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A Survey on Signal Control System for Ambulance and Accident Identification

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Key words: Received Signal Strength Indicator (RSSI), Micro Electro Mechanical Systems (MEMS), Automatic Ambulance Rescue System (AARS), Global System for Mobile communications (GSM), Global Positioning System (GPS), microcontroller, RF module

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Abstract: The major problems which have led to accidents and loss of life are overcrowding of vehicles and managing the tidal flow. These problems can often result in late arrival of the ambulances during accident. To avoid such problems, a system called Automatic Ambulance Rescue System (AARS) is introduced. By mechanically controlling the signal lights, the ambulance can reach the hospital in time using this idea. A control unit is used which controls the traffic lights and gives the shortest path for reaching the hospital, for the ambulance. The accident spot is sensed by the sensor so that the ambulance reaches the accident spot. As the traffic lights are controlled, the ambulance is guided to the hospital through the shortest route. The location of the accident spot is sent to the main server in the ambulance section through the vehicle unit installed in the vehicle. The ambulance, nearest to the accident spot and also shortest path between ambulance, accident spot and nearest hospital are managed by the main server.

INTRODUCTION

Networking is a field where a connection of computers or nodes is linked through bridges, hubs, wireless networks and physical cables by using various telecommunication and networking protocols. Networking is generally divided into wired networks and wireless networks. Wired networks are used to connect different nodes or computers through physical cables such as Ethernet for sharing information and communication between the nodes or the computers. Wireless networks are the networks which does not connect the computers physically but through radio waves or microwaves to manage and control the communication.

One of the most important aspects that has been developed over the years is wireless network communication. Wireless communication eliminates the heavy cost incurred in wired networks due to physical connection of the nodes through and maintenance of the same. Wireless communication can be performed using radio waves, microwaves or satellite networks. Wireless networks allows an individual to communicate with other individuals anytime and anywhere. Wireless networks can be combined with embedded systems for wireless computation and overall monitoring of various systems connected over the network.

The previous systems which were designed for the same purpose had some limitations like expensive hardware, hard core networking between various hardware and software components and the logic required to control the tidal flow. The previous technologies used concepts like magnetic sensors, Radio Frequency Identification (RFID). Sensors like RFID and magnetic sensors. The main question which occurs is, what if the

sensor don't identify the vehicle and if at one signal it is identified and at the other signal it is not. This can create a ruckus and can cause collisions and accidents at times. There is need of a more reliable system which can calculate all the risks and the ambulance can reach the vehicle and back to the hospital in time.

In this study Chowdhury *et al*. (2015), the proposed system is such that the traffic signals can be automatically controlled and the ambulance can be able to reach the destination in time even after crossing all the signals. The database of the nodes is maintained by a server wherein each of the node is assigned with a unique id to address the data. Shortest route is given to the ambulance by the server. The sensor in the vehicle senses if an accident has occurred and the location is detected by the Global positioning system (GPS). When an accident occurs, a sound is produced by the buzzer. The serial data is converted to parallel data by the encoder when the ambulance passes from the transmitter to the receiver at a given junction. The signal on the path of the ambulance is turned from red to green, so that, the ambulance does not have to wait. Priority scheduling is used in such a way that if two or more ambulances meet at a junction then the ambulance reaching first at the junction or the signal post is given the highest priority. This means that the signals on the path of the first ambulance will be controlled. The above operations are done using wireless sensor networks for the ambulance to reach in time.

LITERATURE REVIEW

After analyzing Derekenaris *et al*. (2000) scheme we get to know that this scheme has some drawbacks like it doesn't have signal scheduling strategies. This scheme only provides shortest route to the ambulance by using GIS and GSM. Scheme of Athavan *et al*. (2012) contain traffic scheduling technique using sensors. Drawbacks of this scheme are delay in Notification through server due to use of GSM technology and cost of sensor is too high.

Yang and Guan (2001) scheme introduces new signal timing method using guided vehicles cross intersections. Drawbacks of this scheme are it only provides signal scheduling it doesn't provide any Front end or Backend technology to user and overhead of this scheme is huge. After analyzing the scheme proposed by Nazari *et al*. (2008), we get to know that this scheme provides new shortest path algorithm which is modified version on of Dijkstra's algorithm which is much more efficient than Dijkstra's. But the drawbacks of this scheme are it is for general car navigation system so emergency vehicles does not receive that much of benefit as they required and there is no inclusion of traffic scheduling in this scheme.

