Embedded System Based Smart Highway With Wireless Black Box For Vehicle Accident Monitoring

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Abstract- *Smart Highway Technology is the term for different proposals including vast technologies for improving accident detection, for automating street lights and traffic lights, etc. The main aim of Smart Highway is to develop safer and more convenient highways by using the highly advanced road technologies, IT communication technologies and automobile technologies for the next generation. This project includes automatic street light which glows on when any vehicle come near to street light and interfaced with LDR sensor for to switch off street light at day time, and smart traffic control in which Traffic Signals are signaling devices that are used to control the flow of traffic. Generally, they are positioned at junctions, intersections, 'X' roads, pedestrian crossings etc then, wireless black box for vehicle accident monitoring in which we are interfacing GSM, GPS, MEMS Accelerometer sensor, vibration sensor and RF module.*

Keywords- Smart Highway Technology , Black Box, automatic traffic signal controlling , automatic street light

I. INTRODUCTION

An embedded system is a special computer system designed to perform various functions. The importance of Embedded systems increasing day by day as they control many of the devices which we are using in daily schedule. Since the embedded system is dedicated to specific tasks, engineers can optimize it, can reduce the size and cost of the product, or increasing the reliability and performance. In the last few years the total number of vehicles around the world are tremendously increases. This affects on increasing number of traffic accidents on the road .It also affects on congestion in traffic and consumption of energy. The proposed system is designed to improve the safety in traffic, achieving a reasonable reduction of road death, effective management of energy resources.

The applications in Smart Highway Technology includes: Black box for accidental monitoring system, Automated Street Light, Intelligent Accident Detection and Ambulance Rescue System. In Automated Street Light System, street lights are switched on & off depending on the intensity of the Sun light and also on the movement of vehicle. The LDR (light dependent resistor) is used for this feature .In Traffic signal controlling system, the traffic light is managed depending upon the density of vehicles.

In Black Box system, MEMS accelerometer and GPS tracking system are used for accidental monitoring. If any accident occurs, this wireless device will send mobile phone a short massage indicating the position of vehicle by tracing the location of the vehicle through GPS system to family member, emergency medical service (EMS) and nearest hospital. Accident Detection system and Ambulance Rescue System used to reduce the loss of life of peoples due to accidents and time taken by the ambulance to reach to the location and to the hospital. Here we are implementing the system in which automatic detection of accident by using sensors provided in the vehicle, a main server unit houses the data bases of all hospital in the city, a GPS and GSM module in the concerned vehicle will sent the location of accident to main server which will rush in ambulance from nearest hospital to accident spot. Along with ,there would be a control of traffic light signals in the path of ambulance.

II. TECHNOLOGY USED

1. Black Box :-

It is a wireless technology based on MEMS accelerometer and GPS tracking system which is used for monitoring of accident. The system consists of components of an accelerometer, microcontroller unit, GPS and GSM module If any accident occurs, this wireless device will send massage to mobile phone that indicate the location of vehicle by tracking the location of the vehicle through GPS system to family member and nearest hospital. To detect fall or accident in real-time The threshold algorithm and speed of vehicles are used. The main aim of this technology is to reduce the hazardous in road accident. The accident detection and reporting system for the vehicle can give the notice because it will save the life and give medical treatment on time. The system consist of MEMS accelerometer, GSM module, GPS module. An Accelerometer is used to detect the acceleration. It is only a sensor can use to detect the accident. When the accident is detected, controller gives this

information to GSM module. By using GSM module we can send the location of accident message to family members and ambulance operator, For display the notification of accident to drivers which drives the other vehicles on road the LCD screen are used for these RF module is interface to black box, in this way the other vehicles give space to ambulance. Vehicles fall detection is based on accelerometer. The MEMS accelerometer sensor is installed inside the vehicle seat. The tilt and jerk detecting capability of the MEMS accelerometer it is used in these projects. When the accelerometer is tilted of its axis or it gives output voltage according to it. Accelerometer is used to detects the acceleration force and so it can detect any changes of intilt and jerk detecting capability of the MEMS accelerometer.

