Traffic System Analysis with Priority for Emergency Vehicles in Bangladesh

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science in Electronics and Telecommunication Engineering.

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APPROVAL

I hereby declare that the work presented in this thesis titled **"**Traffic System Analysis with Priority for Emergency Vehicles in Bangladesh**"** is done by **SK. Farhanul Islam** under the supervisor of, **Md. Taslim Arefin**, Associate Professor and Head of Electronics and Telecommunication Engineering, Daffodil International University, in partial fulfillment of the requirements for the degree of Master of science in Electronics and Telecommunication Engineering. This Report has been accepted as satisfactory by the honorable members of the board of examiners after its presentation that was held on 12 July 2021.

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DECLARATION

I hereby declare that, this thesis has been done by **SK. Farhanul Islam** under the supervision of, **Md. Taslim Arefin**, Associate Professor and Head of Electronics and Telecommunication Engineering, Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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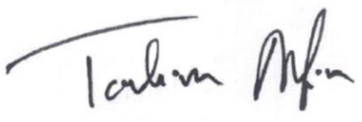

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ABSTRACT

The congestion of the road today becomes an important challenge for densely populated cities like Dhaka, Bangladesh. Emergency response vehicles are one of the main services affected by road delays (e.g. ambulances, fire trucks). This thesis has been developed on traffic system analysis with preference for emergency vehicles by controlling the traffic signals to smooth the traffic flow for emergency vehicles. The RFID (Radio Frequency Identification) technology used to link wirelessly the traffic signals & emergency vehicles together. The main concept behind the suggested system is that whenever an emergency vehicle comes to a standstill owing to significant traffic congestion, RFID placed at the traffic signal (receiver) recognizes the RFID tagged vehicle (transmitter) and communicates the information to the microcontroller. The controller IC in this case controls the traffic light based on the data received from the receiver. The signal is then turned Green for a short period until the vehicle passes past it, at which point it reverts to its normal signaling sequence. This technology delivers commands to the microcontroller to control the traffic lights and shorten response times during emergencies. It also serves as a mission to save lives. There are currently no proven adaptive algorithms, which could give emergency vehicles priority in Bangladesh. This analysis can also draw a valuable lesson for the setting of signals for emergency vehicles and to enable traffic technicians to establish effective emergency signal timing plans. Here I tried to show that how effectively the delays reduced by using this technology with some realistic collected data from different traffic scenarios.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Traffic pollution is an over-growing issue around the world as the population rate is rising; the relative use of vehicles will also rise without any improvement of road networks. Because of this, at any traffic, intersection there would be a risk of high vehicle concentration and it results in increased congestion relative to usual periods during rush hours. In today's real world, traffic signals increase the growth of vehicles. There will be a risk of an extended waiting period due to this situation. For the new traffic-monitoring framework for getting any information about vehicles, no arrangements are available. Because of this, vehicle detection and signal management would become very complicated. Therefore, in emergencies, it causes complexities to reduce the emergency vehicle's wait period, which can place lives at risk.

In Bangladesh, urban infrastructure does not meet this pattern. Network security involves the implementation of tracking devices at main transport network sites to measure and record traffic movement, travel times, accidents and other safety incidents, the ITS facilities management area and the environmental impact of traffic congestion. The traffic management Center (TMC), where data can be processed and images displayed, must be connected to detectors and cameras. Automated collection of traffic signals (real-time sensitive control) and detection of highway collisions could be used by vehicle detectors. Environmental sensors can also be installed in order to monitor the effects of traffic trends on air quality. When emergency vehicles (EV) arrived, nearly all of the respondents had at least one recollection of failing to respond appropriately. The interference with general driving is more serious with the in-vehicle information system (such as on-board unit, smartphone, radio), which can result in a delayed reaction of the driver to the emergency vehicle. To save life and property, emergency vehicles need to move rapidly. Early reaction is very necessary for life and death to be affected in a few seconds in some emergencies. The chance of survival will be decreased by 7-10 percent per 1 minute of delay in first aid patients. For a fire crash, the fire would be doubled by half a minute for any delay. In the case of road collisions, one third of car accident-related casualties will be avoided by ensuring that emergency vehicles are saved sooner, so quick rescue is now an immediate and significant problem. Important development and intensive use of new computing and information technologies must be made in order to be part of the highway and freeway grid and the complete incorporation of the road computer network. [1]

1.2 Research Goal & Objectives

In Bangladesh, the current maximum form of data sharing in traffic signals is manual. In urban traffic light adaptive control, traffic management is only controlled locally at some crossings. In developed countries like the USA, they use LED equipment to display the signals of emergency vehicles to minimize EV rescue delays. Also in Bangladesh, emergency vehicles use the LED lights on the top, but there is some difference. The OBU in the EV can coordinate with the signal controller in other countries as an EV enters the intersection. Then the traffic signal controller switches on the blinking LED of the emergency vehicle, the passersby will respond to the emergency vehicle approach early and then ready for the early arrival. However, since the signal controller does not endorse emergency vehicle signal preemption, EV drivers do have to slow down while traveling into the intersection. To promote the EV going through the intersection, an Emergency Vehicle Signal Preemption (EVSP) device was recommended to overcome this issue by extending the green time or breaking off the red period. It assigns various weights to different types of EVs, such as ambulances, fire trucks, and police cars, so that different types of EVs can be served by the signal controller according to their priorities.

A successful priority for emergency vehicles can only be provided after emerging technology and computer infrastructure have been adapted. In several countries, traffic solutions for mass transit are used and can be modified and applied for vehicles used for emergency responders. Terminated Adaptive control solutions and algorithms (SCATS, SCOOT, Utopia, etc. have launched emergency response priority modules, but are not used because of vehicle identification concerns. The main goal of this research to make a greenway for emergency vehicles by tracing them, and clear the traffic automatically without making any delay. This proposed technology can be applied with many techniques such as Radar Technology, RFID (Radio Frequency Identification), Image Processing Technique, and modules such as GSM, GPS to track emergency vehicles and manage traffic flow by implementing this technique to remove the issue. As those above-mentioned technologies will have high maintenance and installation complexities etc. Therefore, I choose Radio Frequency Technology (RFID) technology for research purposes. It is more user-friendly and less costly than others are methods.

1.3 Report Formation

To make my paper easier to comprehend, I divided it into some parts. The introduction section was addressed in the first chapter. I tried to discuss the literature review and related work in the second chapter of this paper. In the third chapter, I tried to clarify the problem statement of the current method and my solution against it. The Intelligent Traffic Control System (ITCS) and Bangladesh's emergency services, identified by this intelligent traffic control system, are briefly discussed in the fourth chapter. Methodology and model construction are briefly discussed in chapter five. The sixth section is entirely focused on simulation results. The final chapter includes the conclusion part and the possible future scope of my related work.

CHAPTER 2
LITERATURE REVIEW

2.1 Background

Road congestion is often cited as a major and ongoing problem. Following a cursory inspection, it is clear that congestion is a very complicated and imprecisely defined subject field. When locations, conditions, consequences, approaches, and impacts are considered, the problem becomes much more complicated. The issues and remedies differ based on the route type. Highway and inter-urban traffic is usually high volume, high speed, with physical path segregation with few “in route” destinations; junctions are typically linked by on and off ramps and grade separations such as underpasses, flyovers, and bridges. Destinations can be known features like junctions, but they can also be unspecified features like roadside parking or entry at domestic homes, where cars are separated from the flow. A high number of dual-direction roadways and smaller traffic volumes per lane distinguishes urban traffic. There are many junctions, which means there are many touch points. There are less speed limits and a large number of destinations. Urban roads may be classified as terminal, entry, or transit, with each serving a specific purpose. The flow of traffic is being analyzed in order to make the most use of the available capacity. In this case, the word "congestion" most definitely refers to high dense traffic traveling significantly slower than the allowable and expected speed limit. Traffic may also be thought of since particulate, as it is made up of a vast number of discrete elements, some of which may or may not contribute to the total mass flow. A widely known way of mitigating congestion is to expand capacity by widening roads; however, there is evidence that suggests lowering speeds to alleviate congestion, perhaps in an effort to overcome the "phantom traffic jam." In metropolitan transportation, the word "congestion" is most likely to be used when traffic is stagnant for extended periods. The stop-start motion is triggered primarily by interaction at tension points and traffic management controls implemented at intersections. Although considering wave motion has some merit, particle motion could be more suited to investigating traffic flow in an urban setting. The analysis of mass flows is referred to as macroscopic, while the study of individual vehicles is referred to as microscopic. Traffic regulations, like pedestrian controls, differ depending on the form and use of the lane. The widespread adoption and use of multi-user shared public transit methods has long been suggested as a means of reducing congestion and resolving other transportation issues. For centuries, people have had the luxury of sharing anything from shared pack animals to open living areas to shared carriages. Given that this is and has always been an alternative, and that the pollution issue with single occupancy vehicles exists, it appears doubtful that there would be a significant shift of mindset in the near future. With no improvements in conventional thinking and no apparent straightforward solution to traffic congestion issues, there is still an absolute need to strengthen our handling of the problems in the near to medium term future.

2.2 Related Work

The inefficiency of an efficient traffic management system results in tremendous economic damages. It would bring back the loss of human lives, too. Therefore, to fix these problems, lots of good project has to been done. Over the world many work has been done with this related field. Such as, [2]

- The vehicle tracking and density of road vehicles is calculated according to the IEEE paper published on Intelligent Traffic Control System using IR sensors (2009). Vehicle volumes will be determined based on data collected from IR sensors and the running time of traffic lights will be set.
- Dr. r. s. Deshpande, J. G. Rana, release an Embedded Technologies Based Traffic Control System in 2012. In addition to embedded technologies, this paper uses sensor nodes and networks to handle traffic congestion by connectivity between each junction, and monitors congestion based on input obtained from other previous junctions.
- The device would show the status of traffic lights in advance for all emergency vehicles, according to the planned Chakkaphong Suthaputchakun, Zhili Sun and Mehrdad Dianati methods. To encourage the driver of the vehicle to proceed down the junction according to the status obtained. However, there could be a risk of incident of injuries overs peed definition outcomes.
- The IJARSE paper on Complex Traffic Management System using RFID technology was published by Prajakta Waghere, Priyanka Nalawade, Nisha Vanare, Prajakta Kalbhor, Prof. A.J.Jadhav (2017)[5]. It uses IR sensors, a microcontroller based on the state of IR sensors, to monitor traffic flow. This paper deals with the algorithm of decision-making (DMA). Therefore, based on this algorithm, machine flow is planned.

CHAPTER 3

PROBLEM STATEMENT

3.1 Problems of Existing System

Maximum traffic signals in our country are operated manually. Some of them employ a sequential logic traffic system, in which the control lights for the current traffic system are red, yellow, and green indicating stop, get ready, and go, respectively, and each light turns on after the other for a certain amount of time. Therefore, traffic jams are regular, particularly in cities like Dhaka. Our daily traffic structure cannot function efficiently due to the overcrowding of people and cars. It has a significant impact on those in the developed world, as well as a large number of people in developing countries. It has an indirect impact on the entire world, including remote areas. Many times that effect on emergency services and make delay to reach them at the accident point. The current traffic scheme poses a significant risk to emergency services such as fire trucks and ambulances. Let us talk about fire accidents since 1997; the number of fires in Bangladesh has increased more than proportionately, with a daily average of 53 in 2018. Fire Service and Civil Defense estimates show that, according to the web survey, about 250,000 fires have occurred around the world between 1 January 1997 and 31 December 2018. These fires have caused an estimated financial loss of approximately Tk6, 400 crores to the government. According to available fire department statistics, between 2004 and 2018, at least 1,970 people were killed in almost 200,000 fires worldwide. Urban analysts attribute the sharp rise in fires to unplanned urbanization, violation of building regulations, general lack of safety, expanded use of gas cylinders and equipment, as well as the lack of control by the authorities concerned. Prof. Nazrul Islam, urban expert, said that electrical short-circuits; petrol and other burners, cigarettes, gas cylinders and technology devices, and flammable items and chemicals usually trigger fires. The highest number of fires reported last year was 19,642. However, the highest number of deaths, 365 dead and 1,385 injured was recorded in 2011. In terms of financial loss, 2015 was the worst year after 17,488 fires caused the country to lose an estimated Tk850 crores. About 5,802 fires occurred in 1997, according to fire department reports, but they have escalated more than threefold over the years. However, the number of deaths has declined over the last five years, including in 2018. In 2006, 9,542 fires killed 91 people and wounded 873 others. In 2014, 70 people were killed and 210 others wounded in 17,830 fires, and in 2015, 68 died and 216 were injured in 17,488 fires. Considering all of these factors, our traffic infrastructure might be improved. Because if a single emergency service vehicles are stuck at any traffic signal for only one minute it will impact to many lives, in these situations, even a one-second pause will result in serious harm to people's lives. As a result, the current manually operated traffic system can be replaced by an automatic system. [3] [4] [5]

3.2 Proposed Solution of Existing Problems

Time, day, season, weather, and unanticipated events like as accidents or construction operations are all delay characteristics that affect traffic load. The problem of traffic congestion can be alleviated by building new roadways. The only disadvantage is that the environment becomes more cluttered as a result. Rather than building new infrastructure twice, it is necessary to modify the traffic system. The aim of this study is to find a solution by mitigating the impact of traffic congestion without reducing the volume of traffic or the number of journeys made. Though time delays due to traffic have been recorded since the Roman era, the major but indirect effects of traffic have only recently become globally important with the introduction of prime movers that rely on combustion processes to generate motive power. The only solution to this existing problem is to make a greenway or a clear traffic system for emergency service vehicles by using intersection resources and modern technology, like use of Intelligent Traffic Control System (ITCS) to reduce or eliminate the regular traffic flow in the traffic network.

