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Traffic Control System for Emergency Vehicle

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Abstract
Urbanization is growing so rapidly due to which demand is increasing in the transportation field, hence traffic control system plays an important role is handling emergency situations and disaster management. Traffic control system implementation is much necessary not only to avoid the congestion but also to provide the way for the emergency service like ambulances, fire engines etc., this protects many lives from both health and disaster sector. This will provide effectiveness to the traffic control system in both normal and emergency situations. The proposed methodology is about implementation of RF transmitter and receiver with the Arduino to automize the traffic control system to avoid the delay in the arrival of emergency vehicle at the spot where emergency is required traffic control system provides an emergency blue light along with the existing traffic lights to provide the proper indication emergency traffic signal the emergency vehicle will reach the destination without any delay in traffic. This protects many lives from both health and disaster sector. This will provide effectiveness to the traffic control system in both normal and emergency situations.
Keywords: *RF Transmitter, Receiver, Arduino Mega, Arduino Uno, Traffic control system.*

1. Introduction
Traffic lights have been developed since 1912 and serve as signaling devices to regulate traffic at intersections, pedestrian crossings, railway crossings, and other locations. They typically consist of three colored lights: green for allowing traffic to proceed, yellow as a warning for vehicles to prepare for a brief stop, and red to prohibit any traffic from moving forward. [5] The rise in population and the number of vehicles in urban areas has led to a significant and complex problem: traffic congestion. This issue is increasingly prevalent in major cities worldwide. The consequences of traffic congestion extend beyond travel delays [1]. India, being the second most populous country in the world and a rapidly growing economy, is facing severe road congestion issues in its cities. The growth of infrastructure has been relatively slow compared to the increasing number of vehicles on the roads. This is primarily due to limitations in available space and the high cost associated with infrastructure development. As a Result, the existing road infrastructure is struggling to cope with the growing demands, leading to significant congestion problems in urban areas. Technologies such as ZigBee, RFID, and GSM offer cost-effective solutions for traffic control. RFID (Radio Frequency Identification) is a wireless technology that utilizes radio frequency electromagnetic energy to transmit information between RFID tags and RFID readers. The range of RFID systems can vary, with some operating within a few inches or centimeters, while others have a range of up to 100 meters (300 feet) or more. This technology enables efficient tracking and identification of vehicles or objects, providing valuable data for traffic management and control. [6] According to the world health organization, over 5 million people lose their lives each year due to delayed medical treatment. Timely emergency services play a crucial role in reducing mortality rates, as it has been estimated that a 10% reduction in mortality can be achieved with prompt medical

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assistance. However, one significant challenge faced by emergency services is the delay caused by traffic congestion. Ambulances often get stuck in traffic, resulting in precious time being wasted while waiting for the traffic to clear. These delays can have a detrimental impact on patient outcomes, especially in critical situations where every second counts. The time spent navigating congested roads and intersections can significantly hinder the ability of emergency services to reach patients promptly and provide necessary medical care. Addressing traffic congestion and implementing effective traffic management measures can help alleviate these delays and improve the timeliness of emergency services. By implementing solutions such as dedicated emergency lanes, real-time traffic monitoring, and coordinated traffic signal systems, the potential for delays can be reduced. Additionally, leveraging technologies like GPS tracking and communication systems can help emergency services optimize their routes and receive real-time updates on traffic conditions, allowing them to navigate more efficiently. Reducing the time ambulances spend waiting in traffic can significantly contribute to saving lives and improving patient outcomes. It emphasizes the importance of finding effective solutions to mitigate traffic congestion and ensure that emergency services can reach their destinations in a timely manner. One of the major challenges faced by emergency vehicles on the road is heavy traffic. While other vehicles on the road may attempt to clear a lane for the emergency vehicle, it often becomes a difficult task. Clearing a lane manually can lead to chaos and confusion among people, causing further delays. It is a time-consuming process that can hinder the prompt response of emergency services. To address this issue, it is crucial to implement efficient and effective solutions that facilitate the smooth passage of emergency vehicles through traffic. One approach is to utilize technology and automated systems to in clearing the way for emergency vehicles. This can include the integration of intelligent traffic.

2. Proposed Methodology

Nowadays the road traffic is increasing rapidly due to rapid increase in vehicles and hence time taken for the emergency vehicles to reach its destination is increasing. Our proposed methodology will help emergency vehicles to reach its destination earlier by controlling the traffic signals. RF transmitter and receiver module has used in this to control the traffic signal. The block diagram shows the working of traffic signal during the entry of emergency vehicles in the range of RF module shown in Figure 1. Firstly, the receiver in the traffic control system receives the signal from the transmitter which is embedded in emergency vehicle when it comes within the specified range. Receiver sends the received data to Arduino, the microcontroller reads the data and sets the traffic signal according to the data. And in this methodology one more light is introduced to indicate the emergency and its operation will not create complications in the present traffic control system.

