Sudan University of Science and Technology

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Road Congestion Detection For Intelligent Traffic Management

Research Submitted in Partial fulfillment for the Requirements of the Degree of B.Sc. (Honors) in Electronics Engineering

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آيـــة

قال الله تعالى :

﴿وَقَالَ الَّذِينَ أُوتُوا الْعِلْمَ وَيْلَكُمْ ثَوَابُ اللَّهِ خَيْرٌ لِّمَنْ آمَنَ وَعَمِلَ صَالِحًا وَلا يُلَقَّاهَا إِلاَّ الصَّابِرُونَ﴾

صدق الله العظيم

سورة القَصص آيه 80

اله السماء يعطينا النجاح نحن عبيده نقوم ونبني
(نحميا 20:2)

الحمد

الحمد لله الذي جعل لنا من العلم نورا نهدى به و بعد:

نتقد ببحثنا هذا الى كل من يجمعنا بهم رباط العلم من مستمعين و قراء و معلمين اذ نضع بين أيديكم هذا البحث الذي نرجو أن يكون في المستوى المطلوب. راجين من الله سبحانه و تعالى التوفيق و العون.

Dedication

For all who helped us to reach our target, To the university and department that enlightened us through the years and for their deep concern and efforts To the families, for always being there for us and encourage us all the way, And to the friends who gave us hope in times of despair specially Mohammed Mahdi and Mohammed Omer

Acknowledgement

This research thesis is made possible through the help and support from everyone, including: Parents, teachers, family, friends, and essence, all sentient beings. Especially, please allow us to dedicate our acknowledgement of gratitude toward the following significant advisor and contributors.

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Abstract

Vehicular traffic congestion is a well-known economic and social problem generating significant costs and safety challenges, and increasing pollution in the cities. Current intelligent transport systems and vehicular networking technologies rely heavily on the supporting network infrastructure which is still not widely available This work mainly aims to simulate traffic congestion detection in urban areas and emergency cases using PROTUES. In congestion detection, we integrate IR sensor with ARDUINO to determine the road situation. Also in emergency, we use RF identifier to detect if ambulance or police car is coming.

المستخلص

يشكل الازدحام المروري مشكلة اقتصادية اجتماعية معروفة, محدثا تكاليف بليغة, مهددا للأمن والسلامة وزائدا للتلوث البيئي في المدن. تعتمد انظمة النقل الذكية وتقنيات الاتصال للمركبات الحالية بشدة على البنية التحتية للشبكة والتي لا تزال غير متوفرة على نطاق واسع.

الهدف الاساسي لهذا العمل هو محاكاة كشف الازدحام المروري في المناطق الحضرية والحالات الطارئة باستخدام ال Proteus لكشف الازدحام.

نقوم بدمج حساس الاشعة تحت الحمراء مع (الاردوينو) لتحديد حالة الطريق, في حالة الطوارئ نقوم باستخدام دائرة تعتمد على موجات الراديو (الترددات اللاسلكية) للكشف عن وجود حالات طوارئ. في هذا البحث تم تنفيذ المحاكاة و التأكد من كل الحالات (الوضع الطبيعي و وضع الطوارئ و وضع الزحمة).

TABLE OF CONTENTS

List of Figures

List of Tables

List of abbreviation

NHTSA	National Highway Traffic Safety Administration
VANET	Vehicular Ad-hoc networks
MANET	Mobile ad-hoc networks
V2V	Vehicle To Vehicle
V2I	Vehicle to Infrastructure
RSUs	Roadside unit
IR	Infrared Radiation
VIP	Very Important Person
V2X	Vehicle-to-Vehicle and Infrastructure
I2I	Infrastructure-to-Infrastructure
ID	Infrastructure Domain
OBU	On Board Unit
GPS	Global Positioning System
OIS	Optical information system
RIS	Route Information Sharing
LC	length of each cluster
VK	The closet vehicle to the center of the cluster
RF	Radio frequency
LCD	liquid –crystal display
ECODE	Efficient congestion Detection

CHAPTER ONE

INTRODUCTION

1. Introduction

1.1. Preface

With the turn of the century, there occurred an explosion of population across the globe. According to the United Nation's Department of Economic and Social Affairs, Population Division of the world was 7.3 billion as of July 1, 2015. This directly led to more number of peoples living in cities. In this 21st century day by day, more and more people are dwelling in cities. Thus, the traffic in cities becomes more crowded and there is no much concentration to solve this crucial problem [1].

Failure of signals, poor law enforcement and bad traffic management has led to traffic congestion on road networks is nothing but slower speeds, increased trip time and increased queuing of the vehicles. When the number of vehicles exceeds the capacity of the road, traffic congestion occurs. Traffic congestion is caused when the demand exceeds the available road capacity [2].

Nobody enjoys being in traffic jams because the wasted time for trip, increasing fuel consumption, create high degree of noise. In addition, it causes bad effects in environment. Traffic congestion constraint the emergency services such as ambulance, police-cars and fire engines [2].

Traffic congestion in highway networks is one of the main issues to be addressed by today's traffic management schemes Due to the ever-increasing traffic demand, modern societies with well-planned road management systems, and sufficient infrastructures for transportation still face the problem of traffic congestion. This results in loss of travel time, and huge societal and economic costs [3].

“According to the National Highway Traffic Safety Administration (NHTSA) , there are around 43000 deaths /year, 2.7 million people injured/ year and $230 billion social cost. It is required to make our vehicles a bit intelligent so that we can reduce the possibilities of accidents ” [4].

Constructing new roads could be one of the solutions for handling the traffic congestion problem, but it is often less feasible due to political and environmental concerns. An alternative would be to make it more efficient use of the existing infrastructure [5].

Vehicular communication is defined as communication between the vehicles. Vehicular ad-hoc networks (VANET) are a form of mobile ad-hoc networks (MANET) that provide communications between nearby vehicles and nearby fixed equipment. The main objective of deploying VANET is to reduce the level of accidents. One possible way is to provide the traffic information to the vehicles so that they can use them to analyses the traffic environment. It can be achieve by exchanging the information of traffic environment among vehicles. Vehicular networks are fast emerging for developing and deploying new and traditional applications [5].

Connected vehicles refer to the wireless connectivity enabled vehicles that can communicate with their internal and external environments; VANET communication technique is divided into vehicle-to-vehicle (v2v) where data exchange between nearby vehicles and vehicles to infrastructure (v2i) where data exchange between vehicles and fixed roadside units (RSUs) [5].

1.2. Problem statement

Urban cities suffer from traffic congestion that cause increasing waste time, fuel and increase the trip interval. In addition, it causes threat drivers life by increasing the possibilities of accidents.

1.3. Proposed Solution

Use the vehicle-to-infrastructure based traffic management system. A control station (infrastructure) is responsible for managing processing information coming from the vehicles to reduce congestion.

1.4. Aim and Objectives

The aim of this research is to detect and reduce the traffic jam in urban areas.

The three main objectives are:

i. To practical implementation the Efficient Congestion Detection (ECODE)algorithm in urban area.
ii. To simulate the congestion detection algorithm and emergency in urban area using PROTUES.

1.5. State of the art

Krajzewicz ET al.Have used an optical information system (OIS) to gather the traffic characteristics of each area of interest [6]. Moreover, Jain et have installed fixed cameras at roadsides all over the area of interest. In OIS, video cameras have been used to gather the basic traffic data of each road segment [7].

R. Yugapriya, P. Dhivya, M. M Dhivya, and Mr. S. Kirubakaran aver proposed method to reduce traffic signal control problem to the problem of scheduling jobs on processor, and propose algorithm called the Greedy Forwarding Algorithm [8].

Maram Younis Saleh Bani Younes proposed an Efficient COngestion DEtection (ECODE) protocol that aims at evaluating the real-time traffic characteristics of each road segment (i.e., the road section connecting between any two adjacent intersections). Moreover,congestion detection protocol efficiently and reliably detects road segments with high traffic congestion in any urban grid-layout area [9].

1.6. Methodology

This research aim to implementation practical the Efficient Congestion Detection Protocol to enhance the traffic control in urban areas, In this research, we simulate congestion detection algorithm and emergency .in case of congestion we use IR sensor. First IR sensor detects the state of road to determine if congestion occurred or not. If congestion occurred, send signal to controller for processing and controlling the traffic lights according to current situation. in case of emergency we RF module .the RF transmitter send signal to RF receiver and pass it to Arduino which control the traffic according to signal.

1.7. Thesis Outlines

The project consists of five chapters. Chapter 2 introduces the concept of VANET (Vehicular Ad-hoc Network), this applications and previous related work. Chapter 3 describes the congestion detection and simulation component. In Chapter 4 includes an overview of the simulation tools used in the project and the simulation process,and results. Chapter 5 outlines the main conclusions and gives a proposal for future lines of work.

