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Vehicular Pollution and Status Monitoring Using RFID

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ABSTRACT: The proliferation of technology paves way to new kind of devices that can communicate with other devices to produce output mostly on wireless communication. Degradation of air quality in cities is the result of a complex interaction between natural and anthropogenic environmental conditions. With the increase in urbanization and industrialization and due to poor control on emissions and little use of catalytic converters, a great amount of particulate and toxic gases are produced. Existing System: Monitor air pollution on roads and track vehicles which cause pollution over a specified limit. Increasing number of automobiles is a serious problem that has been around for a very long time. Proposed method: The vehicle unit periodic monitoring of the sensor values are noted and send to the laptop via server. Along with the sensor values, Vehicle FC details, Insurance Details, Periodic Service details are viewed on the laptop. If any increase in the sensor readings/Date expired of any insurance, FC, Service an alert will be send to the owner. And also the Transport service regarding vehicle insurance.

KEYWORDS: IoT (Internet of Things), RFID (Radio-Frequency Identification), VB (Visual Basic).

I. INTRODUCTION

The environmental problems are growing rapidly. Air pollutants from cars, buses and trucks, particularly ground-level ozone and particulate matter can worsen respiratory diseases and trigger asthma attacks. Transportation can be responsible for more than 50 percent of carbon monoxide in the air. The air pollution may lead to Chronic Obstructive Pulmonary Disease (COPD) and escalates risk of cancer. The public health is affected due to pollution from cars and trucks can also be very high in the large metropolitan cities. One of the major reasons of air pollution is emission of polluting gases from vehicles which is responsible for 70% of the total air pollution. In order to control the air pollution, the amount of air pollution needs to be monitored and vehicles responsible for polluting should be identified. Internet of Things may become helpful in cities for monitoring air pollution from vehicles and also data related to the amount of pollution on different roads of a city can be gathered and analysed. The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to Offer advanced connectivity of devices, systems, and services that goes beyond Machine-To-Machine communications (M2M) [8] and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices is expected to usher in automation in nearly all fields, while also enabling advanced applications like a Smart Grid. Things, in the IoT, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. Current market examples include smart thermostat systems and washer/dryers that utilize Wi-Fi for remote monitoring. One of the things that make it special and different is that the Internet of Things allows objects to communicate directly or indirectly to Internet. Furthermore, this information does not have to be used only by the user, but by other people for applications or studies.

II. SYSTEM ARCHITECTURE

Arduino UNO board with ATmega328 is used as an embedded controller to interact with the Ethernet shield along with PC/Laptop.

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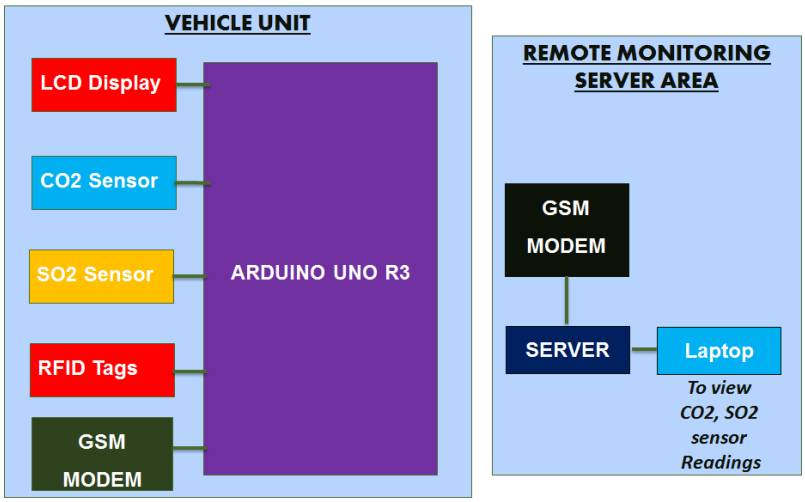

Fig. 1. Block diagram of Vehicular Pollution and Status Monitoring Using IoT

A. Embedded System Platform

The key elements in this system contains embedded system platform which includes Arduino Board with ATmega 328 and GSM modem.