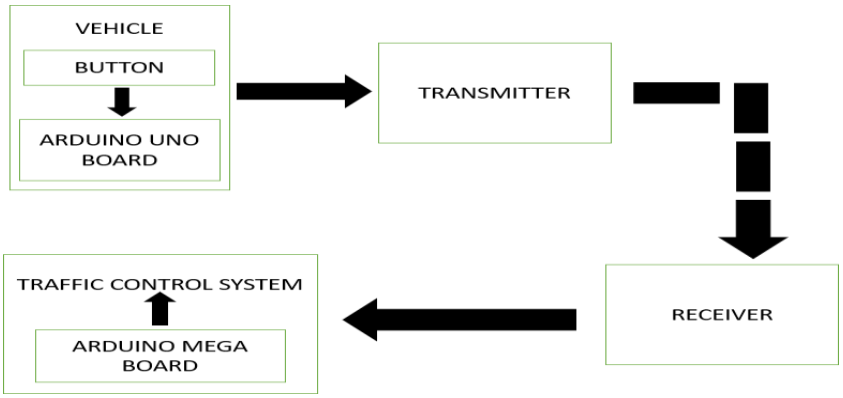

Figure 1 Block Diagram of Proposed System

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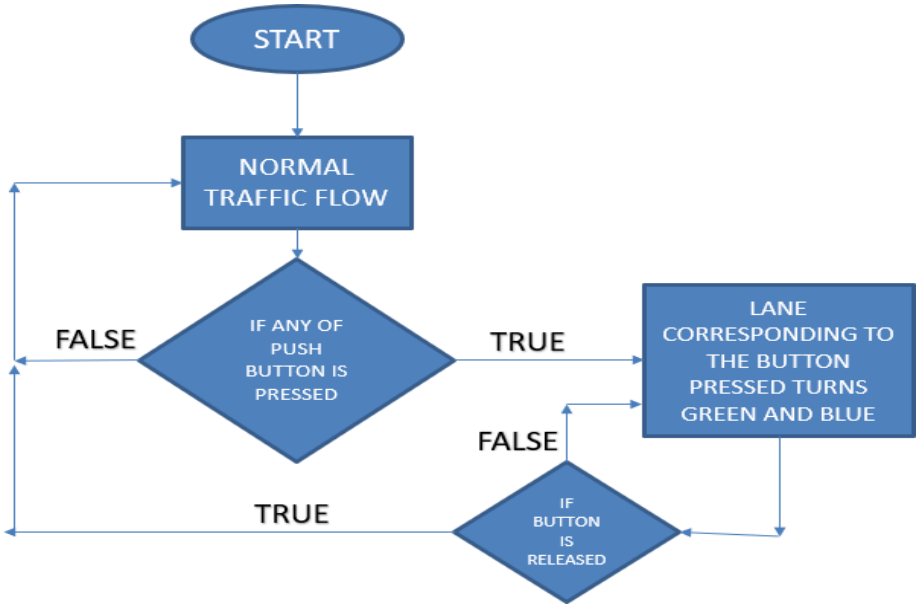

Figure 2 Flow Chart of Proposed System

The flow diagram of the proposed work is shown in Figure 2. It represents both normal working and the emergency working of traffic control system. If there is no signal received to receiver of traffic control system it works normally as the present traffic control system. If receiver received signal from the transmitter, then the signal where road where the ambulance wants to move will become "GREEN" and "BLUE" and other signals becomes "RED" and "BLUE" until the ambulance crosses the road. If there is no signal is receiving to the sensor node at the traffic signal then it again works in normal condition by switching of the "BLUE" light as early as possible [10].

2.1 RF Module

RF stands for radiofrequency. The Arduino may communicate with other microcontrollers via RF, exchanging data in this way. This can be done by using an Arduino and an RF module interface to wirelessly broadcast and receive data. RF 433MHz is a group of electrical RF transmitters and receiver modules that enable radio signal transmission and reception between any two devices. The receiver module at the receiving end receives the data that the transmitter module at the transmitter end transmitted. This broadcast will take place at a frequency of 433MHz. [4].