CHAPTER TWO

BACKGROUND AND LITRETURE REVIEW

2. Background and literature review

2.1. Background

Now a days the population is being increasing day by day the traffic is also increasing with proportionality. When the number of vehicles exceeds the capacity of the road, traffic congestion occurs. That led to many problems are occurred. These problems include traffic jams, accidents and traffic violation at the heavy traffic signal [11].

The traffic jams occur on main way in special seasons and rush hours .that was led to a long waiting time of peoples and high cost of fuel consumption on the road. And in that delay the emergency vehicles are stuck in traffic jams [12]. This will cause many problems mainly when there are emergency cases at traffic light intersections which are always busy and jammed with many vehicles. This situation becomes more crucial when special routing is not provide for the emergency vehicles such as ambulance, patrol car and fire truck when red sign light [13]**.** The emergency will occur any way, any time and on any location. In that case the speedily response is required [12].

The number of vehicles using the limited road networks infrastructure Which was slowly increased. The major consequence of this increase is the traffic management problem. One of the most critical consequences of traffic problem is the delay of emergency vehicles such as, ambulance during accidents to reach hospitals on time, Fire brigade vehicles, police van to catch the thief, and VIP (minister or president) vehicles [12].

This in turn has an adverse effect on the economy of the country, the environment and the overall quality of life. Therefore, the traffic signals need good coordination for the smooth flow of traffic during the busy hours as the traffic is at peaks [11].

Sometimes even if there is no traffic then also people have to wait because there is a certain time limit of traffic signal. Therefore, road users have to wait until the traffic signal turned to green light .therefore we have to find new methods, which solve this problem [12].

Many methods have been developed to minimize the congestion level on the road but most of them either costly or less efficiency. Most used traffic system [14].

Smart traffic light or intelligent traffic lights are a vehicle traffic control system that combines traditional traffic lights with an array of sensors and artificial intelligent to intelligently route vehicle and pedestrian traffic [15].

With globalization and the need for mobility fueling traffic growth all over the world, the problem of congestion on highways and in cities is becoming more and more acute. Intelligent traffic management systems are helping people reach their destinations quickly and safely while at the same keeping traffic's environmental impacts in check. The goal of intelligent traffic management systems is to achieve improvements in mobility, safety and productivity of the transport system through integrated application of advanced monitoring, communication, display and control process technologies both in the vehicle and on the road [16].

Traffic light system is built to avoid road accidents that occur at major intersections. The systems of traffic lights at every intersection to some extent interfere with emergency vehicles to move smoothly into the emergency area [13].

The traffic lights are used mainly for pedestrians to be protected when they cross the roads. The normal function of traffic system is to control the coordination to ensure that traffic moves as smoothly and safely as possible. It was reducing collisions, both vehicular and pedestrians. It was encourage travel within the speed limit to meet the green lights [12].

Recent advances in hardware, software, and communication technologies are enabling the design and implementation of a whole range of different types of networks that are being deployed in various environments. One such network that has received a lot of interest in the last couple of years is the Vehicular Ad-Hoc Network (VANET). VANET has become an active area of research, standardization, and development because it has tremendous potential to improve vehicle and road safety, traffic efficiency, and convenience as well as comfort to both drivers and passengers. Recent research efforts have placed a strong emphasis on novel VANET design architectures and implementations [17].

Road safety has become a main issue for governments and car manufacturers in the last twenty years. The development of new vehicular technologies has favored companies, researchers and institutions to focus their efforts on improving road safety [18].

2.1.1. Vehicular Ad-hoc Networks (VANETs)

Traditional traffic management systems are based on centralized infrastructures where cameras and sensors implemented along the road collect information on density and traffic state and transmit this data to a central unit to process it and make appropriate decisions. This type of system is very costly in terms of deployment and is characterized by a long reaction time for processing and information transfer in a context where information transmission delay is vital and is extremely important this type of system. However, with the rapid development of wireless communication technologies a new decentralized architecture based on vehicle-to-vehicle communications (V2V) has created a very real interest these last few years for car manufacturers. Thus, a new concept was born (as shown in Figure (2- 1)) a vehicular ad hoc network (VANET), which is no more than a specific application of traditional mobile ad hoc networks (MANET)[19].

Vehicular Ad hoc Networks (VANETs) have recently emerged as a platform to support intelligent inter-vehicle communication to improve traffic safety. The road-constrained characteristics of these networks and the high mobility of the vehicles, their unbounded power source, and the emergence of roadside wireless infrastructures make VANETs a challenging and promising research topic [19].

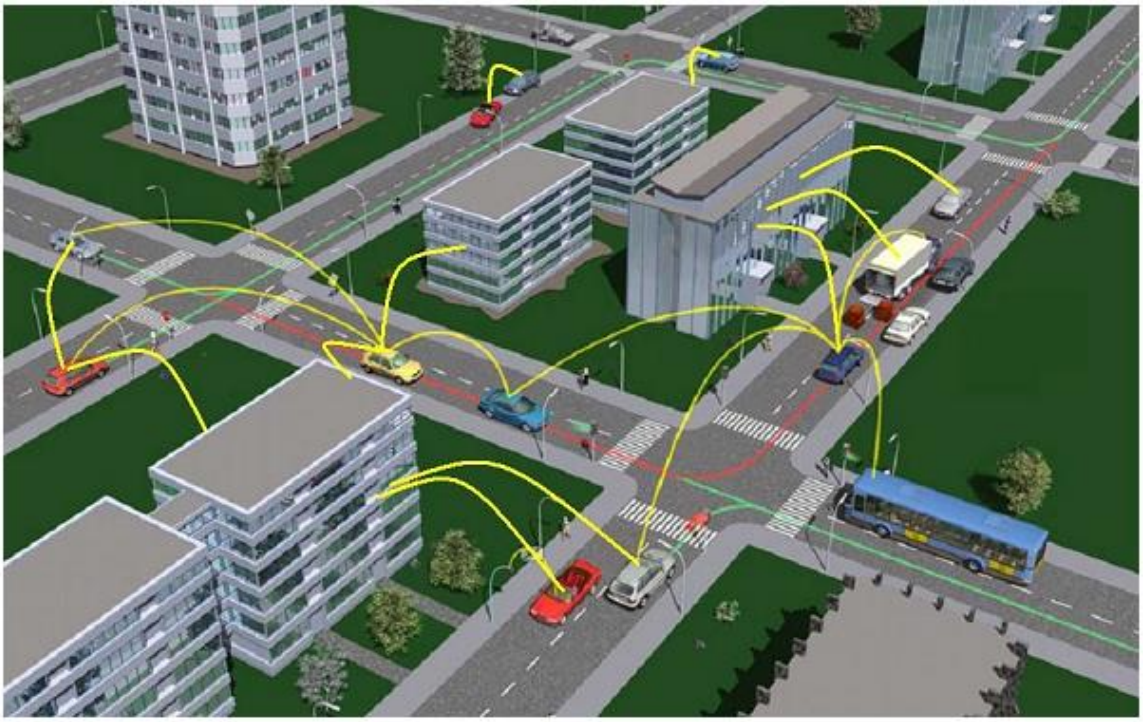

Figure (2- 1): Vehicular Ad-hoc Network.

2.1.2. VANET Communication Modes

There are four types of communications in VANETs, Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), Infrastructure-to-Infrastructure (I2I) and Vehicle-to-Vehicle and Infrastructure (V2X). Since V2I communications also require supporting infrastructure, V2V communications is the only completely distributed way of exchanging the traffic related information. (Figure (2-2)) show the classification of communication techniques that used in VANET [19].

2.1.2.1. Vehicle-to-Vehicle (V2V) systems

This category includes systems that require communication and cooperation with other similar systems in order to carry out their functions. Vehicle-to-Vehicle Communications is the dynamic wireless exchange of data between nearby vehicles that offers the opportunity for significant safety improvements [19].

2.1.2.2. Vehicle-to-Infrastructure (V2I) systems

This category includes systems that require communication and cooperation with the infrastructure in order to carry out their functions. Vehicle-to-infrastructure communications is the wireless exchange of critical safety and operational data between vehicles and highway infrastructure, intended primarily to avoid or mitigate motor vehicle crashes but also to enable a wide range of other safety, mobility, and environmental benefits[19].

2.1.2.3. Infrastructure-to-Infrastructure (I2I) system

It is wireless exchange of data between the two base stations. The base station will collect data from vehicle and processing will be done [19].

2.1.2.4. Vehicle-to-Vehicle and Infrastructure (V2X) systems

This last category includes systems, which feature the characteristics of both the V2V and V2I systems categories [19].