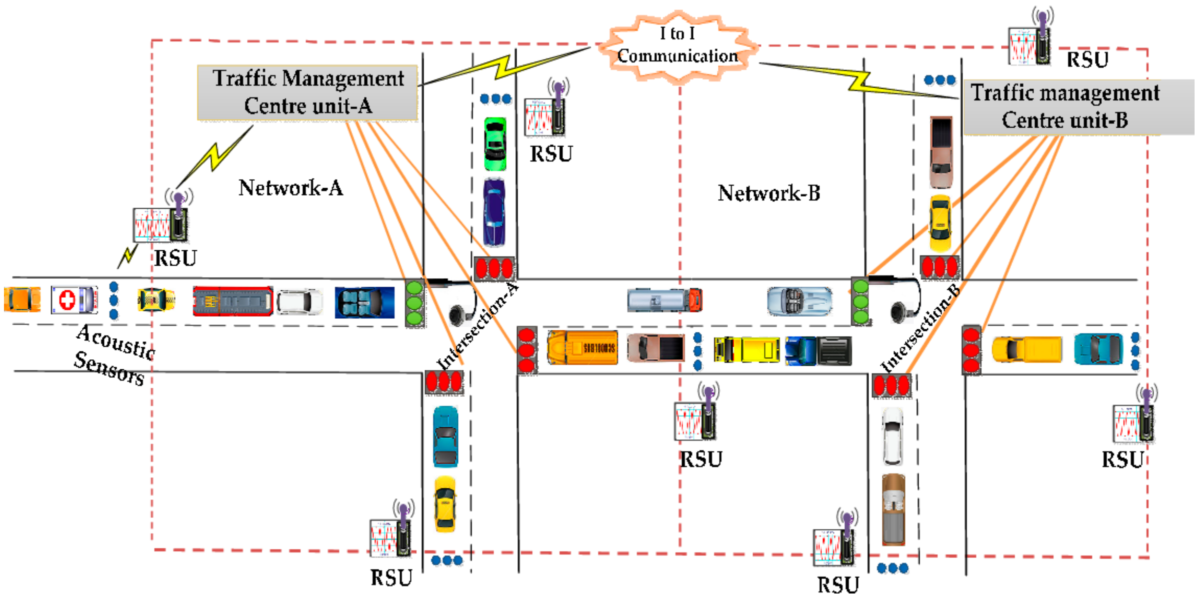


Figure 3.1: Priority System for Emergency Vehicles. [6]

This technology is achieved by communication through RF modules. RF Transmitter attached to emergency vehicle and RF Receiver will be installed nearer to the signaling system. If any emergency vehicles stopped on the way due to heavy traffic congestion, the simple principle behind the system is that RFID mounted at the traffic signal (Receiver) detects the RFID tagged vehicle (Transmitter) and sends the data to the microcontroller. The controller IC used here, according to the obtained data from the receiver, controls the traffic light. Then, for some time, the specific signal is made green before the vehicle passes through the signal and returns to its original signal sequence flow. This system sends instructions for control of traffic lights to the microcontroller and decreases the wait time during emergency times. Here, RFID (Radio Frequency Identification) technology with a range of 10 meters links the traffic lights and emergency vehicles wirelessly. It can improve the traveling capability of emergency vehicles and the service level in the whole traffic network. Depending on the amount of traffic, the traffic signal will fluctuate. The main goals of creating an intelligent traffic control system are to reduce traffic congestion and costs, provide alternatives routes, and increase infrastructure capacity. [7]

CHAPTER 4

INTELLIGENT TRAFFIC CONTROL SYSTEM (ITCS)

Information technology (IT) has already revolutionized many industries by bringing information to bear on the delivery network, including transit networks. For the next few decades, IT will be instrumental in solving surface transport issues, as the 'info structure' is being built alongside the nation's physical transport networks. The goal of Intelligent Traffic Control Systems (ITCS) is to build and deploy solutions for traffic problems. In the 1990s, the term Intelligent Transport Systems (ITS) was adopted in transport and traffic engineering and can be defined as a holistic improvement of conventional transport for control, information and communication. These networks allow for dramatic improvements in capacity, traffic flow, passenger and goods transport efficiency, transport safety and security, and pollution control.

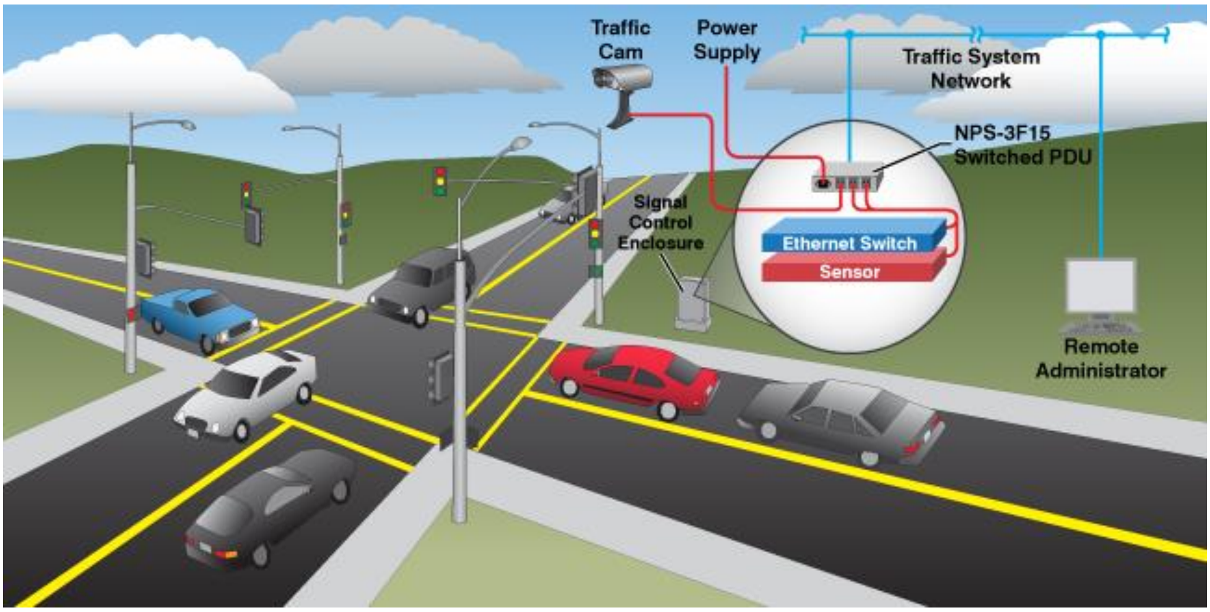


Figure 4.1: Intelligent Traffic Control System (ITCS) [8]

The scenarios explain ITCS applications that deploy communications, power, electronics and computing technology in order to enhance the efficiency of road, transit (rail and bus) and even air and sea transport networks. Intelligent transport networks provide a large and growing suite of technology and applications such as real-time traffic information systems, in-car navigation (telematics) systems, vehicle-to-infrastructure connectivity (VII), vehicle-to-vehicle integration (V2V), adaptive traffic signal management, electronic toll collection, congestion charging, fee-based express (HOT) lanes, low-use vehicles.

There are five spaces of Intelligent Traffic Control System (ITCS); they are Incident management, Demand management, Road maintenance, Traffic guidance & Metrological information.

Various natural calamities like, earthquakes, earth quakes, tornadoes, tsunamis, volcanic eruptions, flooding, mudslides, wildfires, human-caused populations, whether accidental like, hazardous waste spill or nuclear power plant failure or malicious (e.g. terrorist attacks), remain at risk of significant destruction. For example, a hurricane may also be forecast more than 24 hours before its arrival at a given area, while the first quakes or aftershocks of a quake cannot be predicted with any reasonable degree of certainty in advance. The magnitude and course of such a danger occurrence can be forecast with differing degrees of accuracy. None, if there are any such threats, may be fully expected. Society has embraced a number of preparedness approaches to counter these threats. One such mitigation measure is to prepare for the evacuation of the affected area in advance. If evacuation is successful or does not rely, in part, on the time it takes for the city to successfully achieve protection. In addition, the urgency of evacuation depends on the amount of lead time. In anticipation for the arrival of the storm, the initial warning to evacuate can be much longer than the day before the arrival of the hurricane. On the opposite, the evacuation required in response to terrorist attacks or the release into the environment of biological, chemical or other toxic materials may, without prior warning, lead to immediate evacuation. Many reports addressed evacuation from a metropolitan area, but very few considered the synchronization of traffic signals to encourage evacuation. Thus, while work on signal timing for evacuation is the topic of this report, some other similar work has already been reviewed. These works are loosely categorized into several categories: dimensions of human operation and evacuation demand, evacuation routing, evacuation plans and regulations, evacuation, evacuation and Geographic Information Systems (GIS) traffic modeling, evacuation and Intelligent Transportation Systems (ITS) and evacuation signal timing. [9]

4.1 Provided Services by ITCS

The User Service Specifications that must be fulfilled by the ITS Architecture are practical manifestations of what can be achieved by the ITS framework. User Service Specifications can be considered as the highest level of the device technical requirements. User Service Specifications provide a global idea of whether the services can meet aggregate needs, but with each ITS system that is actually enforced at the moment, precisely which User Service requirements are fulfilled varies. As follow, [10]

- ✓ Travel & Traffic Management Specifications: This covers, pre-trip travel details, on-road driver information, route directions, ride matching and reservation, traveler facilities, information traffic control, incident management, travel demand monitoring, pollution checking and mitigation, highway rail intersection.
- ✓ Public Transportation Management Specifications: It includes, public transportation management, on-route transit details, customized public transit and public travel protection.
- ✓ Electronic Payment Services
- ✓ Commercial Vehicle Operations: It has, electronic clearance for commercial vehicles, automatic roadside safety screening and safety control, administrative procedures for commercial vehicles, hazardous material incident response and maintenance of commercial fleets.
- ✓ Emergency Management specifications: Emergency Notification and Personal Security, Emergency Vehicle Management.
- ✓ Advanced Automobile Safety Systems: longitudinal collision avoidance, lateral collision avoidance, intersection collision avoidance, crash avoidance vision enhancement, safety preparation, implementation of pre-crash restraint, and autonomous vehicle service are included.

4.2 Important of ITCS

The Intelligent Traffic System consists of the use of computers, electronic sensors, communications and data processing to monitor the transport system effectively and efficiently in order to improve the mobility, safety and security of transport and to provide timely and consistent information to travelers. Until recently, the design and maintenance of transport networks involved the civil and mechanical construction or expansion of roads, bridges and tunnels, as well as the related undertakings that supply vehicles (including public and private transport systems, trucking, public safety and personal transport agencies) that run on the system. Today, as demand for travel is growing exponentially and the opportunity to construct modern infrastructure is becoming prohibitively costly due to high prices and insufficient resources (including land space), the use of Intelligent Traffic System technologies to strengthen the stability of existing transport infrastructure and increase the operational performance of transport systems is becoming increasingly imperative. This makes it an appealing approach to deploy the infrastructure needed to manage the new transport network. ITS offers improvements in traffic control and enforcement, driver assistance technology, navigation aids, freight forwarding systems, multimodal passenger information, emergency response and environmental protection systems. This not only gives travelers tremendous savings in travel costs and time, but also protects lives by maximizing travel safety.

The technologies of the Intelligent Traffic Grid will help alleviate congestion and optimize network control in particular industries. They are,

- Providing methods and strategies for congestion assessment.
- Providing systems for improved maintenance of the current road network by way of in-vehicle & infrastructure systems.
- Providing the information about real-time traffic and passengers.
- Providing frameworks of road.
- Growing the current road network's ability.
- Providing Road Transport Safety
- Providing Traffic Management & Operations
- Traveler Information
- Disaster Response Management
- Weather & Environmental Monitoring
- Electronic Payment (e.g. Fast Track)

Several researchers have been contemplating the potential impact of the use of new technology. Baxter has examined the potential real-time application of Intelligent Traffic Control Systems (ITCS) technology to improve hurricane evacuation safety and competitiveness in Florida (2001). The potential use of ITCS technology to gather output data after an evacuation and conduct a post-evacuation analysis was also discussed. Similarly, the deployment of ITCS technology to reduce the evacuation time when Florida is affected by big storms was noted by Morrow (2002). Urbina and Wolshon (2003) discuss the benefits of using ITCS technology during hurricane evacuation, based on a survey they carried out. Network management involves implementing the recording and reporting of traffic flow monitoring systems in key transportation network locations, travel times, accidents as well as other safety incidents, the ITCS infrastructure maintenance area, and the environmental impact of traffic congestion. The traffic management Center (TMC), where data can be processed and images displayed, must be connected to detectors & cameras. Automated collection of traffic signals (real-time sensitive control) and detection of highways collisions could be used by vehicle detectors. Environmental sensors can also be installed in order to monitor the effects of traffic trends on air quality. [11]

4.3 Technology's in ITCS

For vehicle detectors, there is a large variety of sensor technology available. This section discusses some of the more traditional and some of the most emerging innovations for tracking traffic.

Radio Frequency Identification (RFID): It uses electromagnetic fields to automatically classify and trace tags applied to objects. The RFID system consists of a compact radio transponder, a radio receiver and a transmitter. When an electromagnetic interrogation pulse is activated from a nearby RFID reader unit, the tag transmits digital data, usually an inventory number, back to the reader. This number will be used to track vehicles.

