

Improvisation of ITS technology in VANET

Project Thesis

Submitted By

|  |  |
| --- | --- |
| 16-32638-3 | Rahman, Mahfuzur |
| 16-32625-3 | Dev, Shovan |
| 17-33095-1 | Wahid, Nasim |
| 16-32620-3 | Shuvo, Saiful Islam |

Department of Computer Science

Faculty of Science & IT

American International University Bangladesh

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| Declaration |

We declare that this thesis is our original work and has not been submitted in any form for another degree or diploma at any university or other institute of tertiary education. Information derived from the published and unpublished work of others has been acknowledged in the text and a list of references is given.

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| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Rahman, Mahfuzur**  16-32638-3  CSE | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Dev, Shovan**  16-32625-3  CSE |
| Signature | Document 2-1 |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Wahid, Nasim**  17-33095-1  CSE | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Shuvo, Saiful Islam**  16-32620-3  CSE |

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| Approval |

The thesis titled “Improvisation of ITS technology in VANET” has been submitted to the following respected members of the board of examiners of the department of computer science in partial fulfilment of the requirements for the degree of Bachelor of Science in Computer Science on (23/02/2021) and has been accepted as satisfactory.

|  |  |
| --- | --- |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Wardah Saleh**  Lecturer & Supervisor  Department of Computer Science  American International University-Bangladesh | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Dr. Md. Sakir Hossain**  Associate Professor & External  Department of Computer Science  American International University-Bangladesh |
|  |  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Dr. Dip Nandi**  Asst. Professor & Head  Department of Computer Science  American International University-Bangladesh | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Professor Dr. Tafazzal Hossain**  Dean  Faculty of Science & Information Technology  American International University-Bangladesh |
|  |  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Dr. Carmen Z. Lamagna**  Vice Chancellor  American International University-Bangladesh | |

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| Abstract |

The total amount of vehicles in the world has experienced a considerable growth, expanding traffic bulk which results in more and more accidents. Intelligent Transportation Systems is one of the solutions to all these problems, which will help to minimize traffic related problems to a great extent and can make our life easier. In this proposed scheme, we are also looking for a smart city frame work where people can lead a safe life on the road. This proposed technology is based on a sensor which can able to manage a decent speed control system. Our improvised technology is also proficient in terms of measuring the distance of an object. This improvised technology also gives focus on a good communication with the driver also by notifying each and every action.

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Chapter 1: Introduction

## Introduction:

Accidents are one of the major issues concerning all over the world. Nowadays, our country is facing a tremendous amount of loss due to road accidents. Also, traffic jam is another big issue that made peoples live miserable. It is a digital communication system between cars, trucks or between any vehicles and base station and also between any vehicle and RSU (Road Side Unit). Car injury avoidance, secure roads, contamination and blockage depletion are some of the goals of VANETs [5]. Intelligent Transportation Systems (ITS) narrate technology applied to vehicles as well as base to carry information between them for better security, efficiency and minimizing traffic blockage [6]. Both vehicle-to-vehicle (V2V) and vehicle-to-roadside (V2R) connections are beard in VANETs to systematically gather traffic reconditions from/to vehicles and roadside units. We propose a real-time algorithm that make uses of VANET connection abilities to keep away vehicles from traffic connected crowding and also the road incidents. A flow chart is proposed which describe whole working system that is able to protect us from the road accident and also can reduce the traffic jams.

### 1.1.1 What is VANET?

The engrossment in this field of VANET (Vehicular ad hoc network) has dramatically grown to develop traffic safety and organization on the roads among the research section. VANET implemented for reduce accident on the roads and also the traffic for daily life and also for gathering the information in the server for safety issues [1]. If a vehicle gets some issues or break suddenly on the road, the whole broadcast information about that vehicle pass through a signal to the other vehicles on a specific range to reduce the accident. For this safety issue VANET requirement MAC protocol which provide that services. Recently MAC protocol applies the TDMA techniques and this technique provide some vehicles to use a same frequency at a time in a specific range. VANET (Vehicular Ad-hoc Network) is a digital network that is deployed to reduce the risk of road accidents and also increase comfort of passengers by exchanging different kinds of data including traffic condition, accidents, etc. There are three different communication ways, one of which is between vehicles with other vehicles which we in other words state as inter-vehicle communication. Another is between vehicles and roadside units like antenna, traffic lights etc., also known as vehicle-to-roadside communication. The last one is between the roadside traffic lights or antenna etc., also known as inter-roadside communication.

