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MANAGE TRAFFIC THE SMART WAY USING IOT

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Master of Science

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MANAGE TRAFFIC THE SMART WAY USING IOT

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Salsabel Jaafar Obaid SULTANI

DEDICATION

I dedicate this research work and pledge it to my prominent supervisor in guiding me during this entire research journey, as well as to my family, specifically "my mother, my husband and my brother" to always help me in my difficult times, and I hope that this achievement in my academic career will be a mercy and joy for my father while he is in his grave.

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First of all I would like to thank my supervisor Asst. Prof. Dr. Abdullahi Abdu IBRAHIM for guiding and helping me along the way in writing this letter. Discussing my progress, problems and thoughts with my supervisor Asst. Prof. Dr. Abdullahi Abdu IBRAHIM several times helped me greatly in understanding the rationale behind the research. It made me better understand the technical need for this research work. He patiently explained to me a slew of things I needed during my research. Without his time and assistance, none of this research would have been possible, and I am grateful to him for giving me the opportunity to work on this interesting topic.

ABSTRACT

MANAGE TRAFFIC THE SMART WAY USING IOT

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Transportation today represents the city's vibrant nerve, which works to link events together and move from one place to another, and that any disruption in the city's transportation system leads to major traffic problems including congestion, traffic jams, delays in arrival time, and more fuel consumption, All this leads to a decrease in the luxury and comfort on the road for people, an increase in economic costs, as well as an increase in environmental pollution in the city, and most importantly, an increase in the number of ambulances that have problems getting to hospitals quickly.

Since manual traffic control by the policeman has not been shown to be effective. And the pre-set time of the signal in all conditions (high or low traffic density) did not solve this problem, unlike the intelligent transport system, which is one of the modern tools in the regulation and optimization of traffic. And now a model has been proposed to effectively solve the above problems using IOT as we know that IOT is the latest technology and is used in many things nowadays and it is very effective. When there is a sensor node and a primary node, the sensor node will be used to calculate the traffic in each lane and will send the information to the primary node which is equipped with the RFID reader which will work on a priority basis for the private cars and then the primary node will make a decision.

Keywords: IOT, RFID, Traffic Light System, IR Sensor, Microcontroller.

TABLE OF CONTENTS

LIST OF TABLES

Pages

LIST OF FIGURES

Pages

LIST OF ABBREVIATIONS

IoT	:	Internet of Things
WSNs	:	Wireless Sensor Networks
M2M	:	Machine-to-Machine
CPS	:	Cyber-Physical Systems
ITU	:	International Telecommunication Union
RFID	:	Radio Frequency Identification
IEC	:	International Electrotechnical Commission
ISO	:	International Standards Organization
LPWAN	:	Low Power Wide Area Network
SIP	:	Special Interest Group
QPSK	:	Quadrature Phase Shift Keying
IEEE	:	Institute of Electrical and Electronics Engineers
WLAN		Wireless Local Area Network
Wi-Fi	:	Wireless Fidelity
GSM	:	Global System for Mobile
SMS	:	Short Message Service
IMT	:	international mobile transport
PWM	:	Pulse Width Modulation

1. INTRODUCTION

1.1 INTRODUCTION

At the present time, science and technology represent the focus of progress in our current world, where we witness every day an innovation for an invention, design or a new concept where these inventions and designs are converted into devices that are implemented to meet human needs, such as mobile smart phones, smart watches, tablets, smart glasses and others. Electronic devices and all of these developments depend on the Internet, which is the main focus of digital technology. And the Internet became involved in the details of our lives, as people became more dependent on them and began to carry out their daily work easily through the Internet and among the most important activities (shopping, communicating with friends, transferring money and other things). The innovations that have combined these services and Internet devices contribute to Producing more inventions and new concepts. One of the most important and unique concepts of our time is the Internet of Things. The internet of things is defined and referred to as IOT as this term was designed by Kevin Ashton by Procter & Gamble in 1999 as a computing concept expressing the idea of the connection of various physical devices to the Internet and the ability of each device to identify itself to other devices. That is, it is a virtual network that combines the various things classified within electronics, software, sensors, and motors, and connects them through the Internet, which allows these things to exchange data between them. It is worth noting that the term “things” in the Internet of Things is not limited to inanimate objects and small devices only, as a “thing” may be a person carrying a surveillance device with him. This concept has contributed to solving many of the problems that caused great damage to human property and nature, and the most important of these problems is the traffic. One of the most important devices that contribute to regulating traffic at intersections are traffic lights, whether to regulate vehicle directions or pedestrian crossing, and you can imagine the world without traffic lights and how many accidents will occur in the absence of traffic lights. Continue to improve traffic lights; many smart traffic lights can monitor traffic conditions in real time including direction, size and intensity. Here we will explain the goal of developing a traffic light system that relies on traffic density by using the concept of the internet of things. The reason for choosing this project is that at the present time it has been proven that manual traffic control by the traffic man has not proven its effectiveness, and traffic control has become more difficult and this is due to the

Increasing human ownership of cars, now the family owns more than one car in addition to the great delay between traffic lights. Among the most important negative phenomena caused by traffic congestion is property damage (accidents) in addition to the air pollution that has been observed in recent years. Therefore, we chose a traffic system that works according to density (the number of vehicles on the roads) through this system based on the control unit that contains special sensors to measure density, and the most important of these sensors are infrared sensors.

1.2 MOTIVATION

The main goal of this research is to find an effective way to reduce the problems of vehicular traffic in intersections and it is clear that this problem has become a cause of tension for governments and citizens. Although many researchers tried to find many solutions, all of them had obvious flaws. In this thesis, the researcher relied on proposing a new concept, which is the design of an intelligent traffic control system using infrared sensors in traffic systems where an infrared transmitter and an infrared receiver are installed on both sides of the road. And the whole system can be controlled by the main control unit. In addition to the proposed system of traffic signal control unit that manages two way traffic lights.

1.3 PROBLEM STATEMENT

Wireless Sensor Networks (WSNs) and Machine-to-Machine (M2M) or Cyber Physical Systems (CPS) have evolved as integral components of the broader term of the Internet of Things. Thus, security issues related to WSN, M2M, or CPS continue to arise in the IOT context with IP being the main communication standard. Therefore, the entire deployment structure must be secured from attacks that may hinder the services provided by IOT as well as threaten data privacy, integrity or confidentiality. Because the IOT model represents a collection of interconnected networks and heterogeneous devices, it inherits traditional security issues related to computer networks. Restricted resources pose further challenges to IOT security because small devices or objects containing sensors have limited power and memory.

1.4 CONTRIBUTION

Traffic congestion at intersections has become common in all countries, especially in countries with high population density, in addition to many solutions that have been developed to solve this problem, as surveillance systems have been used in recent years, and the most important of these systems is video surveillance to control traffic. Previously there were many vehicle detectors and examples of these devices are ultrasound, radar and microwave detector. But these reagents are very expensive, with more difficulty in maintenance and less capacity, in addition to the difficulty in installing and implementing. One of the main disadvantages of radar sensors is that they are affected by metal barriers near roads. Another method of measuring traffic density depending on the section of road occupied was based on the frequency signals placed on both sides of the road, but this method was ineffective due to the need for manual work on the roads. Then, several innovations were made to predict traffic intensity, depending on image processing. However, these techniques were useless because they required high quality images whose quality depended on the weather, especially if the weather was rainy or foggy. But we now propose to design an intelligent traffic control system using infrared sensors in traffic systems where the infrared transmitter and infrared receiver are installed on both sides of the road, and when a car passes on the road between the infrared sensors, the system is activated. Where this system is activated by analyzing the information collected about the traffic density of the different road intersections in order to dynamically adjust the green light delays in the road that has a large traffic volume and the whole system can be controlled by the controller. In addition to the proposed system of traffic signal control unit that manages two way traffic lights.

1.5 AIM AND OBJECTIVE

The main goal of this research is to put in place an intelligent system to monitor traffic at intersections by overcoming many defects and improving traffic management in addition to that this proposal does not affect the basic rules of traffic that have been put in place by the state to maintain traffic laws. Among the objectives of this system are:

i. Use of minimum average cost resources to implement the system.

ii. Inspecting adjacent intersections, not just single intersections.

1.6 SCOPE OF THE RESEARCH

This research focuses on reducing the disruptions and problems that arise due to the density of vehicles in intersections by relying on the smart system that depends on the Internet of Things and wireless networks.

2. LITERATURE REVIEW

2.1 TRAFFIC MOVEMENT

Traffic is a general term referring to the movement of people, goods, vehicles and other means of transport. It moves on public roads either alone or with one another for the purpose of transportation or travel. Traffic is regulated by many laws, as organized traffic provides a safer and more effective movement. As for the accidents that cause disruption in the flow of traffic and traffic chaos, they are: construction work on roads, collisions and stone blocks on the roads. Traffic disturbance on a busy highway may lead to a phenomenon called (traffic waves), and a complete breakdown in the traffic system may lead to traffic congestion and a complete stop of traffic (gridlock).

2.2 TRAFFIC LIGHT

They are signal devices placed at road intersections or pedestrian crossings to regulate traffic flow and to control the flow of traffic safely by using colored lights according to an internationally agreed system. The traffic light is found in many cities in the world. All traffic lights are illuminated in two main colors, red for stop and green for passage. Red is often mixed with orange and green with blue to make it easier to distinguish from color blind people who cannot differentiate between red and green. It has been installed first traffic light figure (2.1) on 10 December 1868, outside the British Parliament in London. This signal was designed by a railroad engineer, "John Peake Knight", so this signal was very similar to the traffic lights of the railways at that time, so that it had two moving arms, one in red and the other in green, which was used to control with movement during the day, in addition to the gas lights that were used during the night. This signal was not operating automatically, but was controlled by a traffic policeman standing next to it all the time. This signal exploded two years after its installation specifically on January 2, 1869 AD and caused injury and in some sources killed the traffic policeman who was standing next to it.

