Implementing RFID for Detecting Vehicular Pollution and Status Monitoring

Nirlipta Kar, Priyabrata Pattanaik, S.K. Kamilla

Abstract:- atmospheric pollution is primarily caused by vehicles on the road. It has led to an increase in the health risks related to breathing such as asthma, bronchitis etc. The poisonous gases exhausted by such vehicles include nitrogen oxides, sulfur dioxide, carbon monoxide and causes various respiratory diseases and lung infection. This has contributed to severe environmental issues such as global warming. The focus of this paper is to monitor vehicle pollution by using Co doped ZnO as sensing material. The vehicle pollution sensing performance of Co doped ZnO result will be remotely controlled by using mobile application. Is uses RFID technology to monitor pollution level on roads and level of various categories of pollutants is measured by this technique.

Keywords: IoT, vehicular pollution, RFID, gas sensor.

I. INTRODUCTION

There has been a rapid increase in the air pollutants emitted from various vehicles such as cars, buses and trucks. Transportation offers its own advantages and disadvantages. It has led to an increase of almost 50 % of CO in the air. The emission of these harmful gases has led to increased health risks. A prolonged exposure to such harmful emissions has led to the Chronic Obstructive Pulmonary Disease (COPD)[1]. In today's scenario, a person needs to visit a pollution check station to know the pollution status of his vehicle and in order to obtain the pollution certificate, a person is needed to visit the center after every three months and go through a lengthy process. The embedded computing devices are uniquely interconnected within the internet infrastructure and is known as the internet of things (IoT). IoT goes beyond Machine-To-Machine communications (M2M) [2] and offers advanced connection of systems, services and devices. Also the visit is successful if the server at the pollution check station is working. To get rid of the problem of a constant visit after every 3 months and to ensure proper working of server, a model is proposed: Implementing RFID for Vehicular Pollution Detection and Status Monitoring. It is an efficient low cost project. This efficiency is better enhanced by using technologies such as Internet of Things (IoT) and RFID. The individual embedded computing devices in current internet infrastructure are connected by internet of things (IoT). IoT connects not only machine to machine communication devices but also those following different types of protocols. IoT gathers and analyzes the pollution data from vehicles whereas RFID is used for accessing control and identifying the vehicles. The objects are communicating directly or indirectly by IoT[3]–[6].

II. SYSTEM ARCHITECTURE

The gas sensors detect the amounts of specific gases in parts per million, abbreviated as ppm and it is a unit of concentration in immediate surroundings. Percent from ppm is calculated by the division of ppm by 1,000,000 and further multiplication by 100. Thus, the detection of 800ppm of oxygen in air means 8% of oxygen in air. A Wheatstone bridge comprising of two voltage dividers connected in parallel with each other is used in sensors to detect gases. Two pins are connected to a sensor and two of them are connected to a heating element. A coating of Co doped ZnO is taken as the sensing element for gas sensors. This Co doped ZnO has been fabricated and its performance as gas sensor was studied, which has been reported by us earlier [7]. The tin oxide SnO_2 becomes oxidized when the heating element receives power and donates electrons releasing positively charged SnO_2 molecules on the coating of sensing element. This leads to a barrier in electron flow, thereby increasing a sensor's resistance. The content of oxygen decreases with the introduction of a deoxidizing gas (C_2H_5OH) in an equation. Thus, there is lesser oxygen that is able to accept donor atoms from SnO_2 coating resulting in the reduction of resistance of sensor due to SnO_2 because of absence of positive charge. The voltage across a load resistor between negative pin of sensing element and ground gives actual gas levels in ppm[6], [8].

III. INTERNET OF THINGS

The trending topic of today's technical, social and economic significance is Internet of Things. Durable goods, consumer products, trucks, cars, utility and industrial components, sensors and other everyday objects are interlinked with strong data analytic capabilities and internet connectivity that are capable of transforming the way we work, live and play. There are impressive projections for the effect of IoT on internet and economy having almost 100 billion computers connected to IoT and expecting more than $ 11 trillion connected by 2025. IoT is expected to offer progressive connection of systems, devices and services that go further than Machine-to-Machine communications and covers a variety of protocols[9]. The significant challenges are raised by the internet of things that could stand in the way to realize the potential benefits. A widespread attention has been gained about hacking internet connected devices,

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concerns about surveillance and privacy concerns. The challenges in new policy, development and legal issues are trending whereas technical challenges are constant.

