



SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

College of Graduate Studies

**Design and Implementation of Vehicles Accident
Notification System**

تصميم و تنفيذ نظام إشعار بحوادث السيارات

**A Thesis Submitted in Partial Fulfillment for the
Degree of M.Sc in Mechatronics Engineering**

PREPARED BY:

Mohamed Alsharef Abdalsalam Ahmed Eltayeb

SUPERVISOR:

Dr. Fath Elrahman Ismael Khalifa

August 2016



Approval Page

Name of Candidate: Mohammed Al Sharef Abd Al Salam Ahmed
ELtaye

Thesis title: Design and Implementation of Vehicles
Accident Notification System

تصميم وتنفيذ نظام إخطار حوادث السيارات

Approved by:

1. External Examiner

Name: Dr. Elsadat Saeed G. ebreel

Signature: [Signature] Date: 27/10/2016

2. Internal Examiner

Name: Dr. Salehuddin Mohamed Ibrahim Edam

Signature: [Signature] Date: 27/10/2017

3. Supervisor

Name: Dr. Fath Elrahman Ismael Khalifa Ahmed

Signature: [Signature] Date: 27/10/2016

الآية

قال تعالى

مِنْ أَجْلِ ذَلِكَ كَتَبْنَا عَلَىٰ بَنِي إِسْرَآئِيلَ أَنَّهُ مَن قَتَلَ نَفْسًا بِغَيْرِ نَفْسٍ أَوْ فَسَادٍ
فِي الْأَرْضِ فَكَأَنَّمَا قَتَلَ النَّاسَ جَمِيعًا وَمَنْ أَحْيَاهَا فَكَأَنَّمَا أَحْيَا النَّاسَ
جَمِيعًا ۚ وَلَقَدْ جَاءَهُمْ رُسُلُنَا بِالْبَيِّنَاتِ ثُمَّ إِنَّ كَثِيرًا مِّنْهُمْ بَعْدَ ذَلِكَ فِي
الْأَرْضِ لَمُسْرِفُونَ (32) صدق الله العظيم

سورة المائدة الآية 32

Dedication

.....To My Father

.....To My Mother

....And All friends Where Ever They Are

Acknowledgment

*Thanks to everyone who lead
this thesis from the dark to the
light with a special thanks to*

Dr. Fath Elrahman Ismael Khalifa

المستخلص

حوادث السيارات تحصد سنويا الاف الارواح وتسبب في الكثير من الاعاقات الدائمة و المؤقتة وتؤدي الي خسائر مادية فادحة علي المستوي الشخصي و علي مستوي الحكومات.وعلي الرغم من ذلك اصبحت السيارات تشكل جزءا لايتجزء من حياتنا اليومية ومكونا اساسيا لحياتنا المدنية.لذلك سعي مصنعو السيارات الي تقليل الحوادث بادخال التقنيات الالكترونية الحديثة علي صناعة السيارات من انظمة الكبح و الكمبيوترات.

من اسباب الوفيات في الحوادث علما بان الاقدار بيد الله هي تأخر اكتشاف الحادث وابلاغ الجهات المختصة حتي تتم المساعدة في الوقت المناسب.في هذا البحث العلمي نعرض نموذج عملي يوضح كيفية اكتشاف الحادث ومن ثم ابلاغ الجهات المختصة حتي تتم المختصة وتسهيل وصول مركبات الطوارئ لمكان الحادث في الزمن المناسب.

يتم تزويد السيارات بمنظومة تتكون من حساس لاستشعار الحادث ومن ثم تحديد الحادث في الزمن المناسب.بعد ذلك تبدأ المرحلة الثانية وهي تسهيل حركة السير لعربة الاسعاف عن طريق تحويل الاشارة الحمراء الي خضراء باستخدام جهاز تحكم لاسلكي وهو عبارة عن مرسل يقوم بارسال اشارات لجهاز مستقبل موجود في منظومة الاشارة الضوئية. في ختام هذا المشروع تم الحصول علي نتائج مبهره تؤكد عمل المنظومه بصورة متكامله و متناسقة و متزامنه تساعد انشاء الله علي انقاذ الكثير من الارواح.

