Design of Intelligent Ambulance and Traffic Control

Sarika B. Kale, Gajanan P. Dhok

Abstract— This paper represents the unique feature which is very useful to ambulance drivers to take an alternate route in case of congestion. The various performance evaluation criteria are average waiting time, average distance traveled by vehicles, switching frequency of green light at a junction, efficient emergency mode operation and satisfactory operation of SMS using GSM Mobile. The performance of the Intelligent Traffic Light Controller is compared with the Fixed Mode Traffic Light Controller. It is observed that the proposed Intelligent Traffic Light Controller is more efficient than the conventional controller in respect of less waiting time, more distance traveled by average vehicles and efficient operation during emergency mode and GSM interface. Moreover, the designed system has simple architecture, fast response time, user friendliness and scope for further expansion.

Index Terms— ARM, Embedded system, Emergency vehicle, Traffic light management.

I. INTRODUCTION

Present Traffic Light Controllers (TLC) are based on microcontroller and microprocessor. These TLC have limitations because it uses the pre-defined hardware, which is functioning according to the program that does not have the flexibility of modification on real time basis[1]. All developed nations have a well developed transportation system with efficient traffic control on road, rail and air. Transportation of goods, industrial products, manpower and machinery are the key factors which influence the industrial development of any country. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control . The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming such a problem. The measures taken are development of new roads and flyovers in the middle of the city; building of several ring such as the inner ring road, middle ring road and outer ring road; introduction of city trains such as the light rapid transit (LRT), and monorails; restricting of large vehicles in the city during peak hours; and also development of sophisticated traffic monitoring and control systems. Growing numbers of road users and the limited resources provided by current infrastructures lead to ever increasing traveling times. One way to improve traffic

flow and safety of the current transportation system is to apply automation and intelligent control methods to roadside infrastructure and vehicles. Transportation research has the goal to optimize transportation flow of people and goods. As the number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important in future. GSM cell phone interface is also provided for users those who wish to obtain the latest position of traffic on congested roads. This is a unique feature of this project which is very useful to car drivers to take an alternate route in case of congestion. The various performance evaluation criteria are average waiting time, average distance traveled by vehicles, switching frequency of green light at a junction, efficient emergency mode operation and satisfactory operation of SMS using GSM Mobile.

The problem of traffic light control can be solved by RFID based system. With this system, we can consider the priority of different type of vehicles and also consider the density of traffic on the roads by installing RF reader on the road intersections. Radio frequency identification is a technique that uses the radio waves to identify the object uniquely. RFID is a technique that is widely used in the various application areas like medical science, commerce, security, Electronic toll collection system, access control etc. There are three main components of RFID: RFID tag, RF Reader and Database. Various types of tags are available but we can mainly divide them into two categories: passive tags and active tags. The passive tags don't contain any internal power source. There are three parts of the tag: antenna, semiconductor chip and some form of encapsulation. The life of the passive tag is very long. The reader sends electromagnetic waves that produce current in the tag's antenna. In response antenna reflects the information stored in it. The active tags contain a battery as an internal power source used to operate microchip's circuitry and to broadcast the information to the reader. The range and cost of these tags is more as compare to passive tags [3]. We have three kinds of tags which work on the three different frequency ranges: low – frequency, high-frequency and ultra high frequency.

II. RELATED WORK

The work in [4] proposed a smart traffic control system based on the wireless sensor network and an alerting system for red light crossing scenario to alert the drivers on other sides to save their lives. This technique is based on the queue length of the vehicles on the traffic lights. They also represent the simulation of 4 models which are used in the different parts of the world and shows competing results in the terms of waiting time and number of vehicles not served first time. Research efforts in traffic engineering studies yielded the queue traffic light model in which vehicles arrive at an intersection controlled by a traffic light and form a queue.

