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Wireless Sensor Network based Pollution Monitoring System in Metropolitan Cities

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Abstract: In this project, we are monitoring air pollution and vehicle traffic congestion which leads to air pollution, driver frustration, and costs billions of dollars annually in fuel consumption. Finding a proper solution to vehicle congestion is a considerable challenge due to the dynamic and unpredictable nature of the network topology of vehicular environments, especially in urban areas. Recent advances in sensing, communication and computing technologies enable us to gather real-time data about traffic condition of the roads and mitigate the traffic congestion via various ways such as Vehicle Traffic Routing Systems (VTR), electronic toll collection system (ETCS), and intelligent traffic light signals (TLSs). Regarding this issue, an innovative technology, called Intelligent Guardrails (IGs), is presented in this project. IGs take advantages of the Internet of Things (IOT) and vehicular networks to provide a solution for vehicle traffic congestion in large cities. IG senses the roads' traffic condition and uses this information to set the capacity of the roads dynamically.

Keywords: VTR; ETCS; Cloud Computing; IOT.

1. INTRODUCTION

Transportation has always a crucial part of human civilization. As there is a huge increase in a number of vehicles, managing the traffic becomes a smart task. This paper provides results in avoiding excess delays, promote safety and reduce environmental pollution. IOT is an innovation which uses the internet to control the physical items. Using IOT we can obtain outcome which is more precise, quick and exact. In IOT all database will be stored on the computer. This storage is done through internet. Later this database is used accordingly to their requirements and applications. Components can be accessed from far place by using IOT, hence it reduces human work or involvement. This makes an investment of system less. All different protocols can be used accordingly to the respective domain in IOT. We all know that India is the second largest populated country in the world. India faces a problem in traffic congestion, it needs a solution to this problem. If we design a control system for traffic in the proper way this congestion problem would be solved. Hence by using IOT concept, this can be solved. If traffic lights work's depending upon the vehicle number in a lane/road, then time management for traffic lights can be done and congestion could be reduced in a great way.

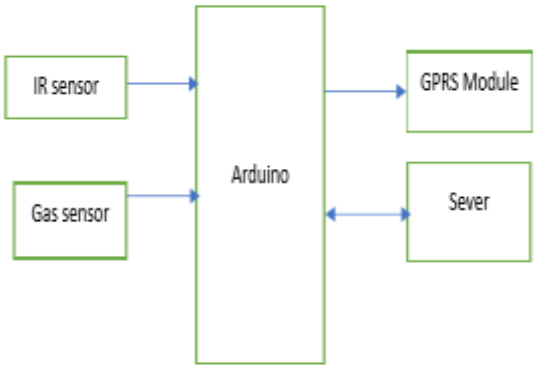

Figure 1.1: Block Diagram.

In the above figure 1.1 we have explained about the arduino and its advantages provided to IR sensor, Gas senor etc.

2. ARDUINO

An Arduino is an open source hardware platform with built in programming support. No additional hardware or software (e.g. Hex burner) is required to transfer your programs (i.e. hex file) to the Arduin0. There are all the necessary peripherals attached for the basic operation. It is based on simple AVR microcontrollers.

Arduino is a growing industry nowadays and the major reason behind it is the vast majority of libraries. Users don't have to invent the wheel again. Long traditional codes have been reduced to few lines now. It is easy to use and enhance productivity. Arduino can be used to make a variety of projects taking analogue as well as digital inputs and can easily interface with different hardware like switches, encoders, Sensors, Motors, relays and many more.

Arduino UNO Salient Features Are:

Microcontroller ATmega328	(MCU)
Operating Voltage (DC)	5V
Input Supply Voltage (External) (MAX)	6-20VDC
Recommended Input Supply Voltage (DC)	7-12V
Number of Digital Input / Output (I/O) Pins	14
PWM (Pulse Width Modulation) outputs	6 (Pin 3, 5, 6,9,10 and 11)
Input Pins (Analog)	6 (A0-A5)
DC Current (Max) (per I/O Pin)	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory (ATmega328) (0.5 KB used by bootloader)	32 KB
Clock Speed (Ceramic Resonator)	16 MHz
SRAM (Memory) (ATmega328 MCU)	2 KB
EEPROM (Memory) (ATmega328 M	1 KB

IR Sensor:- An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiations.