Abstract

Ever since the invention of cars accident was introduced as a major cause of death and car manufactures has been developing new ways to prevent death by accident. Time is very important factor when it comes to saving a person's life, any delay in detecting an accident or failing to locate its position life. The solution proposed by this thesis is to use a combination of collision detection unit and identify an accident and report it to the appropriate authorities and clear the roads for first responders. The collision unit consist of vibration sensor to detect accident, locate the accident using GPS and use a GSM card to report it to the authorities. The ambulance unit is simply a remote controller that clear traffic by turning red lights to green lights in favor of the ambulance.

At the end of research, we have obtained results that proved the system to be functional

Table of Content

NO	Title	Page
	الاستهلال	I
	Dedication	II
	Acknowledge	III
	المستخلص	IV
	Abstract	V
	Contains	VI
	List of figures	IX
	List of tables	X
	List of abbreviations	XII
	Chapter 1: introduction	
1.1	Preface	1
1.2	Problem statement	2
1.3	Proposed solution	3
1.4	Objective	3
1.5	Methodology	4
1.6	Thesis outline	4
	Chapter 2: LITERATURE REVIEW	
2.1	Background	5
2.1.1	Microcontroller	5
2.1.2	Global positioning system	6
2.1.3	Global system for mobile communications	7
2.1.4	Vibration measurement:	8
2.1.4.1	Quantifying the Vibration Level	9
2.1.4.2	The Vibration Parameters, Acceleration, Velocity and Displacement	10
2.1.5	Encoder and Decoder	10
2.1.6	Liquid crystal display	13
2.1.7	Radio frequency	14

2.1.7.1	Type of RF module	14
2.1.7.2	RF signal modulation	15
2.2	Related works	15
Chapter 3: System Design		
3.1	Preface	17
3.2	Vehicle unit	18
3.3	Ambulance unit	19
3.4	Traffic unit	19
3.5	Bit AVR Microcontroller (AT mega 16 L)	20
3.5.1	Microcontroller pin descriptions	22
3.6	Global Positioning System (GPS)	24
3.6.1	Accuracy	25
3.6.2	Timekeeping	26
3.6.3	Error sources and analysis	26
3.6.4	Structure	26
3.7	Global System for Mobile Communication (GSM)	27
3.7.1	GSM specifications	27
3.7.2	GSM network architecture	28
3.7.2.1	Mobile station (MS)	28
3.7.2.2	Base transceiver station (BTS)	30
3.8	Liquid crystal display (LCD)	31
3.9	Amplitude-shift keying (ASK):	32
3.10	Vibration sensor:	32
3.10.1	Application	33
3.10.2	Features	33
Chapter 4: Simulation and Hardware Implementation		
4.1	Preface	34
4.2	Block Diagram of Basic Operations	34
4.2.1	Collision unit	34

4.2.2	Ambulance unit	35
4.2.3	Traffic unit	38
4.3	Circuit diagram	39
4.3.1	Collision Unit	39
4.3.2	Ambulance unit	40
4.3.3	Traffic unit	41
4.4	Flow chart Sequences Operation of collision unit	42
4.5	Flow chart Sequences Operation of Ambulance and Traffic units	45
4.6	Hardware operation	47
4.7	Programming (code):	48
	Chapter 5: Recommendations and Conclusion	
5.1	Recommendations	49
5.2	Conclusion	49
	References	
	Appendix	

List of Figures

Figure No.	Title	page
2.1	Block diagram of decoder 2 to 4	11
2.2	block diagram of encoder 4 to 2	12
2.3	The logic diagram for the 4-to-2 Encoder	12
3.1	Vehicle unit block diagram	18
3.2	Ambulance unit block diagram	19
3.3	Traffic light controller	20
3.4	block diagram of microcontroller	22
3.5	Global Positioning System	25
3.6	describe the mobile station	30
3.7	The um interface or Air interface	31
3.8	pins of LCD and distribution how it connects	32
3.9	Vibration Sensor block diagram	33
4.1	Collision detection Unit block diagram	35
4.2	Ambulance Unit remote controller block diagram's	36
4.3	Case 1 at the traffic light	36
4.4	Case 2 at the traffic light	36
4.5	Case 3 at the traffic light	37
4.6	Case 4 at the traffic light	37
4.7	Traffic Unit block diagram	38
4.8	The circuit diagram of the Collusion unit	40
4.9	The circuit diagram of the Ambulance Unit	41
4.10	The circuit diagram of the traffic unit	42
4.11	Flow chart Sequence Operation of Collusion unit	44
4.12	Flow chart Sequence Operation of Ambulance and Traffic units	45

