667	47	2016-01-21T12:19:18.837Z
12.846341667	80.153281667	42	2016-01-21T12:19:17.133Z
12.846341667	80.153281667	42	2016-01-21T12:19:14.854Z
12.846341667	80.153281667	43	2016-01-21T12:19:13.013Z
12.846341667	80.153281667	47	2016-01-21T12:19:11.397Z
12.846341667	80.153281667	42	2016-01-21T12:19:09.844Z
12.846341667	80.153281667	42	2016-01-21T12:19:08.310Z

Figure 17. Uploaded data into cloud.

3.4 Uploaded the Data into the Map

In order to upload the data into the map, First we have to create the prepare spreadsheet i.e., we need to sign into Google docs and create the spreadsheet. After creating the spreadsheet we have to import that spreadsheet data into the map. The Figure 18 shows the spreadsheet and Figure 19 shows the map.



	A	B	C	D	E
4	12.8463	80.1532	42		
5	12.8463	80.1532	42		
6	12.8459	80.1498	42		
7	12.8459	80.1498	42		
8	12.8459	80.1498	47		
9	12.8459	80.1498	47		
10	12.8459	80.1498	42		
11	12.8459	80.1498	43		
12	12.8459	80.1498	47		
13	12.8459	80.1498	42		
14	12.8405	80.1493	42		
15	12.8405	80.1493	31		
16	12.8405	80.1493	32		
17	12.8405	80.1493	31		
18	12.8405	80.1493	43		
19	12.8405	80.1493	43		
20	12.8405	80.1493	43		
21	12.8409	80.1536	43		
22	12.8409	80.1536	43		
23	12.8409	80.1536	37		
24	12.8409	80.1536	37		
25	12.8409	80.1536	41		
26	12.8409	80.1536	37		

Sheet1 Sheet2 Sheet3

Figure 18. Spreadsheet.

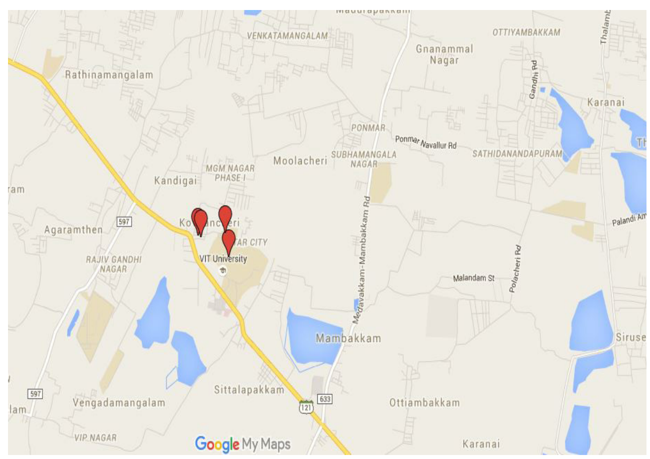


Figure 19. Imported data from spreadsheet.

4. Future Work

The work can be extended to have a Mobile Application integrated to the developed module for the ease of handling and monitoring. This integration can lead to a fully fledged implementation which is of high importance in the current automobile world which strives to facilitate best comfort at the finger tip.

5. Conclusion

This work effectively gives a solution to control the traffic as well as to monitor the environmental pollution. It helps to reduce the pollution along with the traffic. This can be implemented on the vehicles to provide a better communication between the vehicles.

6. Acknowledgment

The first author is indebted to VIT University for providing the required assets and base for completing the research work. Also thanks the research guide for the research support.

7. References

1. Reshi AA, Shafi S, Kumaravel A, VehNode V. Wireless Sensor Network Platform for Automobile Pollution Control, Proceedings of IEEE Conference on Information and Communication Technologies, 2013, p. 963–66.
2. Somov A, Bar A, Savkin A, Spirjakin D, Pirjakin D, Passerone R. Development of Wireless Sensor Network for Combustion Gas Monitoring, Sensors and Actuators. 2011: 171:217–25.
3. Ferdoush A, Li X. Wireless Sensor Network System Design Using Arduino for Environment Monitoring Applications, Procedia Computer Science. 2014; 34:109–10.
4. Coimbra F, Delicato D, Paulo F, Pires P, Pirmez L, Luiz L. A Flexible Web Server Based Architecture for WSN, Procedia Computer Science. 2014; 34:1–20.
5. Wanga F, Hua F, Zhoub D, Suna R, Hua H, Zhaoa K. Estimating Online Vacancies in Real-Time Road Traffic Monitoring with Traffic Sensor Data Stream, ADHOC Networks.2005; 35:3–13.
6. Semertzidis T, Dimitropoulos K, Koutsia A, Grammalidis N. Video Sensor Network for Real-Time Traffic Monitoring and Surveillance, Intellectual Transaction System the Institution of Engineering and Technology.2010 Jun; 4(2):103–12.
7. Liua T, Cedera A, Mac BJ, Guanc W. Remaining Time Improvement of V2V Communication Based GPS Direction Detection, ADHOC Networks.2002; 458–65.
8. Parthasarathi V, Surya M, Akshay B, Siva KM, Vasudevan SK. Smart Control of Traffic Signal System using Image Processing, Indian Journal of Science and Technology. 2015 Jul; 8(16):1–5.