

A Life-Saving Approach: Traffic Control System to Prioritize Ambulance on Road

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Abstract In order to have a long-term approach toward future endeavors, security of life is of utmost importance. The ambulance communicates with the traffic light controller at the nearest crossway through radio frequency technology using RF module, navigation system, and switch array. The command of traffic light guides the ambulance the way forward to reach the destination at the proper time. This paper illustrates the complete use of available techniques in an optimized manner and to utilize it for maximum benefit for the public of the nation. The proposed system has free space path loss equal to 99.16 dB approximately which is good for a wireless system configuration to work efficiently.

Keywords RF module · Navigation system (GPS) · Switch array

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1 Introduction

India accounts to 1.34 billion population and is the second most populous country in the world. With the population growth rate of 1.2% annually, the predictions are reaching 1.53 billion in the coming years [1]. This new era of industrialization and urbanization has made people to shift to the cities leaving their ancestral homes for having a better standard of living, and this goes the same with all the families of the society [2]. Only the metropolitans of the nation itself account to population in the range between 65 lakhs and 2 crores [3]. The trend gives rise to increase in population within the city leading to more traffic. This adversely effects one of the important necessity of humans called ambulance facility. According to CIA (Central Intelligence Agency) world fact book, about 10.1% of deaths in India are caused due to late arrival of ambulance [4]. The term, we call as '*First Aid*,' is one of the prime requirements in a city which, in many cases, can only be provided by ambulances. As the health of the patient deteriorates, he/they require an immediate addressal toward a hospital, which is being fueled up through an early arrival of an ambulance. Though the services are available but are not being utilized at their potential.

According to some present instances like a man bled to death after a two-and-a-half-hour ambulance delay [5], a 15-min travel to hospital took about 45 min, sacrificing the life of an old-aged person [6], a six year old being rushed to hospital due to chronic problem, collapsed on the way due to extension in time of travel [7], pregnant woman died due to the same issue of reaching late [8]. So, it is correct to say that the delay in ambulance costs over to life of many people. The statistics of the increasing problem is, however, very alarming and needs a direct attention. The instant provision to the facility can be achieved if we open up our trafficking roads thus allowing the patient to be treated according to his/her ailment.

Here, we are proposing a system which will eliminate vehicles from the path of ambulance, so that it can reach its destination on time, with the help of proper signaling of traffic lights. The mode of communication between the ambulance and traffic light controller at a crossway is through RF (radio frequency) module where ambulance driver instructs the traffic light controller about its approaching and leaving path across the crossway with the help of navigation system and switch array.

2 Theory and Principle Involved

An idea is put forward only after taking into account all the main principles of the model and keeping in mind about the long-term benefits to mankind and environment from it. The operating principle of the proposed system includes that of RF module, navigation system, switch array. The RF modules use its transeceiving antennas in order to communicate between the ambulance and the traffic lights over

long distances, at the particular frequency of 433 MHz, operating at voltage range of 3–12 V [9] and at the rate of 1–10 kbps without any consideration of line of sight (LOS) communication issue [10].

The switch array with four buttons pointing left, right, up, and down allows the ambulance driver to communicate with traffic light controller, acknowledging about its leaving path from crossway by pressing the corresponding button. The navigation system or the GPS helps the driver to track the traffic light position and the status of traffic on the upcoming path on its way.

3 Fabrication and Methodology

The system works in the radius of 5 km, with traffic light at the center. This consists of two main units, that is, ambulance and traffic light control unit. The ambulance is equipped with a RF transceiver module, switch array, and a navigation system. On the other hand, the traffic light controller, which is controlling the lights with the help of relays and transistors [11], contains a RF module. Both the units are illustrated in the following Fig. 1.

The RF module inside the traffic light controller receives radio signals as soon as an ambulance enters the area within 5-km radius. This now manages the traffic in such a way that the path taken by the ambulance should possess less vehicles. The lights are controlled accordingly with the help of relays and transistors by the controller. From inside the ambulance, the RF module sends signal to the traffic light controller, acknowledging its presence. The navigation system is used to detect a nearby traffic light for the ambulance driver [12], so that the driver can send the direction of leaving the crossway to the traffic light controller, with the help of switch array [13]. The traffic light then makes the path, going to be used by the ambulance to leave the crossway, empty.