4.13	Normal Mode of operation	46
4.14	Crash Mode of operation	47
4.15	The collusion location	48
4.16	The Ambulance unit when it operates	48

List of Tables

Table No.	Title	Page
2.1	Decoder 2-to 4 truth table	11
2.2	Encoder 4-to2 truth table	12

List of Abbreviations

AC	Alternating Current
ADC	Analog to Digital Conversion
ALU	Arithmetic Logic Unit
ASK	Amplitude Shift Keying
ATMEGA	Microcontroller Family
BTS	Base Transceiver Station
CGI	Cell Global Identification
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DOD	The Us Department of Defense
DC	Direct Current
EEPROM	Electrically Erasable Programmable Read Only Memory
EGSM	Extended Global System for Mobile
FSK	Frequency Shift Keying
GDP	Gross Domestic System
GMSK	Gaussian Minimum Shift Keying
GND	Ground
GPS	Global Positioning System
GSM	Global System for Mobile
I/O	(Input/Output) Unit
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
LAI	Local Area Identity
LCD	Liquid Crystal Display
LPC	Linear Predictive Coding
MCS	Master Control Station
ME	Mobile Equipment
MIP	Mobile Internet Protocol
MS	Mobile Station

OCX	Operational Control Of Defense
OOK	On-Off Keying
PIN	Personal Identification Number
PLMN	Public Land Mobile Network
PLMN	Public Land Mobile Network
PUK	Personal Unblocking Key
RF	Radio Frequency Module
RX	receiver Module
SIM	Subscriber Identity Module
SMS	Services Message Service
SPI	Serial Peripheral Interface
SPN	Service Provider Name
SPRAM	Static Random Access Memory
TMSI	Temporary Mobile Subscriber Identity
TRX	Transceiver
TX	Transmitter Module
UTS	Universal Total Station
VCC	Digital Supply Voltage
WHO	World Health Organization

Chapter One

Introduction

1.1 Preface:

According to technological and population development, the usage of vehicles is rapidly increasing and at the same time the occurrence of accident is also increased. Hence, the value of human life is ignored. No one can prevent the accident, but can save the life of injured people by expediting the ambulance to the hospital in time.

Annual Global Road Crash Statistics shows nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day, an additional 20-50 million are injured or disabled, further more Road traffic crashes rank as the 9th leading cause of death and account for 2.2% of all deaths globally, Road crashes are the leading cause of death among young people ages 15-29, and the second leading cause of death worldwide among young people ages 5-14; each year nearly 400,000 people under 25 die on the world's roads, on average over 1,000 a day; over 90% of all road fatalities occur in low and middle-income countries, which have less than half of the world's vehicles. Road crashes cost USD \$518 billion globally, costing individual countries from 1-2% of their annual GDP (Gross Demotic Product), thus road crashes cost low and middle-income countries total of 65 billion USD annually, exceeding the total amount received in developmental assistance. Unless action is taken, road traffic injuries are predicted to become the fifth leading cause of death by 2030.

[1]

According to ministry of interior affairs of Sudan, the car accident in 2014 has been responsible for the death of over 1700 person and more than 4000 injured people.

According to the latest WHO (World Health Organization) data published in May 2014 Road Traffic Accidents Deaths in Sudan reached 9,312 or 3.58% of total deaths. The age adjusted Death Rate is 31.13 per 100,000 of population ranks Sudan #18 in the world.

A number of factors contribute to the risk of collision, including vehicle design, speed of operation, road design, road environment, and driver skill, impairment due to alcohol or drugs, and behavior, notably speeding and street racing. Worldwide, motor vehicle collisions lead to death and disability as well as financial costs to both society and the individuals involved.

1.2 Problem Statement:

Many high way accident in Sudan are unreachable by ambulance and police, and injured people just will be waiting for help that come from a vehicle that passes at the accident site, whose passenger will be willing to help transport injured people to nearest hospital. Many lives can be saved in accident by quickly responding and reach them on the right time where emergency treatment can be performed at the accident site and during transportation to nearest hospital. However, in the recent years several emergency points are established along the high way where the police and ambulance can respond fast in case of an accident. Even though this is a major step in solving the problem, the emergence responders are still faced with the problem of locating the accidents. Moreover, the emergence responders can still be delayed by traffic, especially in rush hours due to traffic lights and the lack of police to clear the road for emergence responders.