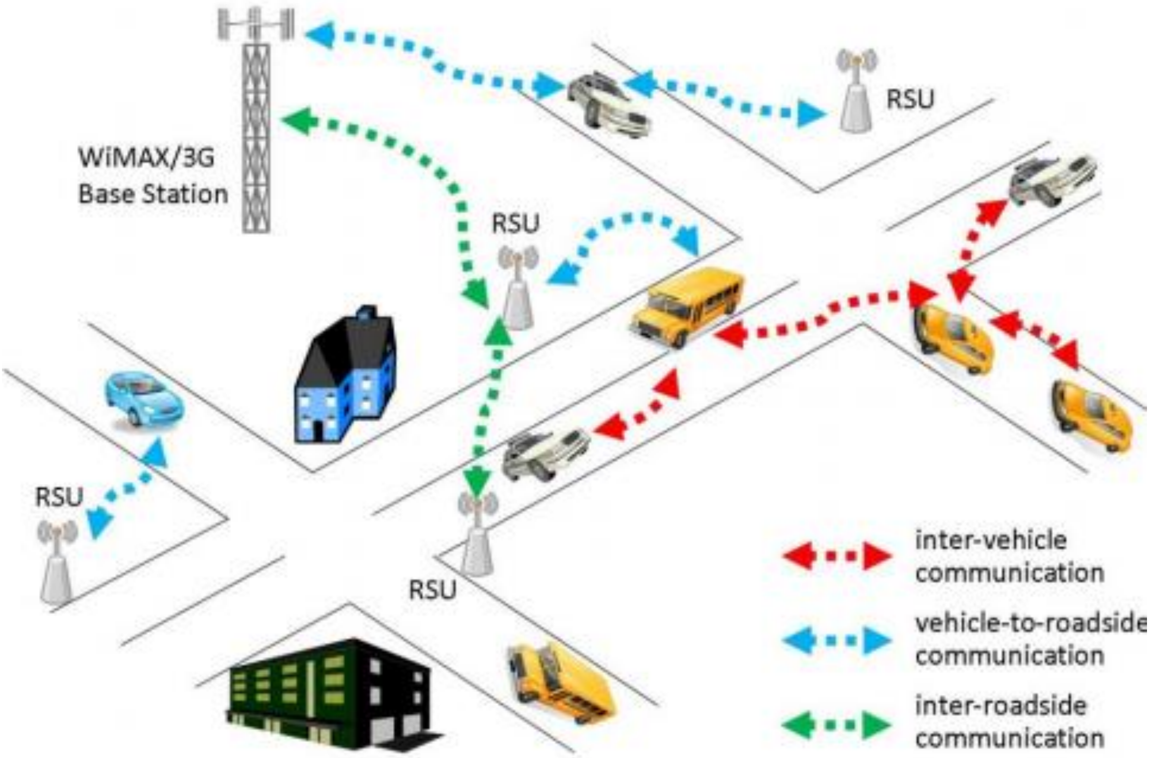

Figure (2- 2): Communication modes in VANET.

2.1.3. Applications of VANETS

The roadside unit (RSU) can be treated as an access point or router or even a buffer point, which can store data and provide data when needed [5]. All data on the RSUs are uploaded or downloaded by vehicles. A classification of applications is also done by as Car-to-Car Traffic applications, Car to Infrastructure applications, Car to Home applications and Routing based applications. The authors discussed the various attacks based on their classification. Based on the type of communication either V2I or V2V, we are arranging the applications of VANETs into following classes:

1. Safety oriented.

2. Commercial oriented.
3. Convenience oriented.
4. Productive applications.

2.1.3.1. Safety Applications

Road Traffic Safety -Work on reducing the number of fatalities/injuries on the roads by alerting the driver about dangers in advance. Safety applications include monitoring of the surrounding road, approaching vehicles, surface of the road, road curves etc. [20].

2.1.3.2. Commercial Applications

Commercial applications will provide the driver with the entertainment and services as web access, streaming audio and video [20].

2.1.3.3. Convenience Applications

Convenience application mainly deals in traffic management with a goal to enhance traffic efficiency by boosting the degree of convenience for drivers [20].

2.1.3.4. Productive Applications

We are intentionally calling it productive, as this application is additional with the above-mentioned applications [20].

2.1.4. Architecture of VANETs

VANET architecture mainly consists of vehicles (V), Road Side Unit (RSU) and Infrastructure Domain (I).Communication is conducted mainly by using wireless standards (e.g. IEEE 802.11p). RSU acts like a router and has high range (coverage) than vehicles range. Vehicles are installed with an On Board Unit (OBU) for communication. It is also installed with a Global Positioning System (GPS) for knowing its own position as well as for tracking other vehicles [20]. (as shown in Figure (2-3)):

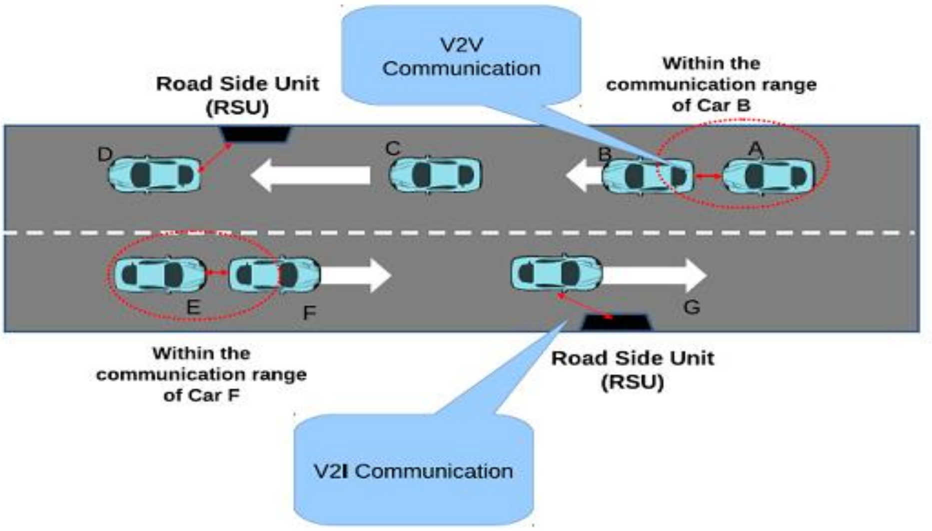

Figure (2- 3): VANETs Architecture.

2.2. Related work

Krajzewicz et al. Have used an optical information system (OIS) to gather the traffic characteristics of each area of interest[6]. Moreover, Jain et have installed fixed cameras at roadsides all over the area of interest. In OIS, video cameras have been used to gather the basic traffic data of each road segment. The gathered photos are analyzed regularly to detect high congestion scenarios in traffic flow. Indeed, this technology requires a significant number of camcorders, which are expensive to buy and to install. Significant algorithms and non-negligible time delay are required to analyze the gathered photos and to obtain the characteristics of each traffic flow. Moreover, to run the analyzing algorithms, powerful processors with adequate memory size are required. OIS clearly suffers from scalability limitations due to the zoom configurations of the cameras used. During nighttime or rush weather (i.e., foggy or rainy), there is no guarantee of obtaining good clarity in the detected photos. This affects the accuracy of the evaluated traffic characteristics [7].

R. Yugapriya, P. Dhivya, M. M Dhivya, and Mr. S. Kirubakaran aver proposed method to reduce traffic signal control problem to the problem of scheduling jobs on processor, and propose algorithm called the Greedy Forwarding Algorithm . To transfer the data faster .The information consists of Speed data which can be gathered from the vehicle speedometers, and position information data can be gathered using GPS receivers fitted to the vehicles. All the data encapsulated in one packet and broadcast over wireless medium. The jobs are subdivided into the equal size. Within 100m all the node the vehicle are called platoon. Nodes are subdivided into equal size platoon each jobs are scheduled under oldest job first algorithm . Then transfer a data from car to roadside sensor platoon the information passed to another vehicle. This second vehicle will check the information with platoon. By this checking, the fault information is detected. This Greedy forwarding algorithm is used to increase the data rate, throughput and decrease the load [8].

ECODE first evaluates traffic characteristics in terms of traffic speed, traffic density and estimated travel time of each road segment separately. The consideration of three different characteristics enhances the accuracy of the traffic evaluation at any road segment. In the case of inaccurate information derived from investigating any of these characteristics due to voluntarily slow-moving vehicles or inaccurate traffic density evaluations, other characteristics can help estimate the traffic situation accurately. This protocol has four phases [9] :

2.2.1. Dissemination and Gathering of Basic Traffic Data

Each vehicle broadcasts an advertisement beacon message periodically. The advertisement beacon message ,message declares the location, speed and travel direction of the sender vehicle on each road segment. Whenever any vehicle receives this message from the surrounding vehicles, it adds the basic traffic data of the sender vehicle to its Neighboring Table ; this is done only if the sender vehicle is located on the same road segment [9]

2.2.2. Road Segment Clustering

In this phase, each road segment is clustered into a set of virtual, adjacent and non-overlapping areas. Traffic characteristics are evaluated locally in each cluster. The number and size of these clusters are determined based on the length of the road segment as well as the transmission range of each traveling vehicle [9]

2.2.3. Local Traffic Evaluation

Each vehicle determines the cluster in which it is located; it also evaluates the traffic characteristics of that cluster zone based on its knowledge of the surrounding vehicles located within the same cluster [9].