After analyzing scheme of Xiao and Tian (2009), we get to know that this system contains emergency rescue system on highway. This system uses two equation one for reliability which is P = PN×PR Where, P is the emergency rescue system reliability on highway; PN is the system reliability; PR is the road network reliability and another equation is POM = f (M, ES, FS) Where. POM is the management and organizations reliability; M is the management reliability; ES is the equipment (facilities) inspection, repair, maintenance; FS is the fault statistics, analysis and report. Drawbacks of this schemes are it is only limited for highways and it only includes reliability and management but doesn't include Traffic scheduling and shortest path.

After analyzing scheme proposed by Tawara and Mukai (2010), we get to know that this scheme is aimed at alleviating traffic congestion by optimizing traffic signal parameters based on pheromone model. Main drawback of this scheme is this just integrated/ comparison of other many small models. Wei Yan *et al*. (2010) proposed the scheme for Medical Emergency Ambulance for Community using Zigbee Technology. Using localization algorithm, the ambulance finds patient location. Advantage of this system is system is sage and communicatuion network is reliable; but drawback is system finds patient location but it is unable to find shortest route to it.

Wei and Hanbo (2011) proposed scheme of controlling the traffic signals in favor of ambulances during the accidents. Scheme uses ITLS due to which there is no loss of time. But drawback of this scheme is delay in message passing due to GSM which queue based technique. Srajan Saxena proposed scheme which intelligent transportation system (emergency vehicles) including accident identification using RF module. Drawback of this system is large overhead and no collision detection system.

Younes and Boukerche (2013) proposed an algorithm for intelligent traffic light scheduling using VANET. Time required for vehicle to pass the traffic light is given by T = a+Fd/Stf where a is startup delay (constant), Fd the distance between the furthest vehicle in the process and the traffic light at the road intersection. Stf is speed of each traffic flow. Drawback of this scheme is complexity of scheduling and controlling.

This proposed scheme (Chowdhury *et al*., 2015) provides automatically controlling the traffic signals so that the ambulance would be able to cross all the traffic junctions and reach hospital without time delay. In proposed system, central unit guides the ambulance to the hospital through the shortest route. The accident is sensed by the sensors installed in vehicles and the location of the accident is tracked using the GPS. The location of the accident is send to the ambulance section using GSM. The

central unit finds the ambulance, nearest to the accident spot and also the shortest path between the location of the accident, ambulance and the nearest hospital. Due to use wireless technologies to transfer information this scheme is more advantageous as there is minimum delay.

SUMMARY

The proposed system is designed in such a way that the ambulance reaches the desired destination in time bypassing all the underlying signals. The system can be divided into three section viz. Vehicle module, ambulance module and the signal module. In order for the ambulance to reach the hospital safely, it is necessary that all the three modules work and coordinate correctly with each other.

For factors like over-speed and rash driving, a vibration sensor and Micro Electro Mechanical Systems (MEMS) is used. The vibration sensor senses if the speed is over limit. If yes then the driver will be alerted and the speed will decrease eventually. The MEMS placed in the vehicle, if gets tilted then a notification will be sent through Global System for Mobile Communications (GSM). With the help of this the ambulance will reach the desired point of accident. The display unit from the ambulance meant for the driver will show the nearest hospitals. The signal module will communicate with the ambulance unit so that the required signals are controlled by the signal unit so that the ambulance can reach the hospital in time. The overview of the system can be understood from Fig. 1.

