الاستهلال

ما الفضل إلاّ لأهل العلم إنّـــــهم
على الهدى لمن استهـدى أدلاّء

و قيمة المرء ما قد كان يحسنه
الجاهلون لأهل العلم أعـــداء

فقم بعلم و لا تطلب به بـــدلا
فالناس موتى، وأهل العلم أحياء

الإمام علي بن ابي طالب

Dedication

To my wonderful parents Reem Al-Alami ,Abdelmohsen Hawwa , to my sisters Maha , Muna to my brother and to my best friend Ahmad

Acknowledgement

This research would not have been possible without the grace of Allah and his guides. Thank Allah to give me the strength to face the hardship , the patience to complete and joy of knowledge .

I would like to thank our supervisor Dr. Abdel Rasoul jabber al zubaidi for supervising this thesis. His knowledge and know how were of extreme importance throughout the work, as well as his advice, help and guidance. His dedication and opinion were useful not only for the completion of the thesis, but also for the professional life ahead of us.

Abstract

Today's traffic light system has a lot of limitations at road junction. The system is not flexible or in other words cannot modify on real time. The static traffic control have fixed timing for the three traffic lights "the green , yellow and red ".The cars waste a lot of fuel and surely the driver waste a lot of time . To solve and monitor the traffic light system and make it more efficient , in this research it has to use an intelligent technique taking the advantage of the sensors, microcontroller and the GSM modem which could add the real time benefit to the system. This research explores the design of semi automatic traffic light control system. The traffic light is designed using microcontroller ATMEGA32 programmed by BASCOM AVR, power supply , IR sensor and GSM modem .

The system solves the wasting time and fuel problem and the problem of the emergency car which waits a lot in the road intersection as well as it solves the problem of the congestion that occurs when an accident in the path happens. The system can be used for the traffic at the road intersections.

المستخلص

نظام إشارة المرور لديه الكثير من القصور خاصة في إشارات المرور الواقعة على اربع مفترقات. الأنظمة الحالية ليست مرنة أو بعبارة أخرى لا يمكن تعديل الوقت بناء على حالة المرور بل الوقت ثابت للثلاث إشارات . فإشارات المرور و تغيرها ثابتة التوقيت لكل من الثلاث إشارات "الأخضر والأصفر والأحمر". المشكلة تكمن في أن العربات تهدر الكثير من الوقود وبالتأكيد السائق يضيع الكثير من الوقت. المطلوب حل أنظمة إشارة المرور وجعلها أكثر كفاءة،يجب استخدام تقنية ذكية و الإستفادة من أجهزة الاستشعار كما يمكننا الإستفادة من انظمة الـ GSM و هي بالتأكيد تحسن من إستغلال الوقت للنظام . يستكشف هذا البحث تصميم نظام تحكم شبه إشارة المرور التلقائي. تم تصميمه باستخدام متحكم ATMEGA32 مبرمجة من قبلBASCOM AVR ، وإمدادات الطاقة، جهاز استشعار الأشعة تحت الحمراء ومودم GSM.

نظام يحل الوقت الضائع ومشكلة الوقود ومشكلة السيارة في حالات الطوارئ التي تتنتظر الكثير من الوقت في تقاطعات الطريق، فضلا عن أنه يقوم بحل مشكلة الازدحام الذي تحدث عندما يحدث حادث في المسار. النظام يمكن استخدامها لحركة المرور في تقاطعات الطرق.

Contests

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Abbreviation

TL: Traffic Light

VCC: Voltage at the Common Collector

GND: Ground

GSM: Global System for Mobile Communications

LED: light emitting diodes

PC :personal computer

A/D: Analog to Digital

XTAL1: Oscillator

XTAL2 : Oscillator

IR: Infra Red

PIR :passive Infra Red

p-n junction : positive negative junction

Chapter one

Introduction

1.1 Preface

The Traffic Light (TL) Controllers those days are based on microcontroller and microprocessor. These Traffic Light Controllers have some limitations due to the using of pre-defined hardware, which is programmed according to fixed time that is never change and there is no flexibility of modification on real time basis. Due to the fixed time for the three colors the green, orange and red signals as the problem of fixed time the waiting time is more and car uses more fuel.[1]

The goal of the driver is to reach at destination without wasting time and money. But resources provided by current infrastructures are limited. So the Traffic management at road is crucial to reduce waiting and traveling times, save fuel and money. Even though present traffic light controlling system handles the traffic at intersections, many times congestion, accidents happened due to its poor performance and the expansion of road infrastructure is not ultimate solution to the traffic congestion. It requires some smart mechanism that deals with the problems in the present traffic controlling system. The proposed system also provides the map feature, which shows the traffic situation of requested traffic signal.[2]

The Traffic density is increasing at an alarming rate in developing countries which call for the need of Advance intelligent Traffic signals to replace the conventional manual and time based Traffic signal system .that consider the priority the density of traffic on the roads .that could be done by making a bridge with IR sensor on the road intersections and make the decision according to the information that the sensor sense. The timings of Red, Green lights at each crossing of road will be intelligently decided based on the total traffic on all adjacent roads. Thus, optimization of traffic light switching increases road capacity and traffic flow, and can prevent traffic congestions. [3]

The primary role of a microcontroller unit in an embedded system is to provide inexpensive, programmable logic control and interfacing to eternal devices. This means microcontroller unit typically is not required to provide complex functions. It is well suited to monitoring a selected variety of inputs and responding to them in real time using the preprogram instructions that are executed by the built in processor. An embedded microcontroller can respond to these inputs with a wide variety of devices. These capabilities can be a very reasonable cost without a lot of effort.[4]

The IR sensor detects vehicle and also detect the emergency vehicle. Thermal radiation is emitted by all the objects in the infrared spectrum. The infrared sensor detects this type of radiation which is not visible to human eye.[5].

In this research, Intelligent Traffic Light Controller based on microcontroller system was implemented using the IR sensor and GSM cell phone interface to provide users who wish to obtain the latest position of traffic on congested roads

1.2 Problem statement:

As the number of vehicles on road is increasing traffic congestion has increased. The main effect of this matter is the time wasting of the people on the road. Also at certain junctions, sometimes even if there is no traffic, people have to wait. Because the traffic light remain red for the preset time period, the road users should wait until the light turn to green. present traffic systems fail to provide traffic information including congested roads and alternate routes available in case of congestion.

1.3 Proposed solution:

The solution for this problem is by developing a system to control the traffic light monitor and a device sends for user on request. The delay for junctions that have high number of vehicles should take longer time than the delay for the junction that has less number of vehicles and developing a system which detects traffic flow on each road and set timings.

1.4 Methodology

Protous program will use to simulate the behavior of the circuit and hardware design will use to design a circuit

1.5 Chapter organization:

The research organize as follow

- Chapter one describe the problem and the proposed solution also it includes the methodology
- Chapter two describe the microcontroller system with the sensor and its appropriate power supply also describe how the GSM modem will support the real

time traffic road and the hardware circuit

- Chapter three is the system hardware design which explain the design and highlight the algorithm flow chart
- Chapter four The design of the system which explain the simulation design of the system
- Chapter five present the simulation results and discussion
- Chapter six present the conclusion and future work.

Chapter two
Literature Review

2.1 Background

A traffic light is a device that generates signals that is posted on road intersection in order to make the driving safe by using a universal color code. In other words a traffic light system is an electronic device that assigns right of way at an intersection or crossing or street crossing by means of displaying the standard red, yellow and green colored indications. An addition, it also works in conjunction with pedestrian displays to assign pedestrian crossing right of way .The traffic lights commonly for vehicles have three main lights, a red light that means stop, a green light that mean go and yellow that means ready to stop. But nowadays there are only two lights, a red light and a green light that mean stop and go respectively. The traffic lights have given many benefits to all road users. Besides reducing the number of accidents, it made the traffic flow smoothly and possibly could save people time.[7]

The world's first traffic light Installed at an intersection in London in 1868, it was a revolving lantern with red and green signals .The lantern, illuminated by gas, was turned by means of a lever at its base so that the appropriate light faced traffic.[7]

After the invention of automobiles, the situation got even worse. Police Officer William L. Potts of Detroit, Michigan, decided to do something about the problem. What he had in mind was figuring out a way to adapt railroad signals for street use. The railroads were already utilizing automatic controls. But railroad traffic traveled along parallel lines. Street traffic traveled at right angles. Potts used red, amber, and green railroad lights and about thirty-seven dollars worth of wire and electrical controls to make the world's first 4-way three color traffic light. It was installed in 1920 on the corner of Woodward and

Michigan Avenues in Detroit. Within a year, Detroit had installed a total of fifteen of the new automatic lights. [8]

At about the same time, Garrett Morgan of Cleveland, Ohio realized the need to control the flow of traffic. A gifted inventor and reportedly the first African American to own an automobile in Cleveland, Ohio, he invented the electric automatic traffic light. Though it looked more like the semaphore signals you see at train crossings today. Many others had obtained US Patents for Traffic Signals, some as early as 1918. But Morgan's Patent was purchased by General Electric Corporation and provided the protection they needed to begin building a monopoly on traffic light manufacture.[8]

The number of road's users is constantly increases, and the resources that provided by the current infrastructures are limited, intelligent control of traffic becomes an important issue in the present day. However, some limitations to the usage of intelligent traffic control exist. Avoiding traffic jams for example is thought to be beneficial to both environment and economy.[6]

2.2 literature Review

In March, 1994, the General Accounting Office published a report to the Chairman of the House of Representatives Energy and Commerce Committee. That report was titled, Transportation Infrastructure, Benefits of Traffic Control Signal Systems Are Not Being Fully Realized. That report was motivated in part by a 1990 review conducted by the Federal Highway Administration that found that 21 of 24 traffic signal systems did not meet minimum standards of performance. That assessment, titled Operation and Maintenance of Traffic Control Systems, was motivated by the Institute of Transportation Engineers publication A Toolbox for All eviating Traffic Congestion and Enhancing Mobility, which had

documented that many local agencies were installing systems without considering the cost of proper operations and maintenance. In 1992, a panel was convened to review the FHWA Report and make recommendations for improvements. These recommendations led to the establishment of federal funding for operations and maintenance, which was included in the ISTEA legislation.[9]

In 2008 A non-cooperative approaches, which give rise to a non-cooperative game, was studied by Alvarez and coworkers. In this model, signalized intersections were considered as finite controlled Markov chains and a solution was sought to optimize the congestion into an avenue. Using a game theory method, they considered each intersection as a non-cooperative game where each player tries to minimize its queue[8].