1.3 Proposed Solution:

The proposed solution is divided into two parts. Firstly, equip cars with vibration sensors, global positioning system (GPS), and global system for mobile communications (GSM). The vibration sensors will identify the collusion and the GPS can accurately locate the time and place of the collusion and use the GSM to send this information to responsible authorities; so that help can be sent to the collusion location. Secondly, equip emergency responder's vehicles with especial device to control traffic light so that every traffic light in favor of emergency responders turn into green light and red for other direction.

1.4 Objectives:

The objective of this research includes:

- To save human life.
- To locate the accident position.
- To decrease the delay of an accident, respond.
- To design circuit that coordinate between vibration sensor, GPS, and GSM to ensure that they integrate properly and the information is sent to responsible authorities.
- To design remote controller that sent signals to the traffic light to turn it into green light for emergency vehicles.
- Simulate the designed circuit using Proteus.
- Performance Evaluation of the synthesis circuit through different scenarios.

1.5 Methodology:

to equip a car with vibration sensor that detect the collusion between the two cars and send signal to the microcontroller to send message by global system for mobile communication (GSM) contain the location of the accident that determined by the global positioning system (GPS) to responsible authorities to take action. Also to clear traffic for ambulance by equip it by remote controller (Transmitter) send signal to traffic light equipped with receiver device to detect the signal to turn it into green and red for the other direction.

1.6 Thesis Outlines

this thesis composed of five chapters, their details as follows

- Chapter one is an introduction.
This chapter includes preface, problem Statement, proposed solution, objectives and methodology.
- Chapter two is a literature review.
This chapter gives background for each component and an idea about related works, analysis of the related works.
- Chapter three is system design
This chapter contains general description of microcontroller, global positioning system, global system for mobile communication, liquid crystal display, Vibration sensor, RF modulation.
- Chapter four is simulation and hardware implementation.
This chapter describes the work of hardware implementation and result of the testing circuit.
- Chapter five is a conclusion and recommendation.
This chapter presents the conclusion that derived from the thesis and some recommendation for future work

Chapter Two

Literature Review

2.1 Background:

2.1.1 Microcontroller:

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP (One Time Programmable) ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips[2].

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems [2].

Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (single-digit mill watts or microwatts). They will generally have the ability to retain

functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just Nano watts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption[2].

2.1.2 Global Positioning System (GPS):

The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver[3].

The US began the GPS project in 1973 to overcome the limitations of previous navigation systems, integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. The U.S. Department of Defense (DoD) developed the system, which originally used 24 satellites. It became fully operational in 1995. Roger L. Easton, Ivan A. Getting and Bradford Parkinson are credited with inventing it[3].

Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS and implement the next generation of GPS Block IIIA satellites and Next Generation Operational Control System (OCX). Announcements from Vice President Al Gore and the White House in 1998 initiated these changes. In 2000, the U.S. Congress authorized the modernization effort, GPS III[4].

In addition to GPS, other systems are in use or under development. The Russian Global Navigation Satellite System (GLONASS) was developed contemporaneously with GPS, but suffered from incomplete coverage of the globe until the mid-2000s. There are also the planned European Union Galileo positioning system, India's Indian Regional Navigation Satellite System, China's BeiDou Navigation Satellite System, and the Japanese Quasi-Zenith Satellite System[5].

The design of GPS is based partly on similar ground-based radio-navigation systems, such as LORAN and the Decca Navigator, developed in the early 1940s and used by the British Royal Navy during World War II.

In 1956, the German-American physicist Friedwardt Winterberg proposed a test of general relativity — detecting time slowing in a strong gravitational field using accurate atomic clocks placed in orbit inside artificial satellites[6].

Special and general relativity predict that the clocks on the GPS satellites would be seen by the Earth's observers to run 38 microseconds faster per day than the clocks on the Earth. The GPS calculated positions would quickly drift into error, accumulating to 10 kilometers per day. The relativistic time effect of the GPS clocks running faster than the clocks on earth was corrected for in the design of GPS.[7]

2.1.3 Global System for Mobile Communications:

GSM stands for Global System for Mobiles. This is a world-wide standard for digital cellular telephony, or as most people know them Digital Mobile Telephones. GSM was created by the Europeans, and originally meant "Groupe Special Mobile", but this didn't translate well, so the now common more globally appealing name was adopted. GSM is a published standard by ETSI (European Telecommunications Standards

Institute), and has now enjoys widespread implementation in Europe, Asia, and increasingly America.

