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Design, Development and Working Model Using Sensors In Intelligent Transport System

Anuj Potnis[#1], Tirumal Malge[#2], Saurabh Sharma[#3], Sachin Patil[#4], P. M. Wale[#5]

[#1-4]UG Students, Civil Engineering Department, Savitribai Phule Pune University, Pune

[#5]Assistant Professor, Civil Engineering Department, Savitribai Phule Pune University, Pune

[1]anujpotnis@gmail.com

[2]tirumalmalge007@gmail.com

[3]sunny.apr23@gmail.com

[4]sspsachinpatil7@gmail.com

[5]pmwale_sits@sinhgad.edu

Abstract

Modern society faces serious problem with transportation systems including but not limited to traffic congestion, safety and pollution. Information technologies have gained increasing importance in modern transportation systems. Automotive manufacturers are developing in-vehicle sensors and their applications in different areas including safety, traffic management, etc. Govt. institutions are implementing cameras and sensors to collect data about environmental and traffic conditions. We study how sensor technology can be integrated with transportation infrastructure to achieve a sustainable Intelligent Transportation System.

Keywords--- Sensors, intelligent transport system, vehicle, e-highway, safety, traffic management., LEDs.

1. INTRODUCTION

The population and economy are increasing at a rapid rate on streets of urban areas throughout the developing countries like India, which has given birth to traffic problems everywhere. Therefore, it has become necessary to resolve these issues and make the transportation system safer and efficient. To make it possible, use of technology and introduction of artificial intelligence (AI) in the field of transportation engineering becomes indispensable component among all. So, the concept of Intelligent Transport System (ITS) was introduced in India.

In any city mobility is a key concern, be it going to school, college and office or for any other purpose citizen uses transport system to travel within the city. ITS can save their time and make the city even smarter. The application of ITS is widely accepted and used in many countries today. The use is not just related to traffic congestion control and information, but also for road safety and efficient infrastructure usage.

In a country with third largest road network in the world the total number of vehicles in 2016 stood at 230 million. Road travel seems to be preferred choice in India with over 60% of population who use personal or shared vehicles for community. There was a rise in risk involved with over 150000 roads accidents in 2017. Moreover, the continued urbanisation and customer sectors the rate of accidents is continuously rising.

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The future of ITS is promising a good product and service with wide scale of development and deployment of these technologies represents a true revolution in the way we think about road transportation. It includes a broad range of wireless and wire line communication-based information, the technology helps monitoring and managing traffic flow reduce conjunction provide alternate route to traveller enhance productivity, safe lives, time and money. Intelligent traffic system provides the tool for skilled transportation and professionals to collect, analysis and archive data about the performances of the system during the specific period of time. The combination of latest information and communication and technology in conventional system of transportation in which

Effective road capacity increases up to 20% without new construction

Major reduction in road casualties

Intelligent Transportation Systems (ITS) which focus on four fundamental principles: sustainability, integration, safety, and responsiveness. These principles will play a fundamental role in achieving the main objectives of the Intelligent Transportation Systems which include access and mobility, environmental sustainability, and economic development.

The success of ITS largely depends on the platform used to access, collect, and process accurate data from the environment. Sensing platforms are broadly classified into two categories. The first category is the intra-vehicular sensing platform which collects data about a vehicle's conditions. The second category, urban sensing platforms, are used to collect information about traffic conditions. Sensor technology is a vital component used for data collection during Vehicle-to-Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications. This data is then provided to transportation management systems for further processing and analysis and subsequent decisions/actions. Smart and intelligent ITS promise to address issues such as high levels of traffic congestions, and improved roads.

Transportation systems have become a fundamental base for the economic growth of all nations. Nevertheless, many cities around the world are facing an uncontrolled growth in traffic volume, causing serious problems such as delays, traffic jams, higher fuel prices, increase of CO2 emissions, accidents, emergencies, and the degradation of quality of life in modern society.

A. Objective:

- To study different types of sensors used in ITS.
- To suggest remedial measures to overcome traffic problems in future.
- To design and develop a working model using sensors.
- To study the implementation of e-highways in India.

