Effective Traffic Management System for Emergency Vehicles

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Abstract – Traffic has always been and is a problem since the use of vehicles. Unless urgent, the traffic seems to be fine. There are several technologies to control the traffic signal in developed countries, yet are not available to developing countries and these countries suffer more of this case. In the developing countries like India, Traffic signals don't work in a network and hence are not easy to modify in case of emergency. The proposed system (Effective Traffic Management System for Emergency Vehicles) gives the control to the emergency vehicle; say an ambulance, which sends radio signals to the vehicles ahead of it. These signals are received by the vehicle unit in all the vehicles and indicates the approach of the emergency vehicle in an lcd screen and a constant buzzer. Additional to this, the system also provides speed control of the vehicles based on particular zones, say accident prone zone or a school zone, which when the vehicle enters that zone, the module indicates the driver and gradually reduces the speed.

Index Terms – Emergency Vehicles, Traffic, Buzzer.

1. INTRODUCTION

Many countries in the world are facing the problem at traffic light intersection that causes accident between emergency vehicle and other public vehicle. The traffic control system in Malaysia specifically has not been equipped with appropriate method when emergency case occurs. This will cause the emergency vehicles such as ambulances difficult to reach the destination on time because of the traffic congestion. Moreover, the situation is getting worse when emergency vehicles have to wait for other vehicles to give way at intersections with traffic lights. This causes a delay of time and may affect the emergency case.

Besides, the collisions with other vehicles from other direction might occur at intersections when emergency vehicles had to override the red traffic lights. All these difficulties faced by emergency vehicles can be avoided using this traffic light control system based on radio frequency. Due to the problem, literature review for related issue prior to undertaking research project is decisive. The literature review will provide information on the technology available and methodologies used by other research counterparts around the world on this topic. The traffic light system designed by Levi L. Rose [1] used only for emergency vehicle. Sensor is used to transmit signal that has been installed in every emergency vehicle to the receiver which has been placed at every traffic light intersection. When emergency vehicle reach at the traffic light intersection, the signal code will be sent information of frequency modulation to the receiver. The receiver demodulates the received code and the red traffic light will trigger at all the junctions. Thus, emergency vehicle will have special route from other vehicle to reach the destination. The traffic light system designed by M. R. Smith et al [2] provided early warning of the approaching an emergency vehicle to find a way out from traffic congestion and lead the emergency vehicle to the destination. The emergency vehicle also may take control of traffic light at an intersection. A transmitter placed on an emergency vehicle transmits a signal to the receivers positioned at the traffic lights whenever it is on emergency mode. The received signal is then processed by a master controller which in turn pre-empts the sequence of the traffic light to control the traffic flow at the intersection which taken by the emergency vehicle. The master controller also provides an output which display signs to indicate that there is an emergency vehicle to the other road users from other direction at the traffic light intersection. Additionally, the display system indicates whether the emergency vehicle has passed through the intersection or not.

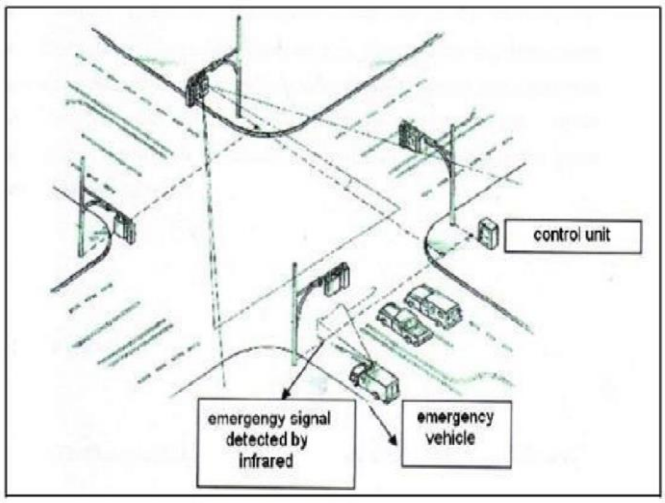

Fig.1 Four-traffic light intersection traffic light [2]

