IOT based Vehicle Emission Monitoring System

Madhuri A. Sangale[1], Dr. A. N. Gaikwad[2]

[1,2]Department of Electronics & Telecommunication Engineering, ZCOER, Narhe, Pune, Savitribai Phule Pune University, Pune

***Abstract*— Traffic management system is a cornerstone of a Smart city. In the current problems of the world, urban mobility is one of the major problems, especially in metropolitan cities. Previous traffic management systems are not capable enough to tackle this growth of traffic on the road networks. The purpose of this paper is to propose a smart traffic management system using the Internet of Things and a decentralized approach to optimize traffic on the roads and intelligent algorithms to manage all traffic situations more accurately. This proposed system is overcoming the flaws of previous traffic management systems. The system takes traffic density as input from cameras which is abstracted from Digital Image Processing technique and sensors data, resultantly giving output as signals management. An algorithm is used to predict the traffic density for future to minimize the traffic congestion. Now a day control system is able to handle traffic management system, but not that much effectively because it requires human feedback. We need a system which must give continues satellite update so that it can handle traffic smoothly. This will be done by using an advanced traffic management system. The system is supported by a circuit embedded in the vehicle, which operates using RFID with clustered systems. Internet of Things (IOT) links the objects of the real world to the virtual world. This is featured by low cost, high scalability, high compatibility, easy to upgrade, to replace traditional traffic management system. IOT based intelligent traffic control systems are designed to support the Smart City vision, which aims at employing the advanced and powerful communication technologies for the administration of the city and the citizens.**

***Keywords*— Internet of Things, Traffic Management, RFID, Wireless sensor network, Sensor.**

I. INTRODUCTION

The proportion of air pollution which is caused by the cars is increasing. In order to solve this serious problem, many countries and regions have already presented a series of emissions standards, meanwhile some methods has been developed, include update motor engine or improve the quality of the gasoline.

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 to 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, then which can be analysed, 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.

II. LITERATURE SURVEY

[1]This paper published by Prasanna Kumar, Maddirala Sri Rama Sekhar, Myla Lova Kiran Verma entitled "Vehicle pollution monitoring and controlling using IoT", in December-2015.

In this paper a novel solution is presented to monitor and control the pollution at the traffic signaling lights. A simple wireless embedded chip is inserted in the personal vehicles to control the ignition on and off remotely. Depends upon the pollution level measured from sensors at the traffic signaling, the operator will send command to the wireless traffic pollution control system. Also a simple radio frequency based embedded chip is inserted in the personal vehicles to control the ignition of remotely via control system at the traffic lights is the best way to reduce the air pollution.

[2]This paper published by Usha S., Naziya Sultan A., Priyanka M., Dr. Sumathi S. entitled "Vehicle Pollution Monitoring Using IoT", in 13th-14th march 2017.

In this paper, according to recent technology development in this miniaturization of electronics and wireless communication technology have led to the emergence of environmental pollution sensor network wireless air pollution monitoring system provides real-time information about the level of air pollution. In these regions, as well as provides alerts in case of drastic change in quality of air. This information can then be used by the authorities to take prompt actions such as evacuating people or sending emergency response team. It uses an Air Quality Index to categorize the various levels of air pollution. The system also uses the AQI to evaluate the level of health concern for a specific area.

[3]This paper published by Ramagiri Rushikesh, Chandra Mohan Reddy Sivappagari entitled "Development of IoT based vehicular pollution monitoring system", in September 2015.

In this paper wireless sensors are used in most of the in real time applications for collecting physical information. The measurement of air quality is one of the difficult areas for the researchers. The main source of atmosphere pollution happens due to vehicles. The high inflow of vehicles in urban areas causing more air pollution and decreasing air quality that leads to severe health diseases. The measured data is also shared to vehicle owner, traffic department and agencies of national environment. This system is a low cost and provides good results in controlling the air pollution especially in the urban areas.

III. KEY TECHNOLOGIES UESD IN IOT

The concept of IOT architecture is used in various scenarios like Auto-ID labs, EPC, ONS all this thing have a target to architect the IOT with a global design.

1. RFID:

RFID technology is the main factor in the embedded communication technology, which have a simple design for the purpose of wireless data communication. It can help to automatically identify the object. RFID is more like a bar code. The concept of RFID Is using Radio signal to automatically detect an object for storing and remotely retrieving data. The Component used in RFID comprises of Tags, Tags Reader, Antenna, Information managing software and storage space. Data is transferred and received by using radio waves. Tags are usually placed on the object. There are different types of tags depending based on power supplies.

2. EPC:

THE AIM of EPC is used as supporting device in RFID. EPC is being developed by the Auto-ID from Massachusetts institute of technology for the purpose of sharing data in real time by using a unique identifying number with the help of RFID and different wireless communication technology using internet infrastructure and platform.