2.2.4. Expanding Traffic Evaluation Area

In order to expand the area evaluated to cover the entire road segment, each vehicle aggregates the traffic evaluation of all cluster areas in such a road segment. Adjacent clusters can communicate directly by transmitting traffic evaluation reports that helps to obtain a more scalable traffic evaluation [9].

CHAPTER THREE

METHODOLOGY

3. Overview

This chapter explains the approach taken in order to achieve the objectives of this project and how the project is completed.

3.1. Implementation Practical of (ECODE)

According to previously study of Efficient Congestion Detection Protocol ,here we want to practical implementation of this protocol using flow chart (as shown in figure(3-1)) and represent the result of this implementation in chapter four using Matlab.

First determine the road length and maximum time in each road segment (assuming 24 one-direction road t , road length is 1000 m, and minimum allowed speed is 20 m/h), Second start of counting the road segment .If road segment equal 24,then compare between the maximum time and the estimated time, if the estimated time more than the maximum time that is mean the road is bad else the road is good. If the road segment not equal 24, determine the total speed, average speed, and estimated time then continue the counting.

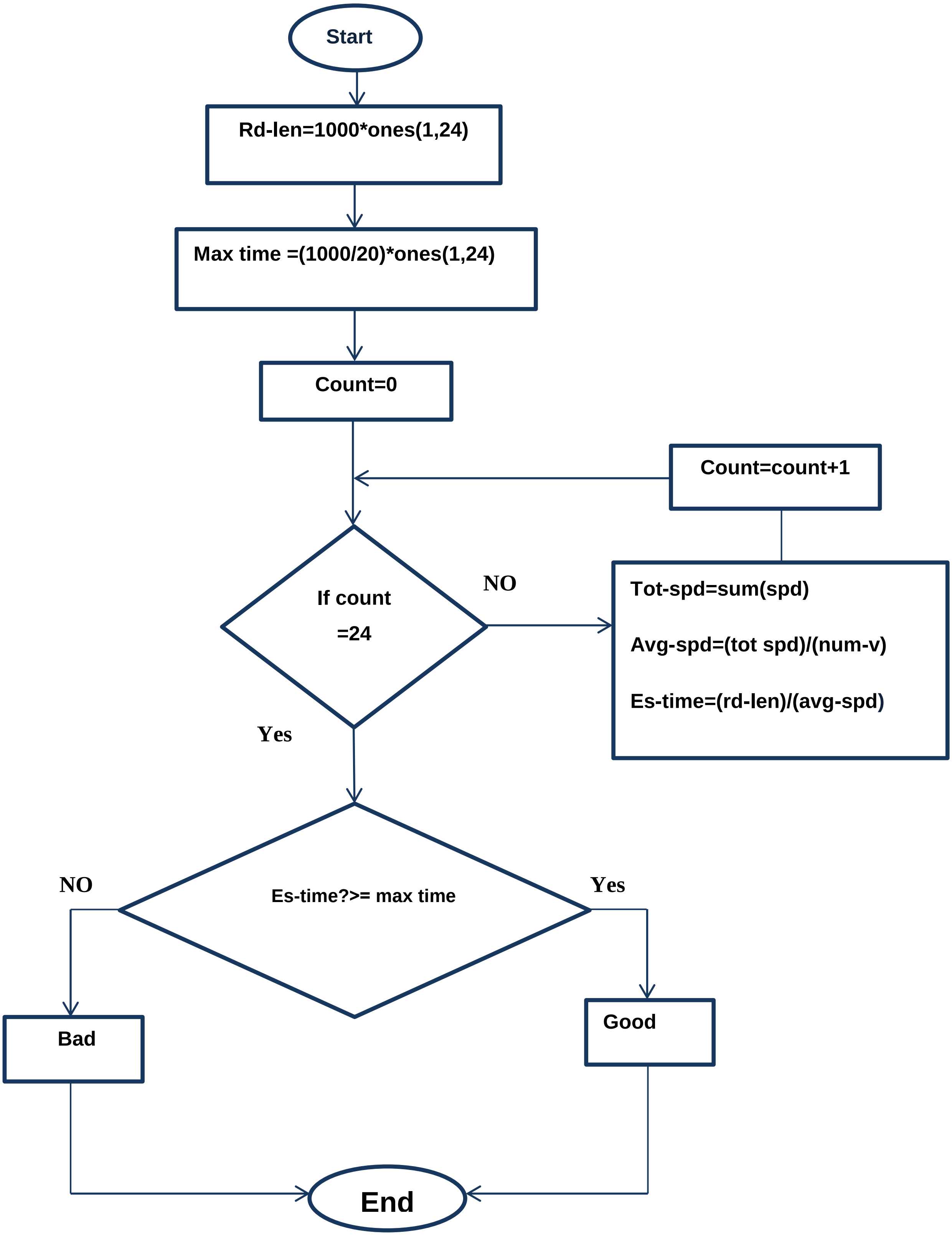

Figure (3- 1): Flow chart

3.2. Introduction of simulation

The traffic lights are used mainly for pedestrians to be protected when they cross the roads. The normal function of traffic system is to control the coordination to ensure that traffic moves as smoothly and safely as possible. There are traffic jams occur on main way in special seasons and rush hours. That was lead to a long waiting time of peoples and high cost of fuel consumption on the road. And in that delay the Emergency vehicles are stuck in traffic jams. Recently most of deaths are caused due to the traffic congestion [11]. Our simulation is divided into two section:

3.2.1. Congestion detection

Growing traffic on roads leads to unwarranted and unscheduled delays that have implications leading to loss of revenue and sometimes-even loss of life. This consideration has led to detection algorithms and offer solutions that aim to reduce unwanted effects [22].

This section detect congestion case using IR sensor , and control traffic light according to IR detection. (as shown in figure(3-2))

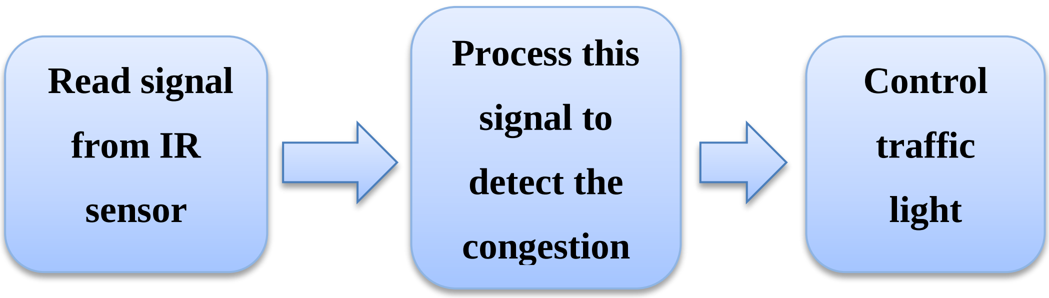

Figure (3- 2): Section one of congestion detection

3.2.2. Emergency case detection

Traffic congestion affect directly in emergency cases which lead to catastrophe. The emergency cases divided into ambulance and police car. ambulance could not go fast as because of traffic jams near to the traffic junction. Solution of this problem is to control the traffic system so that it would be helpful to protect someone's life ,also police car is stuck on the road and could not catch the thief on the time[11].

Second section(as shown in figure(3-3)) aim to detect emergency case by using RF identification and change traffic light situation to let emergency car to pass this intersection immediately.

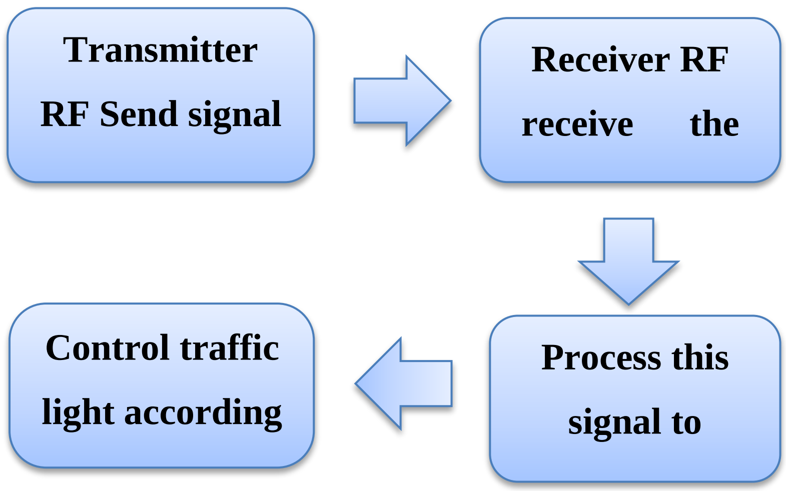

Figure (3- 3): Section two of emergency

3.3. Component of simulation

3.3.1. RF module

(as shown in figure(3-4)) An module of radio frequency module(RF) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system, it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequently (RF) communication. RF communication incorporates a transmitter and/or receiver.