In case of inter-vehicle communication, if car A comes too close to car B, both cars A and B will be sent a signal for that to the driver which shall help avoid accident, provided that they both have VANET. Again, this shall be even more useful in future if cars have driverless control. Getting an alert for a car being too close can help avoid any collision in that case as well. So, this can play a big role in case of safety. Moreover, police can gather information from other vehicles that come in their car’s range regarding accidents or any other emergency as after accident the vehicle will continuously be broadcasting the signal of its accident to any approaching vehicles or vehicles which will be in its broadcasting range.

Using vehicle-to-roadside communication people can know about when to take a turn near a traffic light or to stop to avoid accidents during crossing a road. Again, using inter-roadside communication the ones controlling traffic lights can easily know information about different road conditions and use different traffic lights accordingly or drivers can know which route to take to reach destination efficiently and safely.

## 1.1.2 What is ITS?

In this growing world many countries, including the ones which are said to be poor countries have started digitizing very fast. Traffic has started to become a hectic situation almost everybody wants to avoid. In any city transportation has become a concern. This is where Intelligent Transport System (ITS) can come in handy. Intelligent Transport System (ITS) is a Transport System which makes a goal to minimize traffic problems, which can in other words help people save time and reach their required destination within the allocated time, be it for a student to go school on time to an emergency patient required to go to hospital. ITS gives people with the information regarding traffic condition, real-time running information of vehicles i.e. which route will be better in case we want to go faster or with comfort.

ITS works by using devices such as different electronics, microprocessors, advanced sensors and communication networks. This way it links roads, vehicles and people and comes up with the data which provides people with necessary information regarding efficiency of time, comfort, security and definitely safely.

## 1.1.3 Relationship between VANET and ITS

An advanced protocol introduced on the VANET is the ITS or Intelligent Transportation System. An integrated application aimed at delivering creative technologies related to various modes of transport and traffic control, allowing consumers to be more aware and making the use of transport networks smoother, more organized and more 'intelligent'. For short and extended-range connection within the ITS, radio modem connection on UHF and VHF frequencies is usually utilized. RFID (Radio Frequency Identification) and approachable intelligent beacon sensing technologies have developed the technological capabilities that will grant intelligent transport networks globally to benefit from motor safety. Sensing technologies for ITS are networked networks focused on vehicles and networks.

ITS also includes automatic systems for road safety, such as speed cameras, which detect cars going above the permissible speed limit. To notice a vehicle's speed or electromagnetic loops covered in each lane of the road, many so systems make use of radar. Red-light cameras that route cars that are showing a red traffic light detaining a stop line or a delegated stopping location. Bus lane cameras that distinguish vehicles that drive on bus-reserved lanes. Bus lanes may also be used for taxis or cars interested in carpooling in some jurisdictions. Level crossing cameras which identify vehicles intersecting railways unlawfully at grade level. Double white line cameras that distinguish certain lines crossing cars. High-occupancy lane cameras for cars that detect vehicles that breach HOV standards. ITS also assists link the urban world via the vehicular ad hoc network in a cutting-edge tech-based traffic structure (VANET). Mobile operators play an essential part in these supply chains (beyond providing just connectivity). To make mobile purchases, provide data analysis and navigation resources, provide rewards and discounts, and serve as a medium for digital shopping, dedicated applications may be used.

## 1.2 Motivation:

The road and safety issue of our country was the primary motivation behind our work. The growing opportunities in the IT sector and the digitization of our country. The motive is to ease the lifestyle and ease because by time and as we proceed towards future this is a huge opportunity. Also, to reduce the complex actions that involving driving and to make effective and error-less traffic system.

And lastly to bring a new dynamic and revolution in our country by the introduction of automated vehicle and effortless traffic technology.