2.2 Arduino Uno

The Atmega 328 microcontroller is the foundation of the Arduino UNO circuit board. This board contains a 16 MHz crystal oscillator, six analogue pins, 14 digital inputs and outputs, a USB port, a power jack, and a reset button. The Arduino Uno board can be powered by a USB charger plugged into a computer's USB port, or it can be powered by an AC adapter with a voltage of 9 volts. The Arduino board will use the USB port to get power if there isn't an AC power source available. However, the Arduino board will automatically use the AC adapter if power is provided through both the USB port and the AC adapter at the same time. [7].

3. Simulation

Simulation of this project is done using proteus software environment. (The circuit of emergency vehicle-based traffic control system is shown in figure (1). Here both the RF modules are connected to the Arduino and these Arduinos will act as the encoder and decoder). initially the traffic signal system will be working under normal operation it is when there is no emergency vehicle near the range of the receiver then all the four lanes are working normally with red, yellow and green lights on led display. Red and green lights have the delay of 2seconds each indicating to stop and pass

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respectively. And the yellow lights are given the delay of 0.5 seconds. There is a transmitter installed in the emergency vehicle and receiver part is installed in the signal controller part of traffic signals. There are four push buttons provided inside the emergency vehicle representing four lanes. In case of any emergency condition then the driver will give the input to the transmitter thorough the push button that in which lane the vehicle is coming. This is transmitted to the receiver in the traffic signal system. Which will clear the lane in which the emergency vehicle is coming, so that the vehicle can travel without any delay and reach its destination as quickly as possible. We should concentrate here that there is new thing to be done at the junctions just the developed module can be added to the present system at the junctions. There will be no extra thing to be done except adding this module everywhere.

4. Result and Analysis

The output of the model is represented by similar circumstances. There are four different sets of traffic lights with an additional blue light. And the circuit connection is done without any wired connection between the transmitter and the receiver, so the information is transformed though radio signals. There are several developed projects in this domain. Some of them are where the signal is first transmitted to the base station and then to the traffic signals in which the vehicle is coming is made green until it passes that signal [2]. So, this creates atraffic jam unnecessarily in other lanes till ambulance passes. And the second one is when the transmitter arrives at the signal junction then it transmits signal to the receiver with the help of encoder and the receiver decodes and suddenly turnsgreen light on in the lane in which the emergency vehicle is arriving [3]. Since there are some problems encountered here this idea can be a solution. And the Arduino boards are associated with RF module for transmission and receiving of signals. Under normal condition the traffic system will be working normally that one lane is provided with the green signal and the other lanes with red as shown in Figure 3. This condition will be executed in an order so all the lanes are provided specific time to pass in an order. Consider an incident where we have an emergency situation of accident of a severe health issue of a person who need to be shifted to the hospital soon [8]. Ambulance with the transmitter picks up the person and heads towards the hospital. Now the vehicle has to cross many traffic signals in between so if the lane in which the vehicle is travelling has the RED light, then the ambulance will be interrupted. Even though people make space for ambulance since other lane is in GREEN color it creates a chaos and may lead to traffic jam in some cases. We have traffic police standing in some of the traffic junctions, he will also try to clear the traffic for ambulance but this is also difficult and may take time. Some junctions will have no traffic police.