Several carrier frequencies are commonly used in commercially available RF modules, including those in the industrial, scientific and medical (ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz these frequencies are used because of national and international regulations governing the use of radio for communication.

There are three types of RF module, first Transmitter modules that capable of transmitting a radio wave and demodulating that wave to carry data. Second An RF receiver module receives the modulated RF signal, and demodulates it. Third An RF transceiver module incorporates both a transmitter and receiver.

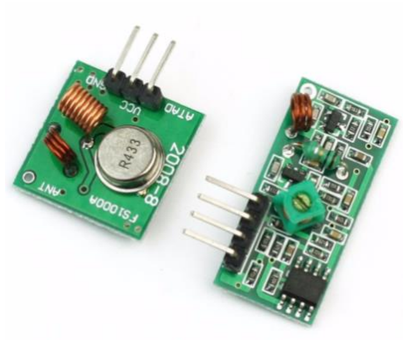

Figure (3- 4): Radio frequency

3.3.2. Arduino

(as shown in figure(3-5)) Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.it supports the languages C and C++.it able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

Arduino has some benefits: Inexpensive, Simple, Open source and extensible software and hardware.

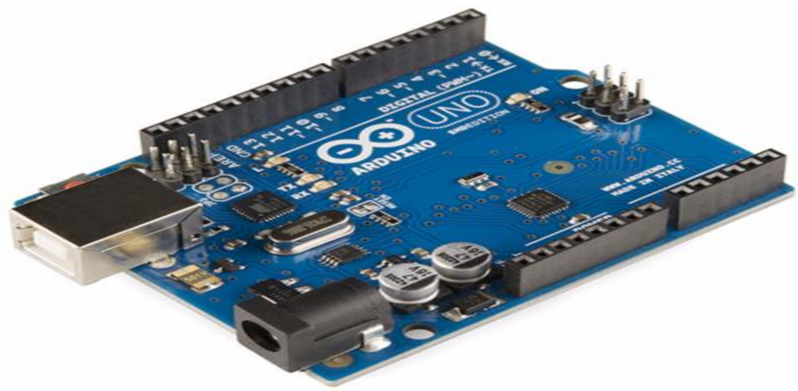

Figure (3- 5): Arduino

3.3.3. IR sensor

(as shown in figure(3-6)) infrared radiation is the portion of electromagnetic spectrum having wavelengths longer than visible light wavelengths, but smaller than microwaves.

The region roughly from 0.75µm to 1000 µm is the infrared region. Infrared waves are invisible to human eyes. The wavelength region of 0.75µm to 3 µm is called near infrared, the region from 3 µm to 6 µm is called mid infrared and the region higher than 6 µm is called far infrared. (The demarcations are not rigid; many define regions differently).

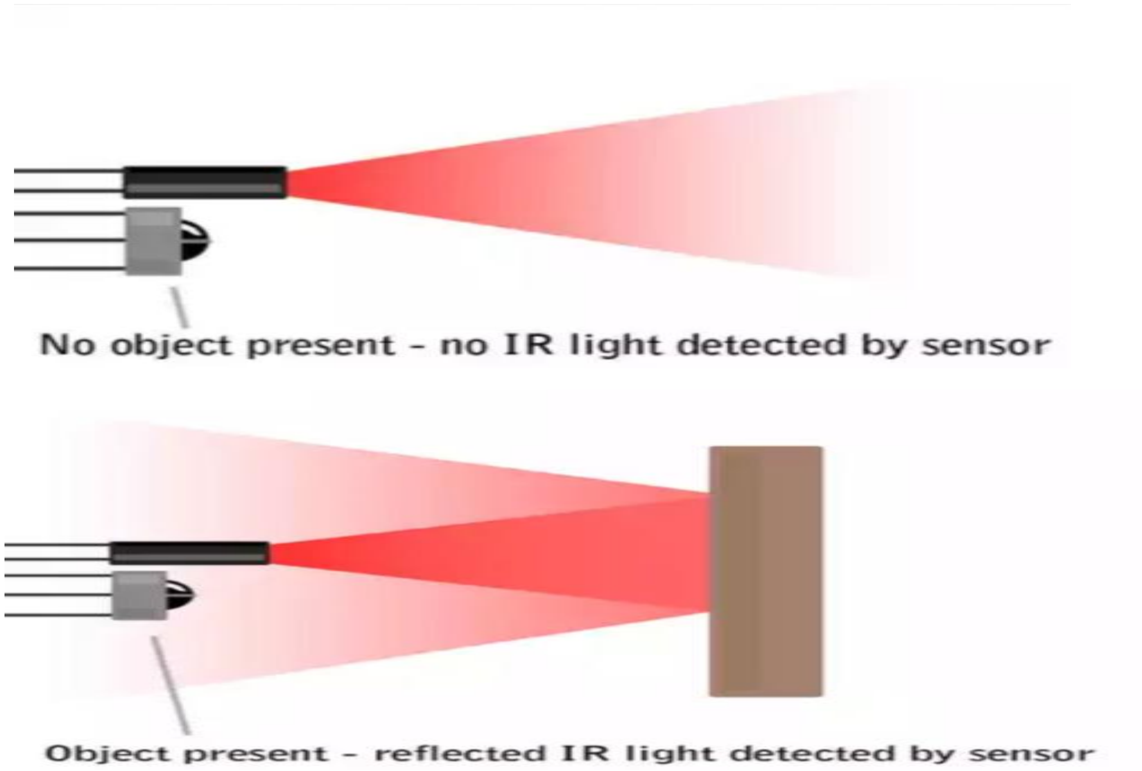

Figure (3- 6): Object detection via IR sensor

3.3.4. LCD

(as shown in figure(3-7)) A liquid –crystal display is a flat-panel display or other electronic visual display that uses the light –modulating properties of liquid crystal. Liquid crystal does not emit light directly. LCD are available to display arbitrary images (as in a general computer display) or fixed images with low information content which can be displayed or hidden ,such as pre-set words ,digits, and 7-segement displays ,as in a digital clock .they use the same basic technology, except that arbitrary images are made are made up of a large number of small pixels ,while other displays have larger elements.

LCD are used in wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays ,and indoor and outdoor signage.

Figure (3- 7): LCD

CHAPTER FOUR

SIMULATION PROCESS AND RESULTS

4. SIMULATION PROCESS AND RESULTS

4.1. Overview

This chapter describes and discusses the final outcome of this project and analysis that have been done to justify its function and to make sure it meets the objectives of the project.

4.1.1. Simulation Results

This part illustrate the results obtained from the simulation and describes each scenario.

4.1.1.1. System block diagram

Figure (4- 1): system block diagram

This simulation consists of:

- IR sensor detect if congestion occur and then send signal to the Arduino.
- RF transmitter send signal to RF receiver in emergency.
- RF receiver receives this signal and passes it to Arduino.
- Arduino receive this signals and change the traffic case according to that signals.
- LCD represents the current situation.

4.1.1.2. Configures of pins

Table (4-1) shows the Arduino pins that we used in our system.

Table (4- 1): Arduino Pins in System Function

Pin	Function
A.0	Receiver of RF (IN)
1	RXD of LCD(OUT)
8	Green LED(OUT)
9	Yellow LED(OUT)
10	Red LED(OUT)
12	Switch(IN)

4.1.1.3. Flow chart

(As shown in figure (4-2)) there are two cases must be considered when designing traffic light .first case, the emergency case must be considered in design steps. when the emergency occur that is detected when the RF transmitter send signal to RF receiver and it passes the signal to the Arduino which it controls the traffic light .

In congestion detection case the IR detect if road is congested or not by using IR sensor. IR sensor was installed at each road, if vehicles cross the IR signal then road is congested and traffic light switched to green light.