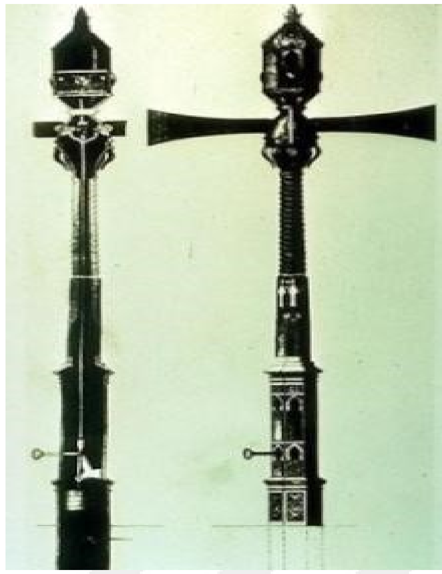

Figure 2.1: The first traffic signal device.

Traffic lights, similar to their current form, with electric lights and without arms, began in America in Utah in the year 1912. In 1914, the American company of traffic signals added an audible alarm to the traffic signal to alert the change in the color of the signal. After that happened "William Gigley of San Francisco" Patented the first automatic traffic signal device using red and green lights in 1917, and William's design was either an automatic or manual option, then in 1920, William Potts, a "Detroit" police officer, developed several automatic signaling systems including this first signal tri color adds a yellow warning light. These three lights let us know when it is safe to drive through the intersection, when to walk across the street, and when to stop, and they also allow motorists, cyclists and other pedestrians to take turns on their way figure (2.2).

Figure 2.2: The first automatic traffic signal device.

2.3 GLOBAL LAWS

International standards state that red should be at the top of the signal, followed by orange, and then green at the bottom. If the traffic light is installed transverse, the arrangement of colors differs according to the traffic rule, so the red lighting is on the left for countries that allow traffic to the right, and it is on the right in countries that allow passage to the left.

2.4 TRAFFIC LIGHT

A person is constantly searching for what provides him with his safety and protection from any dangers that he may face, and therefore we find that he has worked to create traffic signals, which provide him with this protection according to well-studied rules and regulations in which the transit of cars and pedestrians is regulated, so everyone is bound by what this sign states, so it is his right the crossing passes, and whoever has to wait is waiting for his turn, where traffic lights are valuable devices for controlling traffic.

2.4.1 The Most Important Features of a Traffic Light

i. It reduces the accidents caused by wrong traffic.

ii. It increases the ability to deal with traffic, especially at road intersections.

iii. It provides easy, fast and continuous traffic at a specific speed and in specific ways.

2.4.2 Types of Signals

The types of signals will be clarified, which are as follows:

2.4.2.1 Warning Sign

Warning signs are a term that is directly related to traffic culture, and it is a very important part of maintaining the safety of individuals and vehicles, and it is worth noting that people's commitment to these signals reduces the rate of traffic accidents by a very high rate, and warning signs are characterized by being in the form of a triangle with red borders, The signal located inside the triangle varies according to the nature of the warning to be indicated figure (2.3).

Figure 2.3: Warning signs.

2.4.2.2 Guidance Signals

These panels are used to inform the driver and all road users of traffic regulations and the various restrictions and prohibitions that must be adhered to while driving or using the road. These signs show traffic laws and regulations. Those who violate it are subject to violation and punishment. All guide signs are circular in shape figure (2.4).

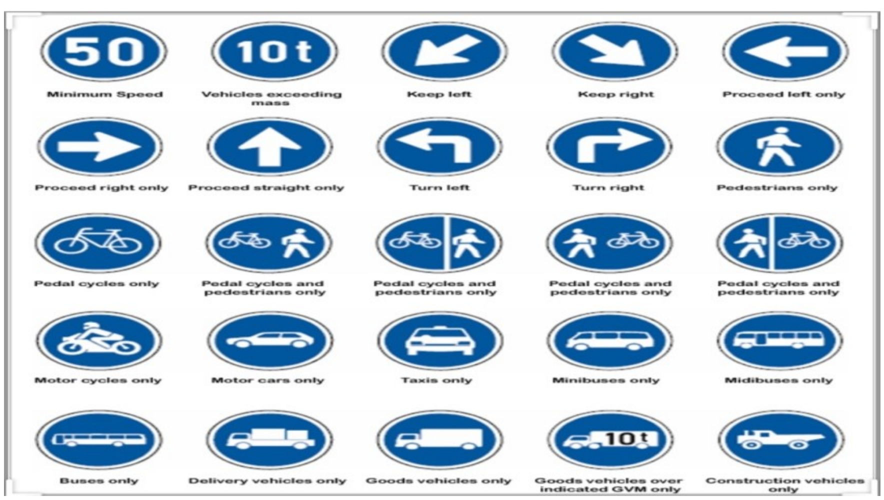

Figure 2.4: Banners guidance.

2.4.2.3 Information Signals

Information signs are used mainly to guide drivers and all road users along the streets and roads to cities, villages, streets and other important and necessary destinations. They are found at intersections to determine distances, directions, places of geographical, geological, historical, and religious and road service facilities. For most information signals, it is square or rectangular figure (2.5).

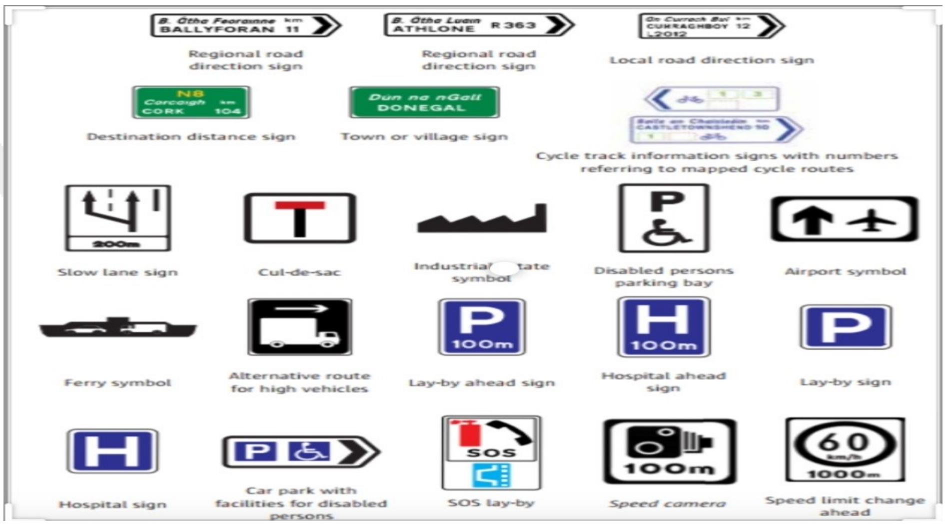

Figure 2.5: Information banners.

2.4.2.4 Traffic Lights

Traffic lights are used to regulate traffic, divide right of way and facilitate the smooth flow of traffic figure (2.6).

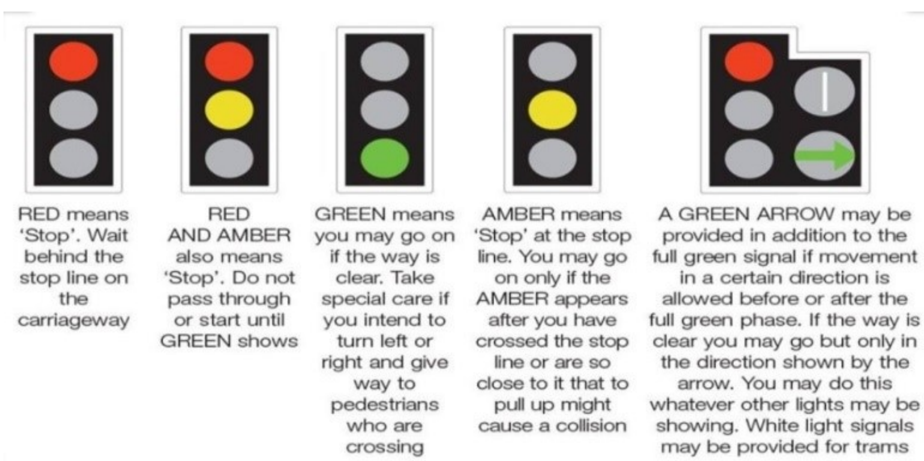

Figure 2.6: Traffic lights.

2.4.2.5 Signs Painted on the Road Surface

Signs painted on the road surface are used to direct and regulate traffic and help the driver to take the appropriate lanes while traveling. Signs painted on the road surface are binding, and the word "stop" is not binding figure (2.7).

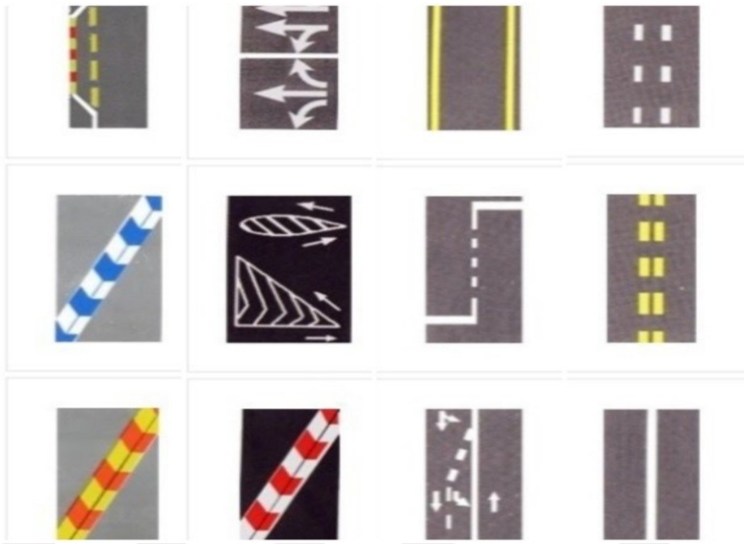

Figure 2.7: Painted banners.