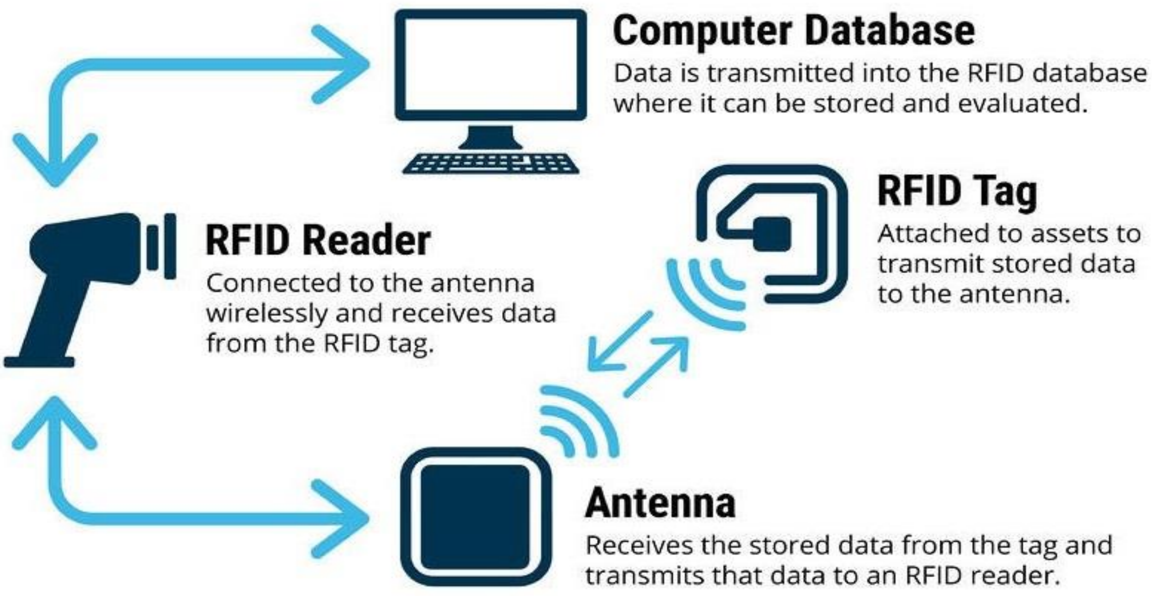


Figure 4.2: Basic RFID System [12]

Inductive Loop: Offers simple traffic parameters (volume, presence, occupancy, speed, headway and gap) for the highest data count precision relative to other widely used strategies. Its design requires the identification of a wide range of vehicle types, which may limit the precision of the detection. This has a well-understood technology. It is oblivious to extreme conditions, such as rain, fog and snow. It has some downside as well, wire loops are subject to traffic and temperature limits, and location usually needs multiple loops to be monitored.

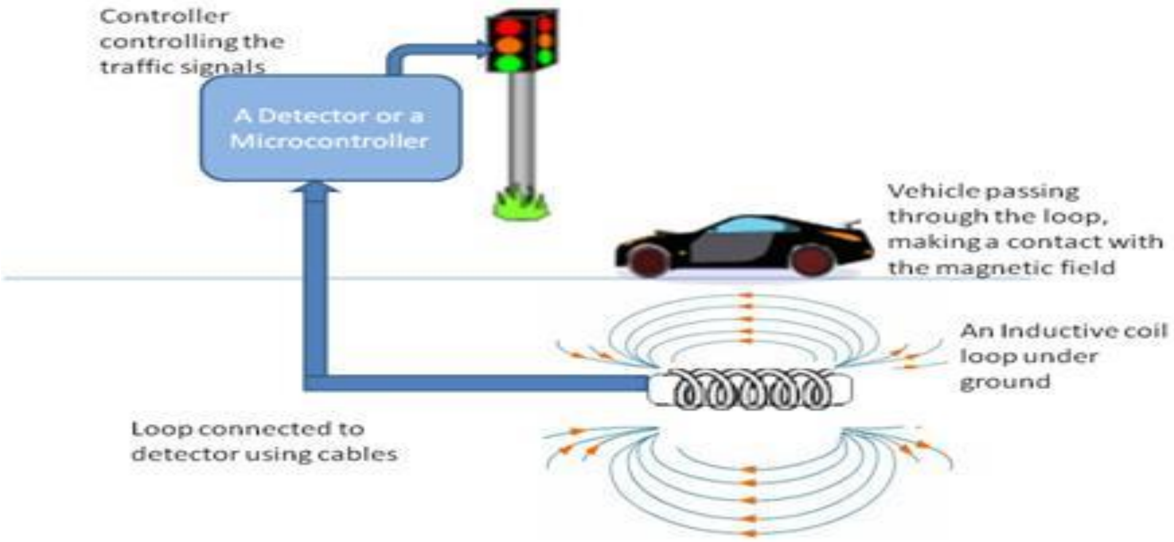


Figure 4.3: Traffic Loop Detector [13]

Video Image Processors: Video based detectors use a microprocessor to decode the input of the video signal. Video tracking sensors use different techniques. The video clip of the target position on the pavement is analyzed by others. It processes the change in the image of the target area as a vehicle passes towards the target area. Another method decides where the target vehicle enters the field of view of the video and tracks the target vehicle from this field of view. The combination of these two methods is still being used by other video sensors. The Video Image Processor (VIP) is a mixture of hardware & software that extracts the desired data from the data of the image sensor. This image sensor may be a normal TV camera or an infrared camera. Speed, occupancy, counting, and presence can be sensed by a VIP. Since the VIP creates a picture of many lanes, a VIP has the ability to have a wealth of traffic information, such as classification of vehicles and identification of accidents. A VIP usually works in the following manner: inside the camera's field of view (FOV), the operator chooses multiple vehicle detection areas. Then image processing algorithms are applied to these zones to extract the desired information, such as vehicle speed or occupancy. The advantages of VIPs are that they are mounted above the road instead of on the road, that the user can position the vehicle detection zones, that the shape of the detection zones can be designed for various reasons, and that the vehicle tracking system can be used. The drawbacks are the need to resolve the detection of objects from the roadway surface caused by shadows, temperature, and reflections. Through designing and assembling the hardware and designing the program algorithms, the drawbacks can be solved (Fig. 05).

Figure 4.4: Thermal Cameras [14]

Microwave Radar: In Europe, microwave detectors have been used widely. They work by calculating the energy within the field of view transmitted from the target vehicles. The detectors calculate speed, occupancy, and presence by the processing of the information obtained in the reflected energy. Any of the benefits of microwave detectors are that because of previous military uses, they are a proven tool, they specifically detect velocity, and if correctly positioned, a single detector will cover several lanes and suitable signal processing techniques are used. Every downside is the excessive marking of the car, which relies on the absorption of side lobe radiation, and the incorrect detection due to a multi-path. Any of these disadvantages can be overcome, in whole or in part, by precise placement of detectors, signal processing algorithms & antenna design.

Infrared Detectors: There are two types of infrared detectors, active and passive (IR). Active infrared sensors operate by transferring energy from either a light emitting diode (LED) or laser diode. The Lead is used for the non-imaging active IR detector and the laser diode is used for the imaging of active IR detectors. The LED or laser diode illuminates the target with all forms of detectors, and the reflected energy is focused on a pixel or pixel detector. Calculated data is then processed using various signal processing algorithms to obtain the desired information. Active IR detectors provide count, presence, speed, and occupancy data in both night and day operations. The laser diode type can also be used for vehicle classification, as it provides vehicle profile and shape data. A Passive Thermal Infrared system senses the energy produced by events in the field of view and can extract the desired information using signal processing algorithms. It does not emit any energy of its own for identifying purposes. Presence, occupancy and counting can be detected by passive infrared systems. Any of the disadvantages of infrared detectors are that they can be used day and night, and can be installed in both side and overhead configurations. The disadvantages are that infrared detectors can be sensitive to adverse weather and ambient light conditions. The ability for detector materials and system construction, as well as advanced signal processing algorithms, should compensate for the disadvantages. [15]

4.4 An Overview of Bangladesh Emergency Services

In order to operate a smart management, it is important to prioritize the designation of emergency response vehicles. ITCS cannot do anything until it was programmed. To run an intelligent traffic system for emergency vehicles, we have to introduce our emergency vehicles to ITCS. Here, I tried to describe about Bangladesh emergency services, which is our main priority of analysis.

Bangladesh Fire Service & Civil Defence

A variety of equipment are used by the fire department. In addition to standard firefighting equipment, these special vehicles are used for a variety of operations carried out by the firefighting Service. Fire department vehicles are basically red in color, they have revolving blue lights, sound signals and the technical characteristics necessary to allow them to function as needed like speed, caring capacity, terrain capabilities & engine power. The carriage and upper structure of the truck contain water tanks, generators and special firefighting equipment. The Bangladesh Fire Service & Civil Defense is an emergency department operating under the Ministry of Home Affairs of the People's Republic of Bangladesh (FSCD). The Department provides fire protection, technical rescue and primary response to chemical, radioactive and hazardous hazards and emergency medical services to Bangladeshi residents. In 1939–40, the British government formed a Fire Service in India. The fire brigade in the city was renamed East Pakistan Fire Service in 1947. Similarly, the Department of Civil Defense in India was initially formed as Air Raid Precautions (ARP) during the Second World War and later as the Department of Civil Defense by legal proceedings in 1951. The

Department of Roads and Highways, dubbed the Rescue Department, was set up for the purpose of job management. The Directorate of the Fire Service and the Department of Civil Defense were merged together on 9 April 1971 and the Department of Fire and Civil Defense was created. Bangladesh has 435 fire stations, 507 vehicles, 185 ambulances and more than 8 fireboats around the country for rescue, safety and fire emergencies. Bangladesh Fire Service & Civil Defense have 500 (approx.) advanced vehicles spread across 435 fire stations. [16]

Figure 4.5: Vehicles of Bangladesh Fire Service & Civil Defence. [16]

EMS-Emergency Medical Service

Bangladesh has 36 public medical colleges, six military medical colleges, and 71 privet medical college with emergency medical services which maximum are situated in the capital city Dhaka. All hospitals are consist a large number of doctors, nurses, technicians, drivers with ambulance. All emergency response vehicles are integrated with a national emergency 999 service. On 12th December, 2017, 999 Emergency Services was initiated by the Bangladesh Police under the Ministry of the Interior to provide all people with emergency services. It is a facility for emergency call centers provided by the Bangladesh Police. From here, emergency police, emergency fire service, and hospital emergency services have been provided. Anyone can dial 999 and receive these ambulance services from any area of the world. The call center is open 24 hours a day, 7 days a week. 999 is a number that is toll-free. To make a call to this phone, the caller does not have to pay any money. Answer units, taking calls, processing and dispatching messages, and radio communication are incorporated into this framework. Monitoring of vehicles via GPS, wireless communication center monitoring of radio & telephone communication is underway. The approach has brought about radical change and integrates emerging technology with human practices. It extends service to all consumers for the equal use of time and human resources, reliability, backup, and data collection. New cars are launched every day. The basic color of the car is a combination of red and white. [17]

Figure 4.6: Medical Service Vehicles in Bangladesh [17]

Department of Police

A law enforcement body operating under the Ministry of Home Affairs is the Bangladesh Police of the People's Republic of Bangladesh. Following the independence of Bangladesh on 16 December 1971 as an independent republic, the police force was recognized and assumed the function of a national police force in January 2004. This department consist of subnational units, specialized units, specialized battalions, intelligences unit and investigation unit. It plays a key role within Bangladesh in preserving stability and upholding law and order. While the police are mostly concerned with the protection of law and order and the defense of people and property, they also play a significant role in the scheme of criminal justice. The Bangladesh police work very closely with Interpol in France and with the work and preparation of many officers at their headquarters there. Public safety issues, injuries and environmental disasters like, fire, pollution, epidemics, terrorism, etc. which are life-threatening, personal reputation, private property, the environment or the values of a free society are all directly related to the police force. The police department carries out all duties such as the security of life, personal dignity, personal property, crime: halting and avoiding unlawful activity, identifying individuals accused of violent activities and misdemeanors, securing entry to courts and administration, finding illicit objects obtained, locating missing persons and products, tracking and securing public meetings, monitoring and securing. A combination of blue, red and white is the basic color of police vehicles. [18]

Figure 4.7: Police Vehicle in Bangladesh [18]

CHAPTER 5
MODEL DESIGNING & ANALYSIS

In a real traffic trial, it is difficult to get traffic solutions based on results. That is unlikely because of the size and scale of actual traffic scenarios. Traffic is still streaming, and we should not perform actual traffic tests in order to use models. The standard intersection model is introduced in this chapter, instruments and method are introduced and model created, analyzed and evaluated. According to the sophistication of the simulation model and the large volume of traffic data, one intersection was chosen for this analysis for data collection and assessment.

5.1 Priority Strategies for Emergency Response Vehicles

Advanced adaptive monitoring of signaled crossings in this scenario includes the installation of necessary equipment's for giving priority to emergency vehicles. In this study, three key approaches are described as:

- Passive Approach.
- Active Approach.
- Unconditional Approach.

Predefined signal plans are used to apply a passive preference policy that decreases vehicle travel times. The positioning of the vehicle or the acknowledgment of its presence at a signaled junction does not require a passive priority approach. Related passive priority techniques include decrease of cycle length and step splitting. Vehicles have unconditional priority given to a signaled junction, no matter which step of the cycle is active. The green light for vehicles is automatically activated at the completion of the active phase (considering minimum safety/green periods for passengers). The unconditional approach is widely used for the priority allocation of emergency vehicles and VIP vehicles. Only when public transit cars are present at the signposted intersection or when priority demand is sent to the control center, successful priority strategies are triggered. The priority strategy is triggered by the specifications of the minimum safety conditions following the submission of the order. Green phase extension, early green phase, green phase insertion, phase replacement or replacement & selective approaches are effective alternatives.

Extension of the Green Phase: As the driver approaches the signposted junction and the green light is on, it can proceed for as long as the public transit car continues to travel across the intersection. The full extension restriction shall be used to reduce the impact on cross-street vehicles. Various programs and sources define the average green extension times ranging from 10 s to 20 s in the scenarios deployed.

Early Green Phase: If the car reaches a signaled junction and the red light is on, it can be shortened to make an early green operation. Full red truncation values are lower than green truncation values since the red truncation is centered on the inter-green matrix (minimum time required for vehicle emergency services entering the signaled intersection (with three or more signal phases), green light may be inserted and is not included in the signal predicted during the approaching public transit era. If there is no traffic load on the lane involved, a certain signal cycle stage can be removed. In this case, the green light of the approaching public transport vehicle will be permitted and delays in public transport vehicles through be reduced. The computer tests the expected crowds to cross the road following detection of the car. [19]

5.2 Methodology

Models are basic representations of fragments of real life. Their goal is to offer insight into complex real-life processes so that we can draw conclusions about what would happen (most likely) if there were to be improvements in the real world or regions of the world. In order to assess the effectiveness of the methods used and to measure the results of the methods used in the traffic system, traffic models are used to classify potential activities that could have an impact on the traffic system. They offer insight into complex dynamics and the opportunity to recognize variables that play a key role in the system. They also give the opportunity to assess the response of dependent variables to changes in independent variables. In "what-if" scenarios, traffic models may be used to demonstrate the effect of such changes on system and system conditions or to create actual traffic artefacts in order to maximize performance.