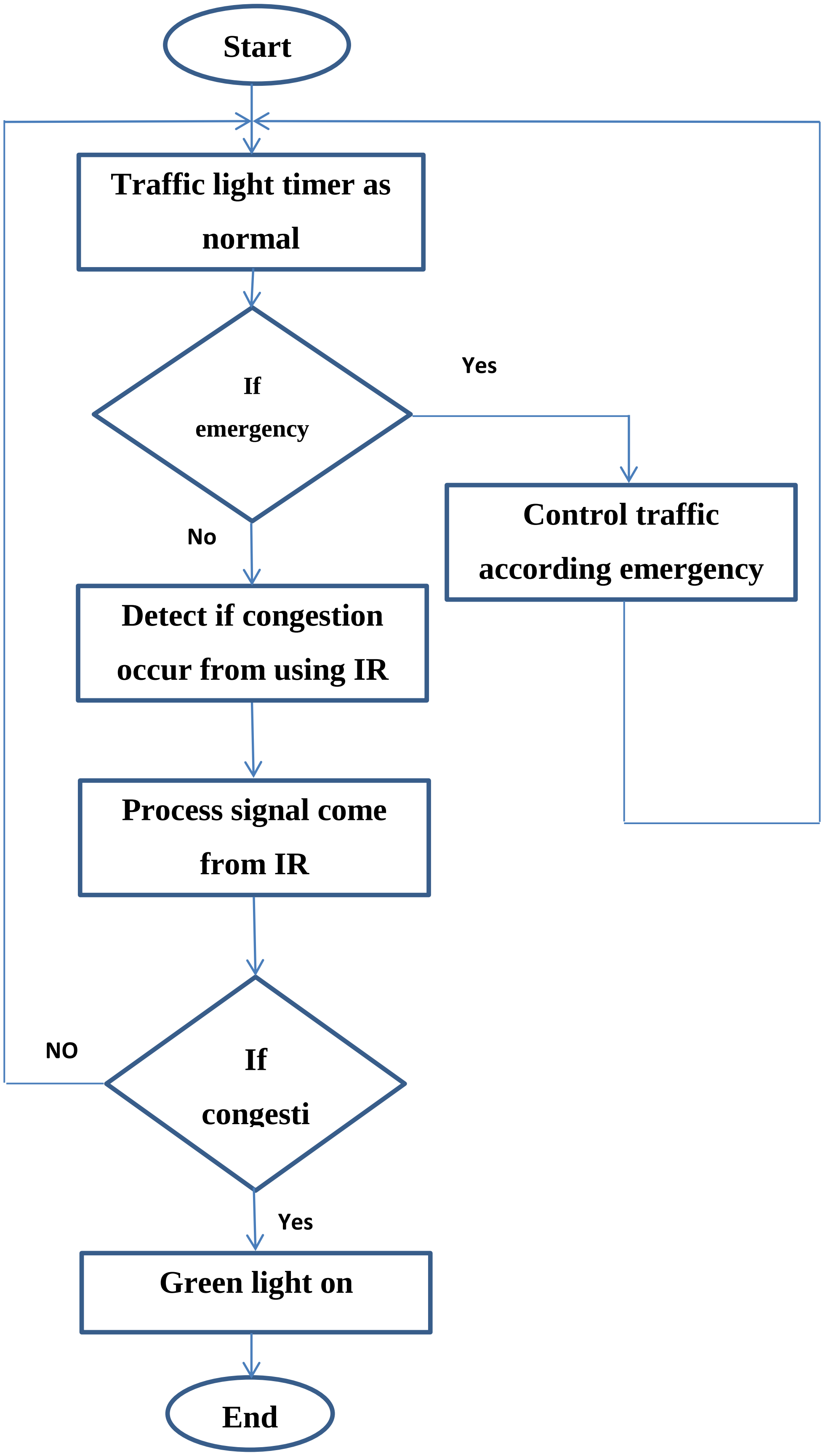

Figure (4- 2): Flow chart of simulation

4.1.1.4. Scenarios

- **Scenario 1**

When the traffic light timer as normal.

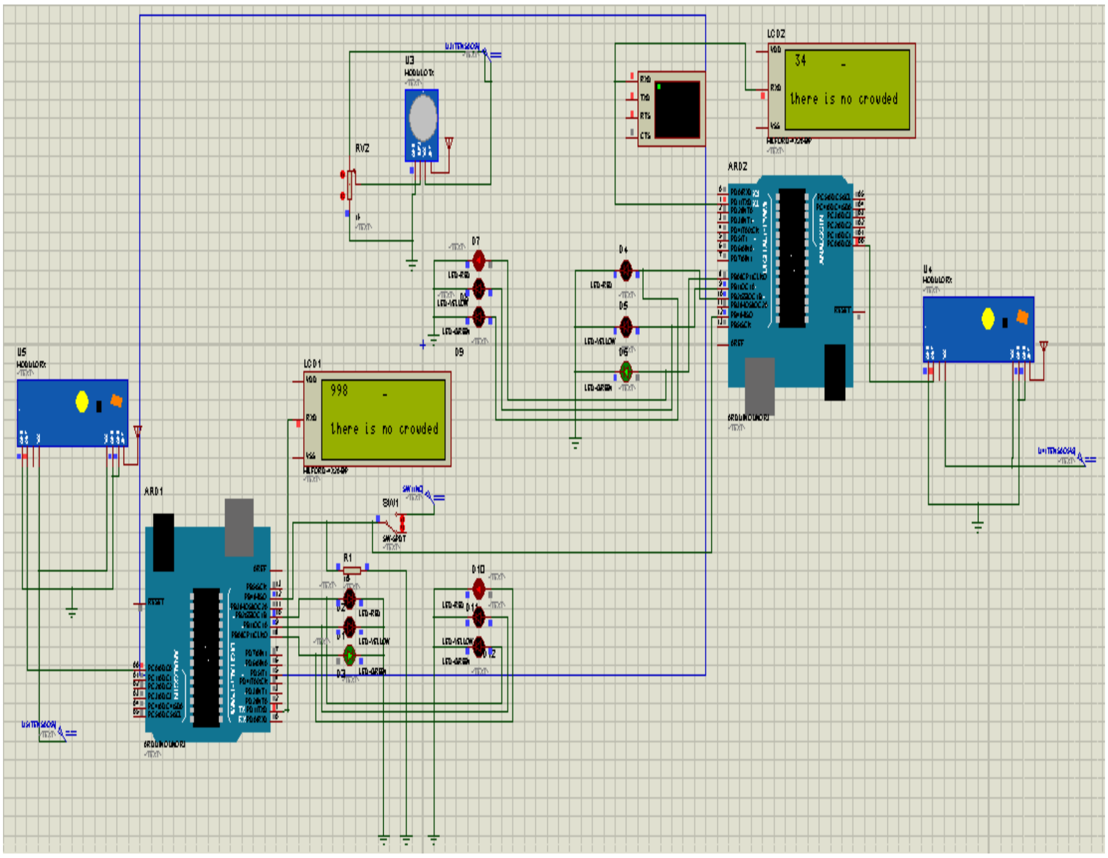

Figure (4- 3): Scenario 1

- **Scenario 2**

There is intersection of four streets the traffic light timer as normal, when emergency occur and the traffic light is red, the RF transmitter send signal to RF receiver and it pass this signal to Arduino, which open the green light.