2.4.2.6 Help Signals

It is binding, clarifies and insures problems in front of drivers, as it indicates obstacles, zigzags, paths or borders of the road edge, and it is reflective to light, as well as signs in the hands of workers, and they are auxiliary signs and are binding because they are legal signs figure (2.8).

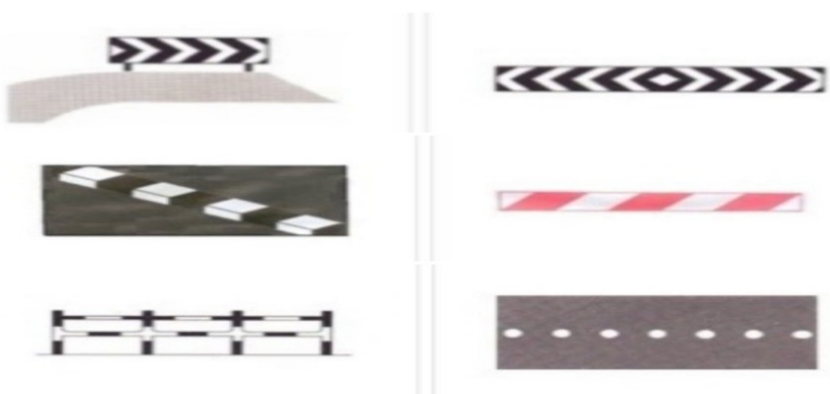

Figure 2.8: Help signals.

2.5 INTELLIGENT TRAFFIC SYSTEMS

The smart traffic system consists in employing modern technologies to increase the efficiency of transport systems and enhance traffic safety, as it relies on computer devices, information technology, communications and electronics to improve transport performance in cities and control to meet many of the challenges that we face in transportation. The proposed intelligent system can maintain dynamic timing of traffic lights by sensing traffic density to reduce congestion with the help of IOT equipped sensors which provide advanced and powerful communication technologies to citizens.

2.5.1 Advantages of the Intelligent Traffic System

i. Significantly improve road traffic.

ii. It replaces the traditional traffic management system.

iii. Low cost.

iv. High scalability.

v. High compatibility.

vi. Ease of upgrade.

2.5.2 Mechanism of the Intelligent Traffic System

An infrared transmitter and an infrared receiver are installed on both sides of the road, and when a vehicle passes on the road between the infrared sensors, the system is activated. As this system is activated by analyzing the information gathered about the traffic density of different road intersections in order to dynamically adjust the green light delays in the road that has a large traffic volume [1].

2.6 THE INTERNET

The history of the internet begins with the development of new electronic computers in the 1950s. The initial concepts of computer networks were developed in computer science laboratories in the United States and France. As the internet became more and more a part of our daily life. People use the internet in order to search for information, so the internet today is considered a tool that develops over time and one of the advantages of this tool is that it not only contains information, but it can provide us with new ways to access content and also communicate with people so we notice the emergence of new terms with each introduction of new technologies.

2.6.1 What Is the Internet?

The internet is a global communication system for transmitting data across different types of media, and it can be described as one of the largest computer networks in our world that works on connecting different networks, whether private, public, commercial, academic, or government networks by means of wireless technologies. It is a group of systems linked together [2] .The one of the most important Internet services:

i. E-mail.

ii. Audio and video conference services.

iii. Watch and download movies and games.

iv. Transfer data and share files.

v. Forums.

vi. Social network.

vii. Messages or instant chat.

viii. Online shopping.

ix. Financial services.

2.6.2 Number of Devices Connected to the Internet

The International Telecommunication Union (ITU) announced that the number of internet users in the world will reach 60% of the total world population by the year 2020. According to the statistics of the ITU, “the number of internet users in the world did not exceed 1% in 1995, while this percentage reached 7% in the year 2000 [3]. The "digital revolution", as it is called at present, was invented in 1989, and its users reached 3.2 billion people in 2015, equivalent to 43% of the earth's population. According to the union's data in 2016, the number of internet users in the Americas reached 65%, in the Commonwealth of independent states 66%, Africa 25%, Europe 79%, Asia and the Pacific 42%, and the Arab countries 41% figure (2. 9).

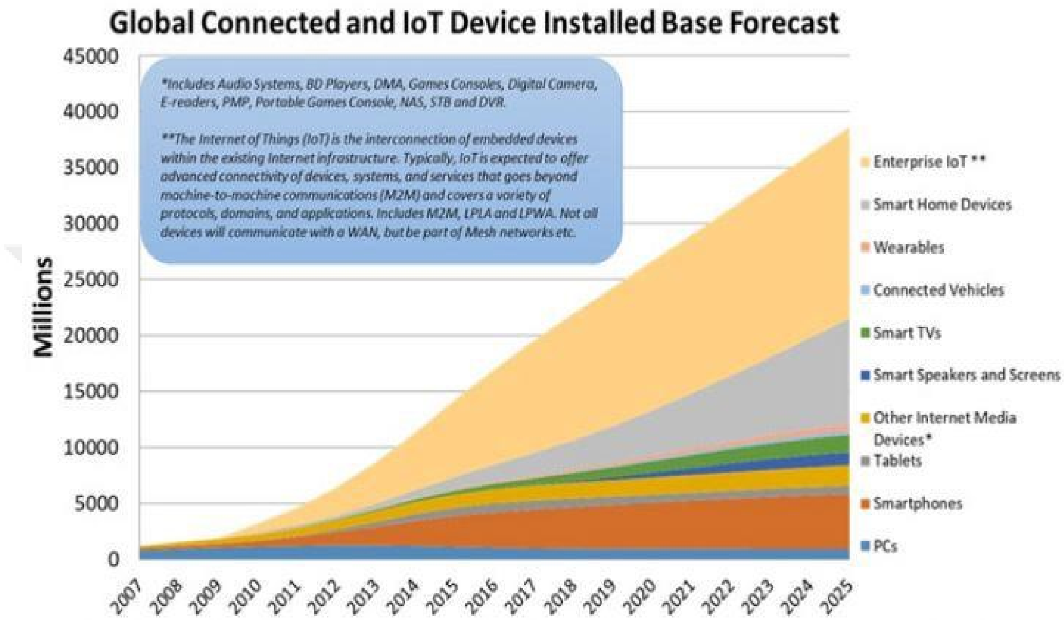

Figure 2.9: The number of devices connected to the internet [3].

2.7 INTERNET OF THINGS

The "Internet of Things" is a term that has emerged recently, referring to the new generation of the internet (the network) that allows understanding between devices interconnected with each other (via the internet protocol). These devices include tools, sensors, sensors, and various artificial intelligence tools, among others. That is, it is a virtual network that mixes many things that are classified within the fields of physics, programming, sensors and motors, as they work to connect them through this network and this work allows them to exchange data between them. It is worth noting that the term "things" is not related only to nonliving things, but may be "anything," meaning that the term includes everything that can return to mind. This definition goes beyond the traditional concept, which is that people communicate with computers and smartphones over a single global network and from within the well-known traditional internet protocol. In addition to that, the Internet of Things (IOT) was announced as a special portable computer concept that expresses that completely different physical devices connect to the network in addition to the flexibility of each device to identify itself to other devices. What distinguishes the Internet of Things is that it allows a person to be free from place, meaning that a person can control the tools without the need to be in a specific place to deal with a specific device. The required functions are performed through remote control of IOT devices, and then the data is shared within these devices through the network that uses standard connection protocols. The importance of the Internet of Things is evident in the coming years due to its activation in daily life. Due to the development of device technologies, the rapid growth of the Internet of Things continues.

2.7.1 Concept of the Internet of Things

The term Internet of Things describes a system in which the digital world is linked to the physical world that forms a global network Since the beginning of the Internet and the communications revolution, information has changed radically as it made a big leap in the world of the Internet, and the trend from the internet of communications to the Internet of things, which made it easier to communicate things and transfer data. When elements (motors, smart cards, sensors, and RFIDs) are connected to the internet, they will be called "smart things" because they will work smarter than things that are not connected to the Internet. The term Internet of Things has been relied on by many developers and researchers. The concept of internet expressions and the concept of the Internet of Things are contributed by users who do not have specialized knowledge in computer networks, but the two concepts are used to connect devices with each other and both are considered a means of transmitting data [3].

2.7.2 Common Concepts of the Internet of Things

Despite the widespread use of the term Internet of Things (IOT) in our world, in addition to proposing various definitions for this term, there is, to this day, no collective agreement on what this term actually includes, but the International Telecommunication Union suggested a definition that was more generalized and comprehensive for the Internet of Things (IOT) [4].
Internet of Things: It is a global infrastructure for all information that provides an advanced quality service through the connection of things (physical and virtual).
Thing: that is, an object from the physical world or the virtual world (information) where it can be identified and integrated into communication networks.

Devices: They are pieces of equipment that contain a feature that enables mandatory communication and the optional ability of sensing in addition to capturing, storing and processing data.

2.7.3 Characteristics of Internet of Things

The Internet of Things does have some characteristics [5].

a. Interconnected: It makes it easy for people to connect device and device to device.

b. Smart Sensing: All devices associated with the Internet of things are characterized by the ability to sense intelligently, as the sensor technology helps to create experiences through which it can reflect real physical perception, things and people.

c. Safety: When we talk about the characteristics or advantages of the Internet of Things, we must not forget about security as researchers and recipients of the Internet of Things where we must work and design for safety, the most important of which is our physical safety and the integrity of our data, i.e. creating a security model.

D. Intelligence: Devices connected to the Internet of things are characterized by the link of information to it, for example, it is controlled by a sensor and equipped with a self-learning feature, the possibility of self-rehabilitation and a thermostat there is cooperation between Cloud computing with Internet of Things where with the help of cloud computing billions of messages can be instantly processed.

E. Save Energy: IOT devices contain a motion detector that turns on the light when the device senses movement, as this can save IOT of energy.