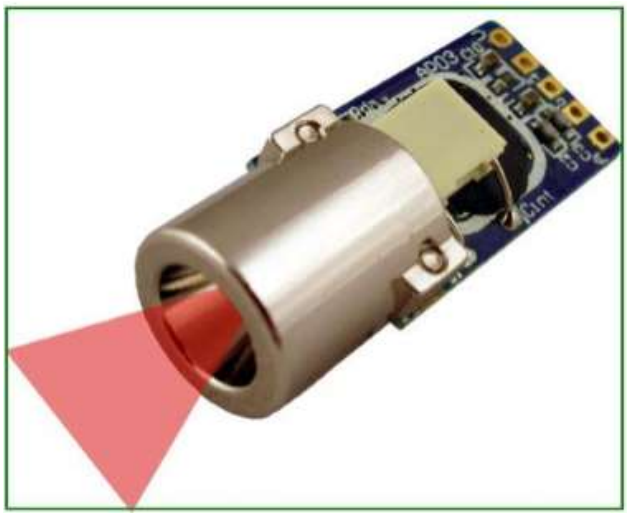

Figure 1.2: IR Sensor.

IR Sensor Circuit Diagram and Working Principle An infrared sensor circuit is one of the basic and popular sensor modules in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time.

Gas Sensor:- Dispersive: An Emitted light is spectroscopic ally divided and their absorption characteristics are used to analyze the gas ingredients and the sample quantity. Non-dispersive: It is the most commonly used method and it uses absorption characteristics without dividing the emitted light. Non-dispersive types use discrete optical bandpass filters, similar to sunglasses that are used for eye protection to filter out unwanted UV radiation. This type of configuration is commonly referred to as non-dispersive infrared (NDIR) technology. This type of analyzer is used for carbonated drinks, whereas non-dispersive analyzer is used in most of the commercial IR instruments, for an automobile exhaust gas fuel leakage.

Figure 1.3: Gas Analyzer.

4. EMBEDDED SYSTEM

As its name suggests, Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor-based system which is designed to

perform a specific task. For example, a fire alarm is a modded system; it will sense only smoke. An embedded system has three components: • It has the hardware. • It has application software. • It has Real Time Operating system (RTOS) that supervises the application software and provide a mechanism to let the processor run a process as per schedule by following a plan to control the latencies. RTOS defines the way the system works. It sets the rules during the execution of the application program. A small-scale embedded system may not have RTOS. So we can define an embedded system as a Microcontroller based, software driven, reliable, realtime control system. Characteristics of an Embedded System:-

• Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example, A pager always functions as a pager.

• Tightly constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must 1. Embedded Systems – Overview Embedded Systems 7 be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.

• Reactive and Real-time – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or deacceleration repeatedly within a limited time; a delayed computation can result in failure to control of the car.

• Microprocessors based – It must be microprocessor or microcontroller based.

• Memory – It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.

• Connected – It must have connected peripherals to connect input and output devices.

• HW-SW systems – Software is used for more features and flexibility. Hardware is used for performance and security.

Table 1.1: GSM network elements impact by GPRS.

Element	Software	Hardware
MS	Upgraded required	Upgraded required
BTS	Upgraded required	No change
BSC	Upgraded required	PCU interface
TRAU	No change	No change
MSC/VLR	Upgraded required	No change
HLR	Upgraded required	No change
SGSN	New	New
GGSN	New	New

The GPRS protocols have a good characteristic in that each layer can be reused to support features in different GPRS nodes. The GPRS stack is designed so that multiple copies of

every layer can be distributed across multiple processors. Thus, it can smoothly scale the network capacity to handle large volumes of data. For example Reference 14, the same SNDCP code can support both SGSN and MS. In other words, the SGSN code can be reused in the MS. GPRS protocol products can be implemented in general computer languages. For example, Trillium delivers its GPRS protocol software in standard C programming language. Lucent/Optimal GmbH provides GPRS protocol stack customization with a man-machine interface, which is designed to be modular and portable.

5. CONCLUSION

This Project may help in the future to be free from traffic problems. As the components used in the system is less cost and efficiency is more because the IR sensors are used for counting the number of vehicles at each way of the junction. The Arduino UNO used is a simple prototype model which works more efficiently.

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