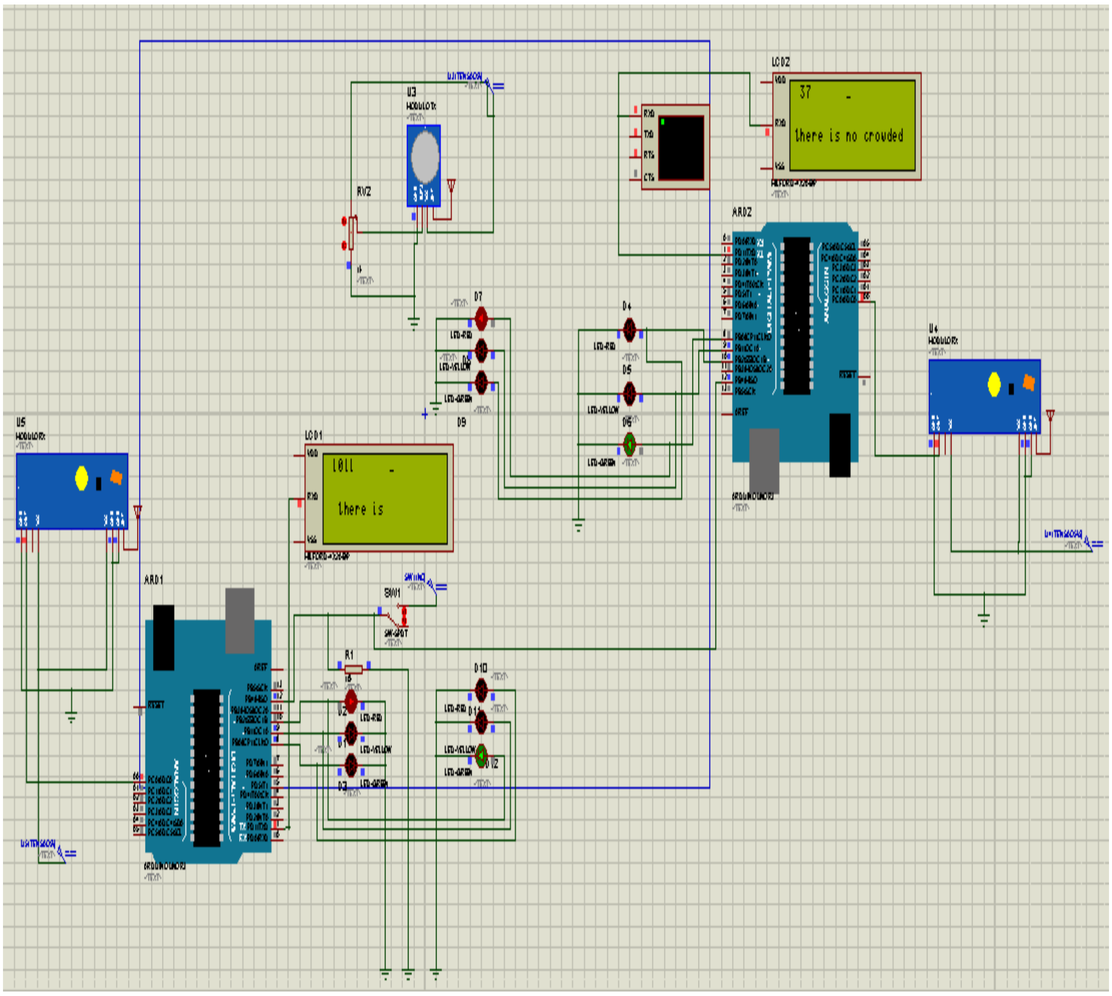

Figure (4- 4): Scenario 2

- **Scenario 3**

There is intersection of four streets the traffic light timer as normal, when IR sensor detects congestion and the red light on, the traffic light is green.

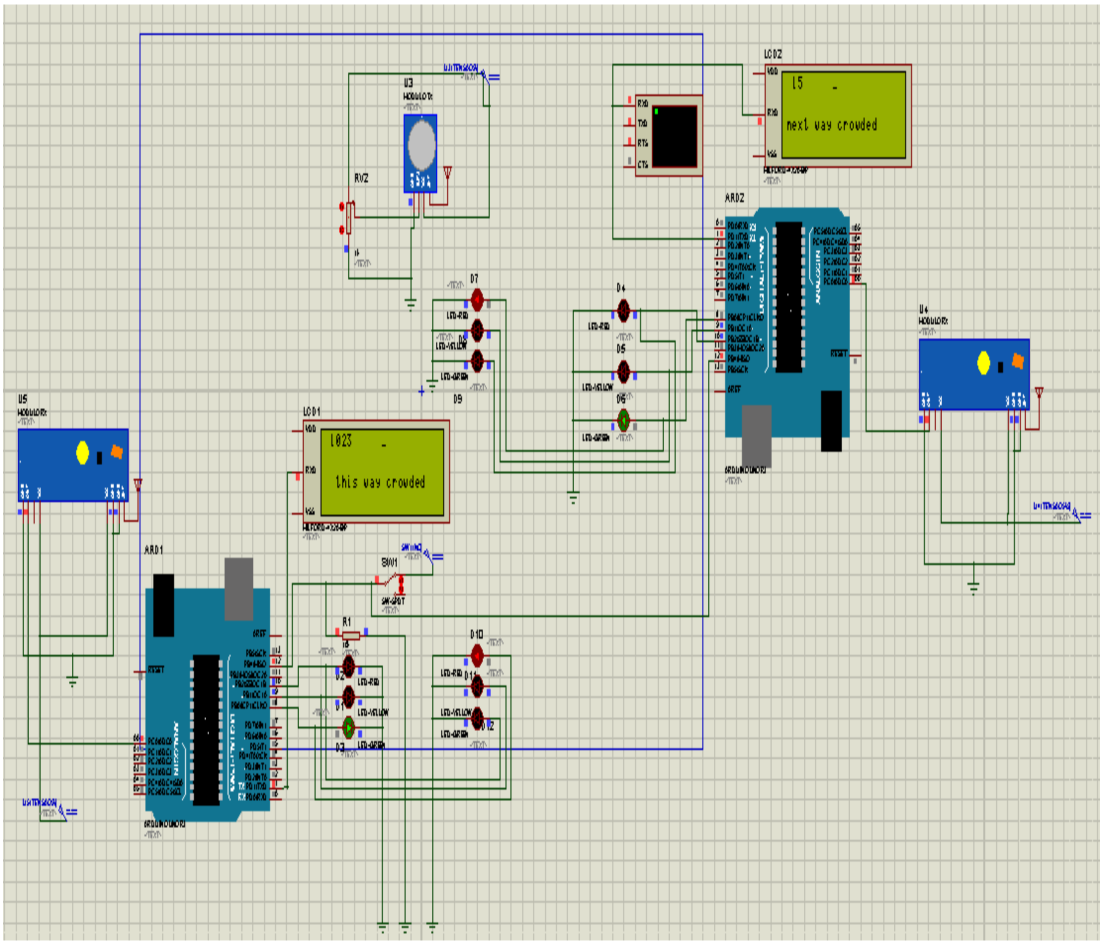

Figure (4- 5): Scenario 3

4.1.2. Matlab result of (ECODE)

edge 1

number of vehicle/s 12

speed 29 27 43 13 16   6 47 32 24 32 27 32

avg speed 27.3333

est time 36.5854

road is good

edge 2

number of vehicle/s 11

speed 36 26 50 11   5   5   3 20 22 18 38

avg speed 21.2727

est time 47.0085

road is good

edge 3

number of vehicle/s 13

speed 39 47 49 10   7 35   5 26 27 43 24 20 34

avg speed 28.1538

est time 35.5191

road is good

edge 4

number of vehicle/s 15

speed 16 10 4 18 8 1 23 7 13 21 11 22 12 21 21

avg speed 13.8667

est time 72.1154

road is bad

edge 5

number of vehicle/s 9

speed 1 17 21 14 10 41 21 44 20

avg speed 21

est time 47.619

road is good

edge 6

number of vehicle/s 15

speed 12 24 23 11 6 24 28 10 20 13 25 23 5 26 30

avg speed 18.6667

est time 53.5714

road is bad

edge 7

number of vehicle/s 10

speed 44 29 8 10 20 37 41 39 16 27

avg speed 27.1

est time 36.9004

road is good

edge 8

number of vehicle/s 2

speed 9 12

avg speed 10.5

est time 95.2381

road is bad

edge 9

number of vehicle/s 14

speed 25 9 25 7 3 43 28 46 35 29 41 44 49 0

avg speed 27.4286

est time 36.4583

road is good

edge 10

number of vehicle/s 17

speed 18 30 16 14 24   7 15 27 17 25 22 18   7 20   3 19 20

avg speed 17.7647

est time 56.2914

road is bad

edge 11

number of vehicle/s 15

speed 27 29 23 17 28 17   1   4 26 15 25   6 17 19   1

avg speed 17

est time 58.8235

road is bad

edge 12

number of vehicle/s 12

speed 18   2 24 10   6 10   7   9   2 32 14 27

avg speed 13.4167

est time 74.5342

road is bad

edge 13

number of vehicle/s 14

speed 25 27 22   6 25 43 44 14 10 28 32 21 10 47 avg speed 25.2857

est time 39.548

road is good

edge 14

number of vehicle/s 2

speed 9 12

avg speed 10.5

est time 95.2381

road is bad

edge 15

number of vehicle/s 3

speed 53 49   4

avg speed 35.3333

est time 28.3019

road is good

edge 16

number of vehicle/s 19

speed 11 11   1 13 14 15 13 12   8   3   6   2   0 14   5   4   5   7 10

avg speed 8.1053

est time 123.3766

road is bad

edge 17

number of vehicle/s 1

speed 72

avg speed 72

est time 13.8889

road is good

edge 18

number of vehicle/s 11

speed 43 17 22 3 9 33 17 45 6 49 27

avg speed 24.6364

est time 40.5904

road is good

edge 19

number of vehicle/s 14

speed 50 14 21 23 38 41 5 9 18 3 26 17 9 10

avg speed 20.2857

est time 49.2958

road is good

edge 20

number of vehicle/s 18

speed 20 14 27 3 22 22 17 6 18 9 4 6 27 2 7 2 13 0

avg speed 12.1667

est time 82.1918

road is bad

edge 21

number of vehicle/s 18

speed 6 3 9 14 3 30 10 9 2 9 1 15 23 19 3 2 23 27

avg speed 11.5556

est time 86.5385

road is bad

edge 22

number of vehicle/s 11

speed 5 41 17 15 37 1 2 33 30 26 36

avg speed 22.0909

est time 45.2675

road is good

edge 23

number of vehicle/s 14

speed 39 14 35 28 20 3 39 17 30 37 5 6 27 24

avg speed 23.1429

est time 43.2099

road is good

edge 24

number of vehicle/s 18

speed 24 22 2 2 3 24 28 21 4 22 3 4 19 10 20 22 17 22

avg speed 14.9444

est time 66.9145

road is bad

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

In the recent years, research in the field of vehicular ad-hoc network (VANET) is done extensively. VANET consist of large number of dynamically nodes, which are vehicles over a area. Different types of technology and applications are being developed for the VANET.