F. Expressing: To facilitate better communication between humans and machines. The devices connected to the Internet of things must be able to be able to tell the status of the connected devices in the surrounding areas.

2.7.4 Confronts of IOT

Through our search in a series of articles on the Internet of Things, we come to an important station that talks about safety concerns and privacy in its uses [6].

a. Security: Security is considered one of the major problems with the Internet of Things because it refers to the preservation of information and data against users who try to steal it and it is considered more vulnerable than the wired network because the Internet of things depends on an aerial wireless sensor network, so the Internet of things is considered the most vulnerable because it directly controls the physical entities and are as important as a traffic control system, monitoring the patient's health, and others, so it is important to conduct a security check here.

b. Resource constrained devices: One of the characteristics of IOT devices is that they have limited resources, that is, their bandwidth is limited, and their devices have a low battery and small storage space, for example, sensors, data collectors, and actuators where it is difficult to perform computing tasks independently, so they work in cooperation with other similar devices.

c. Data understanding: The environment sensors and data collection for the Internet of Things are equipped with actuators, sensors and built-in devices, after which the information or data is analyzed automatically by comparing it with the data of other devices. The data is collected automatically through IOT sensors, but it is not automatically verified because it cannot automatically decide whether this collected data is correct or due to a sensor malfunction, but there is a solution to this problem by making the ability to query devices and link metadata. An example of a metadata is the data range, data type, permissible noise level, and data volume.

d. Limitations of bandwidth: We know that the frequency range of the wireless network is little compared to the wired network, so if the data is transferred over the network it must be exclusive to the useful data only now we know that our bandwidth is very limited, but when we enter the Internet of things(IOT) there are many and many devices connected to the Internet and you need More wide bandwidth, and because the sensors and actuators are generating a very large flow of data because they are constantly sensing the data, so limited bandwidth is a big problem.

e. Storage issues: One of the very difficult problems facing the Internet of Things is storage, because the way the Internet of Things works is to connect different devices with each other via a wireless network. Additional to that there are built in devices present in the environment that work on continuously sensing this environment and collecting data after that this is processed data and decision making, a lot of data will be generated that is likely to be endured and stored in any physical medium, due to the continuous sensing of the environment. This data may be called "big data", which has its advantages that it has multiple characteristics, speed and honesty. It turns out that the storage condition here is part of the problem, there is data that does not need to be stored, but there is data that must be preserved and stored for a few days, such as periodic data and device timers, while there are data that we need to store for a long time, such as decision making data, for this we need many policies that determine this data, how long it will be stored, and where it will be stored.

f. Privacy: We have previously talked about security, which is one of the aspects that refer to the integrity and confidentiality of data, and now we will present the other aspect that relates to the appropriate use of data, which is "privacy" this aspect is linked to the data that is disclosed by unauthorized persons or by non-real persons, i.e. inappropriately disclosing the data where these persons can access the data machine and take it, collect it, store it and use it after that it is disclosed in an inappropriate manner.Internet of Things devices produce vast amounts of data that make it easy for hackers to gain access to and access to someone's private data. One of the most important things that must be taken into account is the size of the sensors, as over time the size of these devices began to diminish until it reached that we could not see them with the naked eye, so people may not be able to know that their personal information has been infiltrated.

2.7.5 IOT Pattern Classification

There are three dimensions of Internet of Things (IOT) patterns [7].

a. Abstraction level: The stages of developing Internet of Things systems are divided into several main stages and be from most to the lowest gradient, as it is a design and architectural analysis of software and systems and detailed design and construction, according to this the patterns of the Internet of Things can be classified in terms of the level of abstraction into three types:

i. High: "Reference Structures" are considered among the architectural models that define the particular elements of architecture and their links to abstraction at a very high level without concern or consideration of delicate design issues.

ii. Middle: it is the opposite of reference architectures, as it works on designing a special architecture for Internet of things programs and systems in order to address all the architectural problems that appear frequently, such as the possibility of ensuring interoperability between all devices that are heterogeneous.

iii. Low: There are many detailed designs recommended to solve recurring design problems such as maintaining high scalability and enabling communication between program parts. These patterns target a specific procedure or limited specifics of the program, but not as a whole. Therefore, we considered that there is a decrease in the level of abstraction of design patterns, so we often use it in the stages of design and detailed construction.

b. Domain specificity: The importance of domain privacy has been determined to examine the applicability and re-use of all types of Internet of things, and it is composed of three types:

i. Specific IOT: Design patterns and IOT architecture that solve a specific problem such as the "healthcare problem" in addition to technical areas such as "the interaction between the computer and the brain".

ii. General IOT: It's design patterns and IOT engineering that apply to any IOT programs or systems.

iii. Any: Architectural patterns for software and general systems as well as design patterns that we can rely on in order to design IOT programs and systems in case their problems and contexts are similar to the problems and contexts of patterns.

c. Quality Characteristic: Program and system design patterns contain quality characteristics. Basically, Internet of Things (IOT) patterns must contain interoperability, which has been defined as a sub-characteristic of ISO / IEC 25010: 2010[8]. Here we use all the characteristics of quality but with the exception of the specific functional suitability found in ISO. / IEC 25010, which is considered one of the very acceptable models for software engineering and quality systems. In addition to this, there are other characteristics that have arisen but are not defined in ISO / IEC 25010, especially in imaging and operating the Internet of things.

2.7.6 Existing IOT Communication Technology

At this stage, although no solutions are available to them, there are a number of different communication technologies that have been proposed, but after what has been published around the world for several devices, short term and fixed communication standards will be used for most communications in order to achieve Internet of Things connectivity critical and massive Internet of Things via low power wide area network (LPWAN) or traditional cellular Internet of Things.

LPWA has been customized for Internet of Things applications because it has a unique feature that enables it to cover a large area, high energy efficiency, data rate, channel bandwidth, and low energy consumption. This technology is similar to the technologies that are currently used to connect controllers and sensors to the Internet without the need for cellular networks or traditional Wi-Fi networks.

Among the most important of these technologies are LoRa, SigFox, and Ingenu RPMA that the Internet connection to "things" was due to the stimulus of future demand in addition to the fact that cellular technology works to provide solutions to connectivity views of IOT devices like EC-GSM-IOT, LTE Cat-M1 and NB-IOT which works to improve use cases and enable the Internet of Things in the future. Currently, the LPWA network has been deployed for IOT applications, including building management system, smart cities, smart agriculture, etc. We will talk here about the prominent technologies of the Internet of Things and divide them. To short range networks, long range networks, and cellular technology [9].

a. LONG-RANGE networks: LPWA technologies are considered one of the most important technologies that provide long-range and low-power communication solutions for the Internet of Things. We will explain some of its popular sections that support MTC and are long-range. LoRa, which is a physical layer protocol as a technology in order to achieve low power, cost-effective and long-range communication, and in this technology we will rely on the wireless "LoRaWAN", which is a controlling protocol for access to the "MAC" media. The LoRa network depends on a private network, which is star to star that contains a peripheral device (node). This device can connect directly to the LoRa gateway from one hop and LoRa consists of the server, the gateway, the nodes (devices) and the remote end.

1. SigFox: SigFox[10] technology provides a low power, broadband network and end-to-end communication solution by relying on patented technologies using narrow band (UNB). Because

M2M connections need to transfer data efficiently in small quantities on low bandwidth, SigFox is well suited for this type of communication.

2. INGENU-RPMA: This technology is contrary to the previously mentioned LPWA technologies[11]. Ingenu RPMA technology is a proprietary technology with a number of regulations more flexible for use across different regions. This means that we can obtain more capacity and higher productivity compared to other technologies of similar scope[12].

3. DASH7: DASH7[13] is a low-power, long-range technology, and is an extension of RFID "radio frequency identification" the active[14]. Where it is possible to make a direct connection between devices. We can use DASH7 for narrowband modulation by using two GFSK levels in the SUB-GHz bands. This technology targets applications of a flowing nature and low-speed, as it supports multiple transfers, even if it is two periods by default, and it can also be extended too many hops.

4. WEIGHTLESS: Weightless is a modern wireless technology released by the Weightless Special Interest Group (SIP) with an open LPWA known as Weightless-P, Weightless-P, and Weightless-W, which have a low energy consumption. This technology has been used for television and radio, as it works on Enabling devices to use such domains as opportunistic users without interfering with the user's primary devices as authorized owners[15].

i. WEIGHTLESS-N: It is considered a UNB standard that supports the communication that is from the end device to the base station (unidirectional) and DBPSK modification scheme is used.

ii. WEIGHTLESS-W: This standard supports different modulation schemes such as 16-Quadrature Amplitude Modulation and Differential-BPSK, where the data rate reaches 10 Mbps.

iii. WEIGHTLESS-P: This standard is used to modify QPSK and GMSK in addition to achieving data rates per second of 100 kilobits. The main disadvantage of Weightless-N is that it supports connections that are one-way and thus limits the number of IoT applications that we can use. However, the fact that two-way communication is not supported extends the battery life for several years, being more than Weightless-W and Weightless-P.

b. Short range networks: This section introduces some of the technologies for short range wireless networks that are used to support short range M2M connectivity such as ZigBee, Bluetooth, and Wi-Fi that are low power. These technologies may not be able to support industrial, civilian, and other related IOT applications.

