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Life Saver : Intelligent Traffic Control System for Ambulance Prioritization Using IoT

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Abstract

Nowadays traffic jam is one of the biggest disquiet. Traffic congestion as well as tidal flow management were identified as the critical impact in modern cities, which have created discomfort for the emergency vehicles. Inspite of all these, road accidents in heavy cities are becoming constant and tend to have the loss of life , which are even more crucial. In this study, the ambulance communicates with traffic light controller with the nearest crossway through a suite of high level communication protocol used to create personal area network called as RF module. This kind of communication between the traffic light controller helps to reach the destination on time. This paper stresses the complete use of available technique in an optimize manner and to utilize it for maximum benefit for the public. The main motto behind our project is to provide a smart way of controlling traffic light timing during peak hours and also to provide smooth flow for ambulance.

Keywords; *Traffic Congestion, tidal flow management, ambulance, traffic light controller, communication protocol, RF module.*

I. INTRODUCTION

Increased population in the large cities is one of the major crisis which is the main reason for traffic congestion. Ambulances are the only transport source which provide emergency medical services to patients. When an ambulance get suck in traffic junctions it leads to a problem especially when someone is in need for an emergency medical treatment. Usually it takes long time to clear traffic, not every ambulances have advanced life saving equipments hence this may leads to risk of patient's life, hence traffic control system evolved for efficient transport to save patient's life.[1]

In India, nearly 10.1% of death are caused due to late arrival of ambulance said CIA (Central Intelligence Agency) the world fact book.[2]. When the health of a patient downs, they has to be immediately taken toward the hospital through an ambulance. Even when there are services available, they are not used effectively.

Previously, there are some incidents happened where a man was put to death after a two-and-a-half-hour ambulance delay [3], a 20-min travel to hospital took about 50-min, sacrificing the life of an person [4], a 6 year old being hurried to hospital due to chronic problem, collapsed on the way due to time extension during travel[5], due to this same issue an pregnant women died by reaching late[6]. Hence, this shows the statistics of problems faced due to traffic congestion.

This problem is solved in our project where we are proposing a system that will terminate vehicles from ambulance path, hence the ambulance can reach its destination on time by making proper signaling of traffic lights. Through a RF(radio frequency) module the arrival of ambulance can be communicated to nearest traffic light at a crossway. To clear the traffic, an instruction is passed from the ambulance driver to the traffic light controller which

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turn the traffic light to green so that ambulance can cross without any delay.

II. RELATED WORKS

A system that includes multiple agent which learn by dynamically interacting with their environment, was developed with two section of modes. The first mode includes an agent who learns from neighbor agent independently. The second mode includes an agent who learns according to neighbor's agent [7]. The system uses a simulation technique for evaluation. The observed results from the simulation technique proves that the system is useful in large cities. The proposed system solves only the traffic and does not specifies any special priority for emergency vehicles. The paper did not explain the inner implementation of how agents work and communicate with each other.

In this paper[8], the system consists of three components – camera, traffic signal and a development board. The camera captures the image and send to the development board, where the process takes place and traffic signal works with respect to the situation. This system undergoes image segmentation principle. The proposed system includes two modes i.e. normal mode and intelligent mode. In normal mode, the traditional method of allocating time interval equally for each lane whereas in intelligent mode, the time is allocated according to the traffic condition that currently takes place. The execution part of this system is slow in real time scenario and is not sustainable for bad weather conditions.

In this paper, the system uses a sensor network where the traffic light's (like green, red and orange) timings are decided according to the traffic conditions intelligently. The unique quality of the proposed system [9] is that the traffic congestion can be checked by any user through GSM message. The user can send message to the base station at any time and know about the traffic condition, the reply from the base station is sent to the respective mobile number along with the congestion free suggested route. This can be possible by mounting the infrared sensors along the roadside. These sensors calculates the density of the vehicles.

This paper introduces a concept called 'Green Corridor' [10]. A smart ambulance is designed with different sensors fitted. These sensors reads the parameters like patient's heart rate, blood pressure and sends the status to the respective hospital's database and simultaneously the traffic signals an be switched through cloud using GPRS message. The signal switching are operated once when the smart ambulance reaches at the particular range. The message exchange are performed using GPRS service through cloud.

In this current scenario, the loss of life are occurring in large number and this can be reduced by providing emergency services on tine. The shortest route are constructed for the accident spots, the server identifies the location and displayed. The traffic signal gets changed once the emergency vehicle is approached. The implementation of this system [11] directly relys on traffic management, hence the emergency vehicles can reach the destination in short span of time.

