Original Article

Comparative study on Traffic Actuated Signal System for Traffic Management System

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Abstract: *Traffic Engineering is a branch of Transportation Engineering which discuses planning geometric design and traffic operation of roadway, highway, street. One of the major fields of traffic Engineering is studying of traffic flow, traffic volume and speed. As the community of the globe develops gradually so the fleet of automobiles also increases. Traffic on the Road depends on peak hours. The traffic is heavy in morning time as compared to afternoon. In rainy Season traffic jam occurs on road after rain has stopped. Due this Problem, the Traffic monitoring is the system which helps to control congestion and avoid traffic accident. Due to traffic congestion, environmental pollution, fuel waste, and waste of time are some of the problems which are faced by the users. Traffic management is a major problem of traffic department in busy roads within the city. Due to traffic congestion during rush hours in today's world, ambulances, fire brigade, and other emergency vehicles are stuck in traffic and unable to reach their terminus in period, which results in the loss of human life, loss of property. This article discusses numerous strategies used to improve the global transportation system.*

I. INTRODUCTION

Road traffic is a complex problem in now a day because of various entities like truck, Buses, bicycles, pedestrian etc. interact one each other, because of increasing population, the population is rapidaly increases by tremendous, so world facing with the managing of traffic. As the population of the world increasing day to day so the number of vehicles also increasing. For These Reason We Need toimplement traffic Management System [1,2]. Due to the rise of development,modernization, and migration, transport planning on the streets has become one of many issues facing people all over the world. Congestion is the most significant barrier that has been observed in many countries, including India [3]. The enlarged density of car in routes all over the world make it challenging for transportation. also, in the existing busy world no one has the time to ask People which way to pick out the reach a Precise Destination. so here the purpose is to resolve the problem at some stage in transportation and ensuring the convenience of passenger. Currently IndianGovernment is trying to develop smart cities and already announces which is nearly 60 cities are selected for better transportation management. So naturally industry hope some eye on gaining something from it with developing some interested of area to smart city structure and bettertransportation system and their management [4-5-6-7].Traffic Management is one of the biggest challenges we face in major cities the uses of vehicles cause traffic congestion, which lead to wasted time due to waiting at traffic signal and increased transport cost due to more fuel consumption [7-8]. Conventional signalized intersections systems are unable to regulate these instances of overcrowding, and Transportation. Gridlock is not a good sign for our country and has created a negative impact, from the economy to the norm.[6]. Due to traffic congestion during rush hours in today's world, emergency vehicles are stack in jam and unable to reach their destinations in time, which causes people die. [2-8]. The implementation of a manual traffic control system based on set time intervals reduces traffic congestion. Due to an unequal distribution of traffic throughout the day, India's present traffic control system is currently ineffective. Due to this vehicle have to wait for long time even if the no vehicles at all [8-9]. Trafficcongestion increases as vehicle volume exponentially rises but road infrastructure cannot keep up. There are various technologies available to detect traffic congestion and improve the effectiveness of congestion management. But there are a number of issues with this technology [9]. It's challenging to coordinate the timing and priority of emergency vehicles. The suggested strategy's major objective is to effectively manage rush-hour traffic, clear way for emergency vehicles, and shorten the time it takes for people to reach their destinations. In traffic management system, most of time use tri-colour signalize system, in this system priority is not given to EVS like ambulance, firefighters and police vehicle, which might cause the loss of lives and vandalism. [6]. The suggested RFID-based system governs and maintains the flow of traffic system at the

junction as the EV arrives, by permitting the efficient flow available of rush-hour traffic congestion, where there is now less concern on the issue of offering a clear solution. [12].

II. LITERATURE REVIEW

Biru Rajak et al. (2011) proposed RFID was utilized to create green lanes for rescue vehicles. Additionally, they have used the GSM module, which sends emergency vehicles the route from source to destination along with a copy to the congestion flow server, which appropriate turnsevery signal along that path green. A vehicle with a specific Radio frequency identification (EV)begins to resume normal operations as soon as it passes the signal. This approach is effective, and we developed our own system based on it someplace with some added features like density calculations and screen presentation [5]. Suresh Sharma, Alok Pithora, Gaurav Gupta (2013) proposed, it is highlighted how using RFID congestion control might help prevent challenges related typically occur with traditional traffic control systems, particularly those relating to laser interference and data analysis strategies. This Radio frequency identification strategies is designed to manage traffic at multi- vehicle, multiple-lane, and multidirectional road intersections. It offers an effective period organizationstrategy. that can be used in various settings The lack of discussion of the channels of communication between the emergency services and the signalized intersections controller is a drawback of this work. Hegde et al., Sali et al. Indira et al. (2013) proposed a Radio frequency identification and global positioning system based instinctive track go-ahead scheme for emergency vehicles. The core target of this research should be to bring down the duration ambulance crews experience when travelling through traffic. By automatically clearing a lane before an intersection, ambulances can reach hospitals faster. This system's limitation is that it requires complete information regarding the traffic's beginning and ending points. It'spossible that the ambulance won't be able to reach its destination if there are obstacles in its way or if the starting point is unknown. It might not operate if the EVS want to change its route for any purpose or if the starting location is unknown earlier [27].