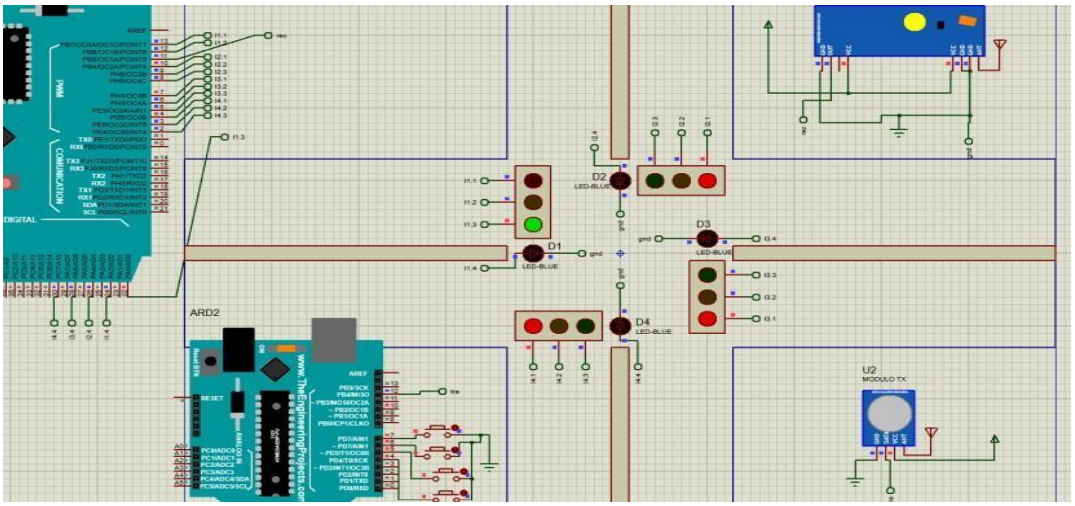

Figure 3 Normal Working Condition of Traffic Signal

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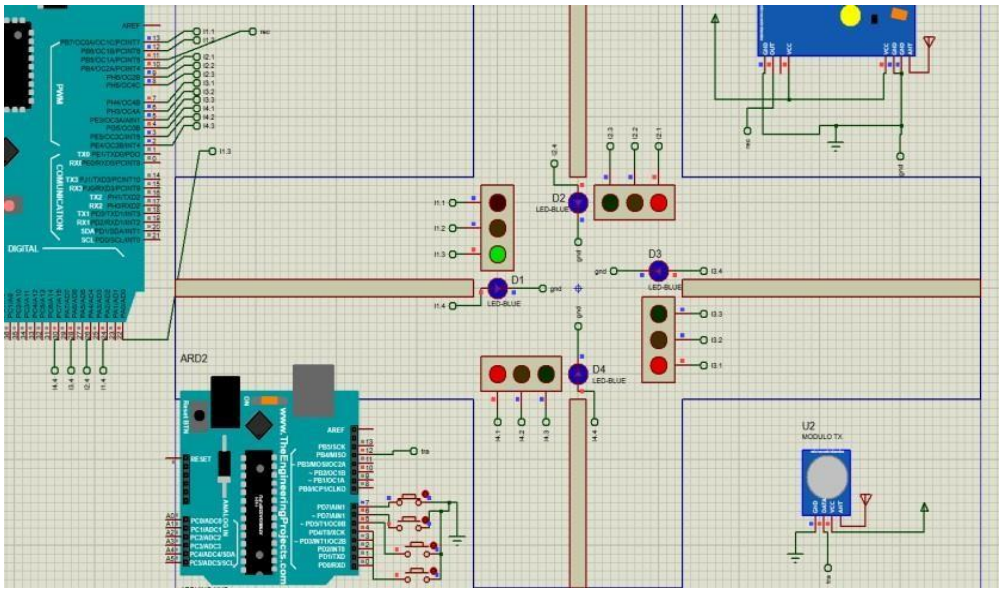

Figure 4 Emergency Condition at Lane 1

In such instances the ambulance with the transmitter will carry the patient and when he reaches the traffic junction, he will press the push button. Consider the case where the ambulance is travelling in the lane 1 then the driver has to press the 1st push button so that this signal is transmitted as analog signal to the receiver in the traffic signals. This analog signals then decoded by Arduino and then this sends signal to the lights in lane one [11]. Now lane one turns GREEN and all other lanes will become RED. This is shown in Figure 4. Now we have another condition that if the traffic signal changes suddenly to red from green this will create doubt in people [9]. For example, let us consider at an instant we have GREEN signal in lane 3 and the ambulance is coming in lane 1 where there is RED signal. Now due to the transmitted signal suddenly lane 3 turns RED and lane 1 turns GREEN. Now people in all the lanes are in confusion of sudden change in the signal. Hence to overcome this there is another light introduced in the traffic signal system it is 'BLUE ' Color which indicates 'emergency'. So, when ambulance sends the signal to the receiver then in lane 1 we have both GREEN and BLUE signal indicating emergency go. And all other lanes have RED and BLUE signals indicating emergency stop. So, the people in other lane will also know that there is an emergency condition and they have to move or stop according to the signal. And when the ambulance passes the junction, the driver switch off the pushbutton. Now the traffic system will work under normal condition.

Conclusion

In this paper, a proposal is presented for an innovative traffic control management system aimed at facilitating the movement of emergency vehicles, benefiting both the general public and those in need. The concept involves the addition of an additional light, specifically designed to indicate emergencies, alongside the traditional red, yellow, and green lights at traffic signals. Under normal circumstances, this new blue light remains inactive. However, when an emergency occurs, such as when an emergency vehicle approaches from Lane 1, the green and blue lights are activated solely for Lane 1, while the red and blue lights are activated for the other three lanes, allowing the emergency vehicle to pass through the signal. Once the vehicle has cleared the intersection, the traffic signal system reverts to its regular operation. To trigger the emergency mode, a manual push button is utilized. Moreover, this adaptable technology can be retrofitted into existing traffic lights across various locations. The implementation of this system plays a crucial and

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challenging role in expediting the clearance of traffic and ensuring the prompt arrival of emergency vehicles at their intended destinations

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