This research paper helps in investigating the whereabouts of Internet of Things by keep in mind its promises and perils. The complex and intertwined ideas from different perspectives are engaged in Internet of Things. The opportunities and challenges faced by IoT includes:

- IoT definitions: The term IoT can be expanded as the Internet of Things in which network connectivity and computing capabilities extends to sensors, objects and everyday items that are not normally computers that allow these devices to generate, consume and exchange data or information with less or no human intervention.
- Enabling technologies: Over the decades, the computers, sensors and other networks have been combined to monitor as well as control devices. The internet of things is getting closer to widespread reality by the confluence of several marketing technology trends. All this consist of ubiquitous connectivity, miniaturization, data analytics advancement and rise in cloud computing[10]–[12].
- Connectivity models: Various technical communication models are implemented by IoT which have their own characteristics. Four of the common models described by the Board of Internet Architecture are: Device-to-cloud, Device-to-Gateway, Device-to-Device and Back-End Data-Sharing. The way IoT devices are connected is highlighted by such models.

IV. RFID

An RFID uses antenna and a microchip through which transmitting and receiving is done. It is also called an IC or an integrated circuit. RFID reader has a microchip that has all the information that the user wants. Broadly speaking, there are two types of RFID tags: battery operated and passive[13]. As the name implies, battery operated RFID tags comprise of an on board battery that supplies power while on the other hand, a passive RFID tag does not comprise of that. Passive RFID works on the principle of electromagnetic energy emitted from an RFID reader. RFID tags that are operated by battery are also referred to as active RFID tags[11], [12]. Three main frequencies are used by passive RFID tags in order to transmit the information:

- 125 – 134 KHz, also referred to as Low Frequency (LF),
- 13.56 MHz, also referred to as High Frequency (HF) and Near-Field Communication (NFC),
- 865 – 960 MHz, also referred to as Ultra High Frequency (UHF).

The mechanical, electronic and electrical systems utilized in buildings can be monitored and controlled by IoT devices. The range of frequency used in home automation systems[14] effects the range of tags.

Reader scans a passive RFID tag which is able to transmit energy to the tag in order to power it enough for the chip and antenna that relays information back to the reader. The information is fed back to the RFID computer program for getting interpreted. Passive RFID tags fall under two broad categories: hard tags and inlays tags. Inlays being too thin are able to stick on various materials whereas hard tags are made up of durable and hard material such as plastic and metal. “Hyper connected world” refers to the general purpose nature of the Internet architecture itself, which does not place inherent limitations on applications or services that can make use of the technology[15]. The information is transmitted by Active RFID by any of the two frequencies either 433 MHz or 915 MHz. it comprise of three major parts, a tag, an antenna and an interrogator. The battery used in an active RFID should be capable of supplying enough power to make it last for 3-5 years. Since, the batteries currently employed are not replaceable, the unit needs to be replaced if it dies. Beacons and transponders are two major kinds of active RFID tags. Beacons are able of sending out information after every few seconds and the signals sent by beacons are readable from a distance of several hundred feet. The batteries employed in them deplete quickly because they transmit data frequently. Just like passive RFID tags, transponders employ a reader for the transmission of information[6][16]. The relevant information is pinged back after the transmission of first signal by a reader to a transponder. Thus, transponders appear to be much more efficient in terms of battery because they get activated only when they are in a close proximity of a reader[8].

V. SYSTEM INFORMATION

This system comprises of two units namely a vehicle and a remote monitoring unit. The gas releasing part of the vehicle that releases CO_2 is installed within the vehicle unit. The sensor senses the LPG gas and an arduino board converts it into the numeric form and RFID tags installed in every unit provides MAC address of the vehicle in order to identify the vehicular number. The pollution emissions by a vehicle are monitored by remote monitoring units[9]. The protocols that describe the second generation (2G) of digital cellular networks that are used by cellular phones are developed by the European Telecommunication Standards Institute (ETSI), and is known as GSM (Global System for Mobile Communications, formerly Group Special Mobile). It has turned out to be the default global standard for mobile communications since 2014.