Real traffic data and a modeling model will provide a strategic example of priority allocation for emergency vehicles. The algorithms for emergency response vehicles can be configured on the basis of a calibrated simulation model and the results can be matched to the regular model situation. A simulation model, consisting of two routes in Dhaka City, has been created (Nilkhet Area). For example, the model intersection between the Azimpur route to Netmarket and the University of Dhaka to BGB is chosen because it has important educational institutions and medical colleges and hospitals. Proper development of a priority algorithms is necessary to define the effect on signal logic in such a way that it is possible to preserve the same or equal level of operation.

Methodology: This technology is achieved by communication through RF modules. RF Transmitter attached to emergency vehicle and RF Receiver will be installed nearer to the signaling system. If any emergency vehicles stopped on the way due to heavy traffic congestion, the simple principle behind the system is that RFID mounted at the traffic signal (Receiver) detects the RFID tagged vehicle (Transmitter) and sends the data to the microcontroller. The controller IC used here, according to the obtained data from the receiver, controls the traffic light. Then, for some time, the specific signal is made green before the vehicle passes through the signal and returns to its original signal sequence flow. This system sends instructions for control of traffic lights to the microcontroller and decreases the wait time during emergency times. Here, RFID (Radio Frequency Identification) technology with a range of 10 meters links the traffic lights and emergency vehicles wirelessly and we can extend the range by using other wireless technologies such as Zigbee.

The main motive of the proposed model is to allow a consistent movement of vehicles to avoid traffic disruption by emergency vehicles during emergencies. As the new paradigm for priority, vehicle clearing is inefficient in addressing congestion management. Therefore, using radio frequency wireless networking technologies, this is a basic design for the "Intelligent Traffic Control System". The basic architecture can be achieved by installing an Arduino Uno (ATmega 328p) microcontroller, RF transmitter and RF receiver, which are specifically designed to run in two modes: normal mode and emergency mode.

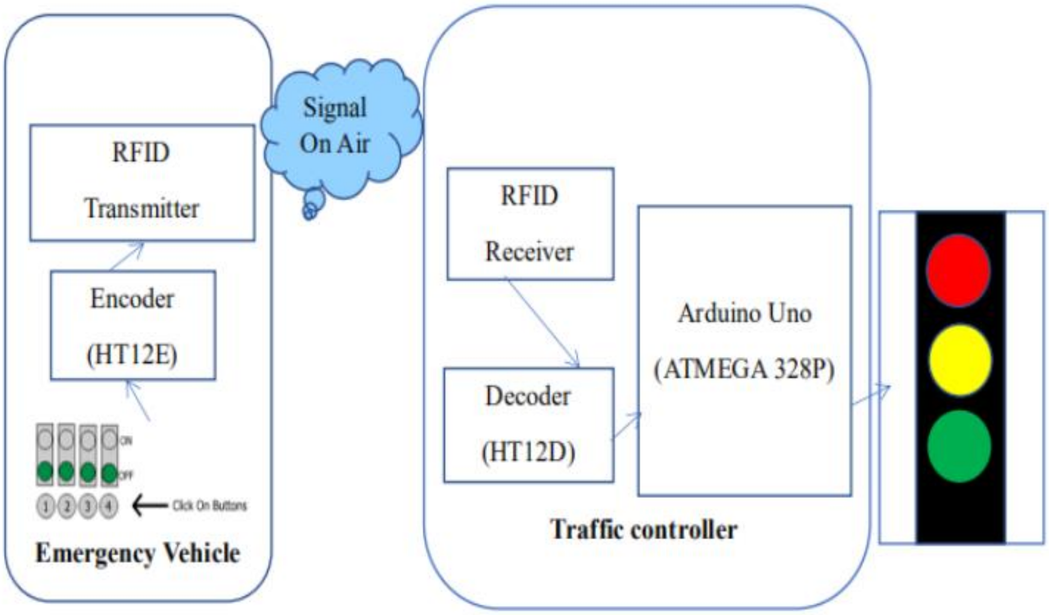


Figure 5.1: Block Diagram of Basic Architecture

Normal Mode: All system operation is based on the on-chip microcontroller operation in normal mode, which is programmed to control traffic signals with fixed predefined time intervals. So, at various periods in time, signals are altered in different ways depending on predefined time intervals. Similarly, each central traffic control system is precisely designed with various functions and methods based on the traffic congestion.

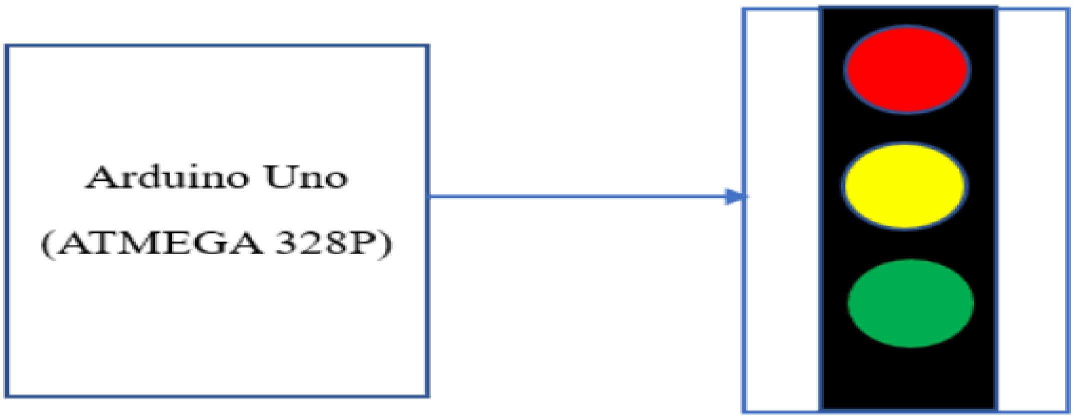


Figure 5.2: Normal mode.

Emergency Mode: In this system, by adjusting the switch status to high on the transmitter side, emergency mode is triggered. When a special switch is triggered, a signal is sent to the RF receiver located at the central traffic control device nearer to each traffic junction via the

RF transmitter along with encoded data. The microcontroller can manage signal states for the seamless flow of the emergency vehicle after data reception. Thus, traffic lights will be operated by the collected data in emergency mode.

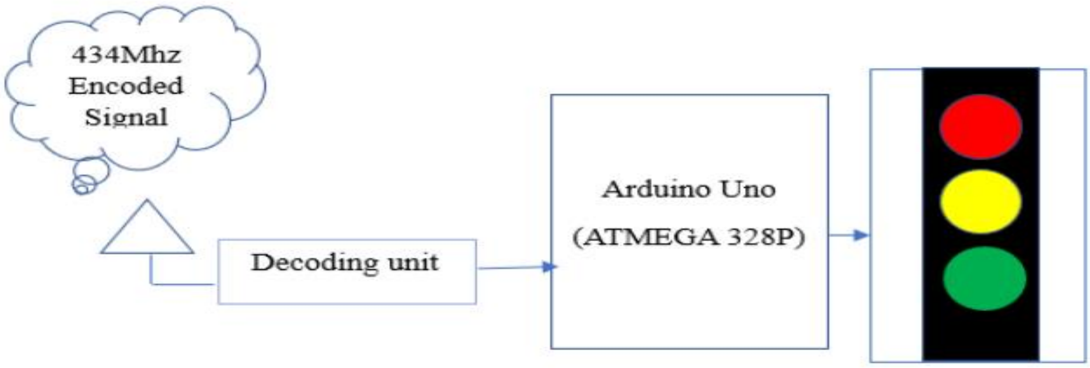


Figure 5.3: Emergency Mode

The radio frequency signal is emitted by triggering switches in emergency mode. A specific signal voltage that is produced will be encoded when the switches are activated (parallel data will be converted into serial data), along with some address bits that provide transmission data protection. Finally, the data pin of the RF transmitter is supplied with this encoded data to create serial contact between the transmitter and the receiver. After the link is formed, a 434 MHz frequency signal can send the encoded data to the receiver attached to the microcontroller via a decoder that decodes the received data signal by regularly testing the signal protection pieces. If the obtained protection bits are matched, then the valid decoder transmitting pin will be triggered and the microcontroller will be supplied with decoded data. And, according to the decoded signal, the microcontroller can monitor the device. Thus, it sends a Green signal to that specific direction when an emergency mode is triggered and sets Red signals to all other roads or directions entering the intersection.

5.3 Circuit Diagram

To create a model circuit diagram, I used a virtual platform named: arduino.cc. Required components to create this design, I need an Arduino Uno, EM-18 RFID Reader, RFID Tag, LED’s: Red, Green, Yellow & Wire to connect them together.

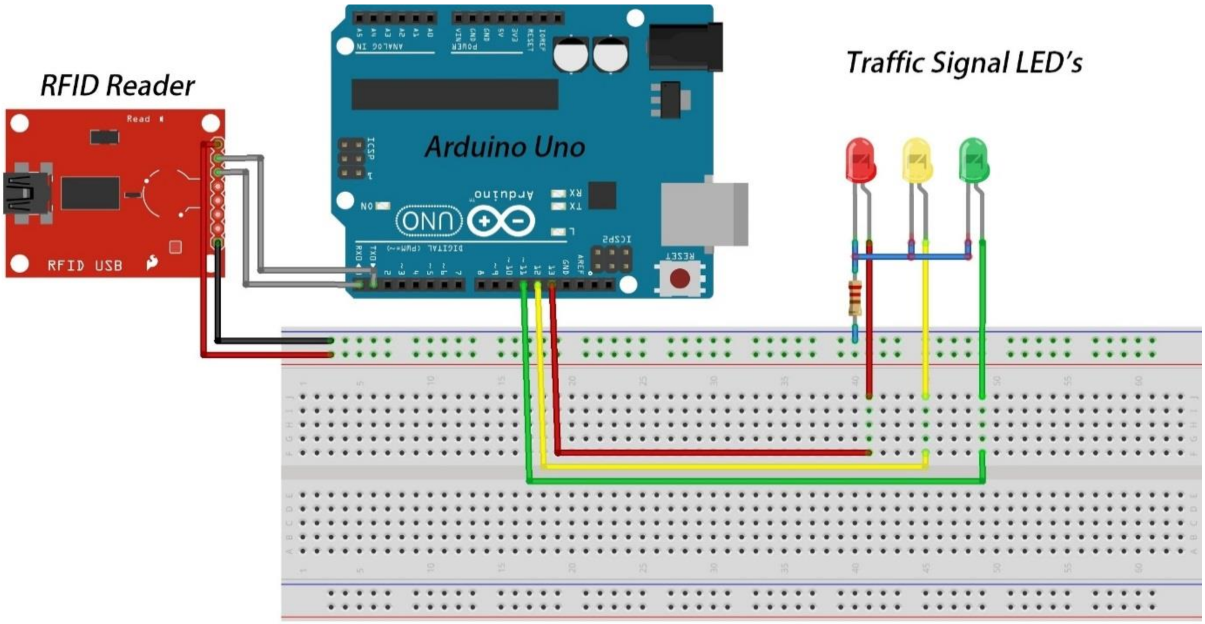


Figure 5.4: Circuit Diagram.

Step 01: Connect and power up circuit. Check the LED's, after power on first it will red, then yellow and at last, it will be green programed. Each lights changes after 10 sec.

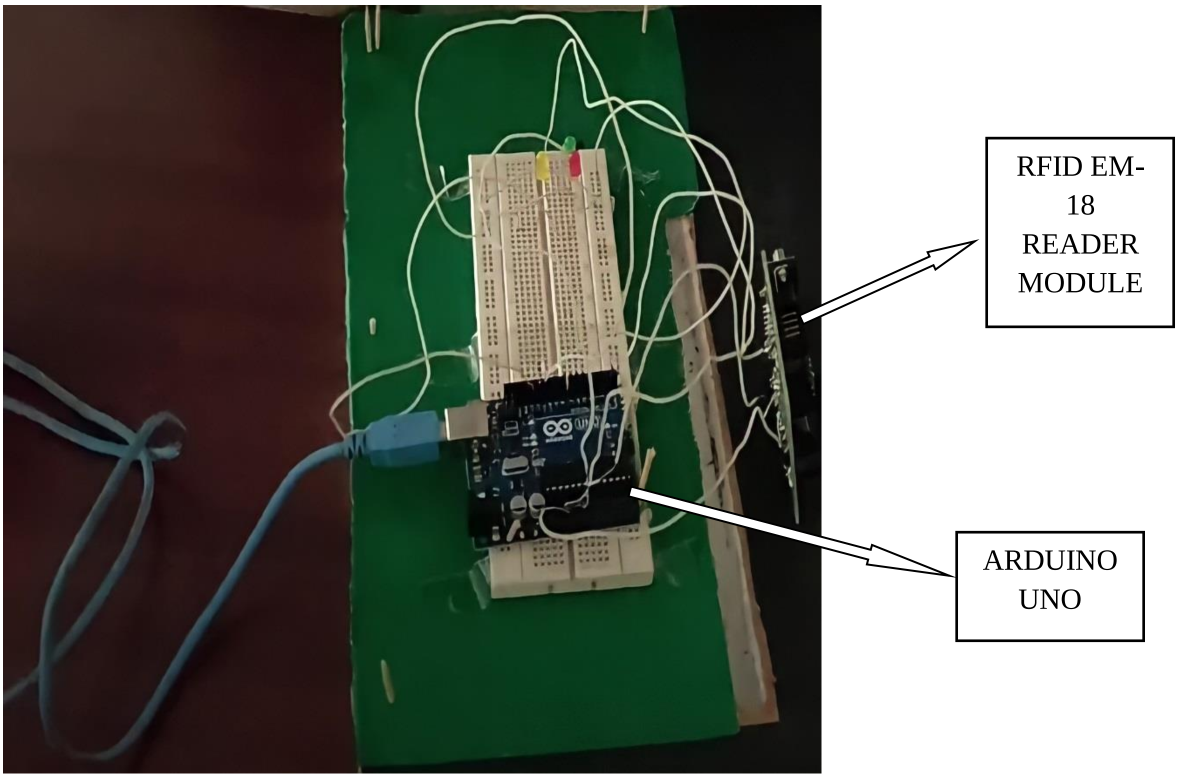


Figure 5.5: Circuit Made With Arduino Uno And RFID Module.