B. Scope:

ITS is necessary for safe, efficient, easy and smooth conveyance of private as well as public transport in least amount of time.

C. Motive:

To make use of intelligent systems on the road to reduce human workload and to increase the safety parameters in the transportation field enabling smooth and efficient traffic flow.

2. TYPES OF SENSORS TO BE USED

*A. Photo-electric sensors***:**

A photoelectric sensor is an equipment used to discover the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver.

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Fig 1. Photo-electric sensors

*B. Motion sensor***:**

A motion sensor is a device that detects physical movement on a device or within an environment. It has the ability to detect and capture physical and/or kinetic movements in real time. A motion sensor is also known as a motion detector. Depending on the ability of the motion sensor, it can detect motions within the device in which it is integrated or the surrounding environment. It is usually connected with a system or software that processes the motion into an action or information.

Fig 2. Motion sensor

C. Infrared sensor:

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

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Fig 3. Infrared sensor

D. Smoke sensor:

A smoke detector is a device that senses smoke, typically as an indicator of fire Smoke can be detected either optically or by physical process; detectors may use either, or both, methods. Sensitive alarms can be used to detect, and thus deter, smoking in areas where it is banned.

Fig 4. Smoke sensor

E. Ultrasonic sensor:

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It is an instrument that measures the distance of an object using ultrasonic sound waves an ultrasonic sensor uses a transducer to send and receive ultra-sonic pulses that relay back information about an object.

Fig 5. Ultrasonic sensor

3. SENSOR TECHNOLOGY

Over the last decade, sensor technology has become ubiquitous and has attracted a lot of attention. Sensors have been deployed in many areas such as healthcare, agriculture, and forest, vehicle and marine monitoring. In transportation, sensor technology supports the design and development of a wide range of applications for traffic control, safety, and entertainment. In recent years, sensors, and actuators such as tire pressure sensor and rear-view visibility systems have become mandatory (due to federal regulation in the United States) in the manufacturing of vehicles and the implementation of intelligent transportation systems, aimed at providing services to increase drivers' and passengers' satisfaction, improve road safety and reduce traffic congestion. Other sensors are optionally installed by manufacturers to monitor the performance and status of the vehicle, provide higher efficiency and assistance for drivers. Currently, the average number of sensors in a vehicle is around 60–100, but as vehicles become "smarter", the number of sensors might reach as many as 200 sensors per vehicle. In, the author presents a classification of three categories of sensors based on the place of deployment in the vehicle: powertrain, chassis, and body. Another work classifies sensors in a vehicle based on the type of application the sensor is intended to support, and four categories of sensors are identified: sensors for safety, sensors for diagnostics, sensors for convenience and sensors for environment monitoring. We extend the classification (four categories) proposed in to include two additional categories of sensors, namely sensors for driving monitoring and traffic monitoring.

4 VEHICLE COUNTING

A. Vehicle Counting Test:

The objective is to count the number of vehicles travelling on highways before installation of tolls in order to get an estimate of the number of vehicles passing through that proposed toll location.

The material Required for this is foam sheet, counting sensors, laser light, and other material required for preparation of the counting board.

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Procedure to be followed is as follows Step 1: Take a foam sheet and cut it by using a cutter according to the various heights of vehicles like cars, light utility vehicles and heavy loaded vehicles.

Step 2: Attach the 3 vehicle counting sensors (motion sensors) to the foam sheets according to the heights of the various type of vehicles to be counted.

Step 3: Now take another foam sheet and place 3 laser lights at the exact height of the vehicle counting sensors.

Step 4: Place the both foam sheets parallel to each other across the road such that the laser is pointing pin-point on the sensor on the opposite foam sheet.

Step 5: Now when vehicles will pass on the road and cuts through the laser light beams, the sensor will count the number of vehicles passing from the road due to disturbance of the focus of the laser light.

Step 6: By this method it is possible to calculate different types of vehicle based on their height and we can calculate the flow or volume of traffic flowing through that road or highway and can suggest some future corrections required for installation of toll plazas on highways.