## 1.3 Objective:

Intelligent Transport System can be specified as the technology that is appealed to carry foundation like road networks, traffic and transport system. In periods of smart ITS, Vehicular Ad Hoc Network (VANET) is an immense automation which can allow security and consolation for the passengers. It assists developing traffic planning on road by exchanging traffic-related figure among vehicles and fundaments. to handle the troublesome incident in roadside, our prefered work offers expending and unconventional assistance that will develop the traffic treatment in the future. Our objective is to decreasing risk of latent incidents as there has been a scaring rise in road accidents, importantly highway incidents in Bangladesh over the past few years. By implement our proposed work we can manage the whole traffic management in our country and can reduce congestion. The aim of this work is to integrate technologies and expertise to create and provide innovative services, to increase the efficiency of existing transport infrastructure, to reduce the traffic jams, to prove the advantage of automated vehicle. We think our proposed work is eligible to deliver our country the environment where people will not be afraid of thinking their safety to go outside of home.

## 1.4 Outline:

This proposed work ensures the safety of the people on the road and the vehicle. Also, finding a proper solution of the ITS technology and adapting the VANET solution in our country and proposing how this technology will elevate the country.

Chapter 2: Literature Review

A systematic Literature review (SLR) creates a remarkable portion in research and execute any all research questions. To create this systematic Literature review (SLR) more structured many protocols and tasks need to define and narrate. A systematic literature review is about spotting, judging and strewing all the available research and applicable to a specific research question or topic zone. In this review, we systematically selected and reviewed nine articles published in scientific forums. The study outcome provides the main contribution of the field, the uses of this network also the important future research directions. Intelligent Transportation System (ITS) have arisen as an effective way to elevate the performance of vehicles on the roads. The goal is to reduce road accident and transportation problem, curtail the traffic jam and collisions, easy driving experience to drivers and a hassle-free lifestyle. There are many papers have been attendant in recent years. This portion covers the research we did, two papers that we follow most and the whole representation of those papers. The work in [2] revealed a challenge covering Vehicle-to-Vehicle (V2V) style where vehicle to vehicle is connected in a certain area to reduce the transmission overhead and improvement of street security. Also, the work in [1] is a view about Smart City Framework using Intelligent Traffic Lights (ITLs). Several new theories such as smart cities and living labs [1] are presented in the recent years where VANETs plays a vital role. The proposed system takes decision for control the system based on the information and communications. In [5] and [6] both have a system to improve the traffic fluency and reduce the waiting time of vehicles and help to avoid traffic jams and collisions by using ITS, VANET, RFID, ARM, signal control, android mobile application, path planning.The work in [7] is a survey about performance of DSRC and WIFI for Intelligent Transport System in VANET. They effort on expanding vehicle-to-vehicle communication (V2V) and keep away from crashes, traffic-jam, allowing security and comfort applications for Intelligent Transport Systems (ITS) and to develop traffic safety on roads. where the motto is same as before but the ways are different.

Chapter 3: The Sensors and the Innards

## 3.1 Previous Work:

In this paper they are working on VANET’s architecture, domain and wireless access technology. In VANET’s architecture section they have three units. These are application unit, on board unit and road side unit. Application architecture is an in-vehicle tool to utilize the travelling proficiencies of the on-board unit. An on-board unit is an instrument that exists in a vehicle to help in exchanging information with neighbors OBUs or with RSUs. Road side unit is a fixed structure created along the roads sides to achieve the required networking abilities for short range wireless communications using IEEE 802.11p [2]. Domains in VANET section in vehicle is responsible for the process of exchanging information between vehicles. Ad hoc encompass on the process of V2V and V2I [3]. In wireless technology section VANET can be implemented in several technologies according to the wanted application such as traffic optimization or road safety. One of the researches introduce a new scheme according to the road safety .it consists of warning message module and traffic density calculation module through an Intelligent Traffic Lights (ITLs) which can help a driver to take proper decision [5]. Another research works only on the improvisation of signal quality in cellular IoT in VANET [7].