W. L. Mitchell has designed a traffic light control system [3] which had overcame the traffic congestion problem and provided an emergency path for the emergency vehicle where the radio transmitter and antenna placed on the emergency vehicle. The radio will transmit the signal to the other vehicle

that nearby. The radio receiver had been placed at four junction traffic light will receive the emergency signal from emergency vehicle that passed by the junction. The first signal code contains a frequency for emergency vehicle while the second signal code contains a frequency for other vehicle. The transmitted signals provide miscellaneous traffic light pole in normal condition or emergency. When the receiver received the signal from emergency vehicle transmitter, traffic light system for emergency vehicle will be activated. W. E. Brill introduced an emergency vehicle detection system [4] for alerting a driver of an approaching emergency vehicle includes a sound signal-producing unit mounted on an emergency vehicle, a sound signal detection unit mounted on a non-emergency vehicle, and a display unit remotely located on the non-emergency vehicle. The sound signal-producing unit has a sound generator for producing and transmitting a sound signal. A switch is used for controlling the operation of the sound generator in combination with a siren.

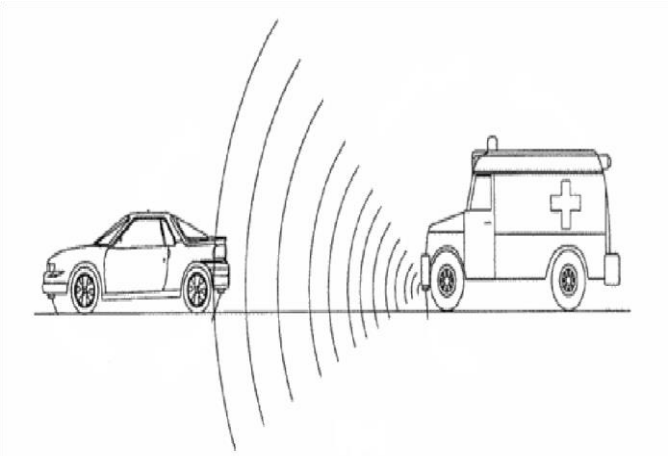

Fig. 2: Sound signal being transmitted [4]

The sound signal detection unit has at least one sound transducer for detecting sound signals and producing an electric current upon detection of a signal. A signal comparator is connected to the sound transducers for comparing the currents from the transducers to pre-programmed patterns. If there is matching pattern, a signal output encoder connected to the signal comparator constructs an encoded signal and transmits the encoded signal to a remotely located display unit through a transmitter. The display unit has a receiver for receiving the encoded signal and passing it to a signal comparator to compare the encoded signal to known patterns and activate at least one illumination device upon detection of a matched pattern.

2. ARCHITECTURE OF THE DESIGN

The design basically consists of a development board over which the entire system is built. Unlike the related works, our system uses the radio frequency module for a different application. The following description tells us more about the components and other modules that are involved in the completion of this efficient traffic management system.

1. RF Module — An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter or receiver. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required in achieving the operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infra-red communication designs as they have the advantage of not requiring line-of-sight operation.

RF Transmitter module: An RF transmitter module is a small PCB subassembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which can be transmitted. RF transmitters are usually subject to regulatory requirements which dictate the maximum allowable transmitter power output, harmonics, and band edge requirements.

RF Receiver module: An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: super-heterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage,Super-heterodyne receivers have a performance advantage over superregenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in the past tended to mean a comparatively more expensive product. However, advances in receiver chip design now mean that currently there is little price difference between super-heterodyne and super-regenerative receiver modules.

2. Relay – A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch,

but other operating principles are also used, such as solidstate relays. Relays are used where it is necessary to control a circuit by a separate lowpower signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

There are many types of relay such as Latching relay, Reed relay, Mercury-wetted relay, Mercury relay, Polarized relay, Machine tool relay, Coaxial relay, Time delay relay, Contactor, Solid-state relay, Static relay, Solid state contactor relay, Buchholz relay, Forceguided contacts relay, Overload protection relay, Vacuum relays, Safety relays, Multivoltage relays. While each relay has its own set of circuit design and function, the one which fits right into our system is the contactor. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. A contactor is a heavy-duty relay with higher current ratings, used for switching electric motors and lighting loads. Continuous current ratings for common contactors range from 10 amps to several hundred amps. High-current contacts are made with alloys containing silver. The unavoidable arcing causes the contacts to oxidize; however, silver oxide is still a good conductor. Contactors with overload protection devices are often used to start motors.

Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 V DC to many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand, to large devices approximately a meter (yard) on a side.