There are many arguments about the relative merits of analogue versus digital, but for my mind it comes down to this: Analogue sounds better and goes further, Digital doesn't sound as good, but does a whole lot more.

Throughout the evolution of cellular telecommunications, various systems have been developed without the benefit of standardized specifications. This presented many problems directly related to compatibility, especially with the development of digital radio technology. The GSM standard is intended to address these problems.

From 1982 to 1985 discussions were held to decide between building an analog or digital system. After multiple field tests, a digital system was adopted for GSM. The next task was to decide between a narrow or broadband solution. In May 1987, the narrowband time division multiple access (TDMA) solution was chosen. [8]

2.1.4 Vibration Measurement:

Vibration is a time-based (periodic/cyclic) displacement of an object around a center static position. The following contributing factors have a complex relationship with the magnitude and rate of the vibration:

- The object's own natural frequencies and stiffness.
- The amplitude and frequencies of any external energy source(s) inducing the vibration.
- The coupling mechanism between vibration energy source and the object of interest.

Vibration measurement is complex because of its many components – displacement, velocity, acceleration, and frequencies. Also, each of these

components can be measured in different ways – peak-to-peak, peak, average, RMS; each of which can be measured in the time domain (real-time, instantaneous measurements with an oscilloscope or data acquisition system) or frequency domain (vibration magnitude at different frequencies across a frequency spectrum), or just a single number for “total vibration.”[9]

2.1.5 Quantifying the Vibration Level:

The vibration amplitude, which is the characteristic which describes the severity of the vibration, can be quantified in several ways. On the diagram, the relationship between the peak-to-peak level, the peak level, the average level and the RMS level of a sinewave. The peak-to-peak value is valuable in that it indicates the maximum excursion of the wave, a useful quantity where, for example, the vibratory displacement of a machine part is critical for maximum stress or mechanical clearance considerations. The peak value is particularly valuable for indicating the level of short duration shocks etc. But, as can be seen from the drawing, peak values only indicate what maximum level has occurred, no account is taken of the time history of the wave. The rectified average value, on the other hand, does take the time history of the wave into account, but is considered of limited practical interest because it has no direct relationship with any useful physical quantity. The RMS value is the most relevant measure of amplitude because it both takes the time history of the wave into account and gives an amplitude value which is directly related to the energy content, and therefore the destructive abilities of the vibration [9].

2.1.6 The Vibration Parameters, Acceleration, Velocity and Displacement:

When looked at the vibrating tuning fork considering the amplitude of the wave as the physical displacement of the fork ends to either side of the rest position. In addition to Displacement the movement of the fork leg can also be describe in terms of its velocity and its acceleration. The form and period of the vibration remain the same whether it is the displacement, velocity or acceleration that is being considered [9].

For sinusoidal signals, displacement, velocity and acceleration amplitudes are related mathematically by a function of frequency and time. If phase is neglected, as is always the case when making time-average measurements, then the velocity level can be obtained by dividing the acceleration signal by a factor proportional to frequency, and the displacement can be obtained by dividing the acceleration signal by a factor proportional to the square of frequency. This division is performed by electronic integrators in the measuring instrumentation [9].

The vibration parameters are almost universally measured in metric units in accordance with International Organization for Standardization (ISO) requirements. The gravitational constant "g" is still widely used for acceleration levels although it is outside the ISO system of coherent units. Fortunately, a factor of almost 10 (9,81) relates the two units so that mental conversion within 2% is a simple matter [9].

2.1.5 Encoder and Decoder:

A decoder is a combinational circuit that converts coded inputs to another coded output. The famous examples of decoders are binary n -to- 2^n decoders and seven-segment decoders. A binary decoder has n inputs and a maximum of 2^n outputs. As known, an n -bit binary number provides 2^n min terms or max terms. This type of decoder produces one of the 2^n min

terms or max terms at the outputs based on the input combinations. Let's take the 2-to-4 decoder as an example, the block diagram and the truth table of this decoder is shown in Figure 2.1 and Table 2.1 respectively.