**3.2 Limitations:**

In this paper they have faced some problems. These problems are Transmission capacity impediments, postpone requirements, security and responsibility rights, cross layering conventions, small effective diameter, security attacks, high dynamic and frequently disconnected topology. Also, in some complex situation like huge number of traffic jam there are some problems regarding object reorganization. One of the papers contains the better communication between vehicle and roadside units. But how a vehicle can detect an obstacle on the road wasn’t mentioned here [7]. what if in the [5], the driver won’t obey the traffic rules or won’t able to take proper decision, the collision must be occurred. Another one has scheme consist of time saver on road of busy peoples, it couldn’t focus on people safety on the roads [6].

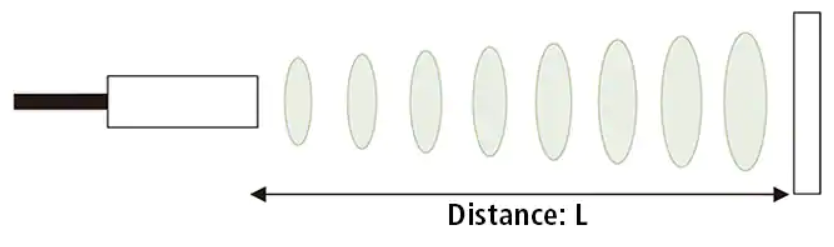
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**3.3 Integrals of Proposed Work:**

**3.3.1 Ultrasonic Sensor:**

An ultrasonic sensor is an electronic tool that, by passing on ultrasonic sound waves, find out the distance of a target object and modify the reflected sound into an electrical signal. Ultrasonic sounds fly faster than the audible speed of sound (i.e. the sound that humans can hear). There are two mains

components of ultrasonic sensors: The Transmitter Radio (which uses piezoelectric

crystals to emit sound). The sensor computes the time it takes between the transmitter's sound release and its interconnection with the receiver in order to resolve the distance between the sensor and the object. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second). 

**Distance L = 1/2 × T × C**

**Figure 3.3.1: Ultrasonic Sensor**

Ultrasonic sensors are used primarily as proximity sensors. They can be used in self-parking vehicle technologies and protective anti-collision technologies. As well as industrial technology, ultrasonic sensors are also used in robotic obstacle detection systems. Ultrasonic sensors are not as sensitive to interference from smoke, gas and other airborne contaminants when opposed to infrared (IR) sensors in proximity sensing applications (though the physical components are still affected by variables such as heat). Ultrasonic sensors are often used as level sensors in closed containers to track, control and regulate liquid temperatures (such as vats in chemical factories). Most importantly, the medical industry has been able to generate photographs of internal organs, recognize cancers, and ensure the health of babies in the womb through ultrasonic technology.

This sensor has some definite layout:

Fixed current: fewer than 2ma

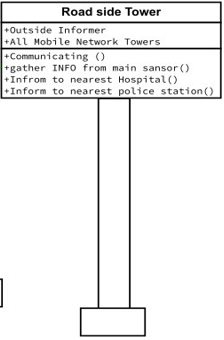
Operating voltage: 5v(dc)

Observation space: 2cm-450cm

Sensor angle: not greater than 15 degrees

**3.3.2 Road Side Tower:**

The Road Side Towers has a vital role in this proposed work. It basically works as a outside informer. In this proposal, we are using all the Mobile Networks as our Road Side Tower because the Mobile Network Towers are already built up in everywhere of the country, also on a specific distance from one another. And we also need something like these in our proposed method thus we can connect them with our main sensor to get all the information and release those among us.

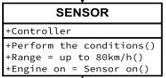


**Figure 3.3.2(2) : Road Side Tower Class diagram and Image**

The Towers will connect with one another and also with the main sensor, thus they can be able to get the information from the sensor connected with the object and also can able to transfer the signal. The towers will be able to connect with the nearest hospital and police station, so that it can inform the hospital and police station if something wrong will happen. The Towers are able to connect with those are situated in its range. So, Road Side Tower is playing a useful and vital role in this proposed work for our safety.

**3.3.3 The Main Sensor:**

This proposed work has its main element and that is the Main Sensor which basically works as a controller. It controls all the conditions and the performance of an object, thus the object can be indirectly control by the sensor. The sensor is the core of our proposed system. The whole working system and connectivity are depending on this sensor and this is the reason to named it the main sensor. The sensor connects with both Ultrasonic sensor and Road Side Tower. Sensor take signals and information from these two parts and perform the task.