In 2009 Helbing and Mazloumian discussed elements of signal control based on the minimization of overall travel times or vehicle queues. They found different operation regimes, some of which involve a "slower-is-faster effect", where delayed switching reduced the average travel time. These operation regimes characterized different ways of organizing traffic flows in urban road networks. Besides the optimize-one-phase approach, they discussed the procedure and advantages of optimizing multiple phases as well. To improve the service of vehicle platoons and support the self organization of green waves , considering the price of stopping newly arriving vehicles was proposed[8].

In April, 2010 Shilpa S. Chavan design an intelligent traffic light controller using embedded system he use the GSM Interface for sending traffic alerts signals for drivers on road and precautions be taken not to indulge in traffic congestion. [1]

In December, 2011 Karthick Kumar Reddy try to improve the traffic light signals by generate three colors on a single traffic light instead of using three different color traffic signal lights and reduce the manufacture cost of the signal

lights by use a minimum number of ports in a microcontroller and cable lines to transmit the signals to the light source.[9]

In April, 2013 Mr.Sarika B. Kale, Gajanan P. Dhokdesign an automatic accident detection and ambulance rescue with intelligent traffic light system In proposed system if a vehicle has met accidents, immediately an alert message with the location coordinates is sent to the Control center. From the control center, a message is sent to the nearby ambulance. Also signal is transmitted to all the signals in between ambulance and vehicle location to provide RF communication between ambulance and traffic section. The vehicle accident observed using vibration sensor and in the control section it is received by the microcontroller and then the nearby ambulance is received from the PC and controller sends the message to the ambulance. The signal to Traffic signal section is transmitted through RF communication. Also if any fire occurs, it is detected using fire sensor and an alarm message is directly sent to the fire station.[10]

In April, 2013 Rashid Hussian uses the wireless sensor network technology to sense presence of Traffic near any circle or junction and a microcontroller based routing algorithm programmed for excellent Traffic management.[11]

The author Ahmed S. Salamaet. provide integrated intelligent traffic light system using photoelectric sensors distributed on long range before and after traffic light on roads. Emergency cases such as , the passing president car and ambulance that require immediate opening of traffic signal. The system has the ability to open a complete path for such emergency cases until reaching the target but this system does not operate wells when more than one emergence Vehicles come on the signal from two sides.[12]

In May,2014 A.D.jadhav eliminate the delay on roads by reducing traffic on road automatically using embedded system and sensors .On each road he place IR sensors which detect the vehicle and give current traffic information on each road.

The timing of signal is adjusted according to traffic level on each road. The road which has level more than other road then this road assign green signal and for others have red is assign. It is also provide the additional functionality of release the emergency vehicle on its occurrence that means when emergency vehicle occur.[5]

In May, 2014 GaniyuR.A. has Developed A Microcontroller-Based Traffic Light System for Road Intersection Control .The microcontroller-based traffic light system for road intersection control was developed to direct the movement of vehicles meeting at a road junction without any collision. To achieve this, the microcontroller allocates time for each path when the vehicles along that path will move and the other vehicles from the other path will stop. When the time allocated for a specific path has been exhausted, the red light will be ON meaning stop and the next line will be ON (green light) which means the vehicle in that path should start moving. When the time is about to be exhausted, the yellow light will be ON in the third path informing the vehicles in that path to be ready to move, and after some seconds the green light will be ON.[4]

2.3Benefit of Traffic Light Controller:

When properly used, traffic control signals are important devices for the control of vehicular in road. They assign the right- of-way to a choice of traffic movements and thereby deeply influence traffic flow. Traffic control signals that are properly designed, located, operated, and maintained will have one or more of the following advantages**:**

1. Provide orderly movement of traffic .
2. Minimize completing movement .
3. Coordinated for continuous movement .

4. Provide driver confidence by assigning right way .[13]

U. S. Department of Transportation in feb 1988 mention another advantage and said that "Traffic control signals are often considered a cure for all traffic problems at intersections. This belief has led to traffic control signals being installed at many locations where they are not needed, adversel affecting the safety and efficiency of vehicular, bicycle, and pedestrian traffic. Traffic control signals, even when justified by traffic and roadway conditions, can be ill designed, ineffectively placed, improperly operated, or poorly maintained. While traffic signals can help in locations where they are justified and installed properly, they also have disadvantages. There will always be some disadvantages even if the signal is justified." They mention some benefits by said that In general, each traffic signal control system is designed to meet the specific social and political objectives of each community. Fundamentally, however, traffic signal control systems strive to achieve the following:

- Maximize traffic flow efficiency and public safety.
- Accurately monitor traffic flows and make appropriate traffic control decisions in atimely manner.
- Moderate fuel consumption and environmental impact of stop-and-go traffic through improvements to traffic flow efficiency.

Advanced traffic signal control systems have demonstrated benefits in several areasincluding travel time, speeds, vehicle stops, delays, energy consumption, andenvironmental impacts. In addition, they have been shown to reduce congestion and thenumber of accidents on roadways. [14]

Table 2.1 summarizes the range of traffic signalcontrol system benefits as reported by the U.S. Department of Transportation

Table 2.1 Summary of ITS Traffic Signal Control System Benefits

Travel Time	Decreased by 8% - 25%
Travel Speed	Increased by 14% - 22%
Vehicle Stops	Decreased by up to 41%
Delay	Decreased by 17% - 44%
Fuel Consumption	Decreased fuel used by 6% - 13%

2.4 Types of Traffic Signals Components and Operations

Most traffic signals will have the following components or part:

I. Main display with red, yellow and green lights.

II. Traffic signal cabinet containing the traffic signal controller and Vehicle Detection Systems, either

III. Inductive loops or sensors

In the many cities, traffic signals mainly operate in three modes:

- **Fixed-time mode:** Under this mode, there are no detections for any approach. The signal continuously cycles regardless of actual traffic demand. Pedestrian walk signals are automatic and will cycle concurrently with the vehicular signal indication.
- **Semi-Actuated mode:** Under this mode, the detection system is present only on a minor cross street. When detection is activated, the green light on a major street is interrupted to allow the minor street traffic andpedestrians to safely enter the intersection. Pedestrian walk signals forcrossing a minor street are automatic, while those for crossing a majorstreet are not. Pedestrians crossing a major street must push the“pedestrian push button” to get the walk signal.

- **Actuated mode:** Under this mode, there are detections for all approaches. The traffic signal is set to provide the green light "on demand"or only in the presence of vehicles[13]

2.5 Examples of traffic light:

There are many examples for traffic light controller like the following examples

- **Pelican**:

Old fashioned pedestrian crossing facility which included the flashing amber, flashing green man. This type of crossing is likely to be phased out and although some are still being installed in different parts of the country.[14]

- **Puffin:**

Pedestrian crossing facility gradually replacing pelican crossings. This type of crossing is designed to be user friendly and safer than the old pelican by: Eliminating the flashing amber period thereby removing the ambiguity from drivers and pedestrians and by varying the length of crossing time to suit high or low volumes of pedestrians or slow moving pedestrians.To drivers, the puffin appears similar to normal traffic signals; it changes from green to amber then to red and eventually to red/amber and finally back to green. For pedestrians, the green man appears for a few seconds but as pedestrians step onto the road, overhead infrared or video imaging cameras control the length of time available to pedestrians, generally up to a maximum of around 32 seconds. [15]

However, a single person crossing quickly would cause the pedestrian stage to end after around 15 seconds. An additional overhead detector monitors waiting pedestrians, if the only pedestrian decides not to cross and walks away, the demand

will automatically be cancelled. This makes the puffin more efficient for traffic and for pedestrians .[15]

- **Toucan:**

Pedestrian and Cycle crossing facility that caters for cyclists, in addition to pedestrians. The only obvious difference between this type of crossing and a puffin is the width of the crossing; extra wide to allow for cycles, and an extra optic next to the green man showing a green peddle cycle .

Figure2.1:Toucan signal

- **Pegasus:**

Pedestrian and Horse crossing facility which has taller poles and extra push button boxes mounted high on the pole for horse riders. [15]

2.6 block diagram

The following figure describe the whole idea of the design

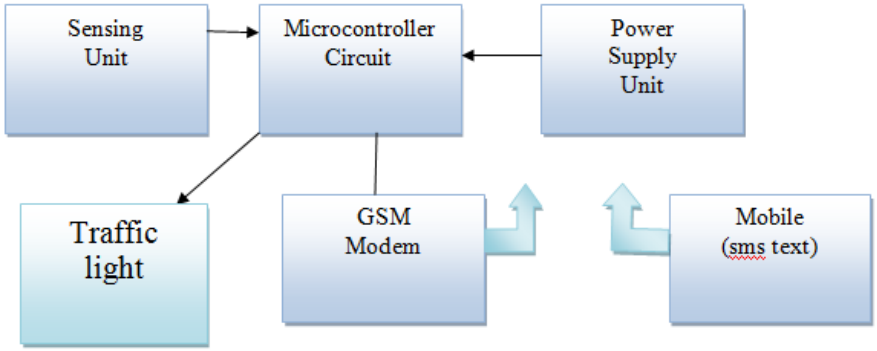

Figure 2.2 block diagram of the system

2.6.1 Sensing unit:

The idea of using sensors to regulate the cycle time of a traffic light is starting to be used by the industry, especially in low traffic conditions. In this research the sensing unit that would be used is the InfraRed sensor . IR sensor detect the vehicles and then according to the program in microcontroller the traffic light change its situation or remind stable

2.6.2Microcontroller circuit:

ATMEGA32 microcontroller will be used in the circuit and its pin will connect with the sensor and the traffic light and the GSM modem

2.6.3 Power supply:

The circuit has to be supplied with voltage not less than 5 voltage and also the circuit must be grounded.

2.6.4 Traffic light

In the circuit there is two colors will be used the green means Go and the red means Stop so the LED will be use with those two colors and connect to the microcontroller

2.6.5 GSM model

GSM model will be connect the circuit to make the system works in real time .

2.6.5 Mobile Phone

Mobile phone or cellular phone can send telephone call to GSM modem over a radio link with private base station.

Chapter three

The hardware design

Chapter Three The Hardware Design

3.1 Review

This chapter is about hardware design in which all the component that the system used is briefly explain and in the last point in this chapter the circuit diagram is showed

3.2 Microcontroller

A microcontroller is smaller than a PC that it is the same comparison as between a real computer and small computer. The microcontroller is capable of carrying out millions of instructions every second. And there are billions of these controllers out there in the world doing just that. It could be found inside cars, stereos, calculators, remote controls, airplanes, radios, microwaves, washing machines, industrial equipment and so on.[16]

In our days, there have been many advancement in the field of Electronics and many cutting edge technologies are being developed every day, but still 8 bit microcontrollers have its own role in the digital electronics market dominated by 16-32 & 64 bit digital devices.