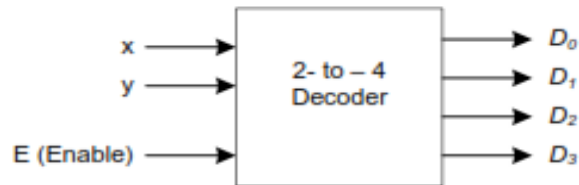


Figure 2.1: block diagram of Decoder 2-to-4.

Table 2.1: Decoder 2-to4 truth table.

E	x	y	D0	D1	D2	D3
0	X	X	0	0	0	0
1	0	0	1	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	1	0
1	1	1	0	0	0	1

From the truth table, you can observe the basic operation of n-to-2n decoders, there is only one active output (min term) for each input combination. The Boolean expression of the output signals are:

$$D_0 = Ex'y', D_1 = Ex'y, D_2 = Exy', D_3 = Exy \text{-----[2.1]}$$

The encoder is a combinational circuit that performs the reverse operation of the decoder. The encoder has a maximum of 2n inputs and n outputs. The block diagram and the truth table of a 4-to-2 encoder are shown in Figure 2.2 and Table 2.2 respectively.

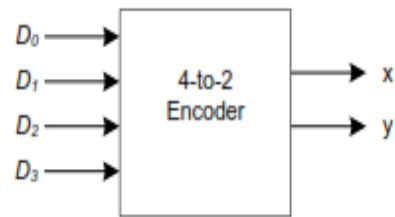


Figure 2.2: block diagram of Encoder 4-to-2.

Table 2.2: Encoder 4-to2 truth table

D0	D1	D2	D3	X	Y
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

Table 2.2: Encoder 4-to2 truth table

From the truth table, we can expressed the outputs as:

$$x = D_2 + D_3 \text{-----}[2.2]$$

$$y = D_1 + D_3 \text{-----}[2.3]$$

Therefore, the logic diagram for the 4-to-2 Encoder can be obtained as shown in Figure 2.3.

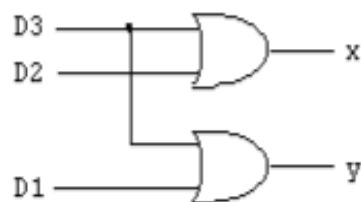


Figure 2.3: The logic diagram for the 4-to-2 Encoder.

2.1.6 Liquid Crystal Display:

A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly [10].

LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in nearly all applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence [11].

The LCD screen is more energy-efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment more efficiently than CRTs. It is an electronically modulated optical device made up of any number of segments controlling a layer of liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. Liquid crystals were first discovered in 1888. By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes [12].

2.1.7 Radio Frequency:

An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. RF communications incorporate a transmitter and/or receiver.

2.1.7.1 Type of RF module:

The term RF module can be applied to many different types, shapes and sizes of small electronic sub assembly circuit board. It can also be applied to modules across a huge variation of functionality and capability. RF modules typically incorporate a printed circuit board, transmit or receive circuit, antenna, and serial interface for communication to the host processor.

Most standard, well known types are covered here:

- **Transmitter module**

An RF transmitter module is a small Printed Circuit Board (PCB) sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which can be transmitted. RF transmitters are usually subject to regulatory requirements which dictate the maximum allowable transmitter power output, harmonics, and band edge requirements.

- **Receiver module**

An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: super-

heterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage. Super-heterodyne receivers have a performance advantage over super-regenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in turn leads to a comparatively more expensive product.

2.1.7.2 RF signal modulation:

There are five types of signal modulation methods commonly used in RF transmitter and receiver modules:

- Amplitude-shift keying(ASK)
- On-off keying (OOK)
- Frequency-shift keying (FSK)
- Direct-sequence spread spectrum
- Frequency-hopping spread spectrum

2.2 Related Works:

Several research projects held by research institutes and car manufacturers around the world have been focusing on inter vehicle communication systems. Considering worldwide systems for emergency reporting regardless of their communication method whether it's wired or wireless, helped to define the strong objectives about our proposed systems. Some of the projects related to the proposed system are listed below:

Manuel Fogue and his partners proposed a prototype architecture called e-NOTIFY, a novel proposal designed to improve the chances of survival for passengers involved in car accidents. The proposed system

offers automated detection, reports, and assistance to passengers involved in road accidents by exploiting the capabilities offered by vehicular communication technologies. The goal of this system is to provide an architecture that allows:

- 1) direct vehicle to vehicle (V2V) involved in the accident,
- 2) automatic sending of a data file containing important information about the incident to the CU, and
- 3) a preliminary and automatic assessment of the damage to the vehicle and its occupants, based on the information received from the involved vehicles, and a database of accident reports. According to the reported information and the preliminary accident estimation, the system will alert the required rescue resources to optimize accident assistance [13].