In Fig. 2, two ambulances are approaching the traffic light, which is at the center of the crossway. Ambulance from path 3 is at 3 km from traffic light, and it has to

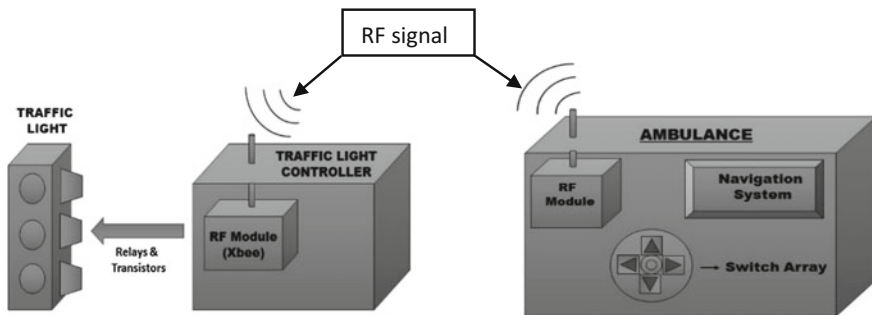


Fig. 1 a Traffic light control unit. b Ambulance unit

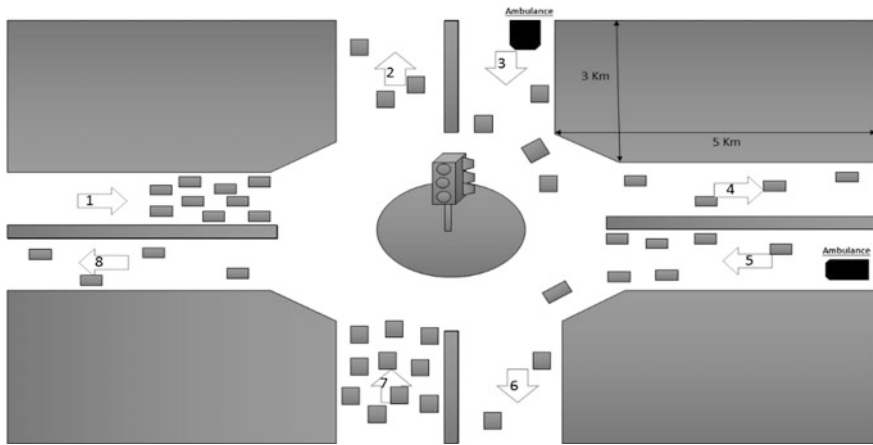


Fig. 2 Path cleared by the traffic light for the two ambulances in the crossway

go toward path 8. Similarly, another ambulance, at 5 km from traffic light, is approaching it from the path 5 and it has to go toward path 6. The traffic light now tends to clear the paths 3, 8, 5, and 6 for smooth run of the ambulances. The priority of the ambulance is decided by the traffic light on the basis of its distance from the ambulance, when more than one ambulance is approaching it simultaneously. In the case of Fig. 2, ambulance from side 3 is nearer than that of ambulance from side 5. Hence, there are less vehicles in path 3 as compared to path 5. More vehicles will be reduced from the path 5 when the ambulance on this path comes more close to the traffic light. Hence, the ambulance finds its way out of the traffic very easily.

4 Mathematical Calculation

We know free space path loss (FSPL) formula for a wireless communication system is given by [14],

$$FSPL(dB) = 20 \log_{10}(d) + 20 \log_{10}(f) + 32.45 \tag{1}$$

where

‘*d*’ is the distance from the transmitter (in kilometers) and

‘*f*’ is the signal frequency (in megahertz)

Taking the values as *d* = 5 km, *f* = 433 MHz, and substituting in Eq. (1),

we get,

$$\begin{aligned}\text{FSPL(dB)} &= 20 \log_{10}(5) + 20\log_{10}(433) + 32.45 \\ &= 13.97 + 52.73 + 32.45 \\ &= 99.159 \text{ dB.}\end{aligned}$$

Thus, FSPL is calculated out to be **99.159 dB**.

5 Conclusion

Precisely, this system holds good for the fact that WHEN THE CITY TRAFFIC HALTS, AN AMBULANCE LIVES and this can be achieved by the above-developed system and of course, through guided effort and cooperation of all individuals of the nation.

The good response from the system's free space path loss for the used dimensions will certainly help us to adopt this method of minimizing death rate due to late arrival of ambulance. The installation cost is also minimal as it only requires very common components for this system to work. Thus, if appreciated, it can act very beneficial in increasing life expectancy ratio for a patient availing the ambulance services.

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