In this research, Simulation of congestion detection in urban areas is done by using PROTUES software tool to simulate circuit that used to detect jam in urban areas. This circuit consists of ARDUINO and IR senor as main components to detection. If IR senor detect the congestion, according to this signal AURDUINO control the traffic lights. In addition, controller the traffic light according to emergency status. ARDUINO identify an Ambulance or police car by RF transceiver.

According to simulation results, we can detect the congestion if it occur also we can make traffic light in green state at Emergency.

5.2. Recommendations

1. Evaluate congestion detection algorithm according to network statistics.
2. Use Passive Infrared Sensor instead of IR sensor because IR sensor cannot differ obstacles (vehicles, human,etc.).
3. We recommend simulating and implementing green wave case in urban areas.
4. Load balancing between several roads that can lead to the same destination according to the congestion.

5. Adaptive timming of traffic, as well as synchronization between traffic signals so as to smooth the traffic flow (i.e vehicles can start moving from the first traffic signal to the another without stopping on the next and so forth.

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References

[1] M. S. a. R. B. J. Gozalvez, "Vehicle to Infrastructure Communications in Urban Environments," 2012.

[2] R.Robinson, "problem in the urban environment :Traffic congestion and its effect " 1984.

[3] L. D. Baskar, B. D. Schutter, J. Hellendoorn, and Z. Papp, "Traffic Control and Intelligent Vehicle Highway Systems: ASurvey," 2011.

[4] V. Kumar, S. Mishra, and N. Chand, "Applications of VANETs: Present & Future " 2013.

[5] N.Kirthiga and Dr.S.Karthik, "Vehicular Traffic Re-Routing For Avoid the Traffic Congestion in VANET," 2016.

[7] D. Krajzewicz, E. Brockfeld, J. Mikat, J. Ringel, C, Rssel, W. Tuchscheerer, P. Wagner, and R. Wsler, Simulation of modern Traffic Lights Control Systems using the open source Traffic Simulation SUMO, 3rd Industrial Simulation Conference, Pages 299-302, 2005

[8] T. Yamashita, K. Izumi, and K. Kurumatani, Effect of Car navigation with route information sharing for improvement of traffic efficiency, Intelligent Transportation Systems, Pages 465-470, 2004.

[9] M. Y. S. B. Younes, "Efficient Traffic Control Protocols for Vehicular Ad-Hoc Networks," 2015.

[10] Vahedha and D. B. N. Jyothi, "smart traffic control system for clearance to emergency vehicles using Arduino software," 2016.

[11] M. A. Tank, H. Mewada, V. Choksi, and M. B. Potdar, "Review on Smart Traffic Control for Emergency Vehicles " 2015.

[12] M.H.A.Ilmudin, N.M.Z.Hashim, A.S.Ja'afar, A.Salleh, A. Ja'afar, and M.F.M.Sam, "Traffic light control system using 434MHz Radio Frequency," 2014.

[13] D. Sarkar, P. Saha, R. K. Das, and D. Roy, " A Smart Traffic Congestion Control Method," 2015.

[14] S.Sujatha and P.Soundeswari, "Vehicle Obstacles Avoidance Using Vehicle- To Infrastructure Communication," 2012.

[15] R. R. Nayak, S. S. K, A. S. Bagalkot, S. M. R. J, G. R. M, and N.Ramavenkateswaran, "smart traffic congestion control using wireless communication," 2013.

[16] S. Zeadally, R. Hunt, Y.-S. Chen, A. Irwin, and A. Hassan, "Vehicular ad hoc networks (VANETS): status, results, and challenges," 2010.

[17] C. T. Barba, M. A. Mateos, P. R. n. Soto, A. M. Mezher, and M. o. A. Igartua, "Smart city for VANETs using warning messages,traffic statistics and intelligent traffic lights," 2012.

[18]C.Diakaki, Markos Papageorgiou, I.Papamichail, K. Porfyri and I.Nikolos,G.R.Iordanidou , "Traffic Management for the 21 St Century," 2014.

[19] S. K. Gaur, S.K.Tyagi, and P. Singh, "vehicular communication ,survey Ad-hoc Network using vehicles," 2009.

[20] R. Patni and G. Jain, "Traffic Congestion Detection and Management Using VANET," 2016.

[21] D. M. M. and B. N. G, "Traffic Congestion Detection by Using VANET to Improve Intelligent Transportation System (ITS)," 2015.

APPENDIX

A.Simulation Code

```
const int buttonPin = 12;     // the number of the pushbutton pin

//const int ledPin =  13;      // the number of the LED pin

int sensorPin = A0;    // select the input pin for the potentiometer

//int ledPin = 13;      // select the pin for the LED

int sensorValue = 0;

// variables will change:

int buttonState = 0;

void setup() {

  Serial.begin(9600);

  // put your setup code here, to run once:

pinMode(buttonPin, INPUT);

pinMode(8, OUTPUT);

pinMode(9, OUTPUT);

pinMode(10, OUTPUT);

}

void loop() {

  String c="";

  for (int w=2; w >0; w--){

  for (int i=4; i >=0; i--)

{//updateDisplay(i, 9);

for (int j=9; j >=0; j--)
```

```
{int t =0;
  sensorValue = analogRead(sensorPin);
  buttonState = digitalRead(buttonPin);
  Serial.write(254);
  Serial.write(1);//delay(500);
  if(sensorValue>950&& sensorValue<990){
    t=1;}
    else{t=2;}
    if(t==1||buttonState == HIGH){
    digitalWrite(10, LOW);
    digitalWrite(9, LOW);
    digitalWrite(8, HIGH);
    }
    else{
  if(w==2)
  {if(i>0){
    digitalWrite(10, HIGH);
    digitalWrite(9, LOW);
    digitalWrite(8, LOW);}
    if(i==0){
    digitalWrite(10, LOW);
    digitalWrite(9, HIGH);
```

```
   digitalWrite(8, LOW);}}
   if(w==1)
 {if(i>0){
   digitalWrite(10, LOW);
   digitalWrite(9, LOW);
   digitalWrite(8, HIGH);}
   if(i==0){
   digitalWrite(10, LOW);
   digitalWrite(9, HIGH);
   digitalWrite(8, LOW);}}}
c +=i;
c += j;
Serial.print("  ");
Serial.println(c);
//Serial.print(j);
 if (buttonState == HIGH) {
   Serial.println("\n");
 Serial.print("_           this way crowded ");
 Serial.println("\n");
 //Serial.println(sensorValue);
 delay(100);
 }
```

```
 else{
   Serial.println("\n");
   Serial.print(" _          there is no crowded ");
   delay(100);
 }c ="";}}}
// Serial.print(" www.theelectronics.co.in");
 Serial.println(" ");
// delay(1000);
 // put your main code here, to run repeatedly
```

B.Congestion detections protocol

```
clear,clc,close all

  st=clock;

% assuming road length is 1000 m
  rd_len = 1000*ones(1,24);

% assuming minimum allowed speed is 20 m/h
  max_time = (1000/20)*ones(1,24);

% 24 one-diriction road (12 two-ways road)
  for iii = 1:24

% new line
  disp(' ')

% displays the road number
  disp(['edge ' num2str(iii)])

% genarate the values (number of vehicles and
vehicles speed) randomly
  [num_v spd]=gen_val(1);


% to display the values of (number of vehicles and
vehicles speed):
  disp(['number of vehicle/s ' num2str(num_v)])
  disp(['speed ' num2str(spd)])


% to calculate the total speed , average speed    and
estimated time:
  tot_spd = sum(spd);
  avg_spd = tot_spd/num_v;
  es_time = rd_len(iii)/avg_spd;



% comparing between the estimated time and time
threshold
  if max_time(iii) >= es_time
good(iii)=1;
    else
good(iii)=0;
    end
```

```
% to display the values of (average speed and
estimated time):
  disp(['avg speed ' num2str(avg_spd)])
  disp(['est time ' num2str(es_time)])


 if good(iii) == 1

% to display the evaluation
  disp('road is good')
    els
  disp('road is bad')
    end
  clear spd num_v
 end

  et=clock;
  tt=et-st
```