1. BLUETOOTH: Bluetooth was designed by relying on the IEEE's 802.15.1 standard for wireless communication in order to be used in short-range communications, i.e. [16]. between devices that are in the 2.4GHz ISM band [17]. This "Bluetooth" technology was originally intended to replace the existing wires in portable devices, so one of its disadvantages is the restriction of communication in the sense that the connection is only one, that is, between two devices only, as this technology is considered a solution for short range communications for IOT applications [18].
2. IEEE 802.15.4 AND ZigBee: This standard is the standard that has been adopted in Low Price Wireless Areas (LR-WPAN). Here we can use three bands of different frequencies with 914 MHz and IEEE 802.15.4: 868 MHz and 2.4 GHz and support 16, 10 and 1 channel respectively[19]. Each is in a 2MHz band, the supported data rate per second is 250 kbps. The main difference between LoRa and ZigBee is the topology options and connectivity bands where "architecture options" support networks, clusters and star topologies [20].
3. Wi-Fi: The first version of this Wi-Fi "Wireless Fidelity" technology was proposed by the IEEE "Institute of Electrical and Electronics Engineers" for wireless communication, but it was released without regard to the special applications of the modern Internet of Things. This "Wi-Fi" technology is designed to provide high-bandwidth communication between devices within a short range in order to provide a high throughput connection. Another name for this technology is "Wireless Local Area Network" (WLAN) as it is in the IEEE 802.11 series [21]. This network operates in the 2.4 GHz and 5 GHz spectrum bands [22]. Access points operate within 1 km coverage, but we can increase it and improve network and productivity performance by using many overlapping connection points in addition to taking into account congested areas. Research has shown that it is possible to intervene to improve low-power Wi-Fi through the alliance called "Wi-Fi HaLow" of M2M smart city [23].

c. Cellular technology: Future requirements related to IOT applications are a major driver driving the force of growth in cellular technology. This section presents the various typical transformations that have been developed for mobile phones, which have been used in order to improve the quality of voice communication and to provide opportunities to solve new communications for users with the aim of ensuring high quality and good service in every place where communication is achieved.

1. 2G cellular networks: The second generation (2G or 2-G), short for the second generation cellular network, because of the low digital data signal in its own range, second generation cellular digital systems (2G) have been introduced according to the GSM standard [24]. To use the 25 MHz spectrum within the 900 MHz range, the "2G" technology has been designed, which allows to activate the "operation" of many users in order to access the available wireless range and reduce the occurrence of any interference in the messages by dividing the 25 MHz band into a total of 124 a frequency of 200 kHz each [25]. From this we explain that there are three primary benefits of the second generation networks over their predecessors, namely:

i. Digitally encrypt a phone conversation

ii. More efficient use of the radio frequency spectrum, allowing more users for each frequency band.

iii. Mobile data services, starting with SMS.

2. cellular networks: The third generation of cell Phones cellular networks is short for "3G", for mobile phone standards and technology after the second generation. The third generation is based on the set of standards of the International Telecommunication Union within the framework of the international mobile transport program "IMT-2000", which is the official name of the ITU "International telecommunication Union" which is available for this generation's systems in order to provide wireless access to the infrastructure of the globally connected communications [26]. Advantages of 3G networks wide area cellular telephone networks, characterized by high speed internet access and the ability to video calls.

2.7.7 Future Challenges for IOT

Before the "adoption" of the Internet of Things can be nominated, there are implications and challenges that we must address [27][28].

a. Privacy and security: The use of the Internet of Things (IOT) of the systems that are partly important and of a wide range has made the need to address security and trust well. Therefore, the Internet of Things has become an important and essential element in the future of the Internet. Recently, challenges have been identified for trust and privacy, which are as follows: Quality of shared information for re-use through applications, providing trust, in addition to providing a secure exchange for information exchange between IOT devices and users, and providing mechanisms that protect devices vulnerable to "dangerous" penetration.

b. Interoperability: In the traditional Internet system, the primary value in it is "interoperability", provided that the connected systems have the ability to "speak the same language" for coding and protocols, as "interoperability" is the main driver of smart societies. Today, companies "industries" use many different criteria to enable them to support their applications. Therefore, IOT systems need a high degree of interoperability.

c. Data management: One of the important aspects of the Internet of Things is "data management". The handling of operations and data formed has become very important when thinking about exchanging types of information constantly.

d. Cost versus usability: The Internet of Things is using development "technology" to connect physical things to the internet. In order to develop people's dependence on the Internet of things, the components necessary to work such as tracking, control and sensing mechanisms must be rather inexpensive.

2.8 RELATED WORK

In this part, literary studies on the topic that have been proposed in this research are presented. These studies show some works related to traffic and ways to worry about its problems.

Researcher "Meenakshi Sundaram" and "Meghana N Swamy" presented search on improving the growing problems that everyone faces due to traffic congestion, as this system proposes to collect traffic information and control traffic signals at peak time through the use of major technologies, including: the Internet of things, receivers and transmitters of radio frequencies that through it, information about traffic is collected in addition to loading cells [29].

In addition to the research published by "Satbir Singh", where he proposed in his research how to effectively deal with traffic on the roads, where he said that we can control traffic congestion well, if we can estimate the number of vehicles passing through the intersection where the researcher stated that it is possible to calculate the number of vehicles passing through the road but before reaching the intersection by using the help of image processing techniques. After that the information is shared with the control center through the use of the Internet of Things [30].

The researcher "FAYEZ ALQAHTANI" presented the results of his research which referred to the work of the Internet of Things application and its relationship in improving the efficiency of intersection of roads for smart cities, this manuscript introduces the Classifier Matrix Recognition System (CMRS) to improve traffic in real time. This classifier matrix system performs an independent and identical analysis of the traffic images at the peak time and a decision factor is generated to infer its conclusion. Conclusion is presented as notice of response by connected IOT systems with users using applications with the help of road connections [31].

Finally the researcher "Popoola MO, Abiola SO, Adeniji W A" explained the solutions that we must rely on in order to reduce traffic congestion problems after he made many questionnaires on this topic and the result of the study was that the causes of traffic congestion are caused by "a lack of Road capacity, poor traffic management, bad driving habits, poor paving of roads, bad drainage system, poor intersections / turns, poor parking, shortage of pedestrian facilities, lack of parking, etc.". The researcher's solutions were to have wide spaces in order to park cars, expand the road, rehabilitate all roads that need attention and traffic education, establish a sewage network, reduce bus stops when necessary, and destroy all illegal buildings / shops [32].

3. METHODOLLOGY

3.1 INTRODUCTION

Traffic management is very important and hard work at the same time. Through the Internet of Things, solutions to traffic problems at intersections were obtained, as this purpose was the main goal of the research, as we focused on our reliance on WSN and IOT, where the Internet of Things (IOT) is one of the latest technologies and effective technologies. Which are widely used nowadays in addition to the use of wireless sensor networks (WSN), which are a group of sensors that are used to transmit or follow a certain physical or chemical phenomenon and then transmit information about the phenomenon wirelessly to the data processing center to take advantage of it without the need for a person in somewhere. There were side problems that resulted from the main problem, and among these side problems is the problem of ambulances not reaching hospitals quickly and the delay of private cars (VIP) in performing their tasks on time, as the main node will have a connected RFID reader that will read the RFID cards in vehicles and their type.

3.2 WIRELESS SENSOR NETWORK

The sensor network is considered one of the best technologies that have been established in the twenty-first century and started at an accelerated pace, as this network consisting of a group of sensors works in following up and transmitting chemical or physical phenomena present in the place and then transmitting the phenomena information wirelessly to the special center for data processing to take advantage of it from without the need for human intervention or presence in the place of phenomena. A wireless sensor network is an important means of interacting with the physical world [33]. The sensor network consists of three important components:

i. Sensing bodies.

ii. Sensors.

iii. Observers.

3.3 WIRELESS SENSOR NETWORK

Wireless sensor networks are a system that self-reconfigures and is distinguished by its response to external conditions. This network consists of several different nodes where it can communicate with each other wirelessly, in addition to that it contains smart and cheap sensors whose mission is to monitor the surrounding changes, then collect, process, and send them. To the monitors [34]. Wireless sensor networks are characterized by several advantages and a set of characteristics are as follows:

a. Wide spread: Wireless sensor networks are spread over large areas, and this urges us on Increase the nodes used within the field in which the sensors are located

b. Dynamic topology: Topology represents the form that allows the devices located within the network to communicate with each other. Therefore, the communication in the wireless sensor network must be dynamic due to the change of nodes, so the network must be able to self-adapt and reconfigure itself periodically.

c. High reliability: When configuring a network, one of the important things that must be taken into account is ensuring the confidentiality of the data that is collected and not being able to spy on it or steal it. This requires that the network be of high reliability.

d. Self-regulation: One of the most important features of sensor nodes is that they are self-regulating, meaning that they can reconfigure themselves based on network conditions without human intervention, because wireless sensor networks are exposed to different environments, that is, they face obstacles that cannot be predicted in advance, so we cannot guarantee the quality of wireless communications in all environments cannot determine the exact location of the nodes due to the presence of some environmental phenomena that cannot be controlled.

e. Application relevance: Wireless sensor networks depend on the application for which they are designed in order to be able to determine what you need from the software, hardware and communication protocols used. Therefore, application information must be integrated with the special administrative structure for wireless sensor networks in order to achieve network security and effective organization.

3.4 INTELLIGENT TRAFFIC CONTROL SYSTEM

The topic of the study of system design for traffic control is considered active as researchers try to devise new methods and different systems in order to solve this issue and by relying on some programs that help in estimating the number of cars and the waiting time for cars on intersecting roads. Many researchers from multiple disciplines collaborate in order to explore effective solutions to reduce traffic congestion problems at intersections, so many different methodologies have been presented in the literature at continuous times, and many of these proposed techniques have been implemented to realistically demonstrate their effectiveness, as well as to take advantage of technological technologies for computers and devices newly manufactured sensors in addition to the use of red radiation sensors [35].

A device that works as an infrared transmitter and another device that receives infrared rays are installed on the sides of the road. When the vehicles are traveling on the road on which the sensors are installed, the system activates, where the information will be collected and analyzed in order to know the traffic density on this road so that some dynamic adjustments are made to the green light delay in the high density road of cars by means of a Raspberry Pi controller that it can control the system entire. Here we are talking about the technology that has been developed for this problem and through the Internet of things, in this system there will be a basic Raspberry Pi node and a sensor node that will work at the expense of traffic on the road and then send the information to the main node that will in turn make the decision.