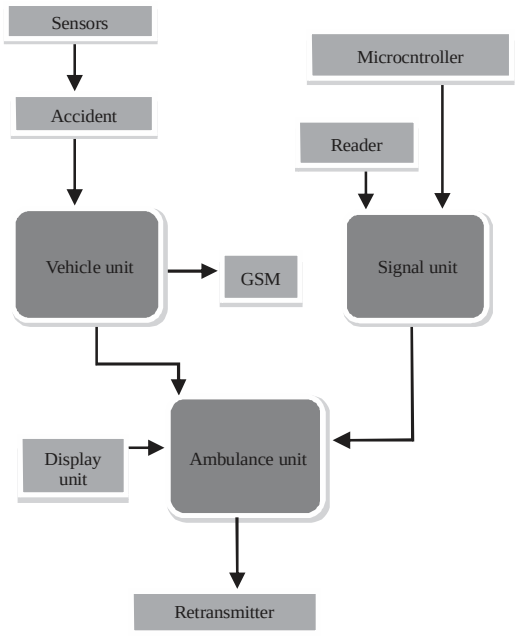

Fig. 1: System overview

Vehicle unit: The vehicle unit uses a piezo electric sensor which is used for measuring changes in temperature, pressure, force or strain by converting them into electrical charge with the use of piezoelectric effect. The piezoelectric sensor used in the vehicle unit measures dynamic pressures which include blast, ballistics and engine combination under changing and different conditions. The system uses ARM7 microcontroller which is an older group of 32-bit ARM processor. ARM uses Reduced Instruction Set Computing (RISC). It requires fewer transistors compared to other. LPC2148 is the IC used in this vehicle unit. It is pre-loaded with many inbuilt peripherals making it more efficient. Power supply, crystal oscillator, reset circuit, UART are the minimum listed hardware needed for LPC2148. It works on 3.3V power supply, transformer is used to step down 230V AC to 9V AC supply and provide isolation between power grid and circuit. Rectifier in LPC2148 is used to convert AC supply into DC and regulator is used to regulate DC supply output, reset button is essential to avoid programming pitfalls and provide clock for RTC operation. LPC2148 has inbuilt ISP which means we can program it within the system using serial communication on COM0. When an accident occurs the indicator indicates through a buzzer which makes a sound.

MEMS is an innovative technology used in the system. MEMS is a technology that, generates continued, sustained improvements in, for example, the functionality of small microphones, small cameras and small electrical signal filters for wireless communication. The system uses GSM which is a widely used telephony system that uses Time Division Multiple Access (TDMA). The GPS used in the system helps to know the current location of anyone, anywhere and at any time, even during worse weather conditions.

Once the sensor senses the accident, the GPS tracks the location of the vehicle. This information is retrieved by the GSM and the location of the accident is sent to the ambulance unit. The buzzer produces sound when accident occurs. The server searches for the ambulance nearest to the accident spot. After searching the ambulance, the server allots a shortest path for the ambulance to the spot and back to the nearest hospital. During the transit of the ambulance, the underlying signals are turned to green from red when the ambulance reaches a junction. The overview ofthe vehicle unit can be understood from Fig. 2.

Ambulance unit: A Peripheral Interface Controller (PIC) microcontroller is used in the ambulance unit. The IC used is 16F877A. The ambulance unit consists of a crystal oscillator, power circuit and serial communication. The oscillator works according to the change in the frequency. In a PIC microcontroller, PIC microcontroller has 40 pins