**Figure 3.3.3: Main Sensor Class diagram**

This Main Sensor has some unique and important rules and configuration. The sensor will active when the corresponding device will on or for any vehicle the engine will be on. The Sensor has some limitations like it has a range that up to 80 km/hour. That means if the sensor is on then the speed of the vehicle cannot cross 80km/hour.

The sensor also has some conditions to work. It basically has four different conditions(D>10m, D=6m-10m, D<=5m, D<=1.5m) and those conditions are totally depending on the distance between two objects. If any object detects by the Ultrasonic Sensor then the signal will pass to the main sensor. The sensor then acts which is depending on the information that take from the ultrasonic. There is more minor controlling function which are also control by the main sensor like buzzer on, indicator on/off, changing the lane of road according to the conditions. And also, one of the most main function of this sensor is controlling the speed and decrease when needed like (speed = current speed/2 or current speed/ 4).

**3.4 Approach:**

**3.4.1 Proposed work:**

This whole method is proposed for our safety on road. Nowadays, road accident and traffic jams are very common for us. So, for secure our lives we have to take actions. This is one of them.

A method is proposed for the safety purpose of our daily travelling life. In this proposed work, there are three component which are playing a vital role to complete the whole task. And those are the Main Sensor, the Ultrasonic Sensor and the Road Side Tower. These three portions are connected internally with one another and pass the information and perform their own tasks.

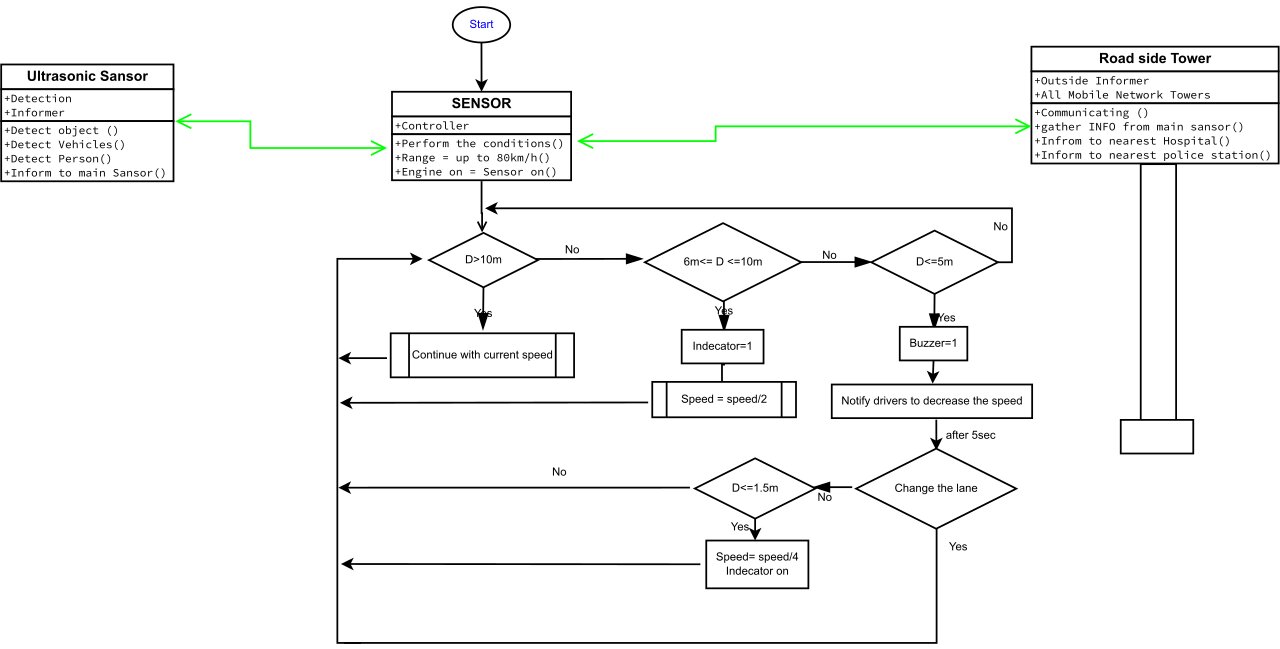
The ultrasonic sensor is using for the detection in this work. It can detect any object or any vehicles or human. So, when it detects human, vehicles or any object in a specific range then it will inform or pass a signal to the main sensor. And, from here the work of the main sensor has begun. And, the main sensor works with some limitations and conditions. First of all, it will check the distance between V2V (vehicle to vehicle) or O2O (object to object). If the distance is greater than 10 meters (D > 10m) then the vehicle will continue with the same or current speed. Else if the distance is between 6 meters to 10 meters (6m<=D<=10m) then the indicator will on immediately and the speed of the vehicle will become half of the current speed (speed= current speed/2). If the sensor cannot find these two conditions then it will go for another condition that if the distance is less than equal to 5 meters (D <=5m) then the buzzer will on to notify the driver to decrease the speed. After that it will wait for 5 seconds for any action from the driver but if no action will be taken from the driver then after 5 seconds the vehicle will change the lane automatically and will going to check the conditions from the beginning. If the lane can’t be changed then the sensor will check if the distance is less than equal to 1.5 meters (D<=1.5m) then the sensor will take an action on the speed again and the speed will become one forth of the current speed (speed= current speed/4) and the indicators will on for the other vehicles. This main sensor will also connect with the road side tower which work is to collect the data of the road situations in a specific range and to inform the nearest hospital and police station if something wrong will occur.