And because the high traffic causes a big problem for ambulances and private cars a RFID reader connected to the basic node was added [36], which works on reading the RFID card in cars continuously and comparing it to the database to search for ambulances and private cars on the road, as this technology helped solve the problem of emergency situations for private cars and ambulances, in addition to solving the main problem, namely traffic department.

3.5 PROPOSED SYSTEM DESIGN

The designed smart traffic control system conforms to the 4-road intersection, meaning that it operates in a "+" form as shown in figure (3.10). Our next step will be to extend our proposed system of traffic lights into a two-way intersection. Our goal in this research is to manage traffic signal systems for dual roads by equipping intersections with two traffic signals consisting of three colors labeled A and B for the flow of forward cars from roads 1 and 2 and on these roads the infrared receivers and transmitters are installed on both sides of them.

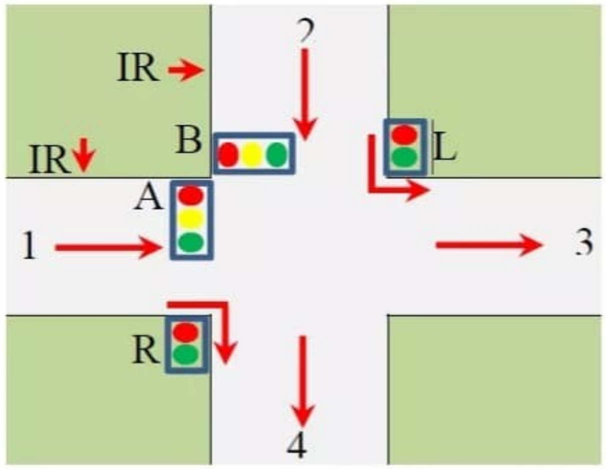

Figure 3.1: Intersection of 4 mono directional roads[1].

3.5.1 Traffic Light Configurations

In the proposed smart system there are two models that are presented:

For the first (first order), vehicles are allowed to drive from Route 2 to the opposite road, which is Route No. 4, as well as turn to the right side, which is Route No. 1, as for vehicles on Route No. 4, they can walk in the opposite direction, which is Route No. 2, and they can also turn into The right side is number 3.

As for the second model (the second arrangement), vehicles are allowed to drive from Route 1 to the opposite road, which is Route No. 3, as well as turn to the right side, which is Route No. 4, as for vehicles on Route No. 3, they can drive in the opposite direction, which is Route No. 1 It can also turn to the right side, which is No. 2. We have shown in table (3.1) the case of traffic lights A, B, R and L that these terms consist of three fields. An example is that A-G ON indicates that the signal A is lit green. This first phase of configuration corresponds to traffic lights A with green traffic lights and traffic L so that vehicles on Route 1 can drive through the intersection. The second stage is consistent with the warning where in signal A the yellow light is active for 5 seconds and during this period the red light of signal B and R are lit. As for the second form, it can be reversed, meaning the reflection of lights[1].

Table 3.1: Traffic light configurations during the two modes of operation [1].

first configuration		second configuration	
Phase 1	*Phase 2*	*Phase 1*	*Phase 2*
A-G ON A-Y OFF A-R OFF	A-G OFF A-Y ON A-R OFF	A-G OFF A-Y OFF A-R ON	A-G OFF A-Y OFF A-R ON
B-G OFF B-Y OFF B-R ON	B-G OFF B-Y OFF B-R ON	B-G ON B-Y OFF B-R OFF	B-G OFF B-Y ON B-R OFF
L-G ON L-Y OFF L-R OFF	L-G ON L-Y OFF L-R OFF	L-G OFF L-Y OFF L-R ON	L-G OFF L-Y OFF L-R ON
R-G OFF R-Y OFF R-R ON	R-G OFF R-Y OFF R-R ON	R-G ON R-Y OFF R-R OFF	R-G ON R-Y OFF R-R OFF

3.5.2 Density Traffic Light and IR Sensors

The main problem of the current traffic system is represented in the timing separators where these timing breaks are fixed inside the codes a system such as this system would be unable to find a solution to the basic problem. Moreover, congestion is observed in one way intersections only. This problem has been repeated in multiple states around the world where the employees used to drive traffic in the middle of cities from morning until evening, and in addition, the activity must be extended green light when the number of cars increases during the day, especially during peak hours, or reduce the green light activity when the flow of cars decreases, especially at night times. Therefore, we will use the infrared receivers and transmitters that will be installed on the sides of the road, which will in turn work on the detection of cars that passes through the installed path. The transmitter (infrared transmitter) generates regular, continuous, square wave signals at a rate of 38 kHz, while the receiver (infrared receiver), which is connected to the main control unit, is working to receive these rays. When a vehicle passes the road where these devices are installed, the infrared ray is reflected and then the system is activated. This system activation process is analyzed by the main control unit that calculates the number of road vehicle density. In fact, there are three modes suggested for the light transmission hatches for traffic: "soft mode crowded mode and normal mode" in the dynamic way, you switch between these modes we have shown in table (3.2) the timing periods for the three different types, where the intervals of time intervals range from (30, 50 and 15) seconds, and these times can be modified by the program. The initial stage of each configuration in the normal situation is equal to 30 seconds. However, if there is congestion in road 3 and road 1 has little traffic, then the beginning stage of the first configuration will reach 50 seconds, while the beginning stage of the second configuration will reach 15 seconds. The beginning configuration period, the vehicles on road 3 will move to their destination, while the vehicles on road 1 are stopped and jammed, when the second stage of the initial configuration begins, the infrared sensor on route 3 starts counting from five.

Table 3.2: Timing slots acquired by each configuration and achieved for the three modes of traffic [1].

Traffic Modes	Configuration	
	Phase I	*Phase II*
Normal traffic	30	5
Jam traffic	50	5
Soft traffic	15	5

3.6 EMERGENCY VEHICLES

Monitoring traffic in road intersections has become a cause of concern for cities, so in recent times many attempts have been made to sequence a traffic signal to make it become dynamic, meaning that it works according to its dependence on the volume of traffic at the same and to do so, sensors are used, but this proposal was restricted. Because it depends on the calculation of the number of vehicles, that is, it does not contain priorities for ambulances or VIP vehicles or firefighters, for this reason there was a disruption in the arrival of these special vehicles. In this research, we were able to solve the problem of controlling traffic lights by implementing a system based on RFID. Through this reader we will be able to take into account the priority of different types of vehicles passing at intersections. RFID has three main components: (RF reader and RFID tag and database). There are three parts of the tag: the semiconductor chip, the antenna, and some form of encapsulation. Also, there are many different types of signs, but they are divided into two types:

Negative signs (it does not contain an internal energy source) and active signs (it contains a battery as it is considered an internal power source and uses this energy to operate the microcircuits in addition to sending the information to the reader). The reader sends out electromagnetic waves that produce a current into the antenna of the tag. Antenna response reflects the information stored in it. We have three types of signs that operate on different frequency bands: Ultra-high frequency and high-frequency (as these frequencies lie between 3 ~ 30 MHZ and 300 ~ 3 GHZ respectively) and the low frequency (where this frequency falls between 30 ~ 300KHZ).

3.6.1 Purposed Work

Within the boundaries of our proposed work, there are 8 RFID readers in each intersection. The single road is divided into two lanes. An RFID reader is placed in each lane in order to track the vehicles passing through the lane. There is a database that stores vehicle information at every intersection with a time record and a traffic light. In addition, every vehicle contains a device. This device contains a RFID that stores the vehicle identification number (VIN).

Vehicle Identification Number: The RFID tag will store the vehicle identification number. This number is divided into three parts:

a. The first part, which is the priority of the vehicle

b. The second part, which is the type of car

c. And the last part is the car number

Priority we suggested that there should be a different priority for vehicles at intersections, as the total vehicles are divided into 4 groups:

i. The first group includes (fire engines, ambulances, and VIP vehicles).

ii. The second group includes (college and school buses and public buses).

iii. The third group includes (cars and bicycles of all kinds).

iv. The fourth group includes (heavy vehicles).

In the daytime, we made the priority for the third group high compared to the fourth group, but at night we made the priority for heavy vehicles that will be higher than cars and bikes.

There are 4 traffic lights in each intersection, as shown in figure (3.11), and in each lane there is a special RFID reader that works in order to store information about the vehicles passing through it [37].

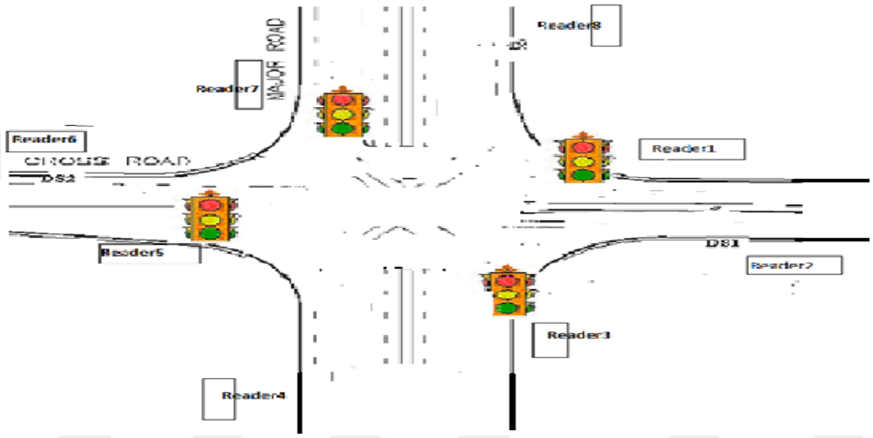

Figure 3.2: Structure of the Intersection & placement of the reader [37].

3.6.2 Intelligent Traffic Light Controller

Cities contain multiple intersections as shown in figure (3.12). Where the traffic light control unit follows the same circular sequence of lights schedule, but in the event that an emergency car is detected at any of the traffic lights, the control unit leaves the sequence table and creates the green signal for emergency car. There is another task for the control unit which is to calculate the time of the green signal depending on the car number, where a time limit is set for it, but in the event that this limit is exceeded, the light gets its turn.