III. OVERVIEW OF PROPOSED SYSTEM

The main motive of the proposed system is to clear the ambulance from getting stucked in traffic jam. If the emeregencyvehicles gets stuck in traffic congestion, there tends to the risk of loss of life. By executing this model, the traffic congestion/ overcrowding can be minimized. In this system, we designed a smart traffic system using wireless communication technology, that can reduce the vehicles being cemented for long time.

Our proposed system contains Arduino UNO module and RF transceiver module, whenever an emergency vehicle comes in contact with the road intersections, the traffic controller will automatically turns into green and provides way for the emergency vehicle to pass the road without any discomfort. This system immediately makes other vehicles to

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wait for a while in other lanes and allows the ambulance to cross through safely as well as quickly.

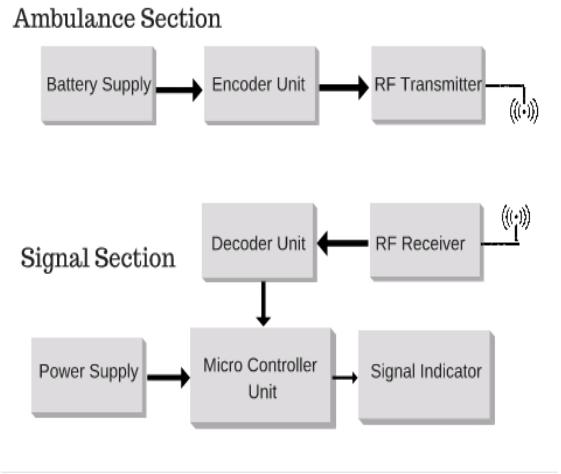

Figure 1: Architecture diagram of our system

Working Principle

In this model, the ambulance is fitted with RF transmitter which is in the oversight of a microcontroller. The ATmega 328P microcontroller is programmed and connected with the Arduino UNO board. The RF transmitter transmits the alert signal when the ambulance siren is switched ON. When the transmitted RF alert signal comes in contact with the traffic signal which is equipped with the RF receiver, the microcontroller at the receiver side will process the received commands for altering the traffic light to green signal.

In this system, the ambulance is being attached with RF transmitter module which is in the oversight of a microcontroller. The microcontroller named ATmega 328P is being programmed with specified functions and connected to the Arduino UNO board. The alert signal from the RF transmitter gets transmitted whenever the siren in ambulance gets switched ON. When the alert signal being transmitted from the RF transmitter communicates with the traffic signal , where the RF receiver is attached to it, the microcontroller equipped in the receiver side will get command to switch the traffic signal to green light.

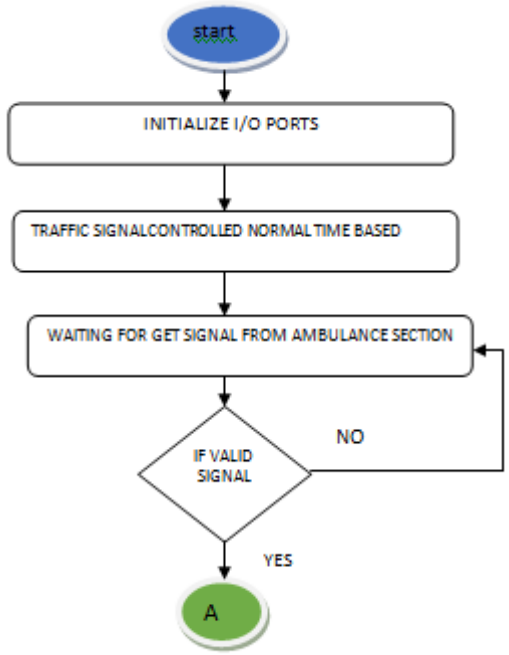

Figure 2: In the case of the arrival of one ambulance

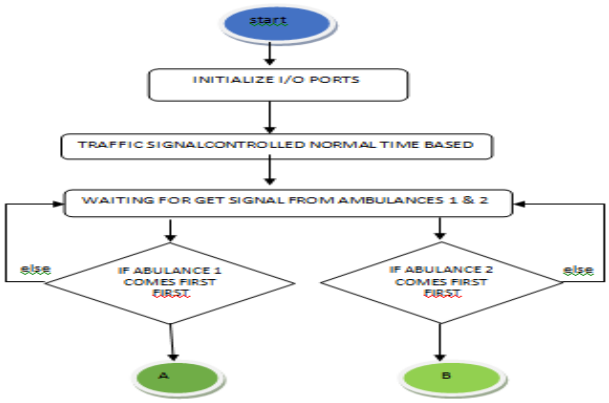

Figure 3: In the case, the arrival of two ambulances at a time

Algorithms used:

A Pretimedalgorithm

Three differentpretimed algorithms were tested. They work like the pretimed algorithms in that one phase is active for a fixed time before the system switches to another phase. Three algorithms only differ in green time.