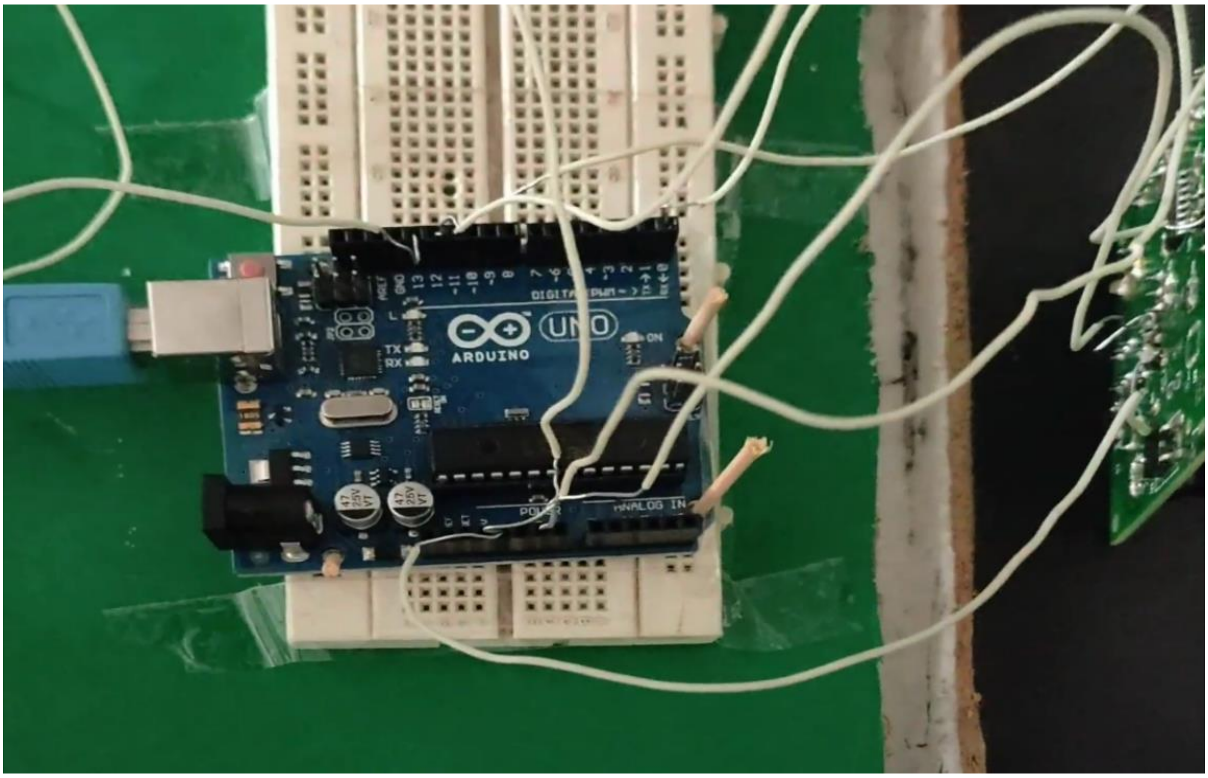


Figure 5.6: Arduino Uno

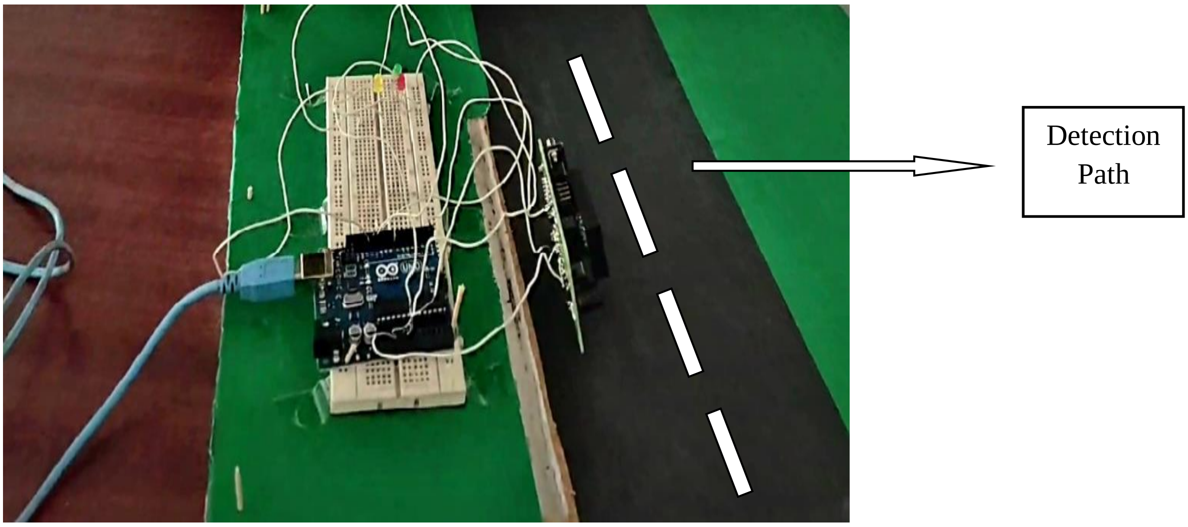


Figure 5.7: Detection Path for Emergency Vehicles.

Step 02: Now suppose that the traffic signal is running on red, and then a RFID tagged emergency vehicle is approaching through that detection path.

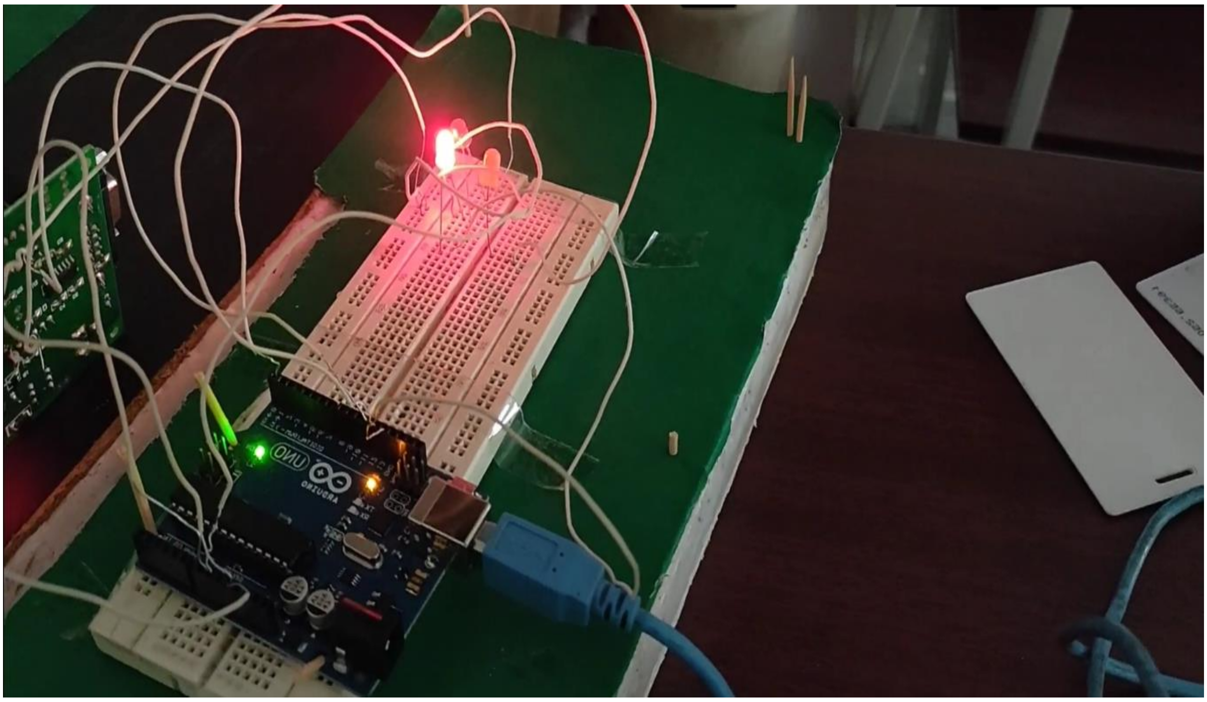


Figure 5.8: Traffic Light is Red.

Step 03: When RFIID tagged vehicle enter in to the range (10 meters) of RFID reader module, it turn off the red signal and turn on the green signal for that path, and make red signal for others path.

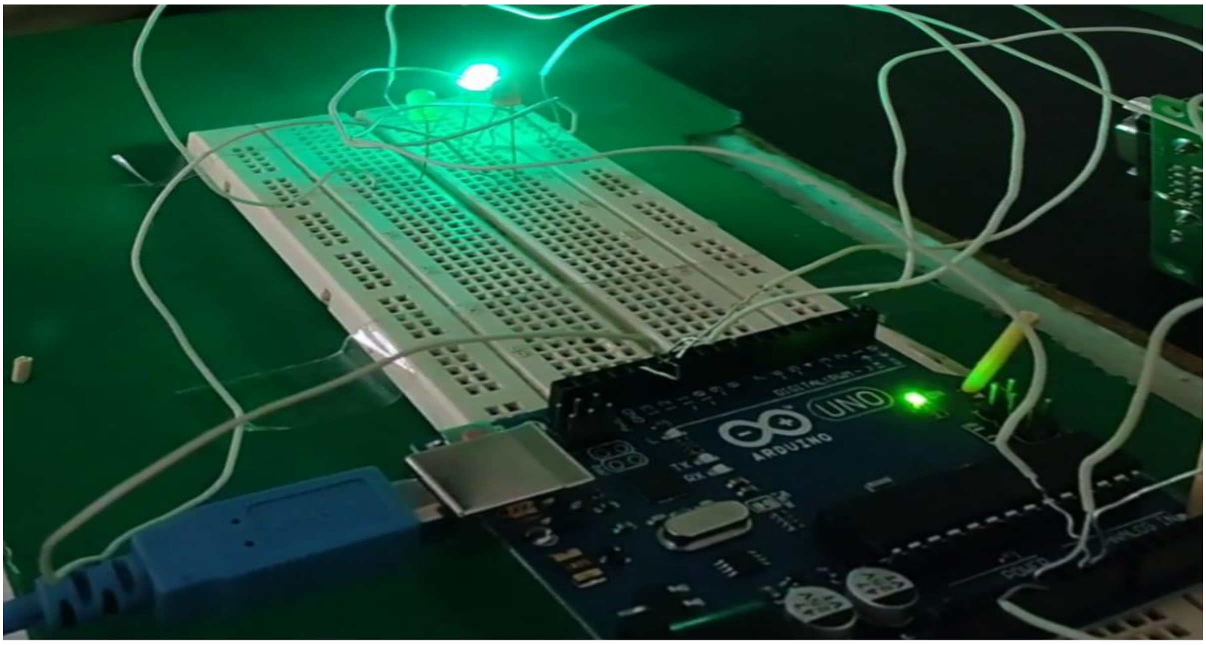


Figure 5.9: Traffic Light is Green.

5.4 Working Principal

- ✓ After successfully connect all parts through wire, I upload the sketch.
- ✓ As programmed, form beginning it operate like a normal traffic signaling system. Like red LED (as “stop”) will be light up for 10 sec and it will off, then the yellow LED (as “be ready”) will turn on and automatically turn off after 10 sec & then green LED (as “go”) will turn on in normal mood.
- ✓ Normal Mood: Now during this normal mood running, suppose an emergency vehicle (like Ambulance) tagged with RFID tag, enter in to that traffic junction and that time if the traffic light in green, it will pass easily through the junction.
- ✓ Emergency Mood: If the traffic light is red and then an emergency vehicle (like Ambulance) with RFID tag enter (range 10 meters) that junction which are modified with this system, then the RFID reader will detect that tag and immediately it turn off the red signal and turn on the green signal (as it programmed) for easy passing.
- ✓ After passing emergency mood period, it automatically goes into normal mood.
- ✓ For loop programming, it will be a continuous process.

5.5 Architecture

System architecture explains the solution of a problem with total preparation. Designers will focus on developing a solution that incorporates both hardware and software implementation tools after proposing a framework with requirements. The system architecture would specify the system implementation following algorithm.

Flow diagram sequences:

1. Power the circuit up.
2. Initialization and assignment of constant values of function interruptions.
3. Checking for signal interruptions (10 sec).
4. If an interrupt is detected, then the interrupt variable values are checked.
5. Based on interrupts received, the respective line would be triggered after assessment.
6. If an interrupt is not detected, after searching for interrupt signals at various time intervals, each line will be triggered.
7. Repeat from step.3 to step.6 with the above procedure.

5.6 Simulation Tool: PTV Vissim

I used PTV Vissin9.005 (student version) as my simulation tool. PTV Vissim aims to accurately model traffic patterns, whether by comparing junction geometries, testing priority schemes for public transport or considering the effects of any signaling. As the world's leading simulation program for microscopic travel, motorized private transport, freight, rail and road transport, pedestrians and bicycles, PTV Vissim displays all road users and their background in a single model. Practical modeling for all road users provides scientifically accurate motion models. PTV Vissim is a microscopic simulation method for modeling the urban flow, traffic and pedestrian networks. In a virtual traffic system, the accurate and timely model depends more on the accuracy of the behavior of the driver. Vissim uses a psychophysical driver behavior model developed by Rainer Widemann at the University of Karlsruhe in 1974, unlike other simulation approaches that use constant vehicle speed and deterministic logic. In many respects, the software has a lot of versatility; the concept of links and connectors allows users to model geometries at any level of complexity. Driver and vehicle feature characteristics allow for human parameterization. In addition, a wide variety of interfaces ensure seamless access to other signal controllers, traffic management systems or emissions models. In addition to detailed analysis solutions, PTV Vissim offers a powerful tool for evaluating and constructing urban & extra-urban transport networks. Simulation techniques can be used to create detailed computational results or stunning 3D models for various scenarios. That is the safest way to ensure that the new infrastructure projects are compelling and comprehensible to decision-makers and the public. [20]

5.7 Input’s Data

Here I used two different area’s (urban & rural) data for simulation. I consider Nilkhet (Dhaka) traffic junction as urban data collection area and Pabna Rooppur Power Plant (Rajshahi) traffic junction as rural data collection area.