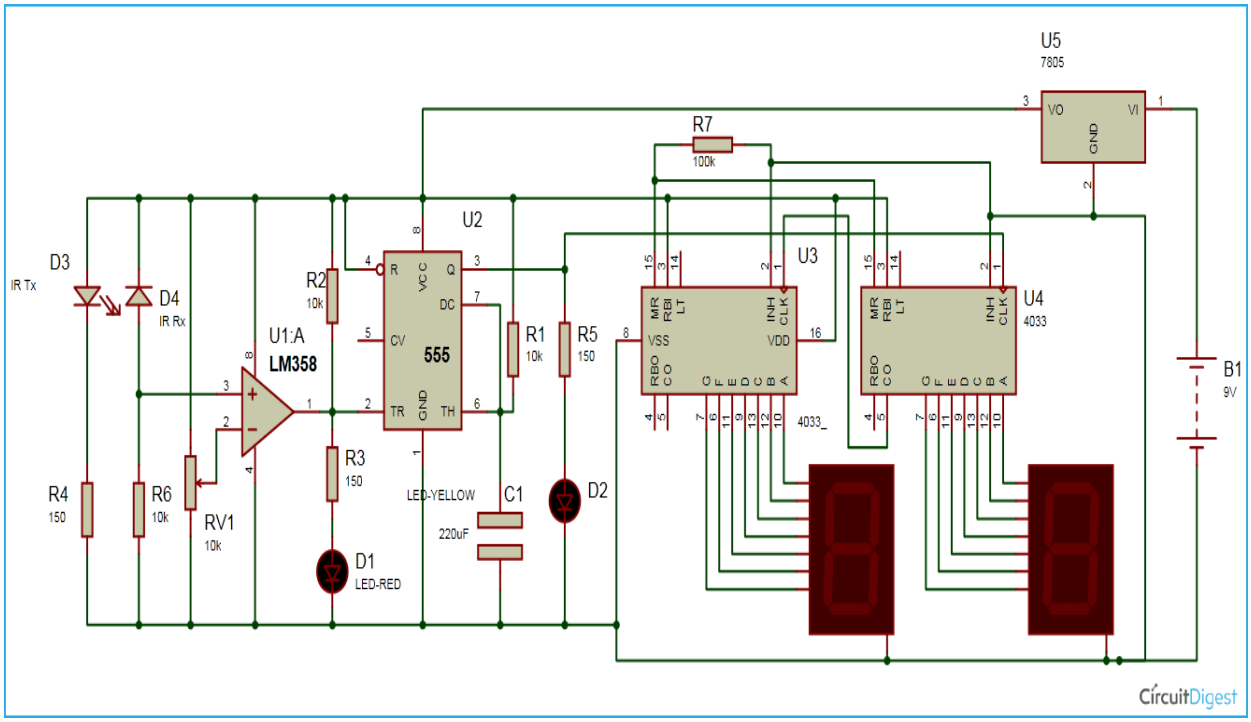

Fig 6. Circuit diagram for vehicle counting sensor

5. SMART TRAFFIC LIGHT SYSTEM

The objective of smart traffic light system is to design and build the smart traffic light system.

The material required for this purpose is Battery, sensors, cables, micro-controller, LED lights.

The procedure to be followed for this purpose is as follows, Step 1: The aim in the first place is to investigate the technologies of the existing system and seek the most appropriate employed devices.

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Step 2: The circuit of the smart light traffic control system is implemented based on the various electronic components that include micro-controller, LCD display, pairs of sensors, many coloured LEDs that represent three colours (red, green, yellow).

Step 3: The smart light traffic system is composed of two separate devices i.e. traffic master controller and handheld portable controller. The traffic master controller is mounted with the traffic lights at the roads intersection and is responsible for the lighting transition and their timing slots. Its implemented design circuit includes micro-controller, the three lights (red, green, yellow) of the traffic lights.

Step 4: The traffic light circuit is then connected to a LED light strip of three different colours (red, green, yellow). It is programmed in such a way that whenever the traffic light shows a particular colour (red, green or yellow) the LED strip also glows in the same colour.

Step 5: In this way the LED strips grabs the driver's attention and accidents can be avoided on traffic junctions.