They have a green time of 20 seconds, 30 seconds and 40 seconds, respectively. The green times where

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chosen since they both resemble reality and are similar to related work. The yellow time is 3 seconds and each algorithm follows:

TABLE 1. PHASE CYCLE ACCORDING TO PRETIMED ALGORITHM.

Attributes	Signal change
West-East	Green
West-East	Yellow
North-South	Green
North-South	Yellow

The reason for testing three pretimed algorithms instead of onestems from the problem of determining how well a pretimed algorithm performs just based on one fixed value. A good result could have occurred because that time happened to be the optimal for just that test case or demand. By exploring several values, a more general result for this kind of algorithm is found.

B Deterministic algorithm

This algorithm was chosen because it relies on sensor values to determine the traffic situation instead of using assumptions. This follows the scope of this paper, as seen in section in which perfect knowledge of the vehicles' information was assumed. Moreover, it uses only the sensor values to determine the order of phases, making it a completely deterministic algorithm. This makes for a interesting comparison, as a learning based algorithm utilizes randomness, meaning thatit is non deterministic.

This time is composed of three terms:

1. Startup time for each vehicle
2. Time needed for last vehicle to reach the center of intersection
3. If the last vehicle is going left, the time needed for the cars goingforward in the opposite direction to traverse the crossing part ofthe intersection.

The calculation for the entire traversaltime is found in Equation

$$Tstart = 0.5 \cdot Nlane \quad (1)$$

Dlast_vehicle is the vehicle's distance to the center of the intersection. This equation is derived from the quadratic formula used on the equation of motion in regards to constant acceleration. Since time cannot be negative in this case, thepositive root is used.

$$Topposite = 0.1 \cdot Nopposite\_lane \quad (2)$$

Nopposite_lane is the amount of vehicles from the opposite road that the last vehicle must wait for. This is 0 if the vehicle isnot going left.

$$T = Tstart + Tmove + Topposite \quad (3)$$

IV. HARDWARE SETUP:

A RF Transceivers

RF converses using a particular frequency disparate IR signals which affects the other IR emitting sources. RF module consists of both RF transmitter and RF receiver. The transmitter and receiver bot gets paired at the frequency rate of 434 MHz. This is often used along for encoding parallel data for transmission feed which reception is decoded by the decoder. HT 12E – HT 12D, HT 640 – HT 648, etc., are some trivially used encoder as well as decoder respectively. The parallel inputs are converted by the encoder into serial set of signals. These converted signalsare transferred serially as RF to the receiving point. RF receiver contains decoder which decodes the serially configured datas and retrieves the original datas as output signals.

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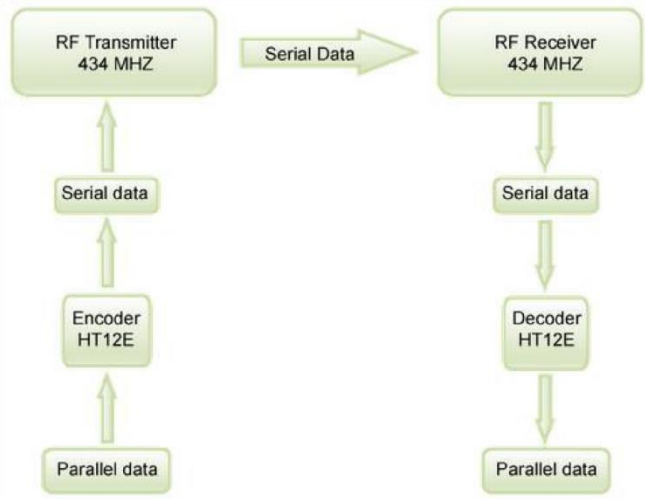

Figure 4. RF Transmitter and receiver encoding & decoding Module

B Encoder HT 12E

HT 12E is an encoder Integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system application.these 12 bits are further divided into 8 address bits and 4 data bits. HT 12E begins with a 4 word transmission cycle upon each enabled transmission.