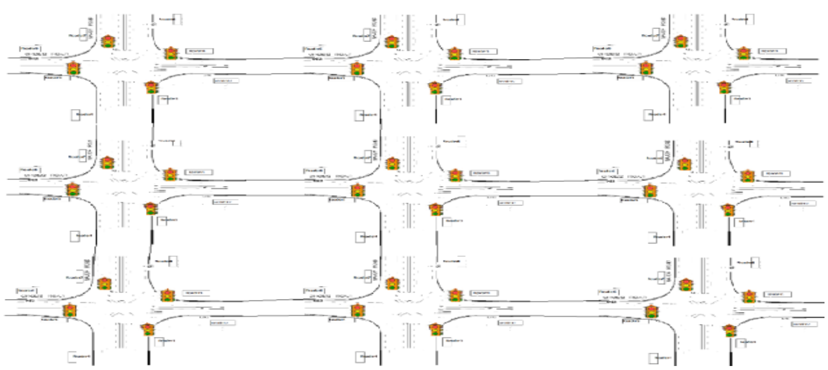

Figure 3.3: Structure of the city roads [37].

3.7 Hierarchical Urban Traffic Management Systems

The urban traffic management system is divided into three subsystems: "Traffic Control Subsystem, Sensor Network Subsystem, and Security Subsystem". The first system, which is the subsystem for the sensor network, collects traffic information at peak time, then it directs it to the traffic control subsystem, which works to manage traffic congestion for regular cars and emergency vehicles at intersections by using special algorithms, while the latter system will provide safety for the wireless traffic control system against abuse and jamming attacks figure (3.13) shows the hierarchical function of the urban traffic management system [38].

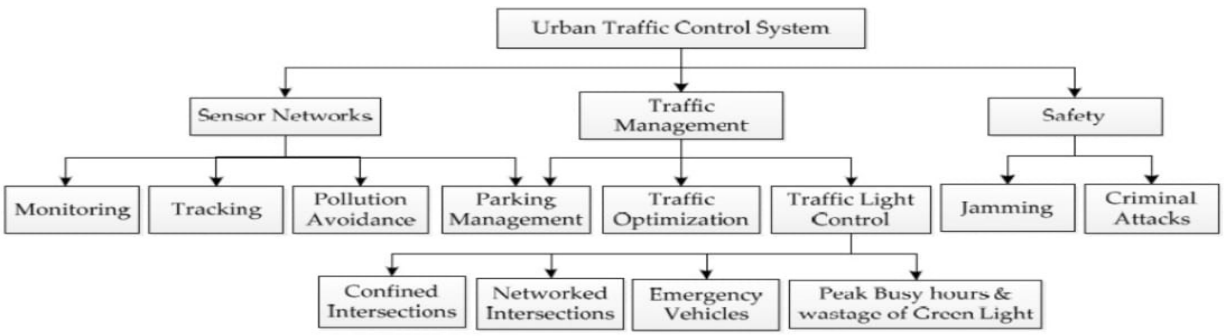

Figure 3.4: Hierarchical functionality of WSN based urban traffic management system [38].

3.8 PROPOSED SYSTEM COMPONENTS

3.8.1 The Sensor Node

The sensor converts natural physical information such as "temperature, speed, light, humidity, pressure, etc." into an electronic signal, where humans or control systems can understand this signal. The sensor node in the traffic control system consists of four basic units, namely:

i. The sensor unit: This unit acquires data.

ii. Processing and storage unit: This unit processes and stores all acquired data.

iii. Radio unit: This unit works on wireless data communication.

iv. Power unit: This unit supplies energy.

The radio unit located inside the sensor node, its communication range depends on some wireless communication technologies (Wi-Fi, Bluetooth, Zig Bee, etc.) [39].

3.8.2 The Central Node

The central node will collect data from all the sensor nodes connected to it wirelessly. After that, the central node will allow timing according to density. In addition, the central node contains a database for the storage process and will read RFID tags to identify the ambulances and emergency cars.

3.8.3 Raspberry Pi

In our project, we will be using RPI as the base node. Where the name (Raspberry Pi) represents the brand name of a series of small-sized computers launched by the (Raspberry Pi Foundation) in the United Kingdom, and the goal of launching these devices was to increase the culture of people in the field of computing. Raspberry Pi is a small computer that does not exceed the size of credit cards and has a low cost that we can connect to a TV screen or computer screen, and it can also connect a keyboard and mouse to it to facilitate control, it can perform many tasks such as surfing the Internet, creating spreadsheets, playing video and word processing [40].

Since its launch in 2012 until now, three generations of it have been launched, namely the Pi 1, Pi 2 and Pi 3, each consisting of models A and B. Model A differs from Model B in that the number of USB ports is lower and it has low memory. Exactly here, the latest version of it will be used, Raspberry Pi 3 Model B, which is a tablet that has many advantages over the previous version. This palette features:

i. Bluetooth 4.1 and Wi-Fi for connectivity.

ii. 4 USB 2.0 ports.

iii. CPU (1.2GHZ, 64-bit quad-core ARMv8).

iv. CSI camera port.

v. Full size HDMI video output.

vi. Audio output jack.

vii. Contains 40-pin GPIO for external delivery.

viii. Micro USB power input.

3.8.4 Arduino UNO

There are a lot of people trying to use arduino because it makes things easier. One of the most important characteristics of the arduino is that it is an open source, meaning we can program it or reprogram it at any time we want, in addition to its ability to communicate with electronic parts (sensors and motors) where it is possible through the arduino device to read the intensity of light, temperature, sound strength and humidity [41]. Will be considered Sensors are inputs to the arduino, after which the microcontroller will perform some operations depending on its programming and then the output the outputs. The arduino is like a board that is based on a 328 megapixel proprietary microcontroller and contains:

i. 2 keys Reset, ICSP.

ii. 6 (analog entrances).

iii. 14 digital inputs and outputs (6 of them can be used as PWM outputs).

It needs a USB cable that connects to the computer for the purpose of running it or via an AC-to-DC laptop or battery in order to continue working. Arduino Uno Board this is one of the first boards in the arduino USB series, here in our project we have used an arduino Uno in the sensor nodes so that through it the inputs from the sensors are received and sent to the main node.

3.8.5 Network Device

Every device in this project needs to be connected to a network in order to be able to communicate in the Internet of Things in order to achieve the connection of the sensor node to the main node, we need a wireless connection between the sensor nodes and the main node, and to implement this connection we need a network such as WIFI [42].

3.8.6 IR Sensor

The infrared sensor is an electronic device that works in order to feel the sides of the ocean, where the movement of objects and their temperature can be detected. This device contains two parts, the first is the transmitter that sends the wave, and the second device is the receiver that works on receiving the wave through the reflection of the infrared wave from the surface to be received by the receiver. This sensor will work for any object within its field of view. In our project, we use this sensor to detect the density of traffic as all the sensors are connected to the microcontroller [43].

3.8.7 RFID

RFID is a type of wireless network that depends on the modern method of barcode, and this method allows it the ability to "determine the items that are directly below the line of sight, in addition to the ability to determine the value of the items at the same time". One of the advantages of the RFID tag is that it is "small in size and has very little energy requirements" this makes it a simple, easy to apply and inexpensive branding[44].

4. RESULTS OF THE PROPOSED SYSTEM

4.1 INTRODUCTON

The testing and results stage is considered one of the vital and very important stages in all projects, research or scientific experiments. This stage is considered this important because through it the results are collected and then they are analyzed and then compared with other results that were taken by the researchers. There are many different variables and environments where we will prove here in this research the correctness or failure of our work. The scientific part of this research was built and implemented using MATLAB R2018a language to get the best results in the previous chapters, the design of the proposed system was completed. In this chapter, we will test the system, collect data on test results, and then analyze them. Here we will apply the proposed system by testing it in many different scenarios with different variables one from the other, and then collect the results that result from these tests. In the end, there will be studies of the results in addition to their analysis in order to know if this system has achieved thegoals for which it was designed.

4.2 TEST AND RESULT

After all the operations of the system and the translation mechanism were identified, then the system's ability to manage traffic was tested, giving priority to ambulances, emergency vehicles, and then police cars. The system was tested on three cases, meaning that we will divide the system into three main stages. Each stage is explained and discusses the situation that has been set (clarified in the system) by clarifying and describing the instructions that will be sent and received by the source and destination host.

4.3 ANALYSIS AND RESULT

In order to clarify the objectives of this thesis, several different scenarios were implemented, the

```
clear,close,
X=[14.9,10.3,8.5,17]; Y=[6.5,16.5,8.2,15];
% uicontrol('Style', 'pushbutton', 'String', 'flashY','Position', [16 5 2 0.5], 'Callback', 'cla');
load Data
traffic = 0;
ambulance = 1;
police = 1;

%% traffic lights are controlled from menu now
if traffic == 0 && ambulance ==1 && police ==1
implay(scenario4)
elseif traffic == 0 && ambulance == 1 && police == 0
implay(scenario2)
elseif traffic == 0 && ambulance == 0 && police == 1
implay(scenario3)

elseif  traffic == 0 && ambulance == 0 && police == 0
implay(scenario1)
elseif traffic == 1 && ambulance == 0 && police == 0
implay(scenario5)
end
```

purpose of which was to test the results in addition to testing the proposed system if it was valid and ready to implement in the first scenario.

It will be clarified if an ambulance is available on route 2 and a police car is available on route 4 and there is a traffic jam on route 1 and 3, we will notice that the priority will be for the ambulance and the police car, where the green signal will indicate that traffic is allowed on routes 2 and 4, while the other roads will have a red traffic signal that indicates that no traffic is allowed figure (4.14).