There are many benefits of the 8 bit microprocessor

1- easy-to-understand-operation
2- very much high popularity
3- Has the ability to simplify a digital circuit
4- low cost compared to features offered

Today's microcontrollers are much different from what it were in the initial stage, and the number of manufacturers are much more in count than it was a decade or two ago. At present some of the major manufacturers are Microchip (publication: PIC microcontrollers), Atmel (publication: AVR microcontrollers), Hitachi, Phillips, Maxim, NXP, Intel etc the figure below shows a lot of examples of microcontroller .[16]

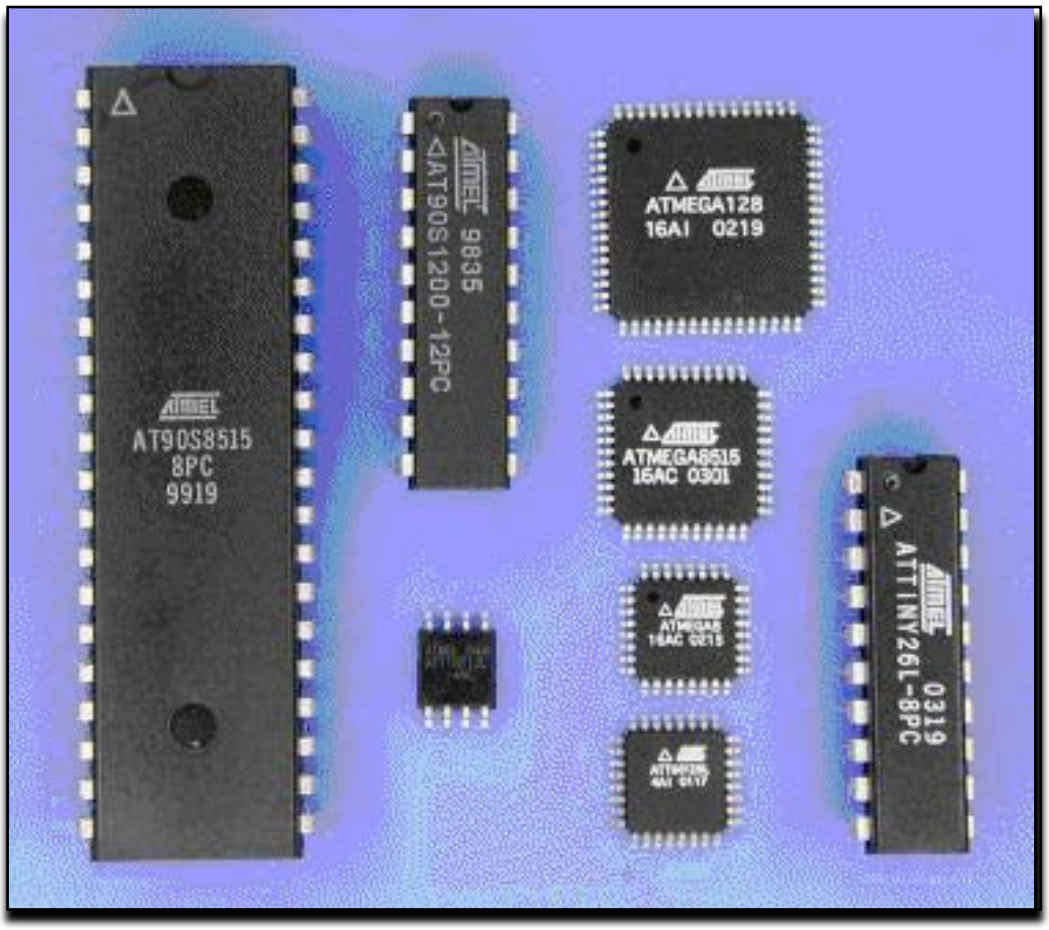

Figure3.1: Examples for many types of microcontroller.

In this system the microcontroller that is used is ATmega32. It belongs to Atmel's AVR series micro controller family.[16]

3.2.1 ATMEGA32's pin diagram

The figure below show the pin of the atmega32 microprocessor

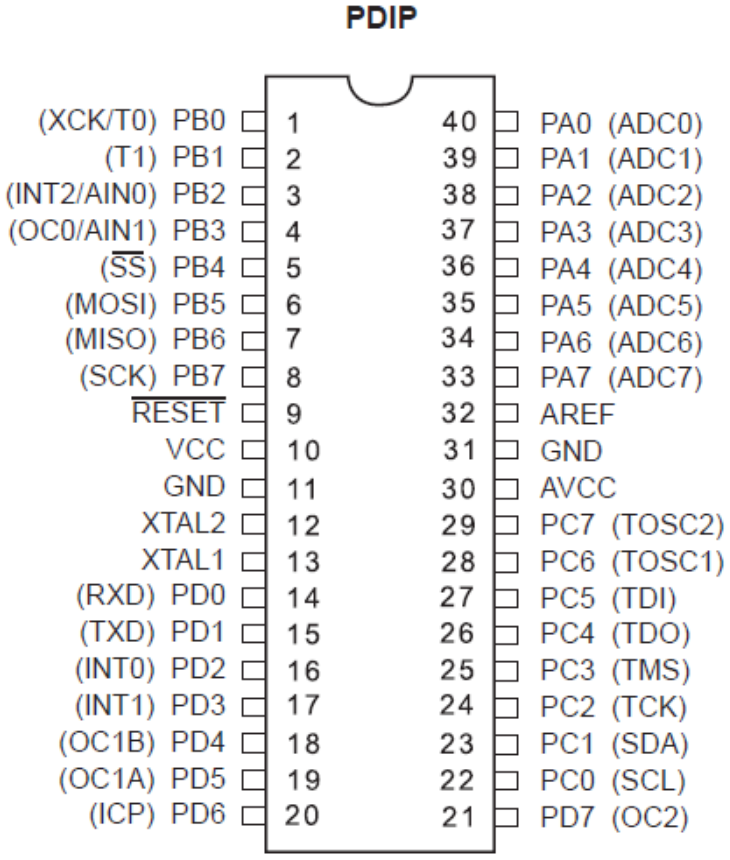

Fig 3.2 the pinout atmega32

3.2.2 Pin Descriptions

The microprocessor has two pin related to voltage the VCC pin which is for Digital supply voltage. And the GND pin which is ground pin .Atmega32 has three ports (port A , B , C and D) they are 8 bits for each port , for example Port A is arrange from PA7to PA0 and so port B and port C .

Port A serves as the analog inputs to the A/D Converter and AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally

Port pins can provide internal pull-up resistors .The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 toPA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The PortA pins are tri-stated when a reset condition becomes active, even if the clock is not running.

The Port B and Port C also Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B and Port nC pins are tri-stated when a reset condition becomes active, even if the clock is not running.

The RESET pin is referred to reset Input and that could be done if a low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running.

XTAL1 Input to the inverting Oscillator amplifier while XTAL2 Output from the inverting Oscillator amplifier but XTAL1 can be an input pin to the internal clock operating circuit.[17]

3.3 Infra red sensor

Infrared is a form invisible light with a wavelength of 950 nano meters**.** Human eye cannot sense this wavelength so that infrared rays cannot be detected visually.The remote handset is used to emit modulated infrared light using an infrared diode**.** This diode emits pulsed infrared waves in a coded form at a frequency of 38 kHz By pressing each button in the remote handset, it is possible to emit infrared rays at a particular coded form. [18]

IR sensor has many types one of them is passive IR sensor or The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by sensing changes in the infrared (radiant heat) levels emitted by surrounding objects. This motion can be detected by checking for a sudden change in the surrounding IR pattern.

When motion is detected the PIR sensor outputs ahigh signal on its output pin. This logic signal can be read by a microcontroller or used to drive an external load.[19]

Features of passive IR sensor

There are a lot of features for IR sensor and here are some of these features

1. Detect a car up to approximately 30 ft away, or up to 15 ft away in reduced sensitivity mode Jumper selects normal operation or reduced sensitivity
2. The Source current it need is up to 12 mA and 3 V, or 23 mA and 5 V
3. Onboard LEDs light up the lens for fast visual feedback when movement is detected
4. Small size makes it easy to conceal
5. Easy interface to any microcontroller like atmega32 in this research[19]

How passive IR sensor work

Passive sensors detect the energy that is emitted from vehicles, road surfaces, other objects in their field of view, and from the atmosphere, but they transmit no energy of their own. The detector in a non-imaging sensor generally has a large instantaneous field of view. The instantaneous field of view is equal to the angle. Objects within the scene cannot be further divided into sub-objects or pixels (picture elements) with this device.[21]

Passive infrared sensors with a single-detection zone, measure volume, lane occupancy, and passage. The source of the energy detected by passive sensors is graybody emission due to the non-zero surface temperature of emissive objects. If the emissivity of the object is perfect, the object is called a blackbody. Passive sensors can be designed to receive emitted energy at any frequency. Cost considerations make the infrared band a good choice for vehicle sensors with a limited number of pixels. Some models operate in the long-wavelength infrared

band from 8 to 14 mm and, thus, minimize the effects of sun glint and changing light intensity from cloud movement. [21]

When a vehicle enters the sensor's field of view, the change in emitted energy is used to detect the vehicle as illustrated in Figure 3.3 below. A vehicle entering the sensor's field of view generates a signal that is proportional to the product of an emissivity difference term and a temperature difference term when the surface temperatures of the vehicle and road are equal. The emissivity term is equal to the difference between the road and the vehicle emissivities. The temperature term is equal to the difference between the absolute temperature of the road surface and the temperature contributed by atmospheric, cosmic, and galactic emission. On overcast, high humidity, and rainy days, the sky temperature is larger than on clear days and the signal produced by a passing vehicle decreases. This, in itself, may not pose a problem to a properly designed passive infrared sensor operating at the longer wavelengths of the infrared spectrum, especially at the relatively short operating ranges typical of traffic management applications.[21]