Here, some real data are included and some vehicle counting has been done by monitoring the traffic of video cameras. Basic data was developed in the excel sheet. On each section, the data sheets with vehicle numbers indicate the peak hours and the traffic flow needed for Vissim input.

Urban Site Data (Nilkhet, Dhaka)

It is a very important junction for capital city (Dhaka). Many vital hospitals, educational institutions and markets are surroundings in this area. I divided it into north, south, east, west signal zone for better understandings.

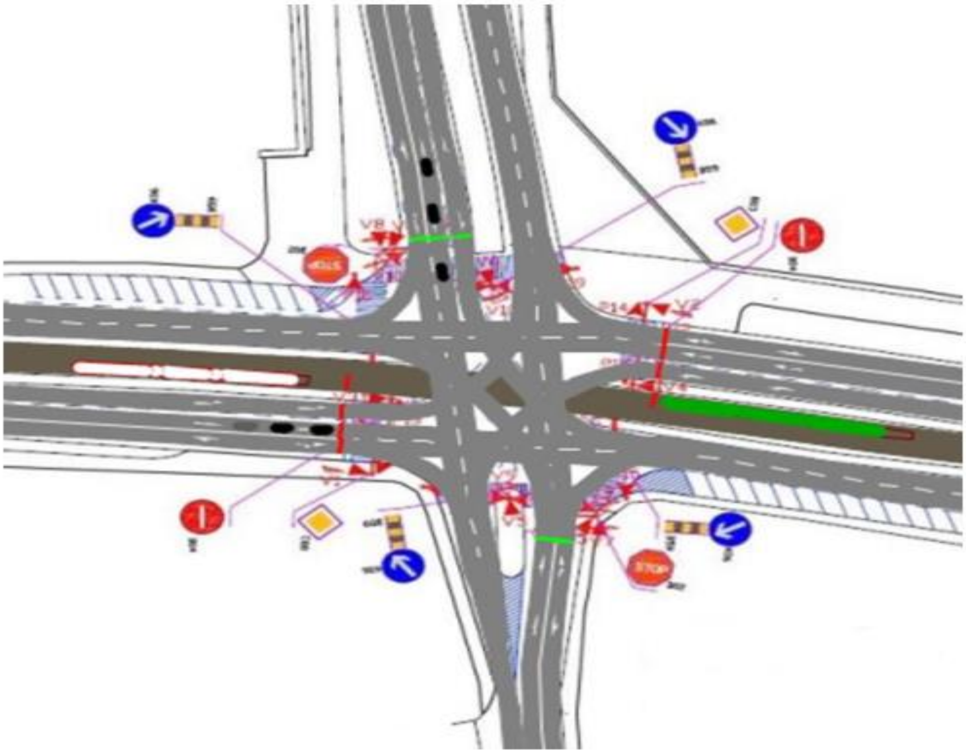


Figure 5.10: Nilkhet, Dhaka Junction.

Zone	South Signal									North Signal								
Start/Mint	Left			Straight			Right			Left			Straight			Right		
Start 7:30	P. C.	H. V.	E. V.	P. C.	H. V.	E. V.	P. C.	H. V.	E. V.	P. C.	H. V.	E. V.	P. C.	H. V.	E. V.	P. C.	H. V.	E. V.
7:45	5	0	0	18	1	1	38	0	0	13	3	0	10	0	0	36	0	0
8:00	3	0	0	14	0	0	37	0	0	19	0	0	10	0	2	40	0	0
8:15	3	0	0	15	2	0	40	0	0	14	0	0	39	0	0	23	0	0
8:30	0	0	0	13	0	0	30	0	0	15	1	0	13	3	0	39	0	0

8:45	1	0	0	13	0	0	33	0	0	3	0	0	49	1	0	25	1	0
9.00	0	0	0	11	1	0	31	0	0	11	0	1	10	2	0	29	0	0
9:15	0	0	0	11 3	4	0	33	0	0	18	1	0	40	3	0	29	0	0
9:30	1	0	0	33	1	0	37	1	0	15	0	0	30	1	0	12	0	0

P.C. = Personal Vehicles; H.V. = Heavy Vehicles; E.V. = Emergency Vehicles.

Table 5.1: South & North Signal Data

	East Signal																		
P.C.	H. V.	E.V .	P.C .	H. V.	E.V .	VIP	P.C.	H. V.	E. V.	P.C.	H. V.	E.V .	P.C.	H. V.	E.V .	P.C .	P.C .	H. V.	E. V.
22	1	0	14	1	0	6	46	0	0	85	2	0	17	0	0	5	29	1	0
23	1	0	12	0	0	4	45	3	0	64	0	0	38	0	0	6	47	0	0
14	0	0	11		0	5	34	1	0	45	0	0	10	1	0	6	37	1	0
19	0	0	10 0	1	0	6	24	0	0	26	1	0	28	0	0	6	26	0	0
13	0	0	12	0	0	4	25	0	0	30	0	0	48	0	0	4	33	0	0
18	0	0	28	0	0	6	12	0	0	40	0	0	39	0	0	5	30	0	0
20	1	0	19	1	0	6	11	0	0	31	0	0	26	1	0	5	39	0	0
18	1	1	22	1	1	3	14	0	0	25	0	0	38	2	0	1	16	0	0

P.C. = Personal Vehicles; H.V. = Heavy Vehicles; E.V. = Emergency Vehicles.

Table 5.2: East Signal Data.

West Signal	Right			Straight			Left			Right			Straight			Left		
Start 16:30	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.
16:45	2	0	0	10	1	2	56	0	0	17	1	0	19	0	0	25	0	0
17:00	4	0	0	119	1	0	54	0	0	26	0	0	16	0	0	23	0	0
17:15	2	0	0	18	0	0	41	0	0	28	0	0	28	1	0	26	0	0
17:30	2	0	0	85	1	0	58	0	0	43	0	0	74	0	0	28	0	0
17:45	2	0	0	78	0	0	42	0	0	27	0	0	91	0	0	15	0	0
18:00	1	0	0	84	0	0	28	0	0	29	0	1	99	1	0	17	0	0
18:15	2	0	0	86	0	0	29	0	0	26	0	0	85	0	0	28	0	0
18:30	1	0	0	67	0	0	25	0	0	21	0	0	75	0	0	19	0	0

P.C. = Personal Vehicles; H.V. = Heavy Vehicles; E.V. = Emergency Vehicles.

Right			Straight				Left			Right			Straight				Left		
P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	VIP	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	P.C.	H.V.	E.V.	VIP	P.C.	H.V.	E.V.
14	0	0	69	1	0	5	26	0	0	30	2	0	91	1	0	4	85	1	0
10	1	1	45	0	1	5	23	0	0	28	0	0	79	0	1	4	86	1	1
8	0	0	57	0	0	4	30	3	0	23	0	0	70	0	1	4	90	0	0
11	0	0	50	1	0	6	24	1	0	25	0	1	72	0	0	5	61	0	0
13	0	0	56	0	0	3	32	2	0	23	0	0	63	1	0	4	77	0	0
9	0	0	81	0	0	4	24	0	0	32	0	0	57	0	0	4	83	0	0
10	1	1	50	0	0	4	20	0	0	11	0	0	44	1	0	4	77	0	0
12	0	0	56	0	0	3	16	0	0	11	0	0	19	0	0	3	77	0	0

P.C. = Personal Vehicles; H.V. = Heavy Vehicles; E.V. = Emergency Vehicles.

Table 5.3: West Signal Data.

Rural Site Data (Rooppur Power Plant Pabna, Rajshahi)

Bangladesh's Rooppur Nuclear Power Plant will generate 2.4 gigawatts of electricity. The nuclear power plant is being built in Rooppur (Ruppur), which is next to Paksey, in the Ishwardi Upazila of Pabna District, on the bank of the Padma River, 87 miles (140 kilometers) west of Dhaka in Bangladesh's northwest. It will be the country's first nuclear power plant, with the first of two units set to start up in 2023. The Russian Rosatom State Atomic Energy Corporation is building the VVER-1200/523 nuclear reactor and essential infrastructure. Bangladeshi and Indian construction corporations, such as the MAX Group of Bangladesh and the Hindustan Construction Company of India, are building "non-critical" infrastructure. Route no.R603 and N704 are main junction which intercepting each other's. Several connecting roadways are also linked with them, i.e., Koroi Tola Road, EPZ Road, Shaheb Para Road, Ruppur-Union Road, Mondol Para Road, Jigatola Road, Sthir-Shako Road. 15 intersections are included in the study network, 12 of which are signalized and three of which are un-signalized. Of the 12 signalized intersections, nine are controlled and pre-timed for the remainder. On the connecting roadways, traffic signals are not modelled on the network.

Figure 5.11: Rooppur Power Plant Main Junction.

Time / Day	Junctions Between Route no.R603 and N704	Number of Vehicles		
		Personal Vehicles	Heavy Vehicles	Emergency Vehicles
Midnight	Side road from N704	10	50	01
Midnight	Intersection between R603 & Sthir-Shako Rd	27	33	00
Midnight	Side road from R603	24	09	00
Midnight	Side road from N704		19	00
Midnight	Roundabouts between highway N704 & R603	36	56	08
Midnight	Division of highway no. R603 from Ruppur-Pabna Rd	44	43	11
Midnight	Side road from R603		23	00
Midnight	Mini-roundabouts of R603	07	07	00
Midnight	Mini-roundabouts of N704	02	05	00
Midnight	Side road from N704	06	11	00
Midnight	Side road from N704	12	19	00
Midnight	Mini-roundabouts between Salimpur-Union Parishad Rd & Joy-Nagar Rd	22	19	05

Off-peak	Side road from N704 to N705	06	55	00
Off-peak	Side road from N705	10	05	00
AM-peak	Connecting Rd between N704 to N705	50	22	00

Table 5.4: Vehicles data Between Route no.R603 and N704

PTV Vissim is a user-friendly application. In the beginning of the process is to load the file's history type. This model was made in this case and loaded from a file. It is laid on after applying the meaning to real traffic infrastructure on a scale. Links reflect the intersection of streets and connectors that separate streets. Priority rules for each fault point at the intersection are determined after approaching the desired speed in the intersection. Since traffic signals are used, there is no need for priority regulations. There is a signal plan and signal heads are positioned at their positions. Simulation is launched and tested for data outcomes. The length of this model is 4200 seconds.

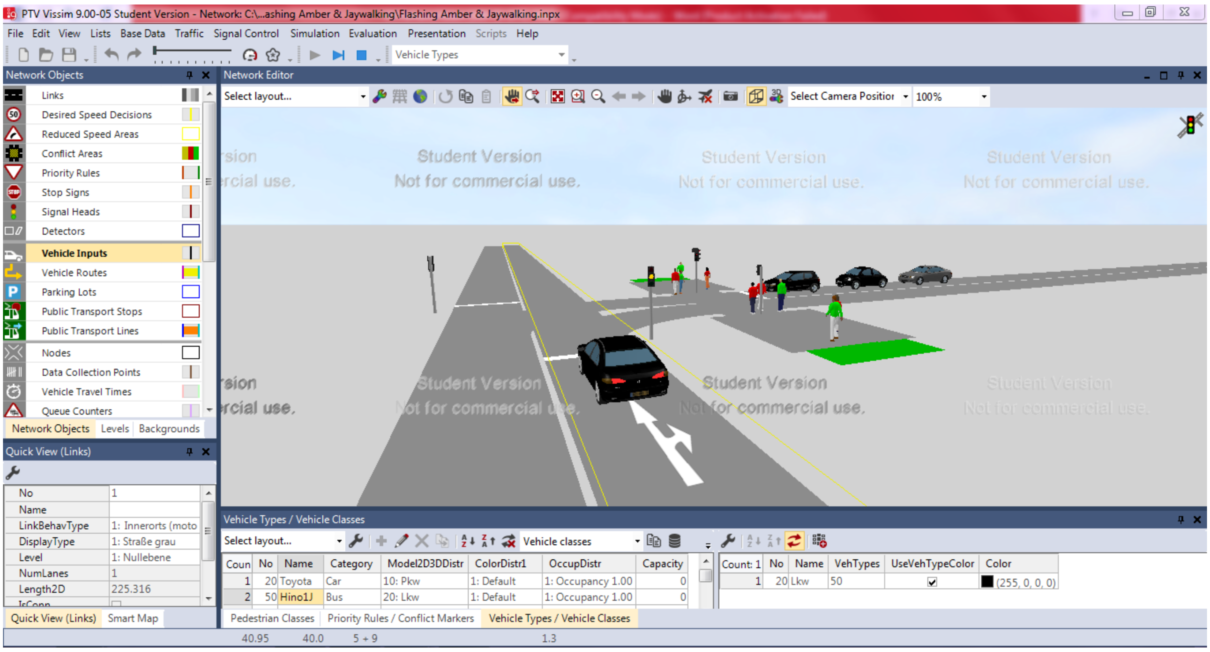


Figure 5.12: Data Inputs in Simulation Tool.

Here at "vehicle inputs" section we have to input our all vehicle data regarding with that signal. To get more accurate results of simulation more accurate data and time will needed. I run this simulation on two different area, where traffic pressure is different and input data are collected in different times. I set traffic signal lights to see that how it effects in normal and emergency traffic mood. In addition, the simulation results is quite satisfied in both sectors, specifically in rural areas because traffic load is normally low in that area.

Figure 5.13: Traffic Signal Operated By Simulation Tool.

Two primary techniques are used:

1. Green extension, in case the emergency vehicle sends priority demand and the green of the vehicle is operating.

2. Red truncation/early green-in cases where an emergency response driver makes a priority request and any other faze is active. A normal signal policy is in effect where emergency rescue vehicles do not require priority.