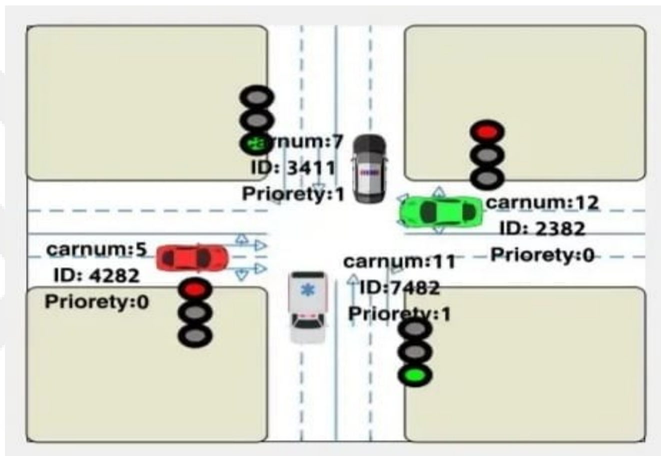

Figure 4.1: First scenario system.

In the second scenario

```
clear,close,
X=[14.9,10.3,8.5,17]; Y=[6.5,16.5,8.2,15];
% uicontrol('Style', 'pushbutton', 'String', 'flashY','Position', [16 5 2 0.5], 'Callback', 'cla');
load Data
traffic = 0;
ambulance = 1;
police = 0;

%% traffic lights are controlled from menu now
if traffic == 0 && ambulance ==1 && police ==1
implay(scenario4)
elseif traffic == 0 && ambulance == 1 && police == 0
implay(scenario2)
elseif traffic == 0 && ambulance == 0 && police == 1
implay(scenario3)

elseif  traffic == 0 && ambulance == 0 && police == 0
implay(scenario1)
elseif traffic == 1 && ambulance == 0 && police == 0
implay(scenario5)
end
```

It is clarified if an ambulance is available on route 2 and there is a traffic jam on route 1 and 3.We will notice that the priority will be for the ambulance, where the green signal will be indicating that traffic is allowed on routes 2, while routes 1 and 3 will have a red traffic light indicating that no traffic is allowed figure (4.15).

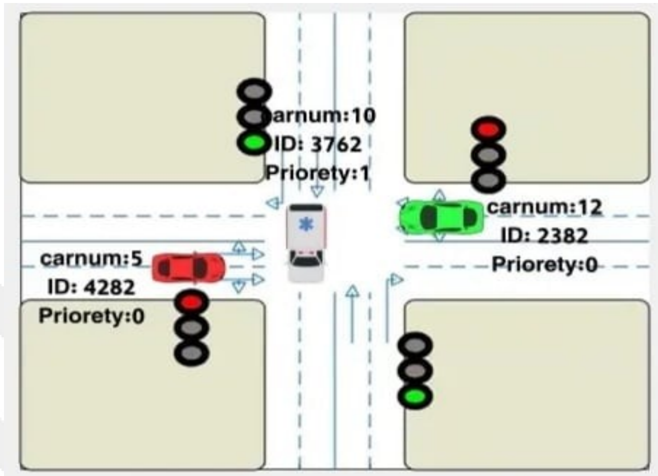

Figure 4.2: Second scenario system.

In the third scenario

```
clear,close,
X=[14.9,10.3,8.5,17]; Y=[6.5,16.5,8.2,15];
% uicontrol('Style', 'pushbutton', 'String', 'flashY','Position', [16 5 2 0.5], 'Callback', 'cla');
load Data
traffic = 0;
ambulance = 0;
police = 0;

%% traffic lights are controlled from menu now
if traffic == 0 && ambulance ==1 && police ==1
implay(scenario4)
elseif traffic == 0 && ambulance == 1 && police == 0
implay(scenario2)
elseif traffic == 0 && ambulance == 0 && police == 1
implay(scenario3)

elseif  traffic == 0 && ambulance == 0 && police == 0
implay(scenario1)
elseif traffic == 1 && ambulance == 0 && police == 0
implay(scenario5)
end
```

It was clarified if the ambulance, police car and traffic jams were not available at the intersection we note that the traffic lights are working as normal figure (4.16).

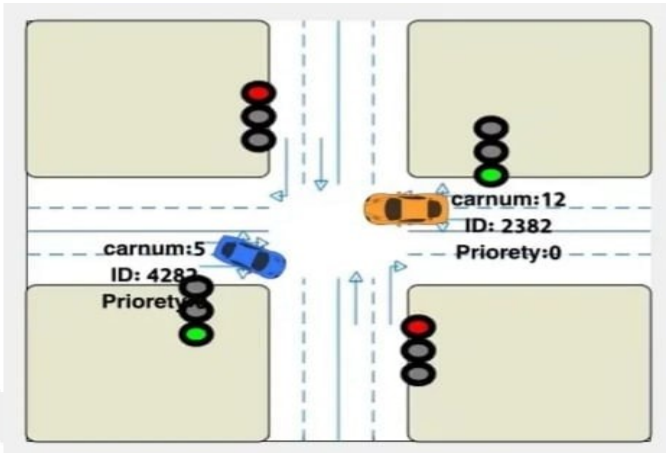

Figure 4.3: Third scenario system.

In the fourth scenario

```
clear,close,
X=[14.9,10.3,8.5,17]; Y=[6.5,16.5,8.2,15];
% uicontrol('Style', 'pushbutton', 'String', 'flashY','Position', [16 5 2 0.5], 'Callback', 'cla').
load Data
traffic = 1;
ambulance = 0;
police = 0;


%% traffic lights are controlled from menu now
if traffic == 0 && ambulance ==1 && police ==1
implay(scenario4)
elseif traffic == 0 && ambulance == 1 && police == 0
implay(scenario2)
elseif traffic == 0 && ambulance == 0 && police == 1
implay(scenario3)


elseif  traffic == 0 && ambulance == 0 && police == 0
implay(scenario1)
elseif traffic == 1 && ambulance == 0 && police == 0
implay(scenario5)
end
```

It was clarified if the ambulance and police car are not available on the roads, but there is a traffic jam on Routes 3 and other roads are not congested, we will note that the traffic lights on Route 3 will be green to indicate that vehicles are allowed to drive, In contrast to Routes 1, 2, and 4, the red signal indicating that traffic has stopped has been activated figure (4.17).

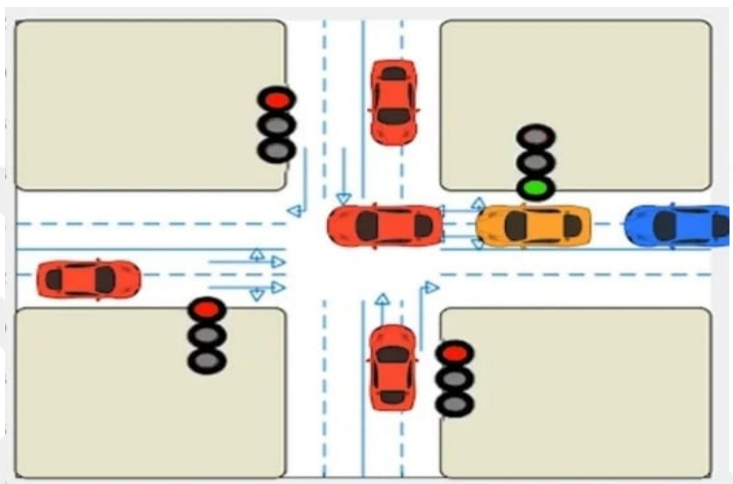

Figure 4.4: Fourth Scenario System.

4.4 SUMMARY

In this part (chapter IV) the details that were specific to the chosen system were clarified, as three scenarios were selected through which the mechanism of work of the intelligent system for intersections was clarified by relying on the priority through which many of the problems that were present at the intersections that were mentioned earlier have been eliminated.

5. CONCLUSION AND FUTURE WORK

5.1 INTRODUCTION

Organizing traffic at intersections is one of the necessities of life, and because of the large number of damages that occur in such places, the smart system has been used, which will play an important role in solving these problems. Where technological progress and the miniature size of the control and sensing devices have contributed to the ability to design advanced and intelligent systems to facilitate the lifestyle and solve these difficulties. The most important feature of this system is the management of roads by relying on priority and without the need for human intervention, and because of this feature, the researcher relied in this thesis on the use of different ideas from the ideas mentioned in the previous theses.

In this part, we will present some suggestions that will contribute to improving and strengthening this system in the future by other researchers.

5.2 CONCLUSION

Although the previous research is represented by good techniques for controlling the sequence of traffic lights, but it does not provide a good service for private vehicles. In our proposed work, these matters have been taken into account and the traffic light sequences at intersections are controlled with greater accuracy and efficiency because RFID is of high accuracy better than the camera. Our smart system always seeks to participate in the scientific community in order to manage the flow of vehicles at intersections and improve the current traffic light system. This intelligent traffic system consists of a central control unit that manages traffic lights at "+" intersections. This system is able to estimate the traffic density through the use of infrared sensors that have been placed on both sides of the road and based on this information will extend the time of the green signal to the road and allow vehicles on this road to move in case of traffic congestion or vice versa, that is, it will reduce the unnecessary green light time on roads where there is no traffic. In addition to that, we used RFID the one that works, in turn, giving priority to private cars and giving the order to light the green signal on the roads where private cars are located.

5.3 FUTURE WORK

Although the idea that was put forward in this thesis has proven itself by showing its ability to connect RFID to the Internet within a concept called "Internet of Things" and that the proposed system is applicable based on the results we obtained by testing different scenarios, the results showed that This system is working properly according to the instructions. However, we will present some suggestions that will contribute to the development of the system. These suggestions can be made by other researchers working in the same field. The proposed system can be strengthened by adding future improvements such as displaying the delay timing and adding a pedestrian crossing button and vehicle accidents. In order to achieve full synchronization, the integration of control units controlling traffic at intersections will be investigated in the future. The study of the performance of the system is done by recording the traffic data and uploading it to the computer platform, where the data studies are applied and analyzed to understand how the traffic will flow at the intersections well. Finally, the operation of traffic light controllers can be based on solar panels.

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