Contactors can be noisy when they operate (switch on or off), so they may be unfit for use where noise is a chief concern. In such cases solid-state relays are preferred. A solid state relay or SSR is a solid state electronic component that provides a function similar to an electromechanical relay but does not have any moving components, increasing long-term reliability.

3. LCD – A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Buzzer – A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play.

3. BLOCK DESCRIPTION

Now a days there is a high traffic at a particular time due to that the traffic signals should maintained correctly to reduce accidents but at the same time during some emergency situations ambulance may blocked in the signal it leads to major cause. To avoid this, based on all statistics, in addition to controlling the traffic signals, the approach of the emergency vehicles must be indicated in a more supplementary way. In that case, radio frequency is utilized for faster, efficient and long range transmission and reception.

An Atmel AT89s52 microcontroller is used for both, transmission and reception sections of the system including the speed control unit. The block diagram of the system (transmission and receiver sections) helps in understanding the system at ease.

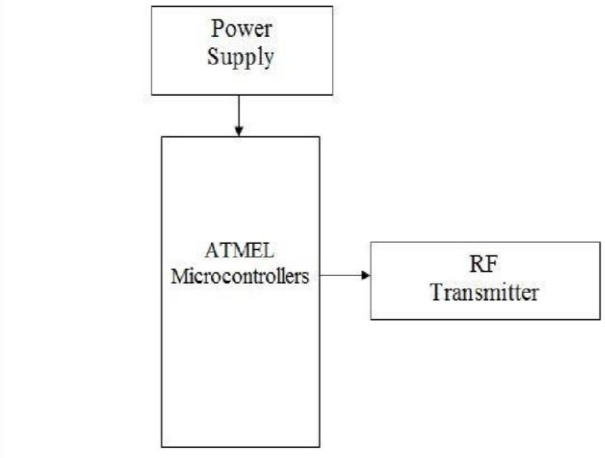

Fig (A) Transmitter Section

This transmitter section is common for emergency vehicles and the speed control zones. When fit into an emergency vehicle, it is fed with a specific message; say if its fit into an ambulance, it is fed with a message "*Ambulance approaching*" for transmission. When it is programmed for a speed control unit, it is fed with the corresponding speed of that particular zone.

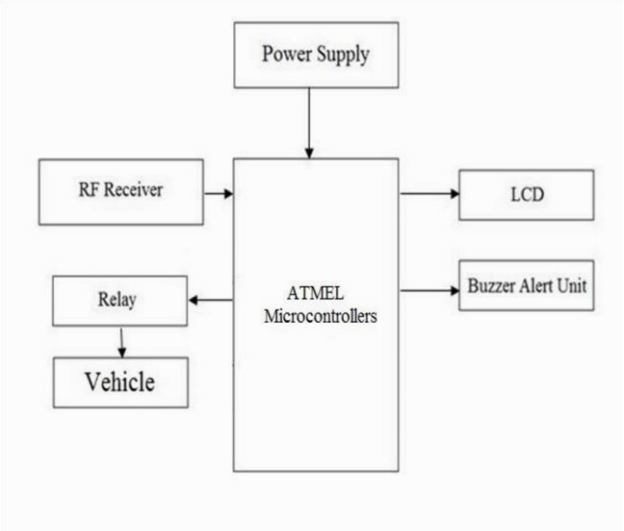

Fig (B) Receiver Section

The receiver section is obviously placed into the vehicles. It collectively performs two functions with one single unit. It receives the information of the approaching emergency vehicle and activates the respective components for indication to the user as well as performs speed control whenever it enters an accident prone zone or a school zone or a hospital zones where the transmitter section of the speed control unit is set.

4. SIMULATION RESULTS

The simulation results are still under process towards completion. However there are few simulation results showing the work of LCD output of our system and the testing of serial communication.

The simulations for the system are dealt with '***Proteus 8 Professional***', which is widely used for simulations globally. The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products include an auto-router and basic mixed mode SPICE simulation capabilities. The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then cosimulated along with any analog and digital electronics connected to it.