B. Arduino Board

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world. The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, and also by several other vendors, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors.

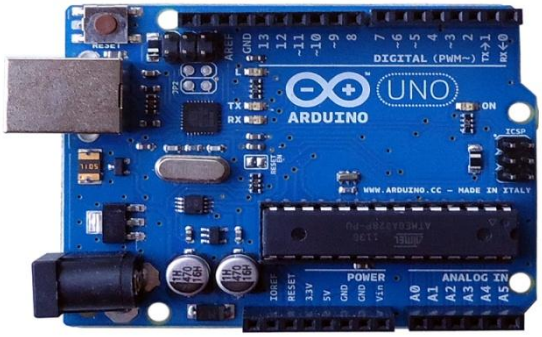

Fig. 2. Arduino UNO Board

These systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C and C++ programming languages.

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C. GSM MODEM

GSM (Global System for Mobile Communications, originally *Groupe Spécial Mobile*), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second-generation (2G) digital cellular networks used by mobile phones. As of 2014 it has become the default global standard for mobile communications - with over 90% market share, operating in over 219 countries and territories. 2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS). This is a plug and play GSM Modem with a simple to interface serial interface. Use it to send SMS, make and receive calls, and do other GSM operations by controlling it through simple AT commands from micro controllers and computers. It uses the highly popular SIM300 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to micro controllers and computers. The modem consists of all the required external circuitry required to start experimenting with the SIM300 module like the power regulation, external antenna, SIM Holder, etc.

D. CO_2 sensors

Chemical CO_2 gas sensors with sensitive layers based on polymer- or heteropolysiloxane have the principal advantage of very low energy consumption, and can be reduced in size to fit into microelectronic-based systems.

Fig. 3. *CO_2 sensors*

E. GAS sensors

The MQ series of Gas Sensors used in this research work are simple and cost effective sensors useful for sensing gases in the air. There is a wide range of sensors available each of which are made to detect a specific gas like Methane, NOx, SOx, LPG, CNG, Carbon Monoxide and Alcohol.

Fig.4. *GAS sensors*

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III. INTERNET OF THINGS

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols[4], domains, and applications. The interconnection of these embedded devices is expected to usher in automation in nearly all fields, while also enabling advanced applications like a Smart Grid.

IoT Applications includes,

a) Environmental monitoring

Environmental monitoring applications of the IoT typically utilize sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile.

b) Building and home automation

IoT devices can be used to monitor and control the mechanical, electrical and electronic systems used in various types of buildings (e.g., public and private, industrial, institutions, or residential). Home automation systems[5], like other building automation systems, are typically used to control lighting, heating, ventilation, air conditioning, appliances, communication systems, entertainment and home security devices to improve convenience, comfort, energy efficiency, and security.

c) Transportation

The IoT can assist in integration of communications, control, and information processing across various transportation systems. Application of the IoT extends to all aspects of transportation systems, i.e. the vehicle, the infrastructure, and the driver or user. Dynamic interaction between these components of a transport system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.

IV. LCD DISPLAY

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence. The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome. Liquid crystals were first discovered in 1888.[2] By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes.

V. RFID

Radio frequency identification (RFID) is a very useful technology for electronically identifying, locating, and tracking products, animals, and vehicles. This work uses RFID technology for tracking vehicles responsible for creating pollution. Communication takes place between a reader and a transponder (Silicon Chip connected to an antenna) often

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called a tag. Tags can either be active (powered by battery) or passive (powered by the reader field), and are available in various forms including tags, smart cards, labels, watches and even embedded in mobile phones. The frequencies used for communication depend on the application, and range from125KHz to 2.45 GHz. Figure 5 shows RFID tag and RF Receiver used in this work. Output of an active RFID transmitter tag is a unique 16 bit ID in serial data at 9600 bps baud rate and the active RFID transmitter transmits 16 bit unique ID on 433 MHz frequency giving range of around 25 meters.