3.WSN:

Wireless Sensor Nodes are sensor which is used to detect various physical parameters such as pollution contents, Quality of air etc. These autonomous sensors are distributed around the network, which will monitor following above parameters, these will pass the desired data to the centralized server. There are several domains introduced with the emergence of the Internet of things. Depending upon Network availability coverage and its use there are several applications like Smart business, Health care, smart home, Automation, Environmental Monitoring and Mobile communication etc.

IV. PROPOSED SYSTEM OVERVIEW

In this project we have build a pollution monitoring system using a RFID reader, PIC microcontroller 16F877A, 16X2 LCD, a Wi-Fi module ESP8266. RFID tags will be pasted on each vehicle. When a vehicle stops at signal RFID reader will read the RFID tag number and will find the vehicle number from the list. Then it will read sensor output and it will be displayed on LCD. It will also send the RFID tag number and gas sensor output to the Thing speak cloud. The received data will be stored in real time and will be available for future analysis. In fact four such systems will be installed at four different locations in the city.

1. Block Diagram of proposed system:

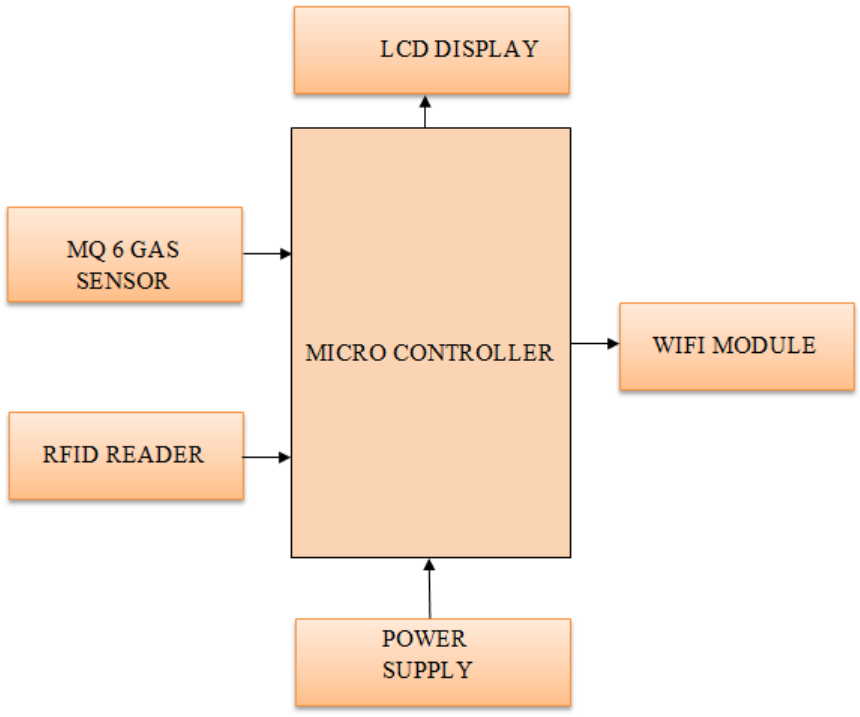

Fig. 1 Block Diagram of proposed system

1. Hardware – PIC microcontroller 16F877A, 16x2 LCD, EM18 RFID reader, Wi-Fi module ESP8266 – 01.
2. Software – Mikro C for PIC microcontroller, Proteus 8.0 for schematic, layout and Simulation.

2. System description:

- Microcontroller- PIC16F87XA
- 28/40/44-Pin Enhanced Flash Microcontrollers Devices Included in this Data Sheet.
- High-Performance RISC CPU
- Only 35 single-word instructions to learn.
- All single-cycle instructions except for program branches, which are two-cycle

- Operating speed: DC – 20 MHz clock input, DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory.
- Pinout compatible to other 28-pin or 40/44-pin, PIC16CXXX and PIC16FXXX microcontrollers.

i. Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler can be incremented during Sleep via external crystal/clock.
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and post scaler
- Two Capture, Compare, PWM modules
  - Capture is 16-bit, max. resolution is 12.5 ns
  - Compare is 16-bit, max. resolution is 200 ns
  - PWM max. resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver, Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

ii. Analog Features:

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
  - Two analog comparators
  - Programmable on-chip voltage reference (VREF) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs are externally accessible

iii. Special Microcontroller Features:

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

iv. CMOS Technology:

- Low-power, high-speed Flash/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low-power consumption

V. STEPS FOLLOWED DURING VEHICLE POLLUTION TESTING

1. Each vehicle consists of CO Gas sensors, RFID tag, Microcontroller and ADC.
2. As soon as vehicle starts the emission readings are sensed by CO sensors in analog form.
3. This analog output is given to ADC to convert it into Digital form.
4. This digital data is saved to RFID tag via microcontroller.
5. The data is received by the RFID receivers which are installed on traffic signals when it comes in required range.
6. RFID receivers send this data to GSM module to send it to the Thing speak cloud.
7. The data is stored and analyzed by the Thing speak cloud.
8. While analysis if the value exceeds the standard value then a warning message or email is send to vehicle user.
9. This online data can be accessed by any vehicle user with its unique ID and password.