R. Sundar, (2014) He is proposed a green wave theory to give any EV passage throughconverting entirely of the red lights in its path to green, so giving the targeted vehicle a full green wave. The main drawback of green waves is that if they are disturbed, they can lead to traffic issues that can be made worse by coordination. When this happens, the line of cars in the green wave gets so long that some of the cars can't make it to the intersections in time and have to stop. Wang et al. (2011) he is proposed the (WSN) by using magnetic sensorAll information given to the system for managing traffic is accurate when vehicles are reliably recognized. This, in comparison to conventional traffic signal systems, offers a better solution by decreasing more traffic, disadvantages of this system are, it cannot handle dynamic traffic [10]. The system is proposed in [4] is based on dynamic traffic control system using RFID technology. has utilized an RFID source and a microcontroller to alter the green signal. For emergency vehicles, they have utilized specific RFIDs, which makes the signal green so that the vehicle can pass when it is detected. However, no accommodations have been made for the congestion between the two signalized intersections. Madhukar et.al (2017) by using ultrasonicsensor, Traffic density can be determined using an ultrasonic sensor. but this system has consequence such as being extremely sensitive to temperature changes and having trouble reading reflections from curved, soft, thin, and small objects. It will also detect any object that enters its field of view, including people, animals, and other objects. Naseer et al. [2018] created a stream of traffic light supervisor that, as soon as an EV approaches the signal, grants priority to that vehicle. The shortest route for an EV can be found by the controller. This study correspondinglyintentions to improve traffic signal systems to ensure that controller may automatically turn on the green light for the roadways when it detects the movement of EVs or pedestrians. However, it is not stated whether a traffic signal will turn green if an EV approaches it without experiencing an emergency. Keep in mind that EVs do not receive any preference when they aren't required to assist with incident recovery [9]. Almuraykhi, Khalid M., and Muhammad Akhlaq (2019). The focus is on MQTT brokers and mobile GPS that use and maintain the STMS location database. The route is transmitted to the ambulance through the mobile app from source to destination, and the Arduino controller notifies the ambulance to clear traffic on that side before reaching that point, since it has the current location and traffic light information for the entire route in its database [27].

Prakash et al. (2020). Vehicle density-based System. This system can open and close the gate mechanically. The buzzer sound suggests that the gate is closed. G. Mahesh Kumar, Eelandula Kumaraswamy (2021) four-way roads based on traffic control blocks. EV reach their destination in time [29]. Road traffic is a complex problem in now a day because of various entities like truck, Buses, bicycles, pedestrian etc. interact one each other, because of increasing population, the population is rapidaly increases by tremendous, so world facing with the managing of traffic. As the population of the world increasing day to day so the number of vehicles also increasing. For These Reason We Need to implement traffic Management System [1,2]. Due to the rise of development,modernization, and migration, transport planning on the streets has become one of many issues facing people all over the world. Congestion is the most significant barrier that has been observed in many countries, including India [3]. The enlarged density of car in routes all over the world make it challenging