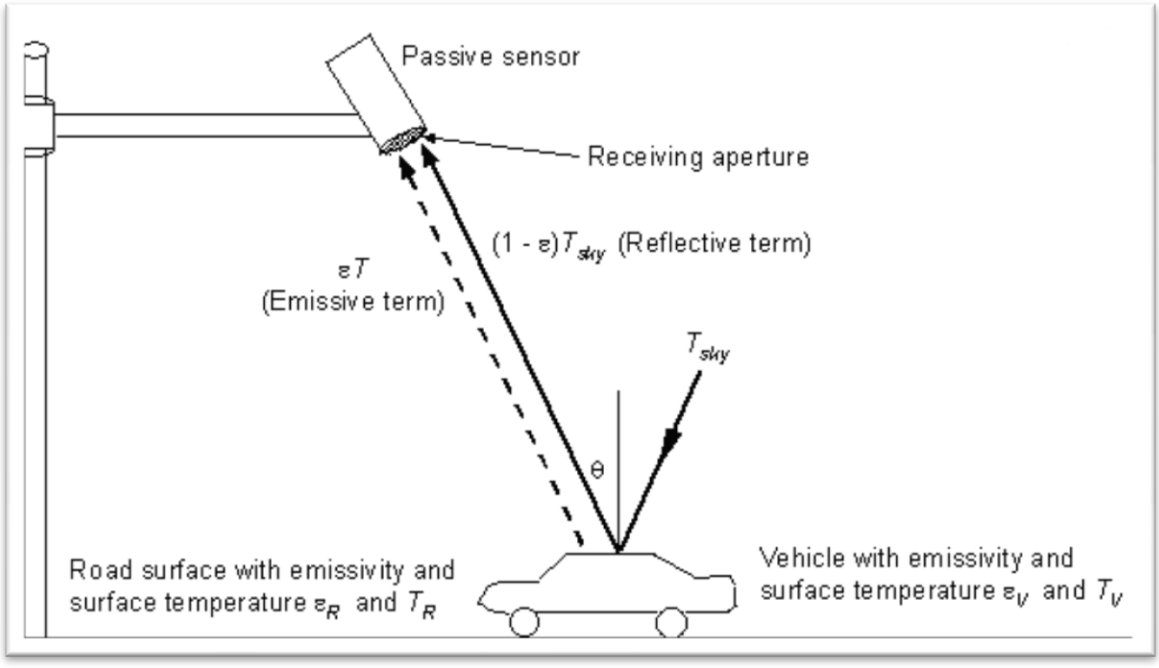

Figure 3.3 Emission and reflection of energy by vehicle and road surface

Active Infrared Sensor

Active infrared sensors illuminate detection zones with low power infrared energy supplied by laser diodes operating in the near infrared region of the electromagnetic spectrum at 0.85 mm. The infrared energy reflected from vehicles traveling through the detection zone is focused by an optical system onto an infrared-sensitive material mounted at the focal plane of the optics.[25]

The active infrared laser sensor has two sets of optics. The transmitting optics split the pulsed laser diode output into two beams separated by several degrees as displayed in Figure 3.3 below . The receiving optics has a wider field of view so that it can better receive the energy scattered from the vehicles. By transmitting two or more beams, the laser radars measure vehicle speed by recording the times at which the vehicle enters the detection area of each beam[25].

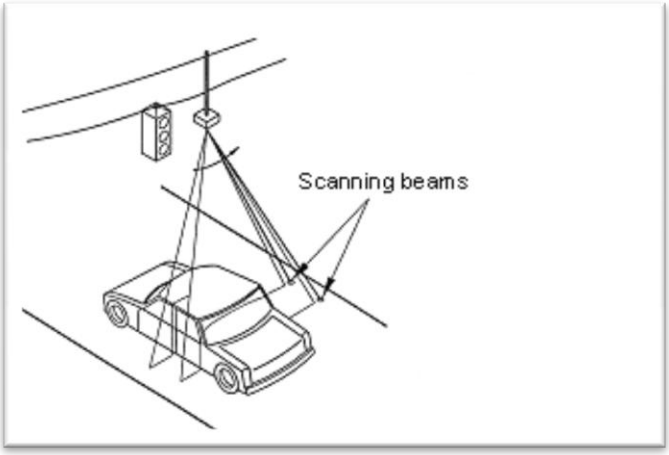

Figure 3.4 laser radar beam geometry.

3.4 The Light Emitting Diodes (LEDs)

The third component is the light emitting diodes (LEDs) which is the most basic output element. Its form and color vary widely to accommodate a wide variety of applications. The color of a LED is determined by the chemicals used for it. Common colors are red and green, but yellow, orange, blue and white LEDs are also readily available, as well as LEDs emitting light in the infrared or ultraviolet bands .[22]

A light-emitting diode (LED) is a semiconductor light source. The color of the light is determined by the energy gap of the semiconductor.When a light-emitting diode is forward biased electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence. Electroluminescence (EL) is an optical and electrical phenomenon in which a material emits light in response to the passage of an electric current or to a strong electric field. The wavelength of the light emitted, and thus its color depends on the band gap energy of the materials forming the p-n junction . The materials used for the LED have a direct band gap with energies corresponding to near-infrared, visible or near-ultraviolet light.as shown in figure below

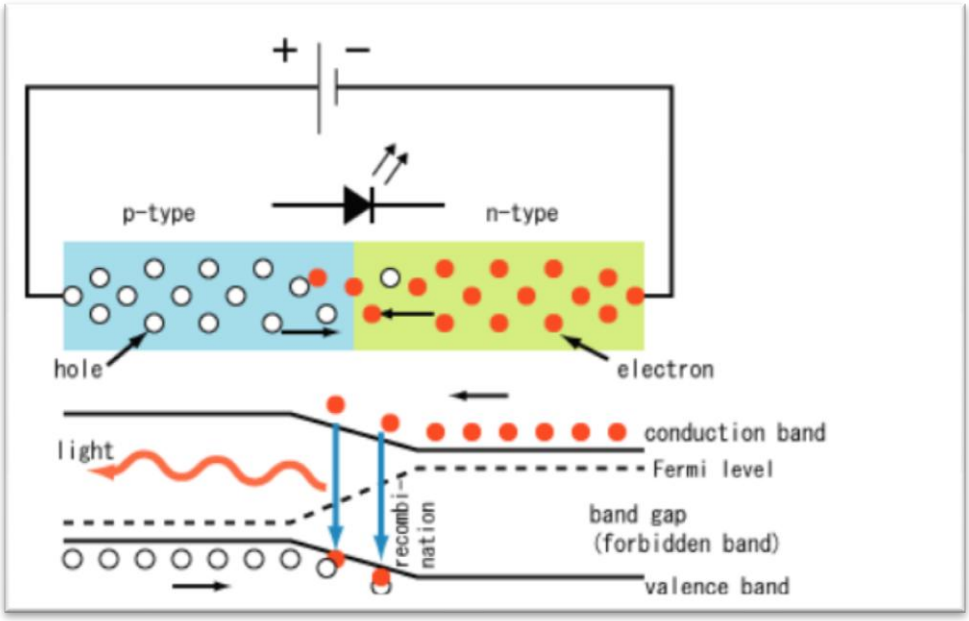

Figure 3.5 Electroluminescence of LEDs

LEDs are usually built on an n-type substrate, with an electrode attached to the p-type layer deposited on its surface. P-type substrates, while less common, occur as well. Many commercial LEDs, also use sapphire substrate. Most materials

used for LED production have very high refractive indices. Light extraction in LEDs is an important aspect of LED production.[22]

3.5 Bascom AVR Programming:

The bascom AVR program is choiced to program ATMEGA32 microcontroller. Bascom is a work in progress; it has its quirks, as any compiler has. It has its share of bugs and problems. It has exceptional value for money. Bascom enables quick prototyping because it has built-in support for almost all AVR microcontroller features.[23]

Bascom is a PC application that will allow you to write programs in Basic , translate these programs on the PC to machinecode and simulate the compiled code also enable you to use external programs to flash the compiled code into an AtmelAVR microcontroller.[23]

Debugging Bascom programs in AVR Studio:

Debugging is a procedure, where we trace program flow with the help of suitable software and/or hardware. While tracing program flow, tracer can find annoying bugs inside the program. If there is no suitable debugging hardware then the simulator can be used, in Bascom-AVR. programmer can also find problems by displaying some “debugging data” on an LCD display or in a terminal window.[24]

3.6 GSM system :

The forth component in the system is the GSM system which is responsible for the emergencies cases like accident that happen in the lane or an emergency car comes in the lane the figure below shows the GSM intelligent alarm system [26]

Figure 3.6 : The GSM intelligent alarm system

The system has a lot of features some of them are that it is full duplex communication with the base and it has voice and message , alert the system can set alarm on or off by controller , the system is programmable with 7 group alarm text messages which they can be indoor and outdoor alarm[26]

3.6.1 Configuration of the base

The figure below shows the connector outside the back of base

Figure 3.7 the base of GSM alarm system

The 10 connector outside the back of base:

1- **I1; I2; I3**, this 3 point for line input, every one point can be connected with ground or open to make alarm out.
2- **O1; O2;** these 2 point for output, you can call in or send the SMS to set it. Ifthis point output goes high, the lamp of OUT 1 or OUT 2 will light in the panel.
3- **SPEAKER;** this point for voice output, it connect to the speaker .the other point of speaker connect to ground.
4- **RELAY1; RELAY2**, this two point will close 3 minute when alarm happened .you can use this two point to start the power supply of the camera when alarm happened, but it could disable this.
5- **SIREN**, this point can output siren tone alarm, this connect to the siren .the other point of siren connect to ground.
6- **GND**,power ground

3.6.2 The remote controller

The figure below shows the remote controller of the GSM system

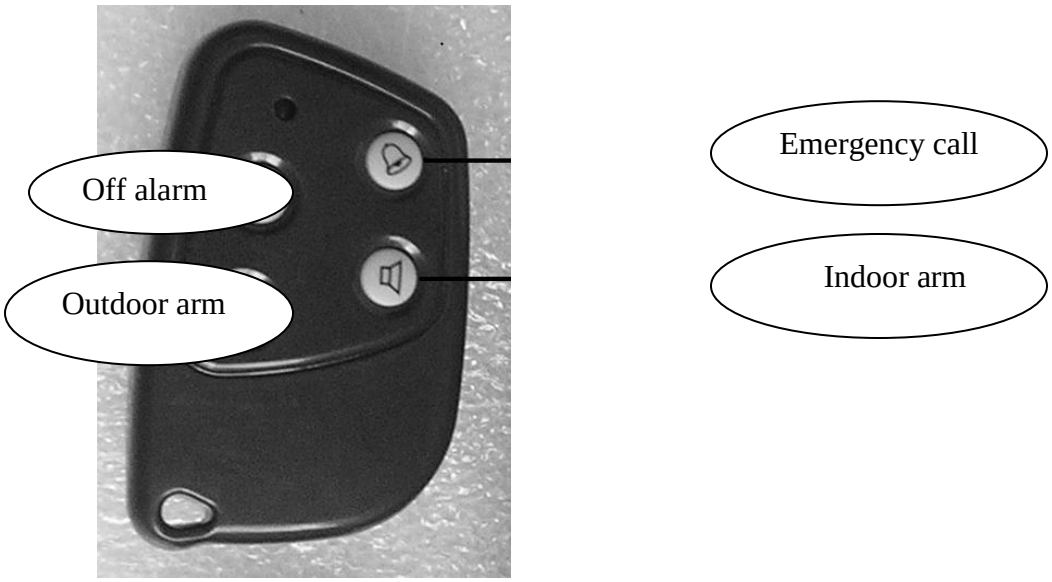

Figure 3.8 the remote controller of the GSM system

As shown above in figure 3.8 the remote controller has four buttons:

1- **Outdoor alarm key**, set alarm work when no one in the home, all the detectors in the home are ready on alarm, the lamp on panel will low flash green.
2- **Indoor alarm key**, set alarm work when some people in the home, some of the detectors are need not work, the lamp on panel will fast flash green; as the first floor no people inside, all of the detectors the first floor are ready on alarm, the second floor live people inside, all of the detectors in the second floor are off alarm when you use indoor alarm key.
3- **off alarm key**, set alarm off, all the detectors are disalarm,the lamp on panel will still green.
4- **Emergency call key**, set emergency call, the lamp on panel will flash red; the system will make alarm,and the base will send the SMS and dial out. [26]

3.7 system design diagram

The figure below shows how the real traffic will view if the system applied

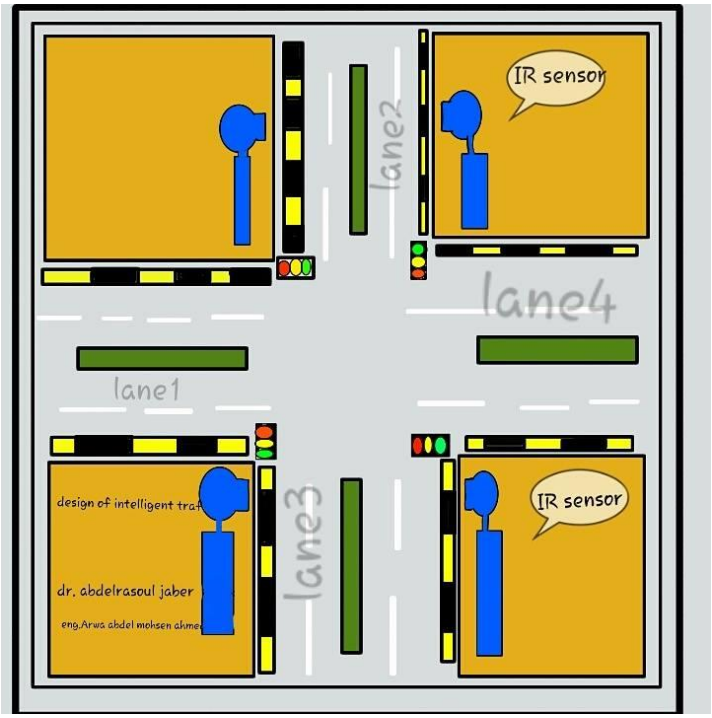

Figure 3.9 the real view of the system

The IR sensor should be in the both side of the street so when the car reach it could detect the car and send this information to microcontroller which decided the traffic light mode and which of the four traffic light should be in “GREEN” mode and which should be in “ RED “ mode .

The figure below shows the block diagram for the traffic light system

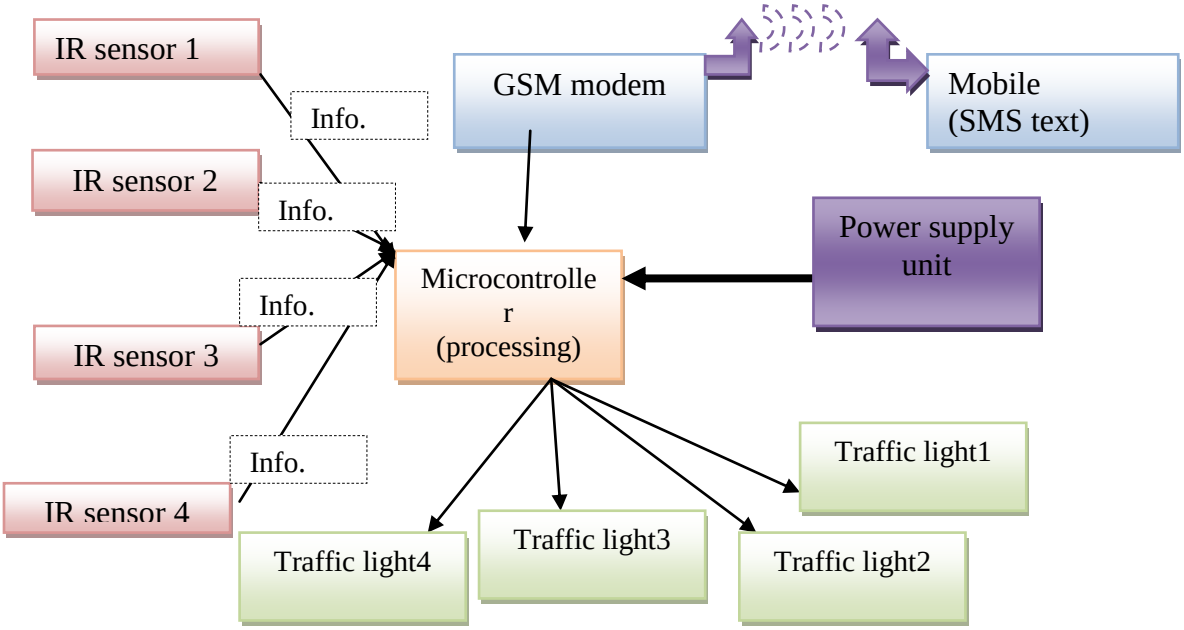

Figure 3.10 the block diagram for the intelligent traffic light system

The figure shows how the real processing happen in the intelligent traffic light system the IR sensor from one to four send the information to microcontroller and the microcontroller process this information .

The processing depend on number of vehicles and the information that the microprocessor take from the GSM modem which maybe an emergency request that is send either from the emergency car or from traffic police man in case of accident. All the information is process and the microcontroller send the information result to the traffic light from one to four one of them will be in " GREEN" mode and three will be in "RED" mode .

Of course the system should be connected to power supply unit which supply the microcontroller and sensing unit with voltage and supply the traffic light as will.

The GSM modem connects to microcontroller and receives information from mobile.[26].

Chapter four

The design of the system

4.1 Review of the sysem

In this chapter the system of the intelligent traffic light controller will be discuss in two part the first part is the simulation which is done by PROTEOUS and the algorithm that the system follow to program the microcontroller 4.2 simulation environment The simulation engine used in this system is PROTOUS (version 8) IR circuit

There are two type of infra red led one is emitter and other is receiver . Emitter IR emit infra red wave up to a short range its about only 1 meter and these IR waves are reflected back from any object and reciver IR led recive the waves and gives the IR signal in analog form but as we deal with microcontroller the circuit of analog to digital convertor is needed .

In the figure below the simulation test the IR circuit and connect this circuit to analog to digital convertor which generate the single in digital form so as to be suitable for the microcontroller signals in this circuit there are two resistor (300 ohm and 10 k ohm) with two pair of IR led with red and green color and its need a 5 voltage .

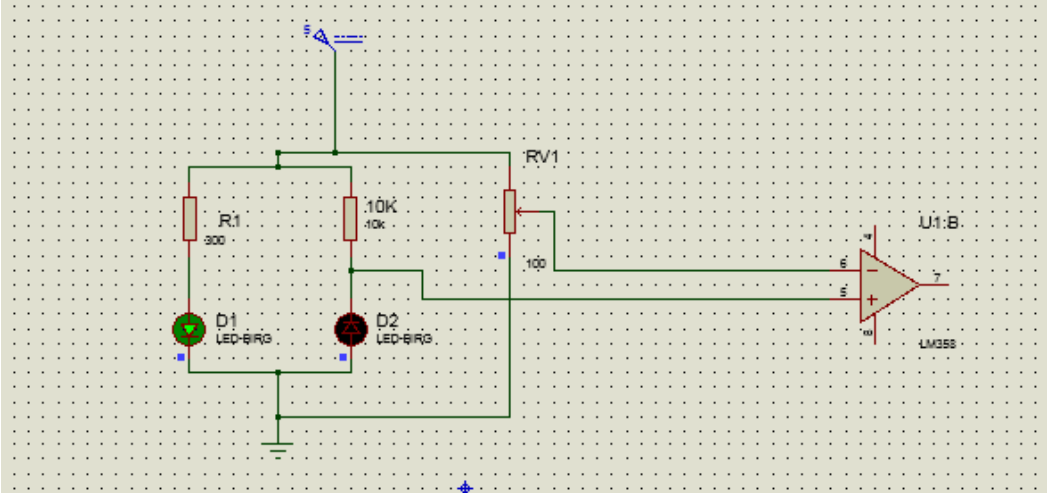

Figure 4.1 IR circuit connected to ADC circuit

In the system the IR circuit is connected to microcontroller with wide distance that can hold like 10 vehicles and the number of vehicles will be counted according to that number we could compare the our lane ,in the less number of car's lane the traffic light must change from red to green and let the crowded side GO and the other side STOP.