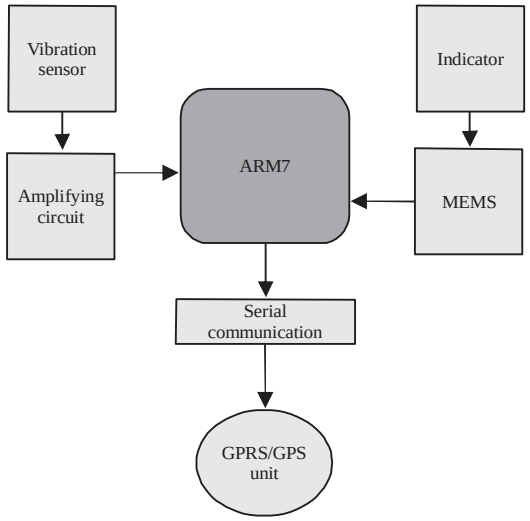

Fig. 2: Vehicle unit

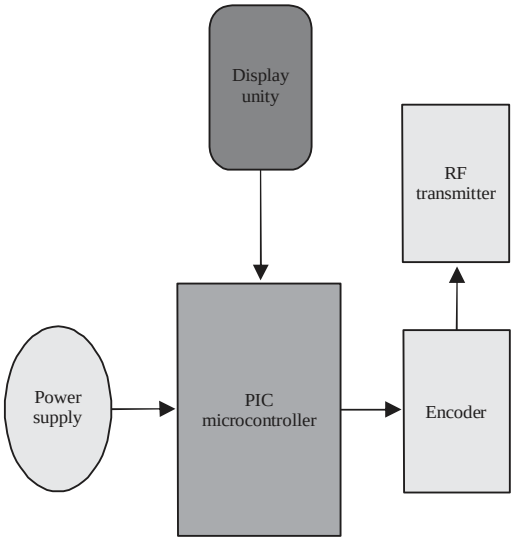

Fig. 3: Overview of ambulance unit

and 5 ports; port A to port E. The MAX232 is used for the purpose of serial communication. It is a dual driver/receiver. The display unit is used for the driver to help himself with various factors like accident spot and shortest route. The encoder converts the serial data into parallel data because the controller performs only serial functions and wireless is parallel communication. An RF module is an electronic device used to transmit or receive radio signals between two devices. The wireless communication may be performed through optical communication or RF communication. The choice is RF for many applications as it does not require line of sight. RF communications use a transmitter or receiver. We can understand the overview of the ambulance unit from Fig. 3:

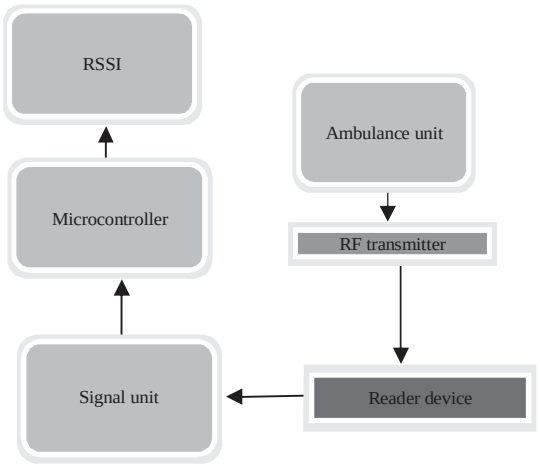

Fig. 4: Signal unit

Table 1: Hardware requirements and working

Requirements	Vehicle unit	Signal unit	Ambulance unit
Micro controller	ARM7	ARM 7	PIC
IC	LPC2148	LPC2148	MAX232
Sensors	MEMS, vibration	Reader	Transmitter
Working	Identify the accident	Identify the ambulance	Identify the signal

Signal unit: The functions in the signal unit are almost same as the functions in the ambulance unit. The microcontroller in the signal unit performs functions similar to the microcontroller in the ambulance unit. A reader device installed in the signal unit reads and receives the data from the RF transmitter installed in the ambulance. The decoder which is installed in the signal unit decodes the encoded information and sends it to the microcontroller. The data is sent only after converting the parallel data back to serial data. The Received Signal Strength Indicator (RSSI) measures the power present in a radio signal which is received. RSSI is a radio receiver technology metric which is normally invisible to the user of the device which consists of receiver but is directly known to users of wireless networking. The output of RSSI is a DC analog level. The ambulance unit is the transmitter and each signal is the receiver. When the data is transmitted to the receiver, the signal comes to green automatically. The decoder converts the data from parallel to serial because the controller knows only serial language. In this way, this system helps the ambulance to reach the emergency site and then to hospital without time delay so that intensive care can be given to the patient in the golden hour and many lives can be saved. We can understand the overview of the ambulance unit from Fig. 4 and Table 1.

CONCLUSION

The numbers of vehicles are going on increasing and hence making a tedious task to manage the tidal flow and

the traffic flow. Many lives were cost due to failure of the ambulance to reach the hospital in time. With the increase in technology, it is necessary that something must be invented for the patients to reach the hospital in time. The existing systems have many disadvantages in where at times the ambulance has to be given the path manually. There is no guarantee that the ambulance will reach the spot or the hospital on time.

The study designs such a system by effectively giving a free way to the ambulance by using latest technologies like GPS, GSM and various sensors. This system identifies the spot of the accident and sends a message to the ambulance system and the central server allocates the shortest path. The signals are turned to green when the ambulance reaches the junction. Although, problems may occur in this case where there is long traffic and the ambulance can take time to reach the junction and hence can cost the life of the patient. The case where two ambulances can be on the same path is also not considered.

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