for transportation. also, in the existing busy world no one has the time to ask People which way to pick out the reach a Precise Destination. so here the purpose is to resolve the problem at some stage in transportation and ensuring the convenience of passenger. Currently IndianGovernment is trying to develop smart cities and already announces which is nearly 60 cities are selected for better transportation management. So naturally industry hope some eye on gaining something from it with developing some interested of area to smart city structure and bettertransportation system and their management [4-5-6-7].Traffic Management is one of the biggest challenges we face in major cities the uses of vehicles cause traffic congestion, which lead to wasted time due to waiting at traffic signal and increased transport cost due to more fuel consumption [7-8]. Conventional signalized intersections systems are unable to regulate these instances of overcrowding, and Transportation. Gridlock is not a good sign for our country and has created a negative impact, from the economy to the norm.[6]. Due to traffic congestion during rush hours in today's world, emergency vehicles are stack in jam and unable to reach their destinations in time, which causes people die. [2-8]. The implementation of a manual traffic control system based on set time intervals reduces traffic congestion. Due to an unequal distribution of traffic throughout the day, India's present traffic control system is currently ineffective. Due to this vehicle have to wait for long time even if the no vehicles at all [8-9]. Trafficcongestion increases as vehicle volume exponentially rises but road infrastructure cannot keep up. There are various technologies available to detect traffic congestion and improve the effectiveness of congestion management. But there are a number of issues with this technology [9]. It's challenging to coordinate the timing and priority of emergency vehicles. The suggested strategy's major objective is to effectively manage rush-hour traffic, clear way for emergency vehicles, and shorten the time it takes for people to reach their destinations. In traffic management system, most of time use tri-colour signalize system, in this system priority is not given to EVS like ambulance, firefighters and police vehicle, which might cause the loss of lives and vandalism. [6]. The suggested RFID-based system governs and maintains the flow of traffic system at the junction as the EV arrives, by permitting the efficient flow available of rush-hour traffic congestion, where there is now less concern on the issue of offering a clear solution. [12].

III. STUDIES DONE WORLD WIDE / RELATED WORK:

A. Zigbee Technology

Zigbee is a wireless technology. In order to handle emergency vehicles, wireless communication using Zigbee modules is essential. It is connected to three parts of the control unit, vehicle and traffic light. Zigbee is also known as trans-receiver. Because it transmits as well as receive the data. ZigBee technology complies with the IEEE 802.15.4 physical ratio specification. The PIC microcontroller's Tx pins are connected to the Rx of the Zigbee module's Rx pins, and vice versa. It operates in unlicensed bands worldwide between the frequencies of 2.400 and 2.484 GHz, 902 and 928 MHz, and 868.0 and 868.6 MHz. 3.3volt power supply the ZigBee module required may be done by lowering the voltage from 5 volts to 3.3 volts [11-12].

a. Hardware Desciption

Pic Microcontroller: Microcontrollers are manufactured using microchip technology. Based on the PIC 1640 originally manufactured by general instruments microelectronics division. PIC controller speed is 3 million rules per second. On-chip devices such as SPI ADC I2C UART Simple Comparator Internal RC Oscillator have built-in programmability. PIC microcontrollers are rapidly replacing PCs when it comes to programming machines.

The 8-bit, 16-bit, and 32-bit microcontrollers Microchip Smart Processor quickly replaced by use of the acronym. At least 40 instructions are present on the microchip, and each one is executed after four clock cycles. Classification of PIC Microcontrollers: Based on the instruction word length, three major types of microcontrollers can be distinguished.

Mainline microcontroller: 12-bit instruction word length, Mid-range microcontroller, 14-bit word count for instructions. Advanced microcontroller. Instruction word length in 16 bits [13].

PIC microcontroller programming is as follows: When the user taps the emergency button on the emergency vehicle, the Microcontroller controls the Zigbee protocol to deliver a signal. In order to transfer data towards the traffic management unit using the Zigbee module and regulate the signal traffic required in emergency scenarios, another Microcontroller is linked to the traffic light because the traffic light is connected to the Radio frequency identification reader then performs some work there. One is used to send and receive data as well as verify the data in the database as part of the control portion. [12-13].

B. Arduino UNO Technology

A microprocessor display called Arduino UNO is made out of an ATmega328P controller chip. Hardware and software for Arduino are both open-source. Arduino employed hardware in the form of an

Arduino development board and software in the form of an Arduino IDE to write code (integrated development environment) [14].

HARDWARE: It serves as the primary controller for the digital system of street lighting as well as the transportable control for EMV. The Arduino UNO has 14 electronic input/output pins. PWM is possible on 6 output pins. It's powered by a 16 MHz quartz crystal oscillator. it. It has a reset button, a USB port, a header, and a power pin. Using a USB cable, the microcontroller board connects to a computer or laptop. The Arduino Software Integrated Development Environment (IDE) is used by the Arduino UNO board for programming and user interface. One of the pioneers was the Arduino UNO and version 1.0 of the software IDE [15].