4.2 The circuit

The figure below shows the complete design for the circuit where the port connected to the traffic light , port c from pin 0 to pin 2 connected to the first traffic light and port c from pin 3 to pin 5 connected to the second traffic light and so on also the IR sensor circuit connected to the port B

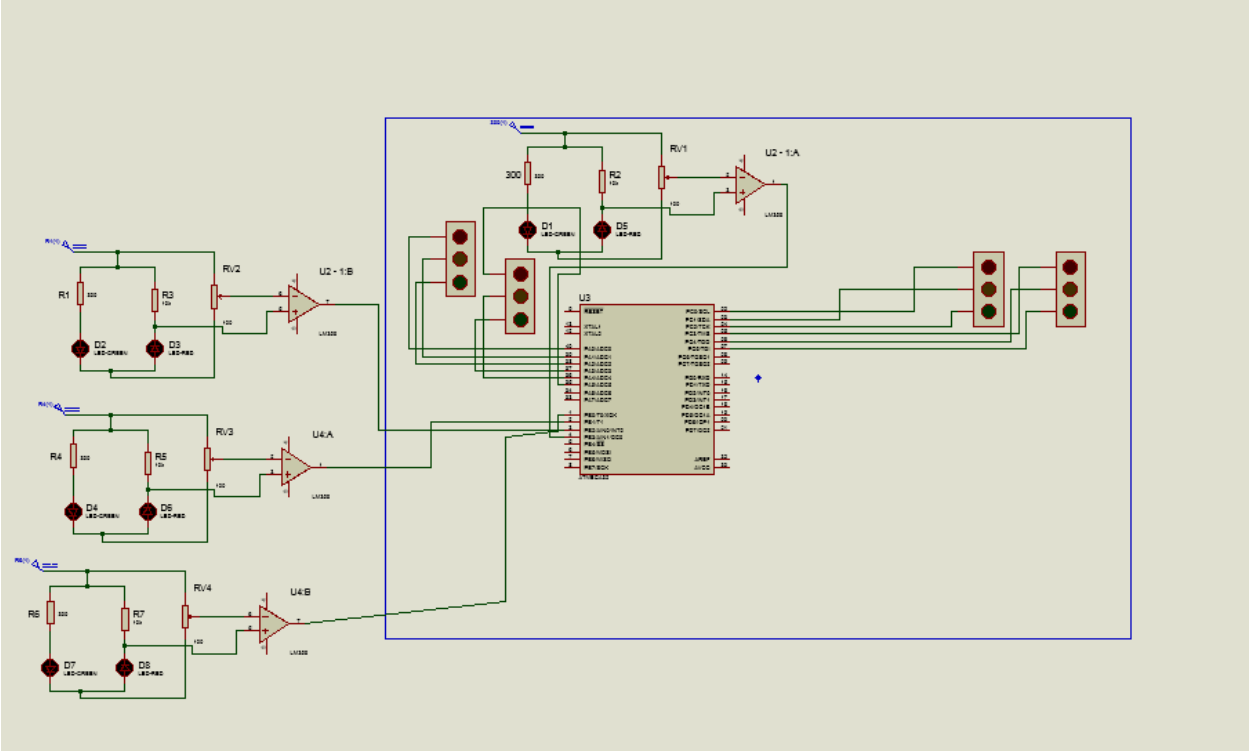

Figure 4.2 complete circuit connected to ADC circuit

4.3 The algorithm

The algorithm in figure 4.2 below shows what is the real mechanism or the real way which the intelligent system should take to achieve the goal of the system .In the beginning the initialization mode will be taken which is the normal mode that the traffic takes nowadays by specify a fixed time for each traffic light and so on .

Then the intelligent system will concern for the first priority cases -the special cases- if there is a special case there would be a message for the microcontroller to change the mode in the traffic light based on the case and the message that received.

The two special cases are

1- The emergency car case

When the emergency car arrive the lane which the emergency car take should be in " GREEN" mode or "GO" mode and all other traffic light should be in the " STOP " mode or " RED" mode .

2- The accident case

When an accident occurs the lane where the accident happened in it should be in " STOP" mode or "RED" mode and all other traffic light should continue works as the system designed .

Otherwisre there will be no messege sends and the sensor in the sides of the roud should send the signals to the microcontroller which will count the number in the 4 sections and the priority in this case will be for the section with less number of car and the time that the ligth will still GREEN is dirctly proparatinal with the number that the road count and that will be for the four section.

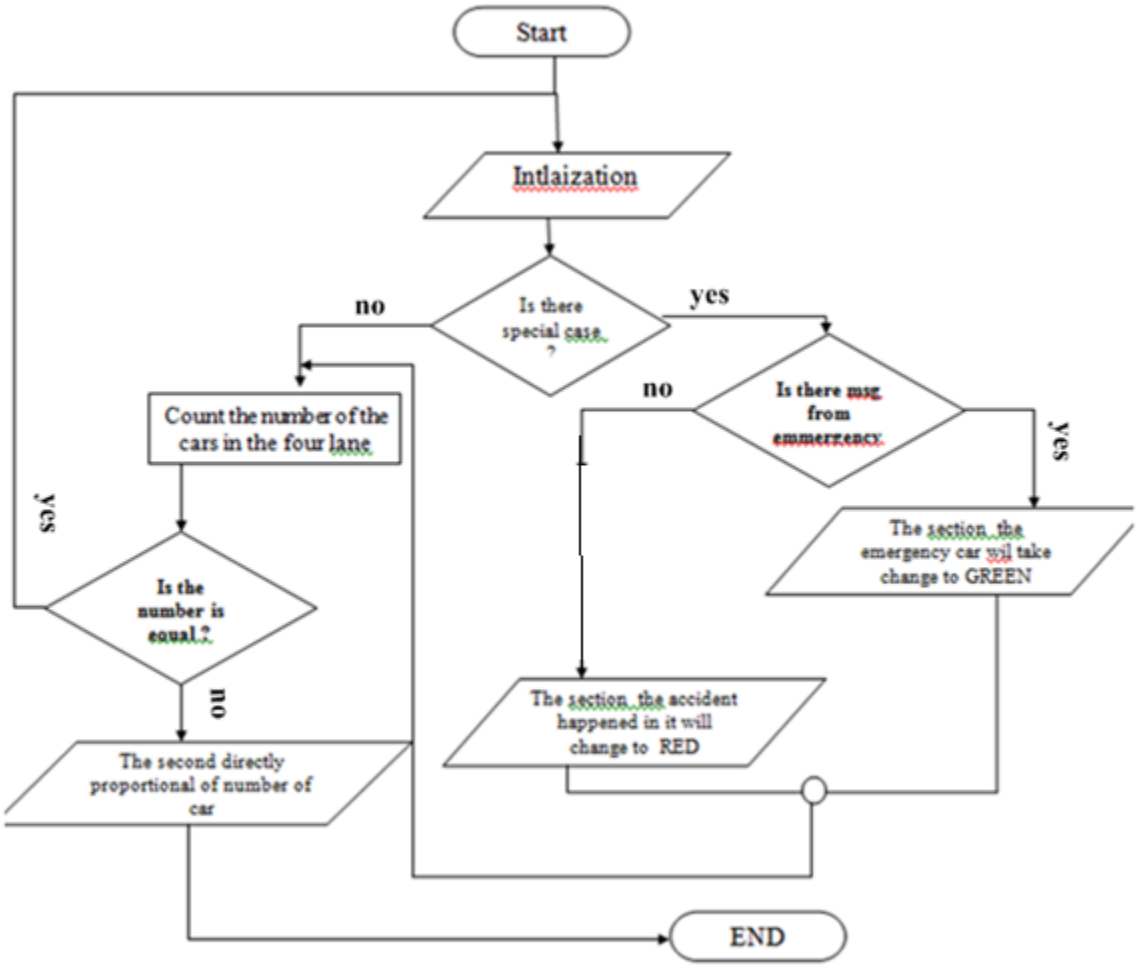

Figure 4.2the algorithm for the intelligent system

4.4 Steps to handle system:

Here are nine steps to handel the system as shown

1. the initialization case start with predefine seconds for the four lane
2. if there is special case go to step 3
3. if there is emergency car go to step 4 else go to step 7
4. make the lane's traffic light GREEN
5. if there is accident case go to sep 6
6. Change the accident's lane to RED
7. Count the car in the four lanes
8. If the number of car is equal go to step 1
9. Let the less number of car's lane GREEN for the second that directly proportional with that number.

The system in the first time will start as the reguraler sutation where there is a limttied seconds for every section. The special case in the system has the first priority and it is devided into two cases the first one is the emergency car case and the second one is the accedient case in the both case the policeman or the driver of the emergency car should send a message to the GSM model told that the car will take the X section or the accedient is in the X section and this section should be in the "GO" sutaion or the light should be GREEN in case of emergency car and " RED " or " STOP " in the accedient case untill the cars move . if there is no messege the sensor in the sides of the roud should send the signals to the microcontroller which will count the number in the 4 sections and the priority in this case will be for the section with less number of car and the time that the ligth will still GREEN is dirctly proparatinal with the number that the road count and that will be for the four section.

4.5Methodology

The methodology that the system will take to achieve it's goal is as the step bellow

1. The IR Sensor and the GSM model Sends the current traffic information to microcontroller.
2. Microcontroller then analyze the sensor or the GSM modem information &its way.
3. Microcontroller decides the traffic level of each section
4. Then Microcontroller takes the decision of glowing signals. The program the program that used to program the microcontroller is mentioned in Appendix A .

4.6 The approach

The research covers the area of microcontroller based system , data acquisition , interfacing and wireless data exchange .

The system design method will be divided into three phases as follows :

Here , the traffic lights will operate according to the equation no. (1) below

$$\text{Traffic lights timing (TN)} \alpha \text{Density of traffic on the lane (D)}$$

But in case of Emergency traffic operation .(i.e. Emergency cars are requesting passage and no accident occurs) . Here , the system will give lane passage command and traffic lights will operate according to the equation no. (2) below;

$$\text{Lane emergency timing (TE)} \alpha \text{Duration emergency car passage (E)}$$

And in accident traffic operation .(i.e. No emergency cars are requesting passage and an accident occurs) . Here , the system will give divert commands and traffic lights will operate according to the equation no. (3) below;

Accident timing (TA) α Duration for settling the accident (A)

Chapter five

Practical environment and result

5.1 Introduction

In this chapter, the intelligent traffic light system was designed, the chapter present the result of the practical system. By showing the figures of the result this chapter descried the procedure of the project.

5.2 The intelligent system's scenario

5.2.1 The normal scenario

In this scenario the vehicles start normally with fixed time for each lane and that is the regular case where the traffic light takes nowadays.

Here in the four lanes the vehicles wait same time and there is no priority for lane above other lane all of them treat as the same priority.