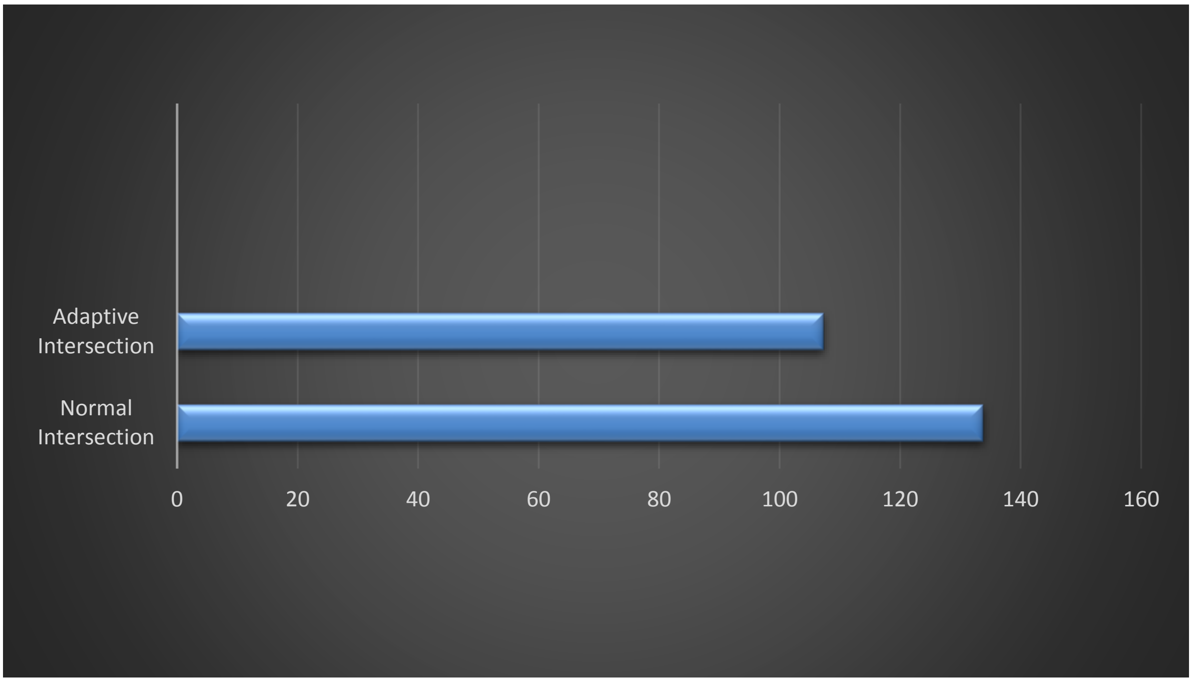
CHAPTER 6
ASSESSMENT OF SIMULATION RESULTS

Conclusions are reached several times after the model simulation is run. In the model, the emergency vehicle is set, and adaptive light control simulation gives this vehicle the priority. Green light is used with the intended direction in emergency services, or special signal control is applied and the signal light is assisted. The last section demonstrates the method of development of the simulation model with a basic setup. The simple setup with adaptive control is explained for emergency services vehicles that affect travel time first through the respective intersection. Specifically, adaptive regulation affects road traffic where signal plans for controlled intersections are not set and designed according to the requirements of road traffic. The priority allocation technique for emergency responder's changes the length of the signal phases, but is limited to the green light needed for others vehicles.

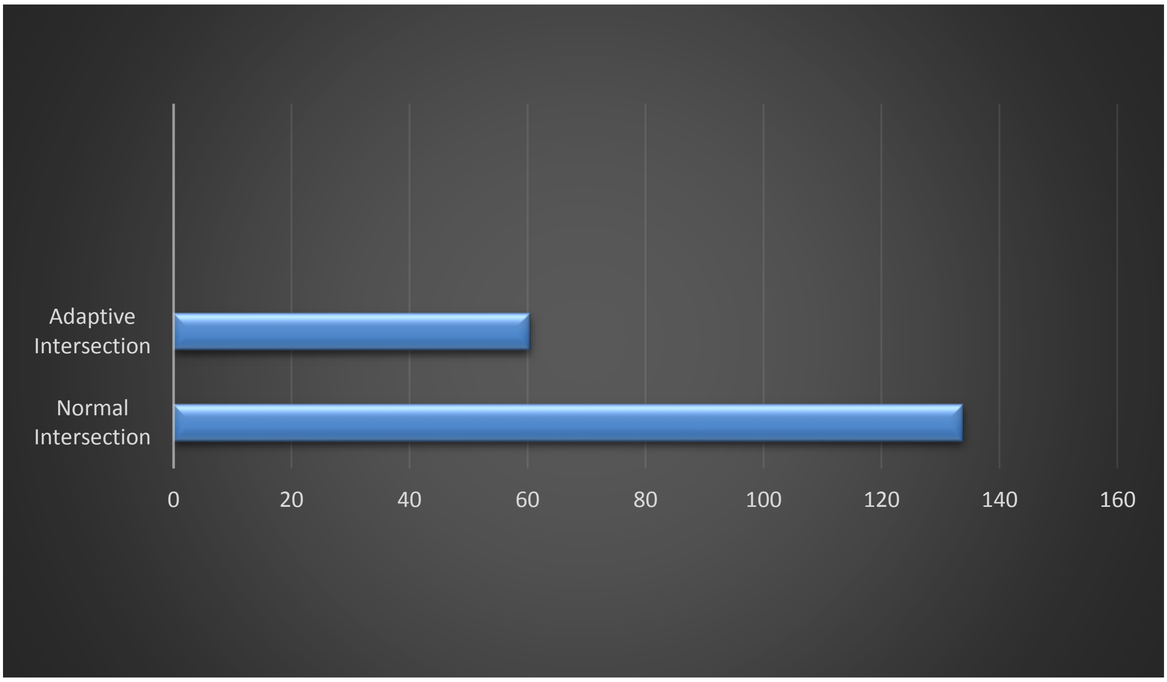
6.1 Emergency Service Vehicles Total Average Travel Time

A basic model and adaptive signal management model that gives priority to selected vehicles is the estimated travel time for emergency vehicles. It can be shown that with proper adaptive signal management application, it is possible to shorten travel time over a modelled junction. That is the product of a few circumstances. At peak hours in the morning, the short span of the simulation is only 4200 and the full impact of adaptive control will be calculated over a longer period. I used only one location and it was possible to use a larger traffic junction grid to show more savings that are meaningful in travel time and get more data that are accurate. Priority adaptive control for emergency support services directly affects travel times for emergency equipment, likely affecting emergency vehicle users by shortening response times for emergency service vehicles.

The average travel time through the junction is the most important variable that illustrates the use of an optimization technique for traffic light managed intersections. The total travel time for emergency responders is measured for each areas, and average values are determined. The total travel time for emergency vehicles was 133.81 sec in both areas. After the adaptive algorithm travel time was implemented, the travel time for emergency vehicles became 107.3 sec in urban area and 60.40 sec in rural area, which is 26.51 sec & 71.41 sec shorter (Graph-1 & Grapth-2) then previous. It is expected that the average speed of emergency response vehicles at intersections will increase. Better outcomes could not be reached because it is impossible to know at the intersection when the chosen car will arrive. A thermodynamic value is generated randomly. On the others side, in rural areas the traffic load is lower than urban areas, it will make a huge improvements in travel time.

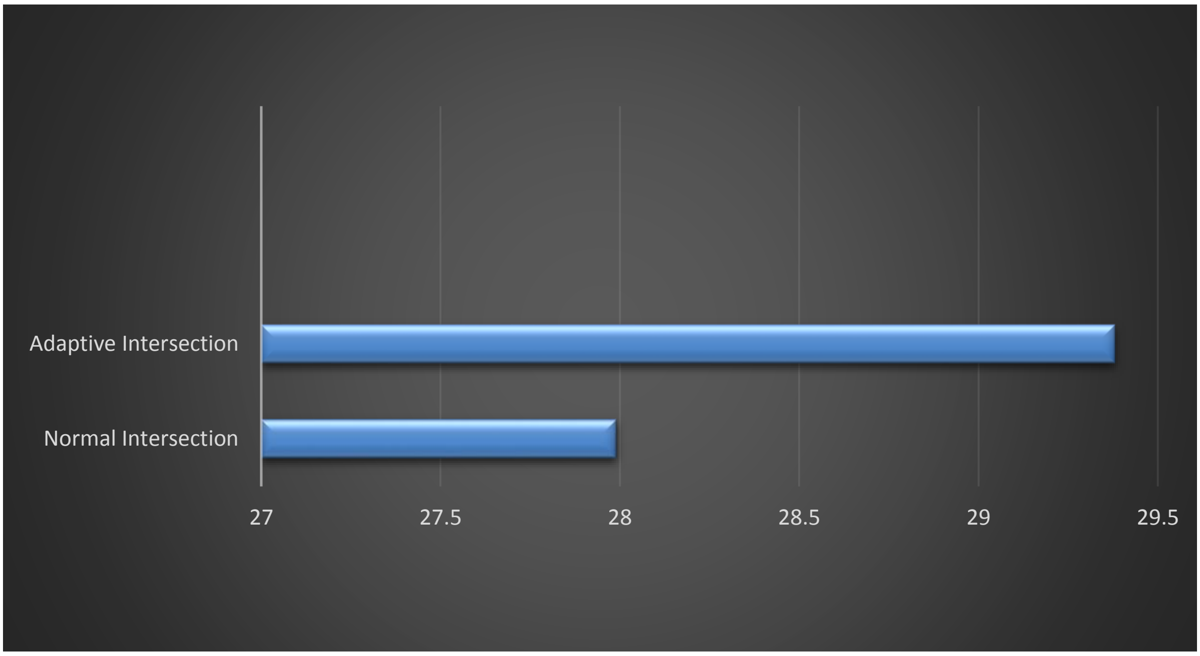


Graph 6.1: Comparison of Travel Time in Urban Area (sec).

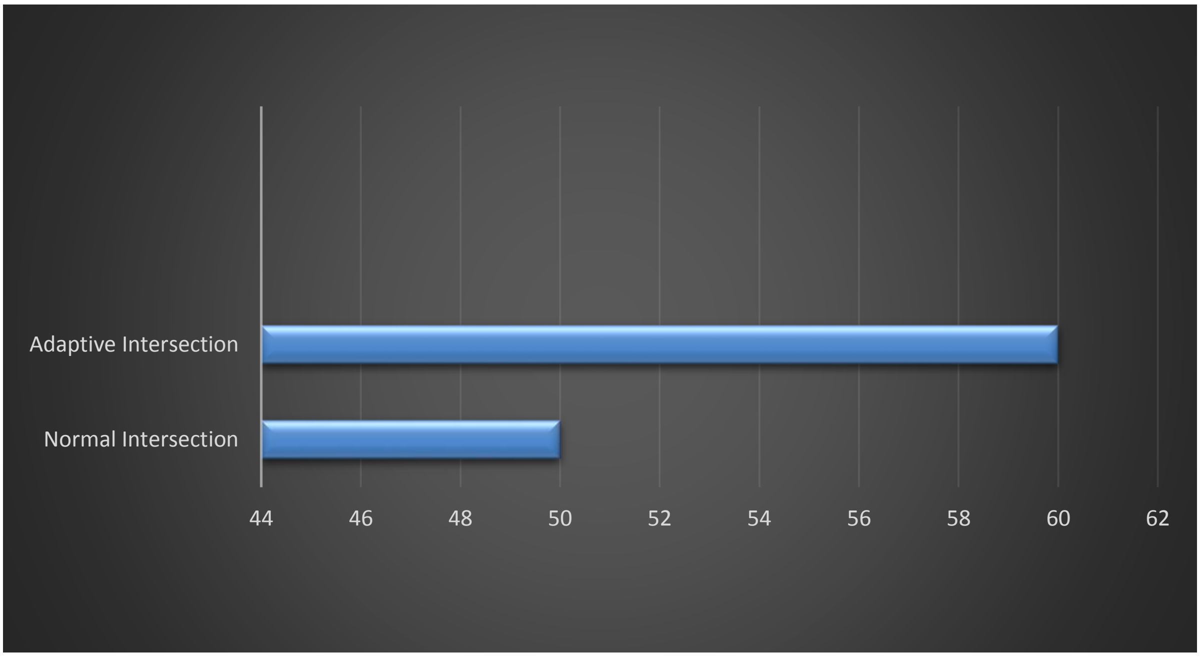


Graph 6.2: Comparison of Travel Time in Rural Area (sec).

Travel times for emergency vetches are shorter and the speed of travel will automatically increased. The speed for the base model is 27.99 kilometer per hour for urban area and it will increased to 29.38 kilometer per hour for the applied algorithm model, with a cumulative increase of 1.38%. Moreover, the speed for the base model is 50 kilometer per hour for rural area and it will increased to 60 kilometer per hour for the applied algorithm model. The discrepancy between others traffic junctions and the junction with the algorithm in place is clearly seen in Graph-3 & 4.



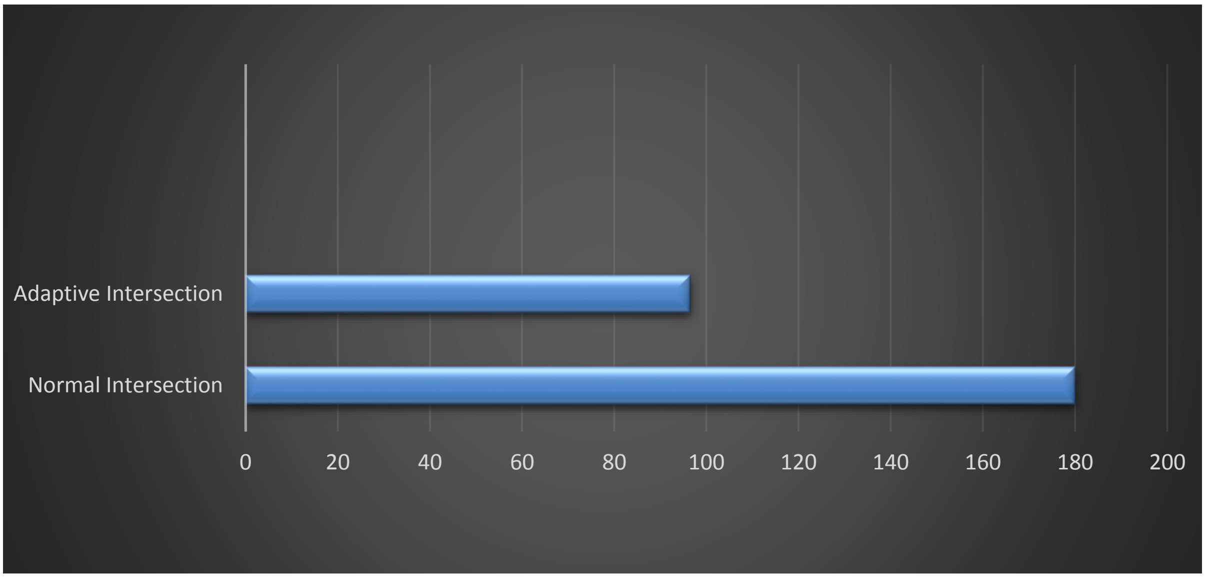
Graph 6.3: Improvement of Speed in Urban Area (km/h).