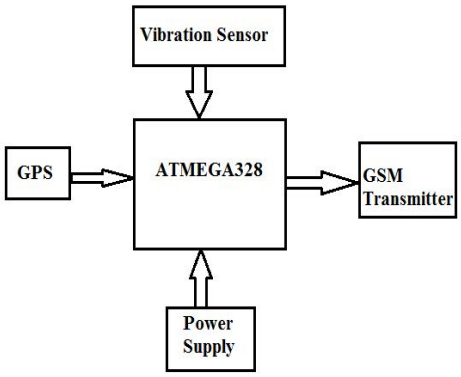

Fig 1.Block diagram of vehicle unit

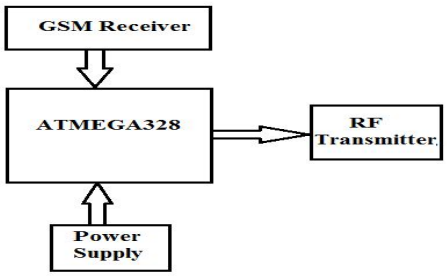

Fig. 2 Block diagram of ambulance unit

2. **Smart Steet Light:-**

In this, the street light is designed in a way where the it can switches on/off automatically based on the sunlight. For these feature LDR is used. Next feature, when nobody else is on road or near Smart street light it's system is turn off the street light This is implemented by interfacing PIR motion sensor to the microcontroller.

These systems are developed to reduce energy consumption using different technologies. The presented work is used to control switching of street light automatically according to light intensity to develop flow based dynamic control statistics using infrared detection technology. The proposed system contains LED lamps instead of High Pressure Sodium Lamps. The LED technology offers several advantages than other technologies like energy saving,, low maintenance cost, high colour rendering index, rapid start up speed, long working hour etc.

In smart street lighting system, PIR & LDR sensors are used.

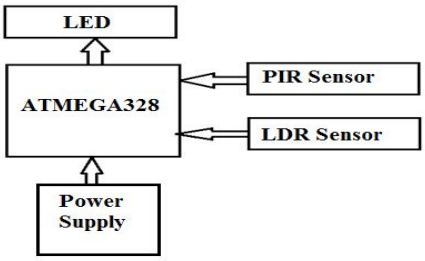

Fig. 3 Block diagram of smart Street Light System

2.1 PIR Sensor:-

PIR is the Passive Infrared Sensor. If any object in the world radiates IR rays then these rays are sensed by these sensor. When the vehicle is passes near the street light it is detected by PIR sensor and street lights are glows.

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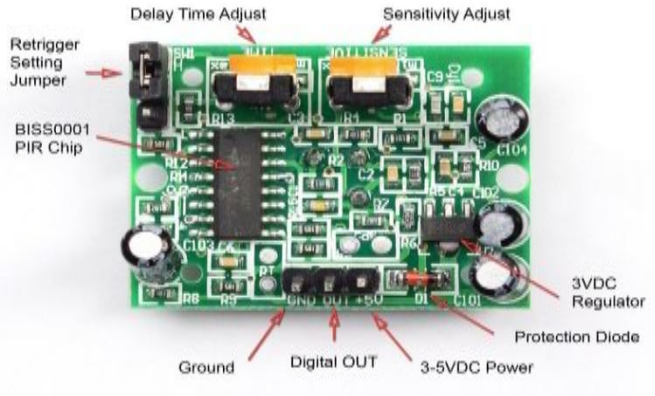

Fig.4 Design Circuit for PIR Sensor

It contains multiple variables like a photocells,FSRs and tilt switches that affects on the sensor input and output so these are more complected than many of other sensors. Basically the PIR sensor itself has two slots in it, every slot is made of a special material which is sensitive to IR. We used lence here is not really doing much and so we see that the two slots are apart from each other at some distance (basically the sensitivity of the sensor). The two different changes are occurred, one is when a warm body like human or animal

passed by it intercepting one half of the PIR sensor, which creates a positive diffential change between the two halves.when the warm body leaves the sensing area, the reverse happen where by the sensor generate a negative diffential change and vice versa

2.2 LDR:-

LDR is the Light Dependant Resistor. In this sensor When light intensity is more, resistance is low and vice versa. Hence the resistance and intensity of light are inversely proportional to each other. we are using LDR for to switch on the street light i.e., when intensity of light decrease on it, it turns on LDR and then the street light are glow.

3. Smart traffic Light Controller :

For the purpose of traffic control, Traffic Lights or Traffic Signals are used it is the signaling devices that are used to control the flow of traffic. They placed or positioned at junctions, intersections, 'X' roads, pedestrian crossings etc. Traffic signals are gives alternate priority to, user who has to wait and who has to go. They will provide instructions to the drivers and pedestrians by displaying lights of standard color i.e. Red, Yellow Green.The system is used to control,smooth and safe movement of traffic. These traffic lights control systems include electro mechanical controllers with clockwork mechanisms or modern computerized systems with easy setup and maintenance. In this paper, a microcontroller based Traffic signal Controller system is designed. It is a simple traffic lights system but can be enhanced to a real time system with programmable timings, pedestrian lighting etc.The real time traffic light controller consists of power cabinet, main controller or processer, relays, control panel with switches.it is a complex piece of equipment. it is not only the ideal implementation for real life scenarios,but also it gives an idea of the process behind the traffic light control system. The objective of the paper is to provide a simple traffic light controller using microcontroller, where the traffic is controlled in a pre-defined timing system. The working of the paper is very simple and is explained below. Consider the following image showing a loop of traffic light operations.