As the picture below the first case is the initialization where all the lane has zero number of car

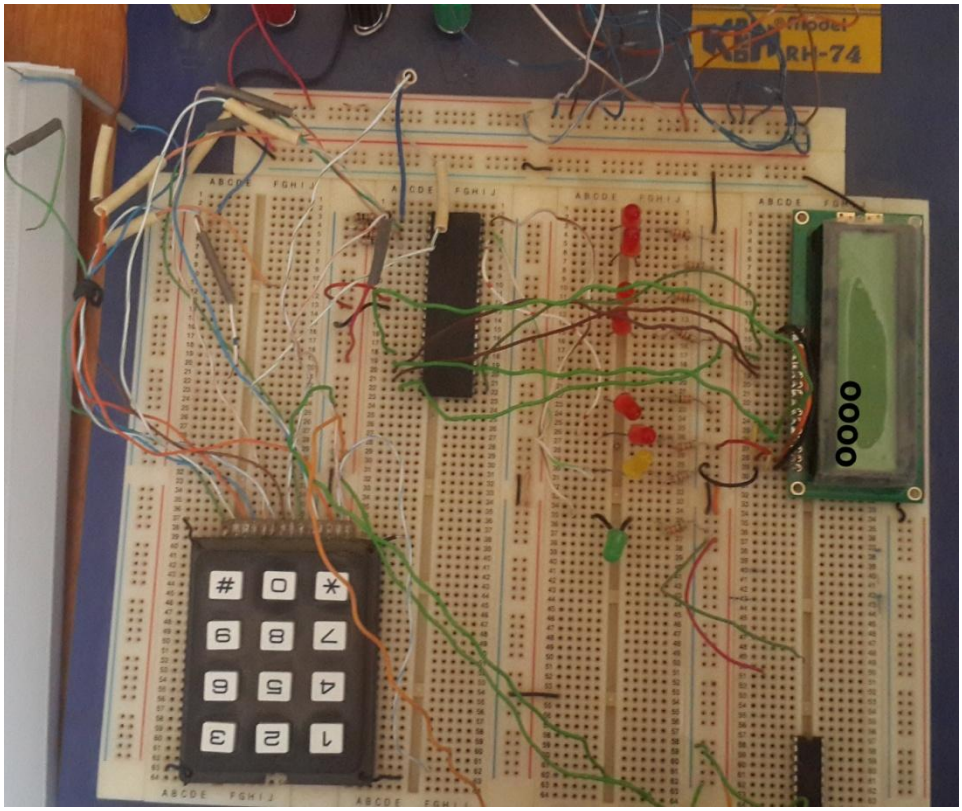

Fig 5.1 initialization case

If the sensor detect more car in the same lane like the picture below it will write it in the LCD screen the lane number with number of car (lane 2 3) that means lane 2 has 3 cars

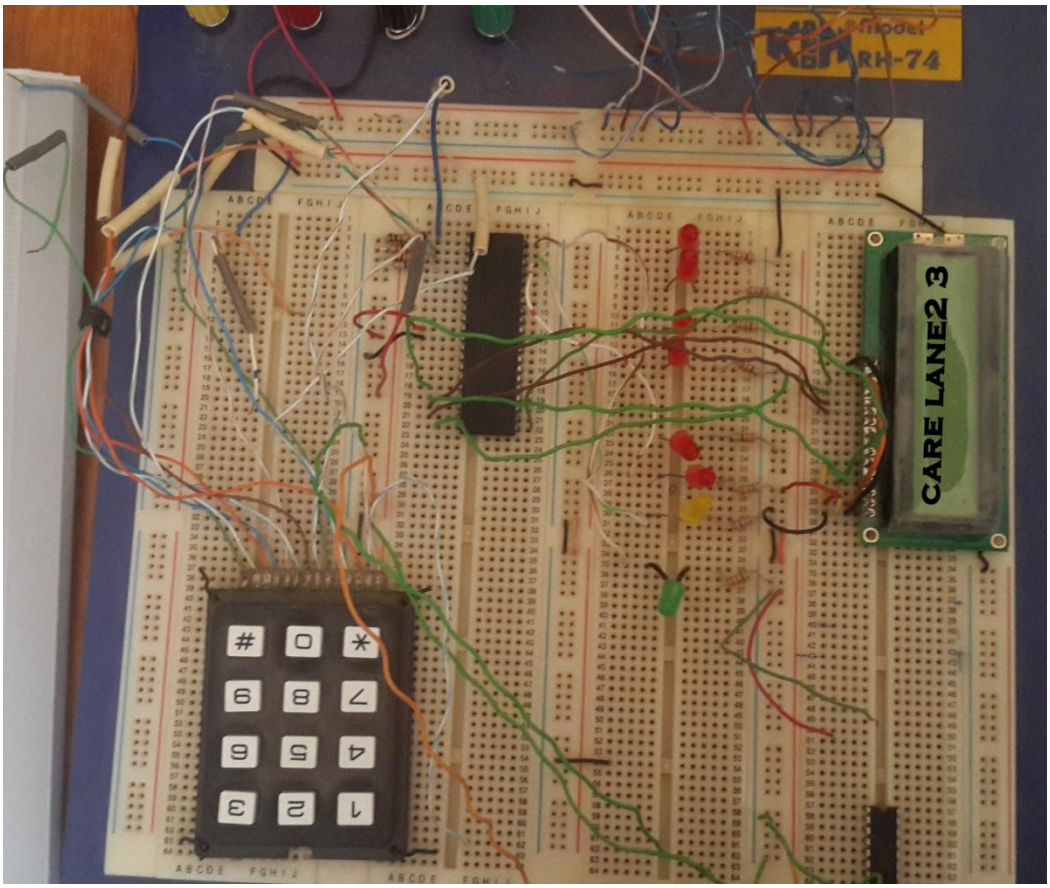

Fig 5.2 counting number of car

5.2.2 The accident scenario

In this scenario there where an accident in some lane and this lane will not take in consideration of the system, as the police man send a message for the GSM system that this lane's vehicles should not count.

This lane's traffic light will be in stop mode as the traffic police man does not push the button again informing the system that the accident has been solved and the lane are in it is normal mode .

The picture below shows case where in lane 1 there are an accident and this make the traffic light of the lane will change to red for this lane and ignore it from the system until the accident solve

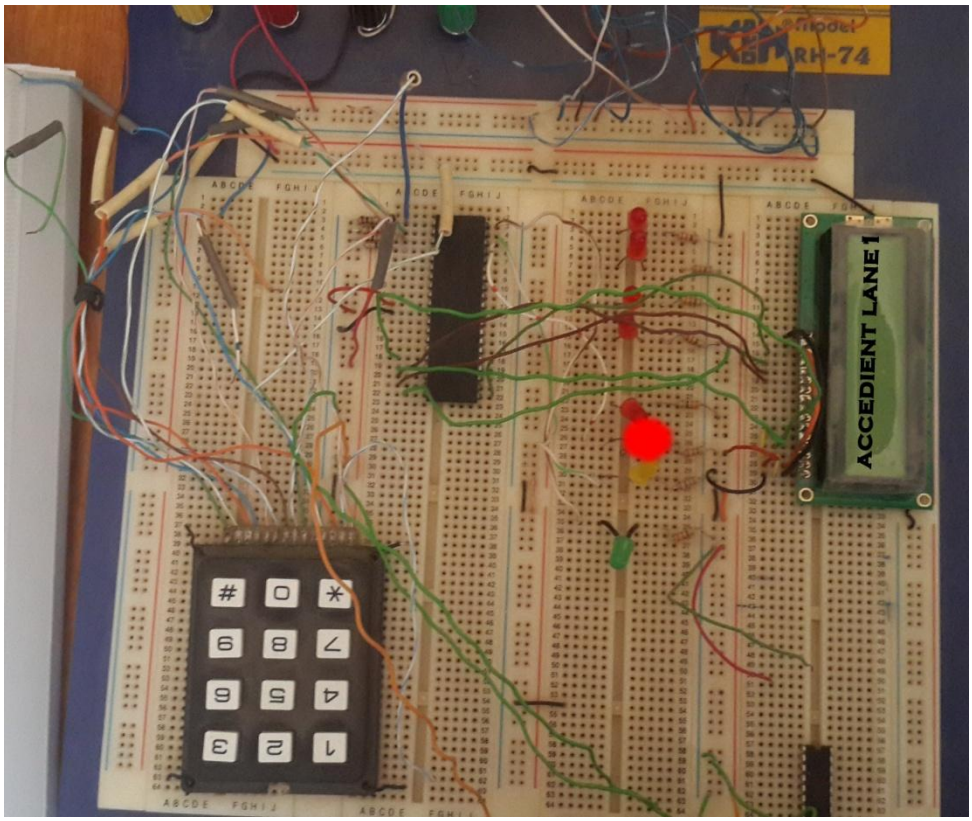

Fig 5.3 the Accident case

5.2.3 The emergency car scenario

In this scenario there where an emergency car want to take some lane and this lane should be in “GREEN” mode because it has the first priority above the three other lanes, as the driver of this emergency car send a message for the GSM system informing the system that this lane should be in “GREEN” mode the microcontroller change the traffic light and do not return this lane to it is normal case unless the driver of this emergency car

push the button again informing the system that the emergency car has crossed the lane.

The picture below shows case where in lane 1 there are an emergency car cross the lane and this make the traffic light of the lane change to green for this lane until the emergency cross.

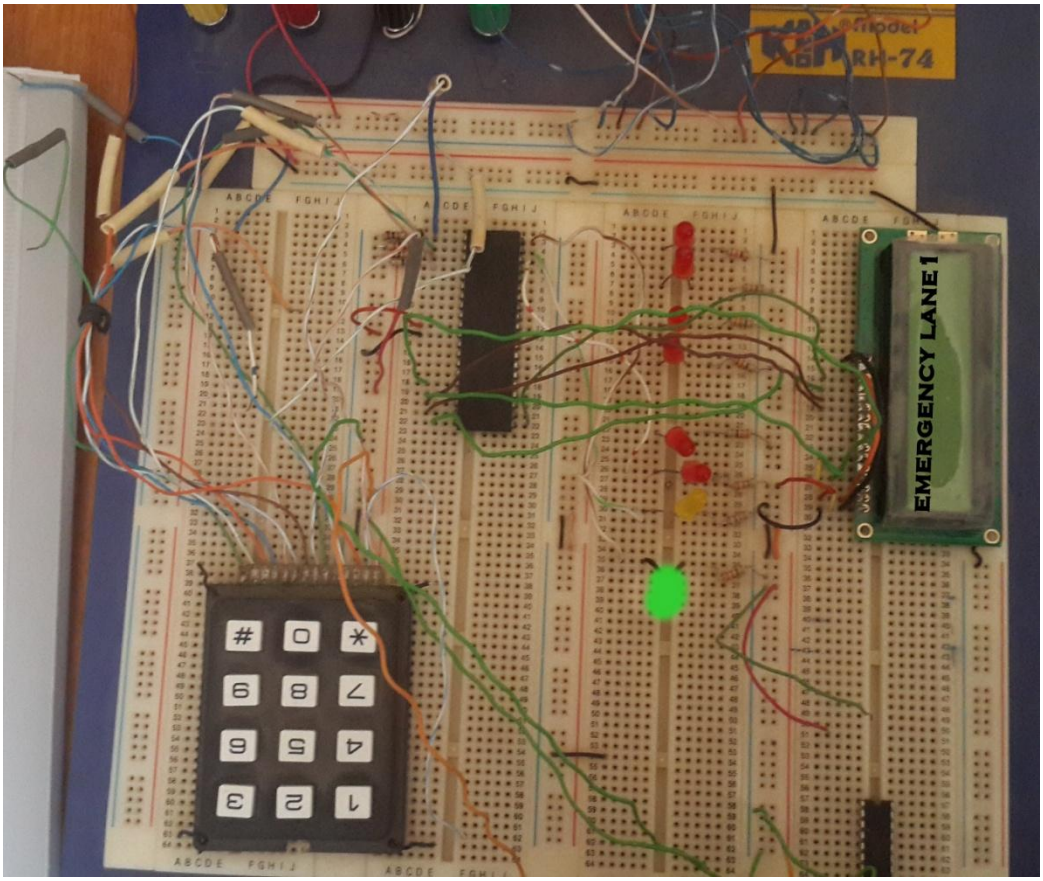

Fig 5.4 The emergency car case

5.2.4 The congestion scenario

In this scenario the vehicles on all lanes will treat as the normal mode with fixed time for each lane because all lane has many cars more than the number that the system could count and that happen in congestion mode.Here in the four lanes the vehicles wait same time and there is no priority for lane above other lane all of them treat as the same priority.