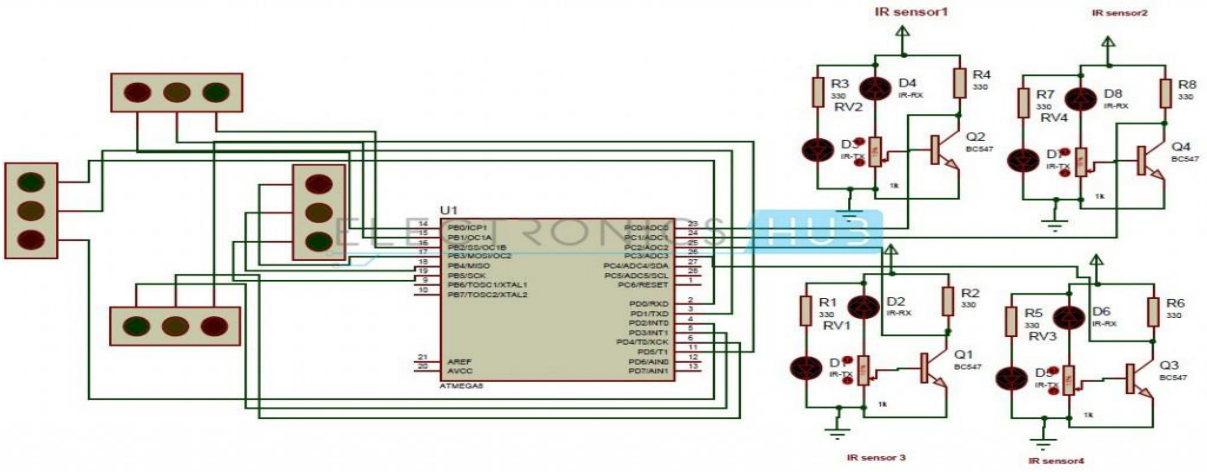

Fig 7. Circuit diagram for smart traffic light system

6. SMART STREET LIGHTING

The main objective is to reduce the consumption of electricity by streets lights by using them only when it is absolutely necessary. Materials required for this is Motion sensors, wires, laser lights, metal protective cases.

The procedure to be followed for this is as follows, Step 1: Place the motion sensors in protective metal cases in order to protect them from weather action.

Step 2: Place laser light equipment exactly opposite to the motion sensor in such a way that the laser focuses on the sensor without any obstruction on the other side of the road.

Step 3: Now when a power supply is provided to the sensor, it will sense the movement of the vehicle which cuts through the laser beam and that will put the street light on.

Step 4: Due to this power consumption is reduced as the lights glow only when any vehicle passes in front of it.

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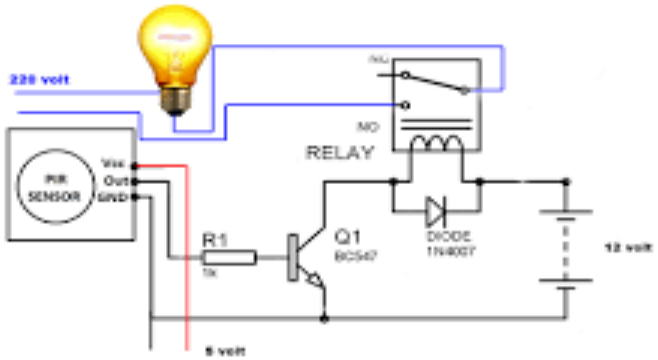

Fig. 8 Circuit diagram for Smart street lighting system

5. CONCLUSION

Sensors will play a vital role for ITS in the future. Their usage enables the development of a wide variety of applications for traffic safety, traffic control entertainment and driver assistance. Sensors provide the mechanism to data acquisition related to the vehicular context (such as road conditions, traffic conditions, vehicle conditions) that can be integrated with the current transportation systems to mitigate some of the problems that past and current transportation systems have been facing. The use of analytical and statistical techniques demonstrates the real potential of integrating sensors with ITS. This integration is a promising research area that will broaden the development of a wide range of next-generation smart applications aimed at improving the safety and traffic control of existing and future transportation systems.

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