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Several research efforts developed different techniques tailored towards the evaluation of the lengths of the queue in each lane on street width and the number of vehicles that are expected at a given time of day. The efficiency of the traffic light in the queue model however, was affected by the occurrence of unexpected events such as the break-down of a vehicle or road traffic accidents thereby causing disruption to the flow of vehicles. Among those techniques based on the queue model was a queue detection algorithm proposed by [14]. Chattarajet al., (2008) proposed a novel architecture for creating Intelligent Systems for controlling road traffic. Their system was based on the principle of the use of Radio Frequency Identification (RFID) tracking of vehicles. This architecture can be used in places where RFID tagging of vehicles is compulsory and the efficiency of the system lied in the fact that it operated traffic signals based on the current situation of vehicular volume in different directions of a road crossing and not on pre-assigned times [15].

III. PROPOSED WORK

All developed nations have a well developed transportation system with efficient traffic control on road, rail and air. Transportation of goods, industrial products, manpower and machinery are the key factors which influence the industrial development of any country. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control system for national development. The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming. In this paper taking e.g. of emergency vehicles as ambulance.

In this paper, the first aim is to collect the information of moving emergency vehicles using GSM, GPS, ARM to provide them clear path. This system can do the following, i) Minimize long waiting time, ii) Achieve smart automatic traffic signal control without human interrupt, iii) Wirelessly monitor patients health parameter through GSM technology, iv) Less chance of accident due to red light violation it gives priority to vehicles like ambulance, Fire brigade, VIP vehicles etc.

Ambulance will consist of Heart Beat and Temp. sensor. When key is pressed, heart beats and temp values will be sent to pre defined mobile phone(Hospital) using GSM. On signal there will be two RFID readers which will detect traffic density on two roads. When ambulance is detected on any road signal for that side will be green. And traffic on that road and other roads will be sent to ambulance through another GSM.

ARM is a 32-bit reduced instruction set computer (RISC) instruction set architecture (ISA) developed by ARM Limited. It was known as the Advanced RISC Machine, and before that as the Acorn RISC Machine. This has made them dominant in the mobile and embedded electronics market as relatively low cost and small microprocessors and microcontrollers. The project is designed using ARM microcontroller. In this project there would be two RFID systems used in the project. The RFID tag would be used to detect the ambulance. Also the Heart beat sensor and temperature sensors are used for patient monitoring and GSM modem will be used to send the SMS to mobile.

The whole setup consists of ARM, Heart Beat Sensor, Temperature sensor, GSM Modem and GPS .The Systems consist of ARM microcontroller. The micro controller cannot process the analog voltages as it is a digital device; so we use inbuilt ADC to convert the raw output of sensor to digital voltage. This digital voltage is feed to controller. The ARM continuously monitors the Temperature value and display on LCD. we are also using serial communication to make connection to hospital using GSM and GPS.

The RFID systems will be connected to microcontroller using serial protocol. The Tag will be attached to the ambulance when the ambulance passes through the reader the Tag would be read and the traffic Light will be made Green Signal. Also the body parameters like Temperature and Heart beat will be measured using sensors and will be sent through mobile to the respective Doctor. We are using GPS to track the position of ambulance, emergency vehicles so it will help us to direct the ambulance to reach the hospital as early as possible and also reach the vehicle to their destination.

IV. HARDWARE IMPLEMENTATION

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory.

The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. The GSM network can be divided into three parts to illustrate this, consider figure 4.1. i) Mobile station, ii) Base station subsystem and iii) Network subsystem.

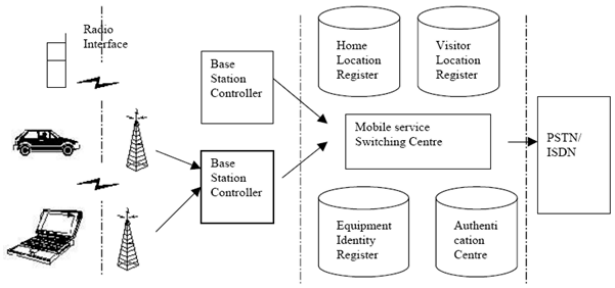

Fig. 4.1 GSM Architecture

GSM uses Frequency Division Multiplexing AND Time Division Multiplexing. FDMA divides the frequency ranges for GSM, which are 890-915, 935-960 and some others that the book didn't have.