5.3 The result

The Following tables are the results for the system operation

Table 5.1 the summery of operation

Normal operation	Traffic lights timing depends on the traffic density.
Emergency mode operation	Give pass command to the lane
Accident mode operation	Give stop command to the lane
Congestion mode operation	Traffic lights timing depends on the traffic density.

table 5.2 shows the resulted traffic timing relative to the cars queuing on the lane.

table 5.2 traffic timing relative to the cars queuing on the lane

Traffic density (D)	Emergency cars	accidents	Timing sec.
6	NON	NON	30
7	NON	NON	32
8	NON	NON	34
9	NON	NON	36
10	NON	NON	38
11	NON	NON	40
12	NON	NON	42
14	NON	NON	44
15	NON	NON	46

The result shows that every car needs about 2 sec to cross the intersection so for the congestion case the maximum car 15 cars would needs 46 second to cross the road.

Chapter Six

Conclusion and Recommendation

6.1 Conclusion

In the next years the problem of the traffic that occurs nowadays will disappear in the roads if it applies the intelligent traffic light system by achieving the goal of the system. So wherever the number of vehicles on road increased traffic congestion should b. The main effect of this matter is the time wasting of the people on the road. Also at certain junctions, sometimes even if there is no traffic, people have to wait. Because the traffic light remains red for the preset time period, the road users should wait until the light turn to green. If they run the red light, they have to pay fine and present traffic systems fail to provide traffic information including congested roads and alternate routes available in case of congestion.

The system solve the traffic problem by reducing the delay for junctions and makes the lane that have high number of vehicles takes longer time than the delay for the junction that has less number of vehicles . the system also detects traffic flow on each road and set timing for each lane , the system also reduce the congestion that happen after the accident, and allowing the emergency car to go without wasting time and delay in its way .

6.2 Recommendation:

Great effort has been made in order to make this work complete in all aspect . but as with all project , there is always a room for improvement and further enhancements . there are a number of way in which this work can be carried forward

1- In this thesis , it could improve by adding readers to each traffic light .
2- In this thesis ,the sensing efficiency could be improved and the number of vehicles that the system take in consideration could be increased.

Reference

1- Shilpa S. Chavan (Walke) , Dr. R. S. Deshpande , design of intelligent traffic light controller using embedded system , Second International Conference on Emerging Trends in Engineering and Technology , 2009.

2- Vishakha S.Thakare, Snehal R.Jadhav , Design of Smart Traffic Light Controller Using Embedded System, IOSR Journal of Computer Engineering, April 2014.

3- Sarika B. Kale ,Gajanan P. Dhok , embedded system for intelligent ambulance and traffic control management , JICER ,April 2013.

4- Ganiyu R. A., Arulogun O. T., Okediran , Development Of A Microcontroller-Based Traffic Light System For Road Intersection Control , international journal of scientific & technology ,May 2014.

5- A.D.JADHAV, BHOR MADHURI T.,intelligent traffic light control system (ITLCS) , International Journal of Soft Computing and Artificial Intelligence, May-2014

6- Levinson, D. The value of advanced traveler information systems for route choice. Transportation Research Part C: Emerging Technologies, 2003.

7- http://www.ideafinder.com/history/inventions/trafficlight.htm 2014.8.1 12:30 pm

8- http://ops.fhwa.dot.gov/publications/fhwahop09055/fhwa_hop_09_055.pdf 2014.8.10 3:00 pm

9- Karthick Kumar Reddy, G. Jagadeesh, P. Traffic signals generation with bicolorleds using pic 18f series microcontroller International Journal of Embedded Systems and Applications ,December 2011

10- Sarika B. Kale, Gajanan P. Dhok Design of Intelligent Ambulance and Traffic Control , International Journal of Innovative

Technology and Exploring Engineering April 2013

11- Rashid Hussian, Sandhya Sharma , WSN Applications: Automated Intelligent Traffic Control System Using Sensors , (IJSCE) , July 2013

12- Ahmed S. Salama, Bahaa K. Saleh ,Intelligent Cross Road Traffic Management System ,2nd International Conference on Computer Technology and Development, 2010

13- http://wenku.baidu.com/view/c89f96c44028915f804dc2ae 2014.8.30 12:00 pm

14- U. S. Department of Transportation report , FEB1988

15- London Road SafetyUnit Research Summary March 2006

16- http://www.cir;30cuitstoday.com/atmega32-avr-microcontroller-an-introduction 2014.9.1 1:30 pm

17- ATMEL , ATMEGA32 8-bitMicrocontrollerwith 32K BytesIn-SystemProgrammableFlash DATASHEET.

18- http://dmohankumar.files.wordpress.com/2011/05/how-infrared-sensors-work.pdf 2014.9.2 10 :00 am

19- Emin Birey Soyen , Pyroelectric Infrared (PIR) Sensor Based Event Detection , nstitute of engineering and sciences of bIlkent university , July 2009

20- http://www.fhwa.dot.gov/policyinformation/pubs/vdstits2007/05pt2.cfm 2014.10.30

21- Data sheet of IR sensor

22- http://grietinfo.in/projects/MINI/EEE/DOC-A.7-TLC%20report.pdf 2014.10.30 12:09 pm

23- http://qsl.net/pa3ckr/bascom%20and%20avr/about%20bascom%20and%20avr/index.html 2014.8.9 11:44 am

24- http://www.svet-el.si/english/downloads/AVR_UK_inside_the_book.pdf 2014.8.9 1:30 pm

25- Infrared Detectors for the Future , A. Rogalski ,Institute of Applied Physics, Military University of Technology ,2009

26- http://files.i4wifi.cz/inc/_doc/attach/StoItem/3570/Manual_YL-007M3BX.pdf 2014.10. 29 12:00 pm

Appendix (A)

```
$regfile = "m32def.dat"                         ' we use the M32
$crystal = 8000000
$baud = 9600

'LCD CONFIGURATION
'--------------------------------------------------------------------------
Config Lcd = 40 * 2
Config Lcdpin = Pin , Db4 = Portc.4 , Db5 = Portc.5 , Db6 = Portc.6 , Db7 = Portc.7 , E =
Portc.2 , Rs = Portc.1
Cls
Cursor Off

Dim Carslane1 As Integer
Dim Carslane2 As Integer
Dim Carslane3 As Integer
Dim Carslane4 As Integer


Config Pinb.0 = Input
Config Pinb.1 = Input
Config Pinb.2 = Input
Config Pinb.3 = Input

Carslane1 = 0
Carslane2 = 0
Carslane3 = 0
Carslane4 = 0

Lcd Carslane1 ; Carslane2 ; Carslane3 ; Carslane4

Config Porta.0 = Output
Config Porta.1 = Output
Config Porta.2 = Output
Waitms 5000

Lane1:
Do
      If Pinb.1 = 1 Then
         Waitms 2000
         Goto Lane2
       Else
       Carslane1 = Carslane1
      End If
      If Pinb.2 = 1 Then
```

```
          Waitms 2000
          Goto Emergancylane1
        Else
        Carslane1 = Carslane1
       End If
       If Pinb.3 = 1 Then
          Waitms 2000
          Goto Accident
        Else
        Carslane1 = Carslane1
       End If
If Pinb.0 = 1 Then
   Carslane1 = Carslane1 + 1
  Cls
  Lcd "cars lane1" ; Carslane1
  Waitms 1000
   Else
   Carslane1 = Carslane1

End If
Loop

Lane2:
Do
If Pinb.1 = 1 Then
          Waitms 2000
          Goto Lane3
        Else
        Carslane2 = Carslane2
       End If
If Pinb.0 = 1 Then
   Carslane2 = Carslane2 + 1
  Cls
  Lcd "cars lane2" ; Carslane2
  Waitms 1000
   Else
   Carslane2 = Carslane2
End If
Loop

Lane3:
Do
If Pinb.1 = 1 Then
          Waitms 2000
          Goto Lane4
        Else
```

```
        Carslane3 = Carslane3
       End If
If Pinb.0 = 1 Then
   Carslane3 = Carslane3 + 1
  Cls
  Lcd "cars lane3" ; Carslane3
  Waitms 1000
   Else
   Carslane3 = Carslane3
End If
Loop


Lane4:
Do
If Pinb.1 = 1 Then
          Waitms 2000
          Goto Normaltraffic
        Else
        Carslane4 = Carslane4
       End If
If Pinb.0 = 1 Then
   Carslane4 = Carslane4 + 1
  Cls
  Lcd "cars lane4" ; Carslane4
  Waitms 1000
   Else
   Carslane4 = Carslane4
End If
Loop


Normaltraffic:
    Cls
  Lcd "normal traffic" ; Carslane1 ; Carslane2 ; Carslane3 ; Carslane4
  Waitms 1000
  Porta.0 = 1
  Porta.1 = 0
  Porta.2 = 0
  Goto Lane1

Emergancylane1:
Cls
  Lcd "Emergancy traffic"
  Waitms 1000
  Porta.0 = 1
```

```
  Porta.1 = 0
  Porta.2 = 0
  Goto Lane1

Accident:
Cls
  Lcd "Accident"
  Waitms 1000
  Porta.0 = 0
  Porta.1 = 0
  Porta.2 = 1
End
```

Appendix (B)