In E. Davila, eCall the authors present an automatic emergency alert system for two-wheeled. This system has features like crash detector and an eCall box, which can be connected over a wired or wireless link which was developed only for two wheelers. The box provides the notification (emergency call) service, which sends eCall's Minimum Set of Data to the Public Safety Answering Point. Early experimental results showed systems reliability of the detector-box wireless communication, and detection of frontal, lateral and roll-over crash types. This system alerts the driver of the vehicle about accidents on the coming roads and also advices to control the speed i.e. acceleration and braking [14].

Chapter Three

System Design

3.1 Preface:

Today circumstances in the field of microcontrollers had their beginnings in the development of technology of integrated circuits. This development has made it possible to store hundreds of thousands of transistors into one chip. That was a prerequisite for production of microprocessors, and the first computers were made by adding external peripherals such as memory, input-output lines, timers and other. Further increasing of the volume of the package resulted in creation of integrated circuits. These integrated circuits contained both processor and peripherals. That is how the first chip containing a microcomputer, or what would later be known as a microcontroller came about. In these project we can use various types of component.

This component works to perform and satisfy the main objectives to detect the location of the accident and also clear the traffic for the ambulance to reach the site of accident quickly.

The system consists of three main units which coordinates with each other and makes sure that the ambulance reaches the accident site without any delay, this system divided into the following units:

- Vehicle unit.
- Ambulance unit.

- Traffic unit.

3.2 Vehicle Unit:

Every vehicle should have vehicle unit as shown in Figure 3.1. The vehicle unit consist of a Vibration Sensor Module - SW-420, microcontroller (ATMEGA16), global positioning system (GPS), and Global System for Mobile Communication (GSM) module and LCD (this optional), shown in the below block diagram. The vehicle unit installed in the vehicle senses the accident and sends the location of the accident to responsible authorities. The vibration sensor used in the vehicle will continuously sense for any large scale vibration in the vehicle. The sensed data is given to the controller. GPS module finds out the current position of the vehicle which is the location of the accident and gives that data to the GSM module. The GSM module sends this data to the responsible authorities whose GSM number is already there in the module as an emergency number.

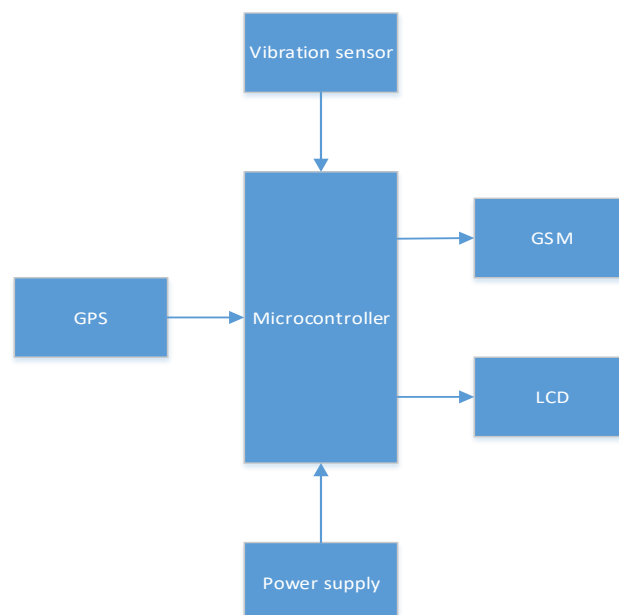


Figure3.1: Vehicle unit block diagram.

3.3 Ambulance Unit:

The ambulance is equipped with remote controller that turn the traffic light into green to clear the traffic for the ambulance to reach the accident site without delay as shown in Figure 3.2.

The remote controller consists of the following component:

1. Push buttons; when a button is pushed it sends one of four variations code accordingly to the encoder which then send the signal to the ASK transmitter to be transferred to traffic light unit (ASK receiver).
2. Frequency shifting keying transmitter device (ASK TX); it sends the signal to the ASK receiver.
3. Encoder.; it code the signal before sending the signal to the ASK receiver.

The following block diagram shows the ambulance unit.