All of these actions and conditions will work when the sensor will on and the sensor will on immediately when the engine of the vehicle will on. And when the sensor will active, the vehicle has a limitation of speed that is up to 80km/hour. As the proposed work is about O2O (object to object) style detection, the system will work slightly different for humans who will use the system through their mobile or smart watch. Then there will be no speed limitations for the mobile or smart watch users. The system will work and detect directly in a specific range and notify the user through buzzer or vibration. So, by doing all these, the system will work for our safety.

**3.5 Models:**

**3.5.1 Flow Chart:**

This is the proposed work which is presented as in a flowchart. This flow chart describes how the whole system works and when the main sensor performs the conditions and also communicate with both ultrasonic sensor and the road side tower.



**3.5.2 Pseudo code:**

This is the back up pseudo code of the proposed work and this one is also describing how the main sensor performs all the conditions.

**Step-1 :** Initialize

**Step-2 :**  ITS sensor = 1 [Objects max speed will be locked at 80 km/h] Ultrasonic sensor is connected to ITS sensor (Ultrasonic sensor is being used for distance measurement between Object to Object )

**Step-3 :** If O2O Distance > 10 meters; then Object speed will not be changed .

**Step-4 :** If O2O Distance < 10 meters: Object speed will be decreasing gradually, until speed = ½ of previous speed.

**Step-5 :** If O2O distance <= 5 meters ; Alarm will be on for notifying drivers to decrease the speed to change the lane of that object [If it is done ,then go to step-3 ]

**Step-6 :** If O2O distance <=1.5 meters ,speed =1/4 Besides Object indicators light turns on -and after 2 sec brake lever will be pressed automatically. [If speed will not be decreased]

Chapter 4: Evaluation

## 4.1 Demonstration:

In VANET ITS or Intelligent Transportation System is very crucial which requires Vehicle to its necessary infrastructure communications using WAN or Wide Area Network. Accidents on the road and traffic have become a major issue to be alarmed. ITS is is a necessary step towards solving this problem, that is going to help to solve the traffic-related issues more effectively. There are some proposal which is based on RFID and ARM controller to narrow down and solve traffic issues with accurate signal and controlling them then we can use mobile application models for this as well. The path planning will be issued to find the best traffic or route for the user to reach their proper destination. Some systems are already implemented regarding this issue to solve the problem. This will make the system much more effective.

The primary objective of vehicular ad hoc networks (VANETs) is to improve driver safety and to make traffic more efficient. Most of the ongoing applications of VANET are based on the change and interchange of messages of safety and others between nearby vehicles and between vehicles and nearby roadside communication units. This communication will gather a huge amount of data which will require typical storage, computation, and communication resources needs. In the past few years, a mass change has occurred in the vehicle and traffic system and people tend to lean more and more towards automated vehicular systems. VANET and ITS provides the necessary requirement to fulfill users need of basic communication between two or more application of VANET. Vehicle to user communication is not used anywhere in the past few years. Although the Tesla corporation has developed a fine artificial intelligence system that makes the automated vehicle more user friendly and makes user more passionate and driven about the idea of VANET and ITS, which is our primary goal. To make a secured traffic system so the rate of accident lessens and the user becomes more attracted to use automated vehicular systems.