Figure 5. module of encoder HT 12E

C Decoder HT 12D

HT 12D is an decoder Integrated circuit belongs to 212 series of decoders. The selected pair of encoder or decoder should contain same number of data format and addresses. HT 12D can decode 12 bits, out of which 8 are address bits and others are 4 data bits. The 4 bit latch data type output pins will be changed until new one is received.

Figure 6. module of decoder HT 12D

D Arduino UNO

Arduino is an open source electronic prototyping platform, which is simple and inexpensive software. Arduino is an extended version of C/C++ programming language. In Arduino, we can create a control program on the host PC download where it runs automatically. Even if we disassemble the USB connection to PC, when the reset button is pushed the program still runs. When we remove the battery and insert Arduino board in a closet and reconnect the battery, the program we stored in the last will run. To debug and develop the program we should bring together board to host PC. When this process is made, we don't need PC to run the program.

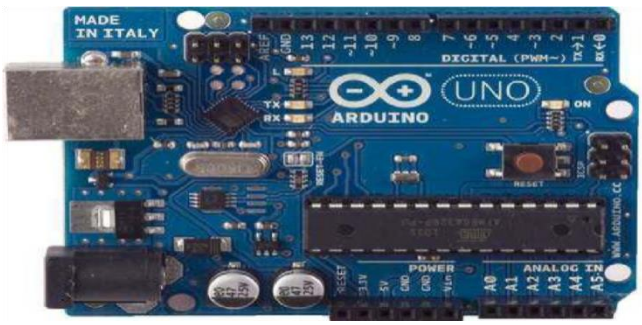

Figure 7. Arduino UNO board

E Micro controller

The ATmega 328P is an single-chip micro controller that has 8-bit AVR RISC processor code which combines 32KB ISP flas memory with read-write functions, 1024 EEPROM,2KB SRAM, 23 common I/O lines and has 32 working registers, three adaptable timer/counters with comparative modes,2-wire byte oriented serial interface ,SPI serial port, USART serial program and finally 6-channel 10-bit Analog to Digital converter consisting of 8 channels in packages such as TQFP and QFN/MLF , 5 software selected for power saving modes and

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internal oscillator predefined with the watchdog timer. This microcontroller device from 1.8-5.5 volts.

Process at transmitter side:

In ambulance, the micro controller is programmed for signal transmission through radio frequency to the traffic light at the reception part.

Process at receiver side:

In the receiver side that is in traffic light pole, the signal from the RF transmitter being equipped in the ambulance is received by the micro controller. Once the signal is received from the transmitter, the traffic controller turns the traffic light into green signal, which provides way to the emergency vehicle to cross the crossway.

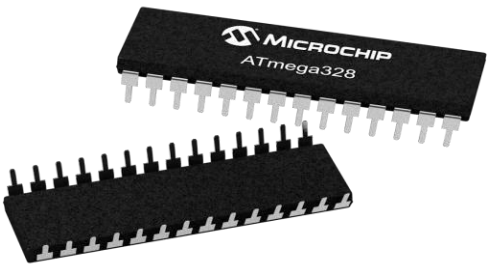
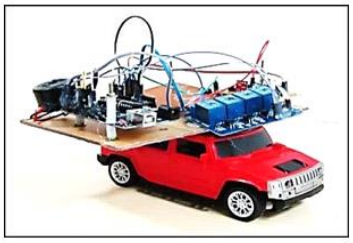


Figure 8. Microcontroller chip of ATmega 328

V. EXPERIMENTAL RESULTS:

This project has two sections where the first section RF transmitter which override progression of traffic light. Meantime, the second section has RF receiver and microcontroller circuit which generates series of traffic light for intersection. The working system has accomplished the desired result and verified by using the activated green light and red light in traffic signal where we can monitor the ambulance 100m far from the traffic signal.