C. RASPBERRY-PI

The most recent Model B from the current generation is quicker and more potent than its previous because it is powered by the most recent Broadcom 2837 ARMv8 64bit CPU. with integrated Bluetooth and wireless connectivity. Additionally, it features a video or audio jack, which is excellent for assessing how much traffic is on the road at any given time. The Raspberry Pi controls each element both individually and collectively. There are three Raspberry Pi generations. pi-1, pi-2, pi-3 Because the Raspberry Pi 3 is 50% quicker than other Raspberry Pi models, the current operating system is incompatible with Raspberry Pi models 1 and 2, and Raspberry Pi 3 is also the most recent model, we used it in our proposed solution. Broadcom SOC and GPU are present. CPU frequency should be greater than 600 M Hz. RAM must be greater than 250 MB. It includes six USB ports and an SD card with OS. [17-18]

IV. METHODOLOGY ADOPTED WORLD WIDE (FLOW CHART)
Table 1: Technical Overview of Traffic Monitoring [19-20]

S. No	Technology	Advantages	Disadvantage
1	Inductive Loop detector	It is not sensitive to adverse weather conditions like snowfall, mist, or precipitation. give count data high precision than other commonly techniques.	Not specific with emergency vehicle
2	RFID (Radio-frequency identification)	Used to detect EV	RFID only recognizes vehicles equipped at a point on the road. They did not survey weather the vehicle is emergency state or not
3	Microwave radar	not influenced by climate speed evaluation Several Track operations available	Vehicle detection using continuous wave Doppler sensors is not possible.
4	Acoustic	In some models, multi-range operation is possible. Manual detection. Not sensitive to precipitation.	Low temperature can affect the accuracy of vehicle count.
5	Magnetometer	Not sensitive to precipitation. Some model transmit data over a wireless RF connection.	Maintenance and installation must close to lane. Pavement life span is decreased by poor implementation.
6	Magnetic	Insensitive to adverse meteorological conditions like snow, rain, and storm. It can be used when the loop is not executable, e.g., bridge desk	During assembly, a road must be excavated.

7	Infrared based detector	Multiple lane detection available.	The objects could not be distinguished by the change in their temperature. So inaccurate weather sensitive. Very expansive,

Table 2: Overview of WCT (Wireless Communication Technology) [20]

Technology	Standard	frequency	Range	Feature
Bluetooth	It is specified by the IEEE as per IEEE 802.15.1	Frequency of Bluetooth is 2.4 GHz	Grade 1: 300feet Grade 2: 33 feet Grades 3: 3feet	Usable with reduced power model.
Ultra-wide band	It is specified by the IEEE as per IEEE 802.15.3a	Frequency range of UWB in between 3.1–10.6 GHz	UWB has range <30m	Very fast file transfer between server and portable device
Wi-Fi	It is specified by the IEEE as per IEEE 802.11a; 802.11b/g/n	Frequency range is 5.8 GHz 2.4 GHz	<100m	High speed.
GSM	-	850/900/1800/1900 MHz	reliant upon the supplier	Excellent capacity and transmission quality.
GPRS	-	125 KHz, 13.56 MHz, 902 to 928 MHz	reliant upon the supplier	Intensive resource use, a limited availability periods.
RFID	-	125 KHz, 13.56 MHz, 902 to 928 MHz	RFID range equal to 3 meters.	Cheap in cost
ZigBee	It is specified by the IEEE as per IEEE 802.15.4	Frequency of Zigbee is 2.4 GHz	<75m	There are many protocols available for mesh network.
Wi-MAX	It is specified by the IEEE as per IEEE 802.16	Frequency of Wi-MAX is 2–11 GHz	Wi-MAX has range <10 km	many users served with great velocity.
Raspberry pi	It is specified by the IEEE as per IEEE 802.11ac	1.5GHz	<40km	Programming skills, build hardware and software
Arduino	It is specified by the IEEE as AT Mega 328p	16MHz	Above 40 km	Programming skills, build hardware and software

Table 3: Priority Based Overview [20]

Authors Reference	Proposed Approach	Technology used	Point of view	Outcome
Hussian et al. [21] Nabeel et.al. [22] (2013)	established a transportation system	WSN (Wireless sensor network)	Smooth passage of emergency vehicles	Rate of traffic flow smooth. Detection of stolen vehicles. Priority to emergency vehicle clearway.