**4.2 Analysis and Comparison**

## 4.2.1 Analysis:

Every research work will get popularity when it can able to introduce with new scheme. To go through the whole paper, it can be spontaneously prescribed that if we work on the implementation of our research, it will bring another revolution on our transportation system. Actually, our proposed technology is based on a sensor which can able to manage a decent speed control system. Our improvised technology is also proficient in terms of measuring the distance of an object. This technology is so much potential that it performs any action with the vehicle engine directly if the controller of the vehicle isn’t

obeying all the rules and regulation have been made for this. This improvised technology also gives focus on a good communication with the driver also by notifying each and every action. It is capable of minimizing the risk of collisions and also traffic jam. Eventually after connecting all the analytical standard, it can be said that this technology can have a much better effect.

## 4.2.2 Comparison:

For the acknowledgement of any research work there should be focused on another key point that is whether the research work is better than the existed ones or not. One more time we are ensuring that our improvisation technology is the best of all the related previous work in this field. It can be understood through a comparison between all the previous work and our proposed work .Before working on our research we had discovered some information of previous work and its limitation through some paper.

Most of the previous works are formed of vehicle to vehicle style but the main thing is a collision is not just for the vehicle ,any type of object can cause for a collision .In contrast, we change the style of object to object for our working principle . In previous work there might be used Intelligent Traffic Lights as Roadside Tower. On the contrary, we used Mobile network Towers as Roadside tower which is smarter and faster technology than ITLs. Even though There came out many different solutions from that previous works like using signal control, Intelligent Traffic Lights (ITLs), routing protocol etc. our intention is composing a different type of solution through using ultrasonic sensor (which can measure the distance of an object) and ITS sensor (to control the speed of a vehicle) The working principle of both two combined sensor is described on the flowchart. Whereas, we are pretty much sure that our proposed solution is more acceptable than all the previous ones. One more point is that in all the previous paper their motive is either reducing traffic jams or about public safety. Whereas our motive stands both on reducing traffic jams and also on public safety.

Chapter 5: Conclusion and Future Work

## 5.1 Conclusion:

Nowadays in the world, road accidents and traffic problems are one of the major issues for the people. So VANET is the giving the solution for these two major reasons along with many other various reasons as well. Users require safety on road in future. VANET applications is the proper way to reduce the future accidents and also the traffics. So, it must be implanted using trusted computing-based solution to promote trust amongst road users and their vehicles and infrastructure. a systematic and effective approach was represented to manage the traffic and road accident issues. Different works about ITS are compared. The key idea is to create a smart city framework for VANET by this proposed work which Consists a smart and safe transport system. This solution provides a good impact on our Environment and Sustainability which is really useful and safe. People should use the system ethically. Government help which is also necessary for this big change in our country.

## 5.2 Future work:

Due to their broad scope of applications and equipment’s, such as passenger security, developed traffic production and infomercial, vehicular ad hoc networks (VANETs) have been exhaustively analyzed. First of all, with the advancement of technology and the sudden increase in the number of smart vehicles, the introduction of this proposed work is necessary; typical VANETs face many technological difficulties in deployment and management due to less flexibility, measurability, insufficient connection and deficient intelligence. Cloud computing is considered a way for VANETs to meet these criteria. Next-generation VANETs, however, may have unusual statements for high-mobility autonomous vehicles, low latency, real-time applications and networking, which traditional cloud computing does not fix. The integration of fog computing with the traditional cloud for VANETs is also addressed in current and future VANETs as a theoretical solution to many problems. In addition, by integrating Software-Defined Network (SDN), which offers constancy, programmability, and global network perception, fog calculating can be improved. In potential VANETs focused on fog and a mixture of fog and SDN, we offer two sample scenarios for timely transmission of safety messages.

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