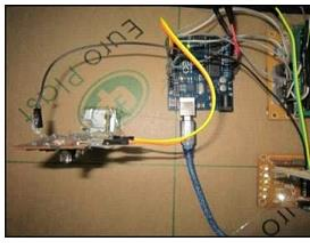


Figure 9. Ambulance module Figure 10. Traffic Light module

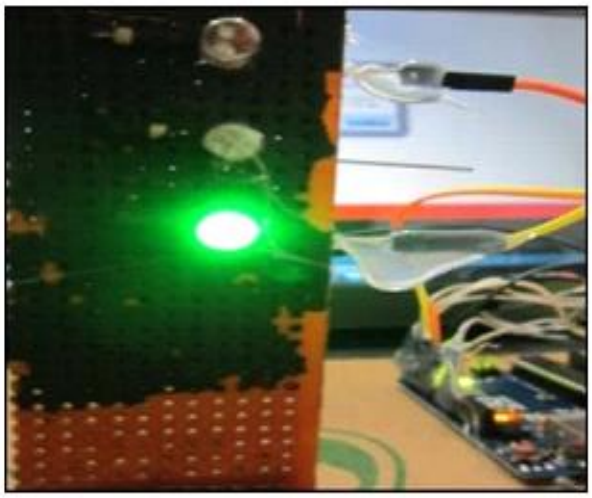


Figure 11. Ambulance is detected and green signal is glown

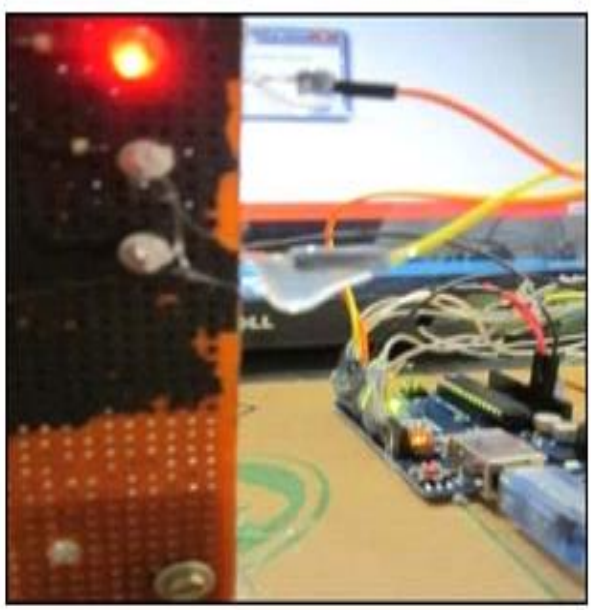


Figure 12. Ambulance is not detected and red signal is glown

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TABLE 2. COMPARISON OF MODULES

	Infrared module	RF module
Coverage range	40%	90%
Data rate	69%	50%
Power consumption	42%	81%
Bidirectional mode of operation	50%	100%

Generally the traffic control system has different types of time interval for different traffic areas. The average waiting time for the emergency vehicles in unique were not given priority. Due to the uncertainity of these vague situations, our proposed system defines the prioritization for the emergeency vehicles to pass through the traffic signals in an efficient way so that they can reach destination on time.

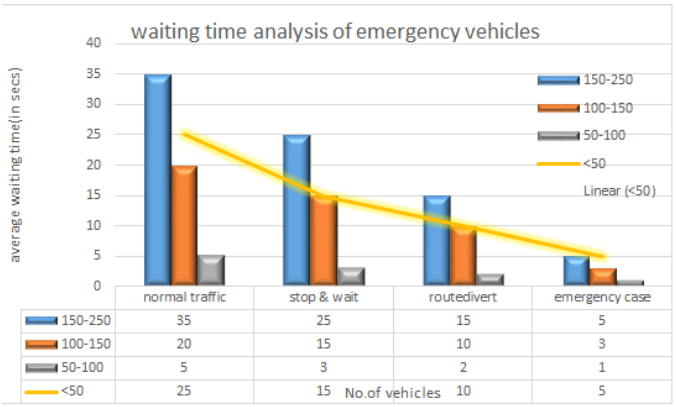

TABLE 3. WAITING TIME ANALYSIS OF EMERGENCY VEHICLES

VI. CONCLUSION

This system finds the solution to end the problem of traffic congestion by monitoring the traffic junctions and vehicles on roads which is capable of handling the situation on road without any human participation. The traffic is managed by a signal controller which perform interactions between the traffic volume or ambulance to other signal. Without any doubt this system can handle situations with multiple ambulances reaching a traffic junction is achieved. Hence, this method minimizes the death rate due to traffic congestion, where installation cost is also less and it requires simple components to work. Thus, this project has direct impact on humanity and it will solve major issues faced by the emergency vehicle, it will be beneficial for patient transportation system in upcoming period

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