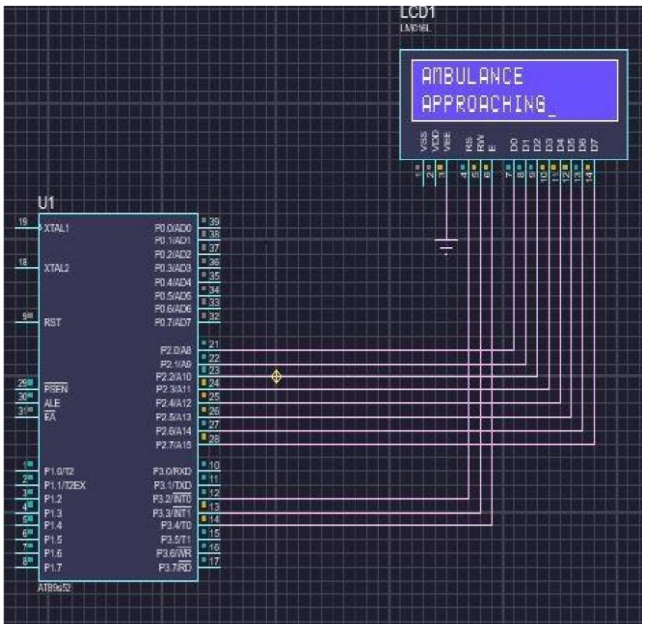

Fig (C) LCD Simulation using Proteus Design Suite

Fig (C) shows the LCD simulation where it displays the message "***Ambulance approaching***", which is a representation of the partial output of the receiver unit placed in the emergency vehicle.

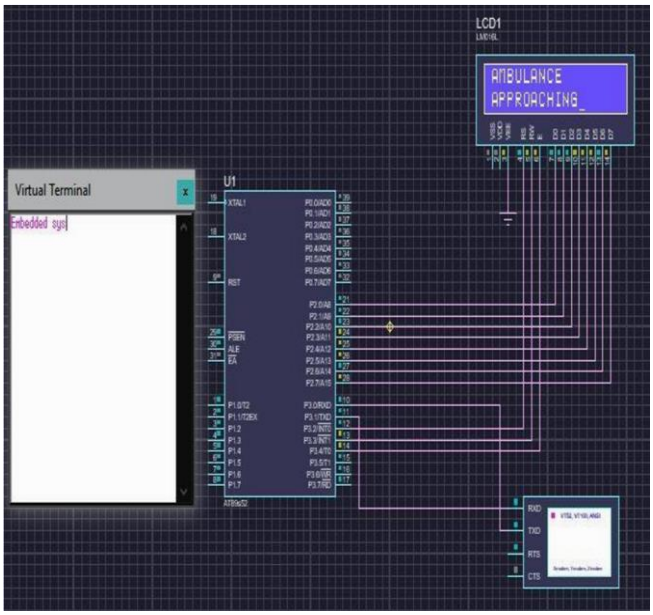

Fig (D) LCD Simulation with serial communication

The above figure, Fig (D), shows the LCD simulation alongside the output, which is really a virtual terminal, of the serial communication which is coded into the program. Here for experimental purposes, a simple message 'Embedded sys' is sent for serial communication check.

5. FEATURES OF PROPOSED SYSTEM

The proposed system is different and divergent in many ways. While every related systems focuses on controlling the traffic signals, which tend to malfunction most times, this efficient traffic management system uses radio frequency to indicate vehicles farther away in front of the emergency vehicle.

To avoid misuse or unwanted triggering of the system, the system can be given with a patient presence circuit to ensure that the system can be switched on only when the patient is aboard or if the ambulance is on its way to board the patient.

In a similar way of the use of radio frequency, the traffic police situated in the upcoming of the next signal junction can be alerted of the approach of the emergency vehicle, in order to make sure that there is enough space can be regulated for the vehicle to pass in the required time.

The speed control zones, such as accident prone zones can be updated with the placement of the speed control transmitter units at the respective zone with a standard speed limit or a specified speed limit; which has to be programmed.

There is a special feature in the speed control unit that is specified for the hospital zone. It is fed with a trigger signal that activates the circuit in the receiver section of the vehicle unit, which disables the horn while the vehicle is the premises of the hospital zone.

6. CONCLUSION

Statistically, the developing countries are the major victims of traffic, which also turns out, has an adverse effect on the environment. While traffic is inevitable, it in its least way, can be managed using this proposed system with a focus on the emergency situations. Adding to that, like the proverb ***"Prevention is better than cure"***, the system is provided with a speed control unit, based on the zonal units, which are placed in the respective zones, that controls or regulates the speed of the vehicles in the zone.

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