Graph 6.4: Improvement of Speed in Rural Area (km/h).

6.2 Stop Time Average of Emergency Services Vehicles

In addition to other criteria, it is very important to determine how long an emergency vehicles driver has been waiting for the intersection to pass. At the basic junction, in both areas, the average stop time was 180 sec and the average stop time has decreased at the adaptive signal operated junction to 96.5 sec. To read from graph-5, it is obvious that the stop time is almost cut in half. Waiting time is very important, because it is cumulative. At modified intersection, expected time is accrued. Since waiting time is greatly improved at this junction, it is safe to say that waiting time on the entire road will be drastically decreased.



Graph 6.5: Comparison of Waiting Time (sec).

6.3 LOS Measurements

The level of service (LOS) is a metric used to assess how well a transportation facility is performing from the perspective of passengers. Six levels of service are often established, each with a letter designation ranging from A to F, with LOS A indicating the best operating circumstances and LOS F indicating the worst. [21]

In the case of the base intersection chosen, LOS is C. Waiting times are improved after introducing adaptive signal control, but LOS has not changed because this intersection is not too complicated to adjust LOS for adaptive control of this sort and number of emergency response vehicles. The LOS for the simple intersection is 26.46 and the adaptive control model is 27.88.

LOS	Traffic Signal With RFID	Traffic Signal Without RFID
A	≤10 seconds	≤10 seconds
B	10-20 seconds	10-15 seconds
C	20-35 seconds	15-25 seconds
D	35-55 seconds	25-35 seconds
E	55-80 seconds	35-50 seconds
F	≥80 seconds	≥50 seconds

Table 6.1: Measurement table of LOS.

CHAPTER 7
CONCLUSION & RECOMMENDATION

Traffic pollution is currently a major issue in cities in developing countries, such as Bangladesh, due to the growing number of vehicles. The capital city of Dhaka, with an estimated 8 million commuters every day and a total size of 306 square kilometers, has just 7% traffic roadways (compared to 25 percent urban standard). The current traffic lights obey the hand-held traffic control system operated by the traffic police. As result, many vehicles have to wait at the traffic signals for a long time. This case is not different for emergency service vehicles. Therefore, I am proposing an RFID automatic traffic control scheme. In this case, each individual emergency vehicle is fitted with a special radio frequency identification (RFID) tag to track the vehicle and I have used an RFID reader to read the RFID tags attached to the vehicle's windshield. It counts a number of vehicles using an IR sensor that passes in a certain direction of the road over the given period and automatically sets the time for the traffic signal. This system is designed to provide emergency services for ambulances, VIP vehicles, police cars, fire brigades, etc. When the RFID reader at the traffic junction reads such vehicles with a special RFID tag, the green light will be switched on for a fixed time. In essence, this paper addresses the study of traffic in metropolitan areas. The RFID technology and the different facets of RFID are being researched. The proposed system handles traffic at intersections with different objectives at different times more efficiently and reliably. In the analysis part, we can see that by using this setup, an emergency vehicle can improve their travel speed, time and decrease the waiting time in traffic junction.

IOT (Internet of Things) can be included in this analysis in the future. The estimated traffic level can be calculated, and the signal timer for that path can be changed accordingly. It can be used to locate stolen cars. More improvements will be obtained in the future by exploring this technology with longer-range RFID units. It can be improved at a multi-road intersection by extending it to all highways. With different technologies such as radar technology, facial recognition technology and modules such as GSM, GPS, this technology can be expanded in the future. A technology for the use of mutual networks is coming up with LTE, which is marketed as 4 G LTE, is a standard for high-speed wireless internet networking for mobile phones and data terminals. It is based on GSM/EDGE and UMTS/HSPA network architectures, increasing capability and speed using a separate radio protocol, along with main network upgrades.

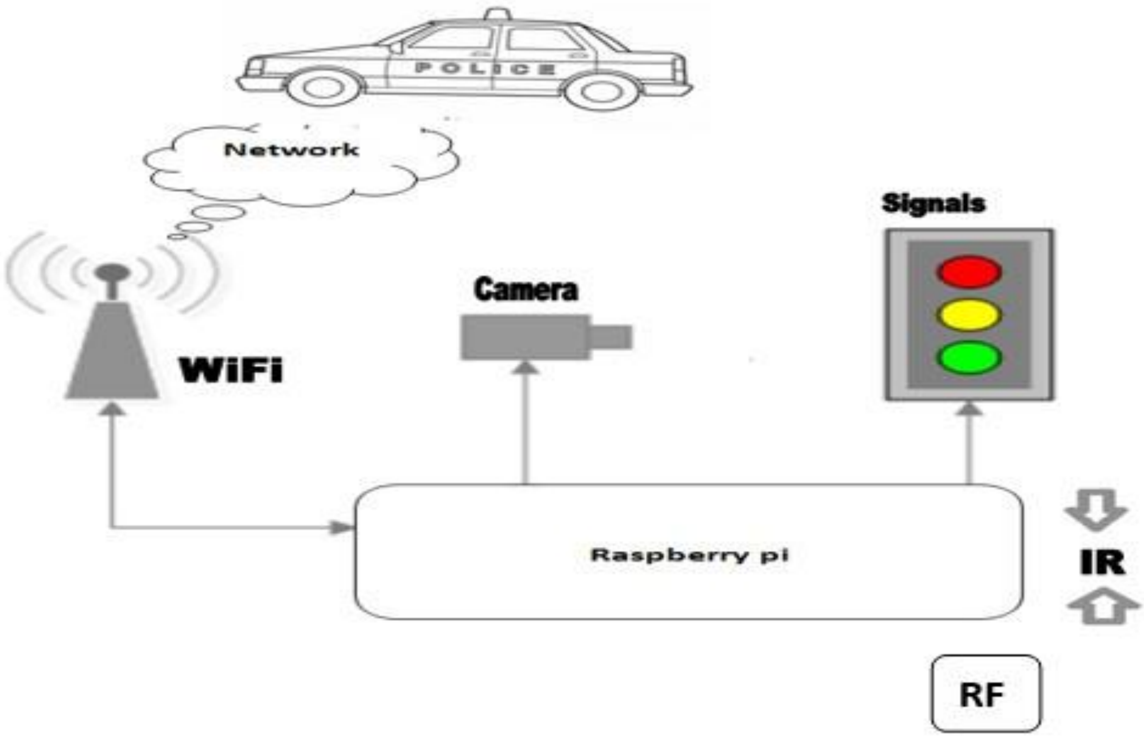


Figure 7.1: IOT Based Traffic System [22]

In order to share data between the OBU vehicle and the RSU (vehicle-to-infrastructure technology) or between the OBU (vehicle-to-vehicle technology) of the vehicle driving on the same road, the OBU must be equipped with a GPS receiver, enabling information to be shared between users and to be changed easily and dynamically due to changes in traffic conditions. Contact systems are essential to the exchange of information between vehicles within the fleet or between vehicles and the control center with regard to fleet management. DSRC technologies are also used for the identification and control of parcels in loading/unloading procedures. In order to identify and inform vehicles on routing directions, positioning technologies and enhanced maps are needed. Integrating future cooperative technologies can be paired with technologies for intersection management and access control in the metropolitan environment, for example. The data generated by vehicle-to-vehicle or vehicle-to-infrastructure contact systems can then be sent to the Traffic Management Centre, which integrates all available data from various sources and uses strategic solutions (dynamic traffic lighting, access control and variable signal signals) to influence traffic conditions.

Working together on a common problem statement will provide the synergies needed to construct an AI-based network across Southeast Asia. [23]

APPENDICES

```
int yellow_led=12,red_led=13,green_led=11,count=0,countp;


char* rfid_id[]={"270021BEBE06","270021BCFE44"};//Replace your RFID tags
here
char* names[]={"Ambulance-1","Ambulance-1"};
int presence[2];

void setup()
{
Serial.begin(9600);
pinMode(yellow_led,OUTPUT);
pinMode(red_led,OUTPUT);
pinMode(green_led,OUTPUT);
}

void loop()
{
  int i;
  char response[12];
  int ch;
  delay(200);
  signalchange();
  if(Serial.available()>0)
    {
        i=0;
        do
        {
            while(Serial.available()<=0);
            response[i]=Serial.read();
            Serial.print(response[i]);
            i++;
        }while(i<12);
        response[i]='\0';
        if(strcmp(response,rfid_id[0])==0)//User1 rfid received
        {
          digitalWrite(red_led,LOW);
          digitalWrite(green_led,HIGH);
        }
        else if(strcmp(response,rfid_id[1])==0)//User2 rfid received
        {
          digitalWrite(red_led,LOW);
          digitalWrite(green_led,HIGH);
        }
        delay(5000);

    }
   if(countp==1)
   {count++; }
   if(countp==0)
   {count--; }


}
```

```
void signalchange()
{
 if(count==0)
  {
    digitalWrite(green_led,LOW);
    digitalWrite(yellow_led,HIGH);
    delay(1000);
    digitalWrite(yellow_led,LOW);
    digitalWrite(red_led,HIGH);

    countp=1;
  }
  else if(count==50)
  { digitalWrite(red_led,LOW);
    digitalWrite(yellow_led,HIGH);
    delay(1000);
    digitalWrite(yellow_led,LOW);
    digitalWrite(green_led,HIGH);
    countp=0;
}
}

uint8_t getID() {
  // Getting ready for Reading PICCs
  if ( ! mfrc522.PICC_IsNewCardPresent()) { //If a new PICC placed to
RFID reader continue
    return 0;
  }
  if ( ! mfrc522.PICC_ReadCardSerial()) {   //Since a PICC placed get
Serial and continue
    return 0;
  }
  // There are Mifare PICCs which have 4 byte or 7 byte UID care if you
use 7 byte PICC
  // I think we should assume every PICC as they have 4 byte UID
  // Until we support 7 byte PICCs
  Serial.println(F("Scanned PICC's UID:"));
  for ( uint8_t i = 0; i < 4; i++) {  //
    readCard[i] = mfrc522.uid.uidByte[i];
    Serial.print(readCard[i], HEX);
  }
  Serial.println("");
  mfrc522.PICC_HaltA(); // Stop reading
  return 1;
}
```

REFERENCES & PLAGARISM REPORT

[1]https://www.aa.com.tr/en/asia-pacific/bangladesh-alarming-rise-in-road-crashes/1692643

[2]https://scholar.google.com/scholar?q=traffic+system+management+related+papers&hl=en&as_sdt=0&as_vis=1&oi=scholart

[3] https://www.dhakatribune.com/bangladesh/nation/2019/02/26/fire-incidents-in-bangladesh-triple-over-22-years#:~:text=The%20number%20of%20fires%20has,a%20daily%20average%20of%2053.&text=At%20least%201%2C970%20people%20were,to%20available%20fire%20service%20data.

[4]https://unb.com.bd/category/Special/fire-incidents-in-bangladesh-triple-in-22-years/13435

[5]https://www.thedailystar.net/country/news/interactive-chart-fire-incidents-rise-bangladesh-1722880

[6]https://www.semanticscholar.org/paper/Traffic-Management-for-Emergency-Vehicle-Priority-Kapileswar-Hancke/169cf18448fb8ffe162084a66a06cd9ebb799195

[7]https://www.abr.com/what-is-rfid-how-does-rfid-work/

[8]https://psca.gop.pk/ptms/

[9]https://iopscience.iop.org/article/10.1088/1757-899X/455/1/012023

[10]https://www.hindawi.com/journals/wcmc/2020/8841893/

[11]http://www.iraj.in/journal/journal_file/journal_pdf/1-368-150003276743-45.pdf

[12] https://blog.ttelectronics.com/rfid-technology

[13] https://www.elprocus.com/dynamic-road-traffic-signal-control/

[14] https://www.chandleraz.gov/blog/heat-sensing-cameras-bring-innovation-intersection

[15]https://www.dnsstuff.com/network-traffic-monitors

[16]http://www.fireservice.gov.bd/

[17]http://www.mohfw.gov.bd/

[18]https://www.police.gov.bd/

[19]https://link.springer.com/article/10.1007/s13369-019-03913-8

[20]https://www.ptvgroup.com/en/solutions/products/ptv-vissim/

[21]https://www.trpc.org/DocumentCenter/View/2798/Appendix-O--Level-of-Service-Standard-and-Measurement

[23] https://www.pantechsolutions.net/iot-based-intelligent-traffic-management-system

[22]https://www.pantechsolutions.net/iot-based-intelligent-traffic-management-system

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< 1% match (student papers from 25-Apr-2014) Submitted to Amity University on 2014-04-25
< 1% match (publications) Miroslav Vujić, Ivana Šemanjski, Pero Vidan. "Improving Energy Efficiency by Advanced Traffic Control Systems", Transactions on Maritime Science, 2015
< 1% match (Internet from 21-May-2014) http://www.ermt.net/docs/papers/Volume_2/issue11_November2013/V2N11-115.pdf
< 1% match (Internet from 12-Nov-2020) http://dspace.library.daffodilvarsity.edu.bd:8080/bitstream/handle/20.500.11948/1089/063-19-483_P03933.pdf?isAllowed=y&sequence=1
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