Chakraborty et al. [23] (2014)	Actual traffic management algorithm which is improved.	RFID	System based on, reach at a junction simultaneously, the green light is indicated depending on how far the emergency vehicles are from the junction. Priority will be given to a vehicle that is nearest to the intersection.	Priority based on, less distance from intersection point. Efficient control over vehicles with primary concerns
Farheena et al. [24] (2014)	Techniques to regulate traffic signals and minimize overcrowding are described.	IR and global positioning system	assessment of an emergency vehicle's category and congestion intensity.	Priority based signaling method trouble free flow of traffic. Economical, fuel saving
Rajeshwari et al. [6] (2015)	Implemented traffic control system.	WSN	Priority based signal system and give priority to EV and save lives, property.	Clear way to emergency vehicle.
Bilal Ghazal (2016)	Smart Traffic Light Control System	PIC microcontroller, IR sensor	Estimation of EV fixed in the overloaded streets by using XBee wireless system, in emergency mode and provides clearance to path	Priority based signal system
Rajeshwari et al. [6] (2014)	implementing an automated traffic management system to reduce gridlock, clear ambulances, and identify stolen vehicles	RFID ZigBee, RFID tag	Both in traffic controller and vehicle ZigBee and buzzer are installed. Whenever an EV come in range, the buzzer gets on, and the light turns green	Any emergency vehicle passage by converting all of the red lights in its path to green, so giving the targeted vehicle a full green wave.
Nellore et.al. (2016)	Based on optical sensing, traffic management gives emergency vehicles preference.	RFID	If more than one emergency vehicles arrived at a time at intersection then controller detect the distance of EV is same from intersection or not. If they are in same distance then chosen randomly or if not then arranged in ascending order of reach as a priority.	Provide a Distance-based emergency vehicle dispatching. Used for more than one emergency vehicles.
Reddy et al. Madhusudhan et al. Anumandla et al. and Tiwari et al. [25]. (2017)	SVANET (Smart Vehicle Ad Hoc Network) communication optimization for traffic-related issues with a security approach	RFID, Arm7 microcontroller	Hybrid communication is used to communicate from the vehicle to the entrance and back in the reverse direction.	System has less cost and more effectiveness comparing to V2V and V2I
Iswarya, Gowram, Bharath et al. and Reddy et al. [26]. (2018)	Traffic-controlling audio devices for emergency vehicles	ZigBee, RFID reader, Arduino	Sound sensor to find frequency of EV and predict its presence. The sound sensors communicate to Arduino using ZigBee module. Then accordingly, Arduino make	No time wastage to arrive at destination for emergency vehicle

|			changes in the traffic light.	
Almuraykhi, Khalid M., and Akhlaq et al. [27] .2019	System of Intelligent Traffic Signals for Emergency Response Vehicles	Arduino controller. STMS	The focus is on MQTT brokers and mobile GPS that use and maintain the STMS location database. The route is transmitted to the ambulance through the mobile app from source to destination, and the Arduino controller notifies the ambulance to clear traffic on that side before reaching that point, since it has the current location and traffic light information for the entire route in its database. .	Priority to give emergency vehicle.
Prakash et al. [28]	Control of traffic congestion using an Arduino platform, including stolen vehicle detection and automated signal clearance for emergency vehicles.	Infrared sensor, Radio frequency transmitter and receiver, sole smart card (RFID tag), Arduino	Vehicle density-based system. This system can open and close the gate mechanically. The gate closed suggestion is signified through buzzer sound.	detect the density of the vehicle. . EV can also permit smoothly.
G. Mahesh Kumar, Eelandula Kumaraswamy 2021	Smart Traffic Junction Using Raspberry Pi	Raspberry Pi	multiple lanes with obstacles for traffic regulation.	EV reach their destination in time.

BLOCK DIAGRAM
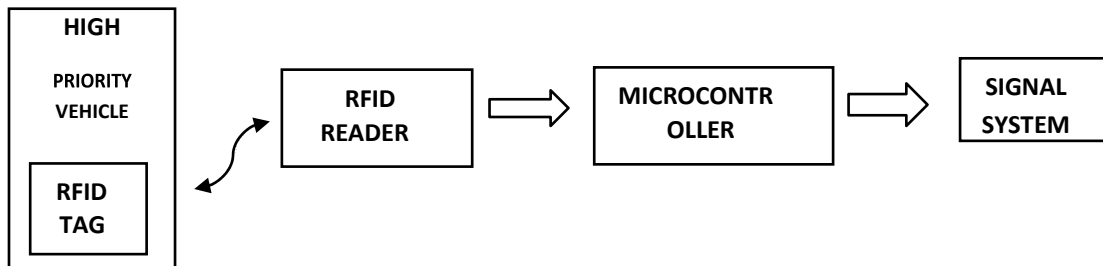
Figure 1: Signal Control System for Emergency Vehicle [9, 29]

All emergency vehicle must be equipped with RFID tags. Each RFID tag having some id. This entire ID was stored in a traffic control database. RFID readers are installed in the traffic signal section, that RFID reader used to received that the ID number. Generally, RFID reader is used to detect the vehicle with embedded RFID tag.