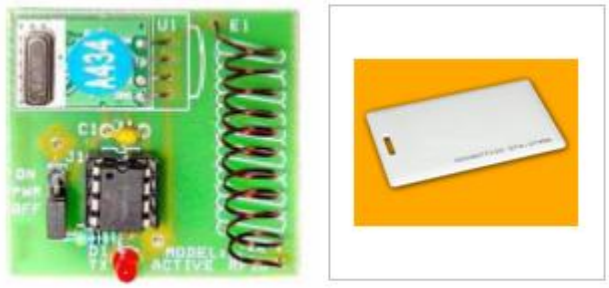

Fig. 5. RFID Tag

a) RFID Reader:

The RFID reader reads EM4100 family transponder tags that are brought in proximity to the reader and output the unique tag identification number through RS232 serial port @9600 bps. The reader output 12 byte including one start, stop byte and 10 unique data byte. The start byte and stop byte are used to easily identify that a correct string has been received from the reader. The middle ten bytes are the actual tag's unique ID. Vertical and horizontal parity checking has been done in card reading algorithm to ensure data integrity. One status LED is provided to indicate card detection. RFID (radio frequency identification) systems use data strings stored inside RFID tags or transponders) to uniquely identify people or objects when they are scanned by an RFID reader. These types of systems are found in many applications such as passport protection, animal identification, inventory control systems, and secure access control systems, robotics, navigation, inventory tracking, payment systems, and car immobilization. Because passive tags require a strong RF field to operate, their effective range is limited to an area in close proximity to the RFID reader.

VI. SYSTEM IMPLEMENTATION

It consists of two modules vehicle unit and remote monitoring unit. Vehicle units, which resides in a vehicle consists of CO2, LPG GAS sensors, RFID tags and GSM modem. Remote monitoring server area holds the server unit, GSM modem and Laptop. XAMPP is used as local host server to view the Arduino contents in the remote area of server.

VII. RESULTS AND DISCUSSION

Present paper is designed using ATmega328 microcontroller in the Arduino environment. It is proposed to design an embedded system which is used for IoT applications. After uploading the code into the Arduino the computer window shows the results by using the VB application. The result shows that, it will work well for all kinds of applications and responds immediately to the user's commands.

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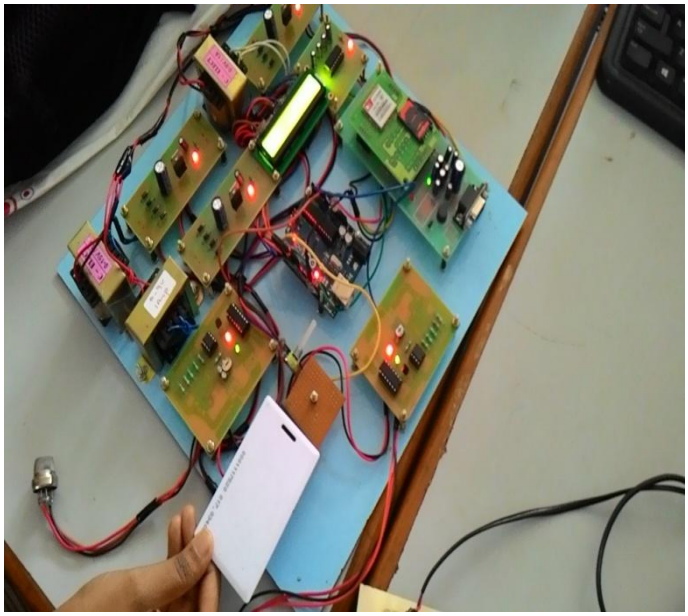

Fig. 6. Transmitter Side reading RFID tags

Fig. 7. Receiver Side GSM unit along with Laptop

Fig. 8. LCD shows Sensor readings

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Fig. 9. Remote server level output

VIII. CONCLUSION

From the proposed system, a low cost RFID based application can be designed using Arduino and the applications of Home automation, Industrial control, Transportation can be achieved easily. The vehicle unit periodic monitoring of the sensor values are noted and send to the laptop via GSM modem. Along with the sensor values, Vehicle FC details, Insurance Details, Periodic Service details are viewed on the laptop using VB. If any increase in the sensor readings/Date expired of any insurance, FC, Service an alert will be send to the owner, also the Transport service regarding vehicle insurance.

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