VI. BLOCK DIAGRAM

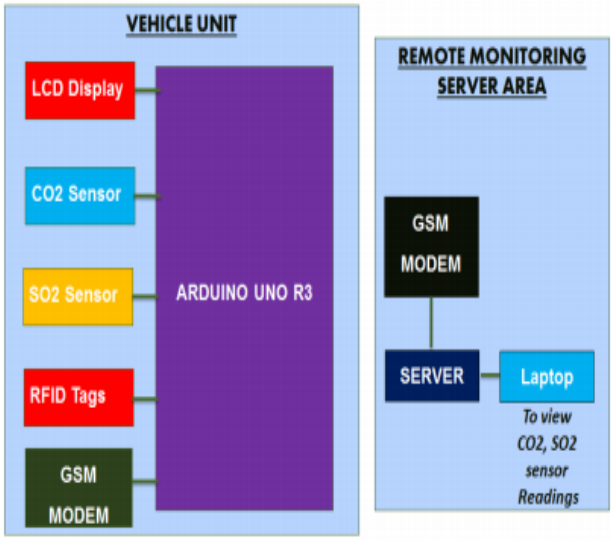

Fig. 1 Block Diagram

VII. HARDWARE INTERFACE REQUIREMENT

- Embedded system platform which comprise of mega 328 and a GSM modem.
- Arduino board is a microcontroller board which is grounded on at mega 328. The digital input/ output pins used here is 14, analogue inputs used here are 6, a 16 MHz ceramic resonator with a USB connection, a reset button which resets values and a power jack.
- A Bluetooth module for connecting RFID tag with the android application.
- Sensors in order to do the comparison between the standard and the measured ppm.
- LCD display to demonstrate the pollution level of the car.
- RFID reader is used to identify the id of the RFID tag.

VIII. SOFTWARE INTERFACE REQUIREMENT

The connection between the android application and the device is done by Bluetooth. All the information about the modules and about the vehicles is contained in the application. This application also stores the statistical information on the pollution test conducted by the vehicles. Embedded C will be used for the interface coding of Arduino module.

IX. SECURITY

Any product, vehicles etc are tracked or located by the RFID technology. RFID technology is used to track any vehicle which has its pollution level greater that the standard value RFID technology used in this paper. Tags are the silicon chips or transponders and are attached to an antenna. Broadly speaking, there are two types of tags: active and the passive. Active tags are battery powered whereas passive tags are reader field powered. The message is passed between a tag and a silicon chip which is associated to an antenna. This system is used in applications such as passport protection and animal identification.

X. RESULT

A microcontroller is used in an Arduino environment and IoT is used to design this system. The Arduino code is inserted in the system and VB application is used to display the output. It has been illustrated by the result that it is capable of functioning in all the environments and based on the commands of users, immediate response is provided.

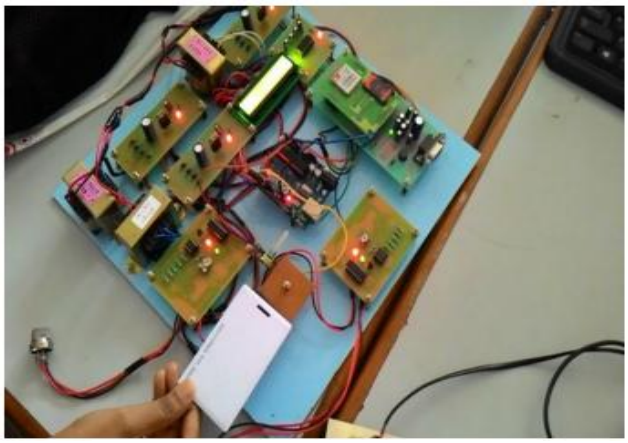

Fig.2 Transmitter Side reading RFID tags

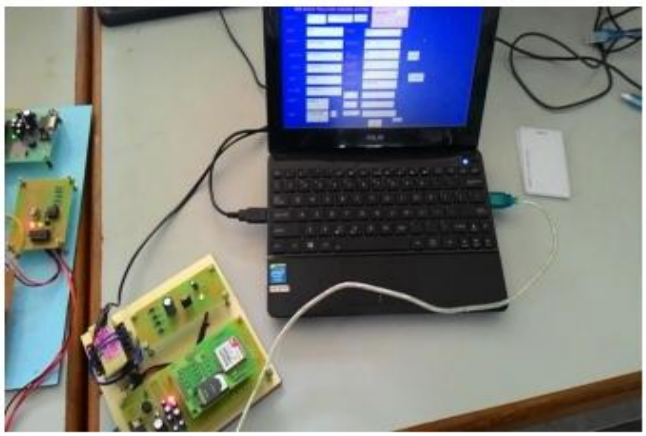

Fig.3 Receiver Side GSM unit along with Laptop

Fig. 4 LCD shows Sensor readings

XI. CONCLUSION

The cost effective solution to get rid of the vehicle emission is provided by this system. This material for sensing system is taken here as Co doped ZnO, which has better selectivity, sensitivity and reproductively. It can be used for other purposes also once mounted on a vehicle. One is secure from the server's end also as only an authorized person can know the information of vehicle's pollution. The purpose of this system is to provide information only to the authorized person and any information of the vehicle cannot be edited. This makes the system very secure from server's end also. The willingness of government is employed because the dataset of owner of the vehicle is needed.

XII. FUTURE WORK

The elements on which we are working in this system include Bluetooth connectivity and it can furtherly be converted to the IOS module for the range of anti-theft and elements of the system.s

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