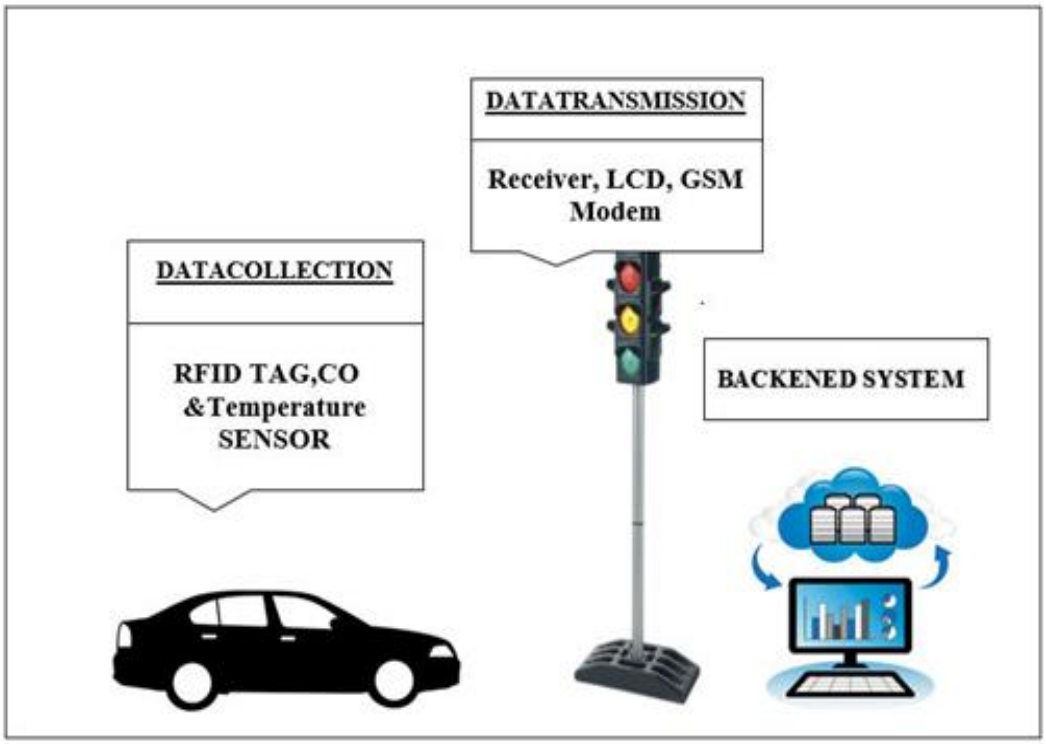

Fig. 2 Proposed systems

VI. SYSTEM DESIGN

1. Inspection system design:

Inspection system can be divided into data collection and data transport. RFID technology is well employed here. RFID tag is mainly responsible for data collection, while data transport can be realized via RFID reader.

i. Data Collection:

The active RFID tag is designed to collect the emissions data from the vehicle exhaust system. Although active RFID tag has a lifetime which is limited by the on board power source, it is not an issue for WINS because there is already a power supply in every vehicle. In a typical vehicle exhaust system, there are usually to built-in gas sensors installed on the exhaust system. Therefore, the value is collected as the emissions data. In particular, the three sensors in the exhaust system of an automobile, the one is settled before the catalytic converter and the other one after it to evaluate if the catalytic converter works well.

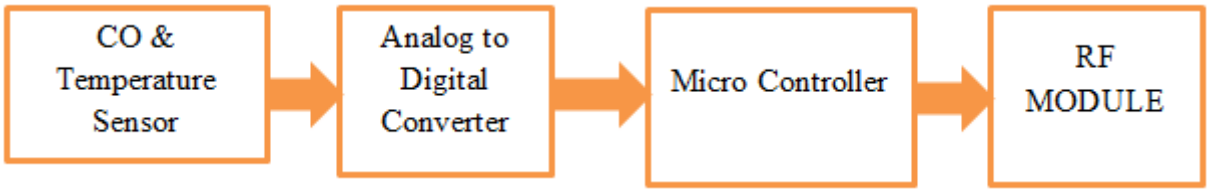

Fig. 3 Interfacing of data collection part

To collect emissions data from the downstream sensor better, an analog-to-digital converter (ADC) is also designed to connect RFID tag. It is a device that uses sampling to convert a continuous quantity into a digital number and has been widely used for signal conversion problems. With ADC, the voltage signal (values) being outputted from the gas sensors is first converted into digital signal, and then stored in the RFID tag directly via the wires. A prototype of the RFID tag with ADC is made as shown in Fig.3.

ii. Data Transmission:

RFID reader will receive emissions data when the vehicles which are installed with RFID tag drive into inspect range. Once the RFID reader receives the data from the tags, the most cost-effective way for data transmission is Thing speak cloud using ESP Wi-Fi adaptor. First it will send SSID and Password. Then it will send store to Thing speak cloud address. It can steadily transmit these data to the control system.