Each is divided into 200kHz wide channels. As far as TDMA goes, each time slot is 577 micro seconds long, 8 time slices is a frame, lasting for a grand total of 4.615ms. A multi frame consists of 51 frames, 51 multi frames make up a Super frame, and 2048 Super frames make a Hyper frame which is 2715648 frames.

In RFID briefly the RF stand for “radio-frequency” and ID means “identifier” that allows an item, for instance a library book, to be identified, accessed, stored, reprogrammed and communicated by using radio waves.

There are several methods of identification, but the most common is to store a unique serial number that identifies a person or object on a microchip that is attached to an antenna. The combined antenna and microchip are called an "RFID transponder" or "RFID tag" and work in combination with an "RFID reader". In RFID system consists of a reader and one or more tags. The reader's antenna is used to transmit radio frequency (RF) energy. The tag will then modulate the electromagnetic waves generated by the reader in order to transmit its data back to the reader. The reader receives the modulated waves and converts them into digital data.

Frequency refers to the size of the radio waves used to communicate between the RFID system components. Just as you tune your radio to different frequencies in order to hear different radio stations, RFID tags and readers must be tuned to the same frequency in order to communicate effectively. The read range of a tag ultimately depends on many factors: the frequency of RFID system operation, the power of the reader, environmental conditions, physical size of the tags antenna and interference from other RF devices. The Sunrom RFID Card Reader's antenna was designed with a RFID operation at a tag read distance of around 7 cm.

Global Positioning System (GPS) satellites broadcast signals from space that GPS receivers, use to provide three-dimensional location (latitude, longitude, and altitude) plus precise time. GPS receivers provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth. The output is serial data of 9600 baud rate which is standard NMEA 0183 v3.0 protocol offering industry standard data messages and a command set for easy interface to mapping software and embedded devices.

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

The sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heart beat[16].

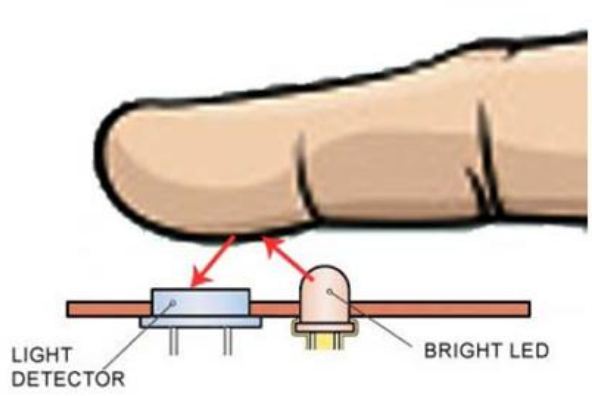

Fig. 4.2 Sensor principle

Following figure shows signal of heart beat and sensor signal output graph. Fig.4.2 shows actual heart beat received by detector (Yellow) and the trigger point of sensor (Red) after which the sensor outputs digital signal (Blue) at 5V level.

Fig. 4.3 Signal View

Fig.4.3 shows target pulse rates for people aged between 20 and 70. The target range is the pulse rate needed in order to provide suitable exercise for the heart. For a 25-year old, this range is about 140-170 beats per minute while for a 60-year old it is typically between 115 and 140 beats per minute.

V. CONCLUSION

The proposed framework is capable of providing its customizable best route identification based on multiple possible optimization factors such as travel time, fuel cost, and distance. The dynamic time management scheme operates in real time and emulates the judgment made by a traffic policeman on duty. This system aims at saving a large amount of man-hours caused by traffic problems and accidents, where prevention can save lives and property. It is able to manage priority emergency tag vehicles. It offers a valuable detailed database records and preference to planner and investigators.

The proposed work considers not only the priority of the vehicles but also the density of the vehicles on the road and controls the traffic light sequence efficiently and more accurately and the accuracy of the RFID is more than Camera’s so it also improves the performance of traffic light Violation Detection System.

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