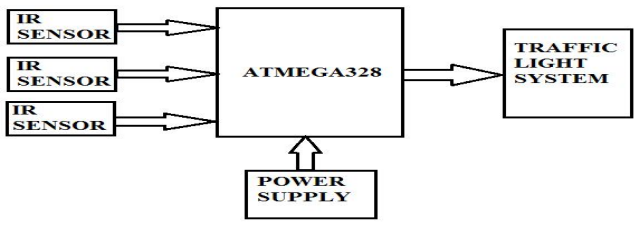

Fig 5. Traffic Signal Controlling

In that, first the Lane 1 gets its Green light turned. Hence, in all the other Lanes, their corresponding Red lights are turned on. After a time delay of predefined time say 5 seconds, the Green light in the Lane 3 must be turned on and the Green light in the Lane 1 must be turned off.As a warning indicator, the Yellow light in Lane 1 is tuned on indicating that the red light is about to light up. Similarly, the yellow light in the Lane 3 is also turned as an indication that the green light about to be turned on.The yellow lights in Lanes 1 and 3 are turned for a small duration say 2 seconds after with the red light in the Lane 1 is turned on and green light in Lane 3 is also turned on.The green light in Lane 3 is also turned on for a predefined time and the process moves forward to Lane 4 and finally Lane 2The system then loops back to Lane 1 where the process mentioned above will be repeated all over again.

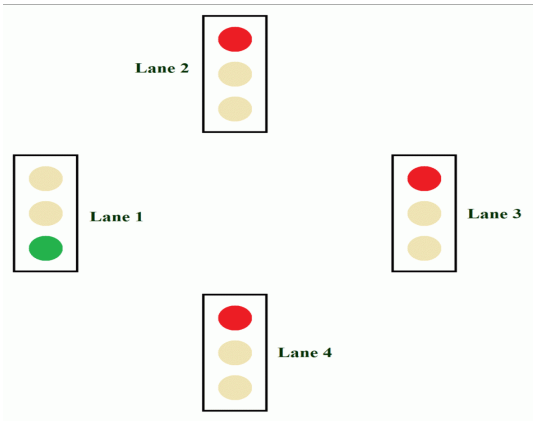

Fig.6 Traffic control discription

III. HARDWARE DESCRIPTION

1. Microcontroller (ATmega328) :-

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters, internal/ external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes.it operates between 1.8-5.5 volts.

Fig . 7 ATmega 328 Microcontroller

2. SIM800 GSM Modem :-

Fig .8 GSM Modem

The GSM was developed at Bell Laboratories in 1970. It is widely used in the world for mobile communication system. Hence the GSM is stands for global system for mobile communication (GSM). It is technology of open and digital cellular which is used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. 64 kbps to 120 Mbps of data rates has been carry by its digital system There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells.as per the implementation domain, each cell are varies.The GSM contains five different network such as macro, micro, pico and umbrella cells.

3. 433MHz RF Tx/Rx Module :-

Fig 9 RF Module

Generally, the wireless systems designer has two main aspects: first, it must operate over a certain distance and second, it transfer a certain amount of information within a data rate. The RF modules have a very small dimension and have a wide operating voltage range of 3V to 12V.RF modules are 433 MHz RF transmitter and receiver modules. The data sent by transmitter is in serially which is received by the receiver. For data transfer, the Transmitter and the receiver are duly interfaced to two microcontrollers

4. GPS Module :-

Fig .10 GPS Module

GPS receivers are mainly used in smart mobile phones, fleet management system, military applications etc.GPS is stand for Global **P**ositioning **S**ystem (GPS).it is a satellite-based system that uses satellites and ground stations for tracking or finding location on Earth. It is also called as Navigation System with Time and Ranging (NAVSTAR) GPS. For accuracy purpose, its receiver needs data from at least 4 satellites.

IV. CONCLUSION

Thus we have presented a system which can be implemented in highways for smart traffic control, smart Street light system, detection of cause and location of accidents on road so that they can get medical treatment in least time without stopping in heavy traffic. This system can be effectively implemented in cities, states or countries with large population for better results to help the people who suffered from accidents.

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