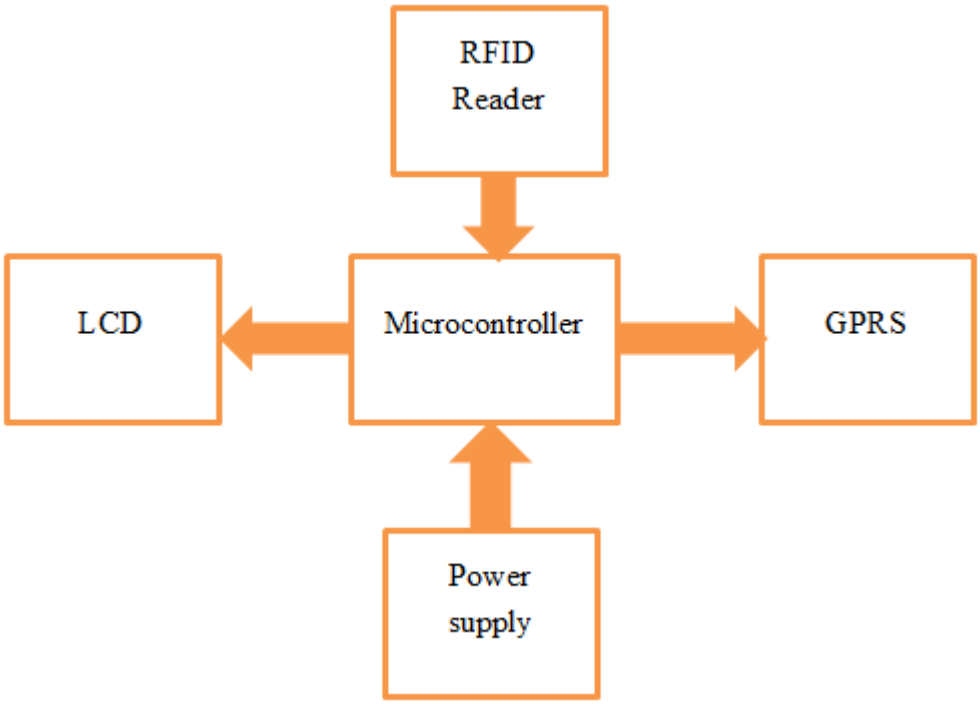

Fig. 4 Interfacing of data transmission part

iii. Displaying data:

An RFID reader will read data from the RFID tag and it will be displayed on LCD with Vehicle number. Also sensor output will be displayed on LCD. Both Vehicle number and sensor output Will be displayed on Thing speak cloud.

iv. Control system design:

The control system as a vehicle notification center, its chief role is to notify drivers with SMS or e-mail to repair their cars as soon as possible until detected qualified when their vehicle emissions exceed the allowed figure. Meanwhile, the drivers also can check their cars detail emissions information (e.g. when, where, how) via the control system. They can login the website and input their account such as mobile number, vehicle licenses or Tag ID to inquiry.

VII. Advantages And Dis-advantages

1. Advantages:

1. No polluting vehicle is spared.
2. The car may belong to any influential person, the system is fair to all.
3. Helps to reduce pollution levels.

2. Dis-advantages:

1. Problem of security may arise if the data in PC is mis-handled.
2. RFID Readers need to be rugged and more sensitive.

VIII. Conclusion

The proposed system is used to monitor and control vehicular air pollution using IoT. This system is cost effective solution for vehicle emission problem. The proposed system is effective and reliable for vehicle emissions inspection. It is capable to measure the value of pollutants emitted by the vehicle continuously and display it on 16x2 alphanumeric LCD display. Also if the pollutant level exceeds the prescribed value, then a SMS will be sent to the respective authority to take necessary disciplinary action.

IX. Future Research

This system is used to monitor and control vehicular air pollution using IoT. Though the feedback is given to the owner of the vehicle about emission levels he should be followed up to rectify. This may be taken for future scope by sending repeated mails and assurance from the owner that he has rectified.

In future work we can add more sensors for accident detection, ultrasonic sensor to detect obstacles at front side in case of poor visibility, alcohol sensor to detect the alcohol content in the drivers cabin, LPG sensor to find if there is any LPG leakage which may cause fire in the vehicle.

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