The main system can then check the tag's category and priority in the database and execute the appropriate action when the RFID reader reads the unique ID present on the tag. For that, the red signal is changed to a green signal In Fig no. 2 each emergency vehicle in this scenario, a ZigBee transmitter module is deployed, and a ZigBee receiver will be set up at the traffic intersection.

The buzzer will activate when the vehicles are needed for an emergency. As a result, the signal will be sent from the ZigBee transmitter to the ZigBee receiver. As a result, the traffic light will turn green. Once the ambulance has passed and the receiver has stopped receiving the ZigBee signal, the traffic light changes from green to red.
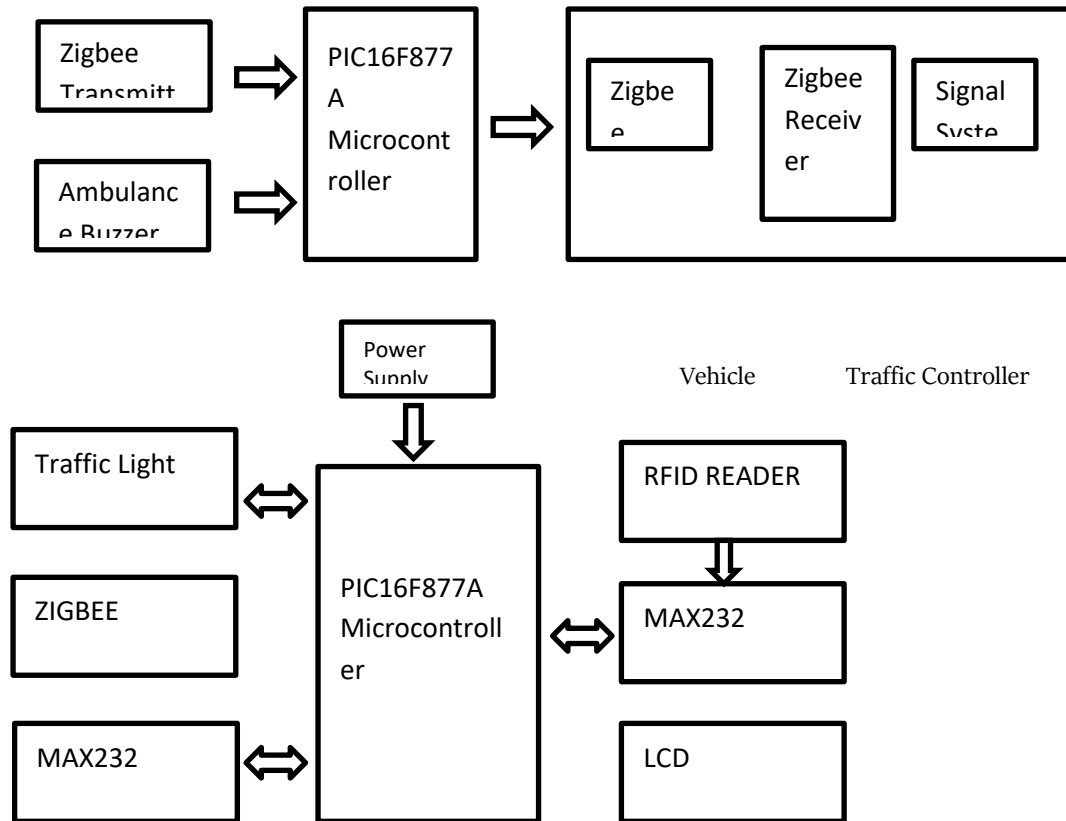
Figure 2: Emergency vehicle clearance system [12],[29]

V. CONCLUSION:

In this paper, various intelligent traffic management system was reviewed. Using an RFID reader and RFID tag, green wave system, wireless communication features, and other technologies were utilized. disadvantage, advantage, priority based, have been mentioned and summarized briefly in table 1 ,2 and 3. This paper represents the RFID methods for clearance of emergency vehicles. The country's internal traffic situation is worse daily. The suggested solution is beneficial for use when technology and digitization get more prominent. This paper introduces emergency vehicle detection in a proposed traffic control system that does not require human intervention. Several people's lives are in danger if emergency vehicles are detained in traffic for an extended period of time. When traffic lights are turned to green for emergency clearance, more people will arrive at their destinations on time and many lives will be saved.

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