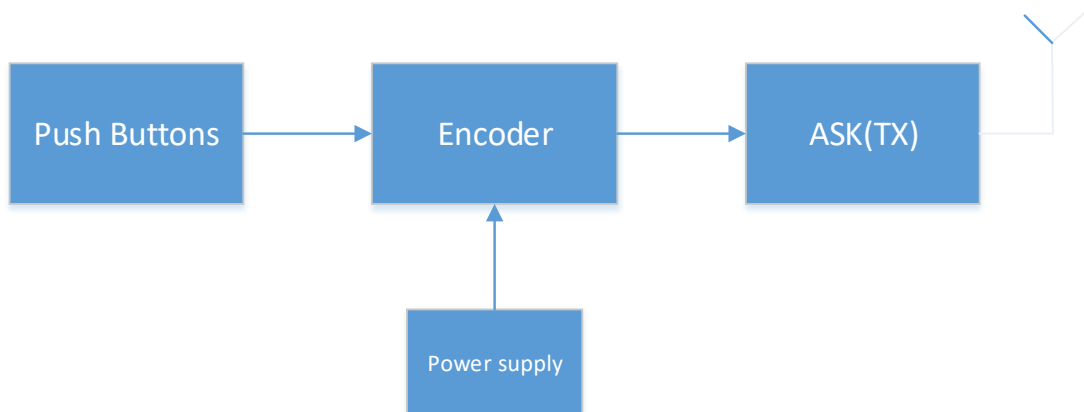


Figure3.2: Ambulance unit block diagram.

3.4 Traffic Unit:

The traffic light is equipped with receiver which is turn the traffic light into green light according to signal came from ambulance unit (remote controller) as shown in figure 3.3.

The traffic unit consists of followings components:

1. Amplitude shifting keying receiver device (ASK RX).
2. Decoder.
3. Microcontroller ATMEGA8.
4. LED for traffic light.

The block diagram show in Figure 3.3 explain the configuration of traffic unit.

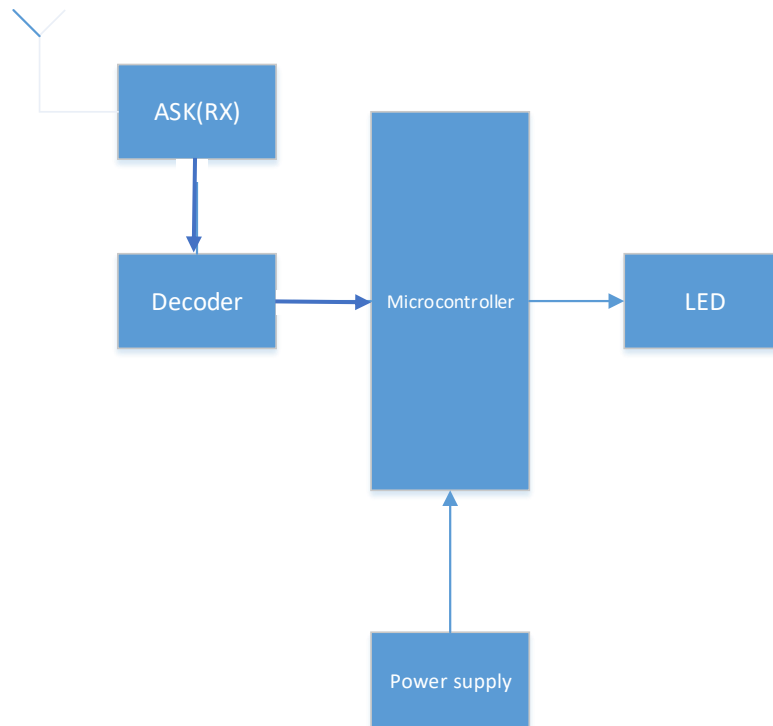


Figure3.3:

Traffic light controller.

3.5 8-Bit AVR Microcontroller (AT Mega 16 L):

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional Complex instruction set computing (CISC) microcontrollers. The ATmega16 provides the

following features: 16K bytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 512 bytes EEPROM, 1K byte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary-scan, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the USART, Two-wire interface, A/D Converter, SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping [15]. This allows very fast start-up combined with low-power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run [16]. The device is manufactured using Atmel's high density nonvolatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash

memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega16 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications. The ATmega16 AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in circuit emulators, and evaluation kits. [16]

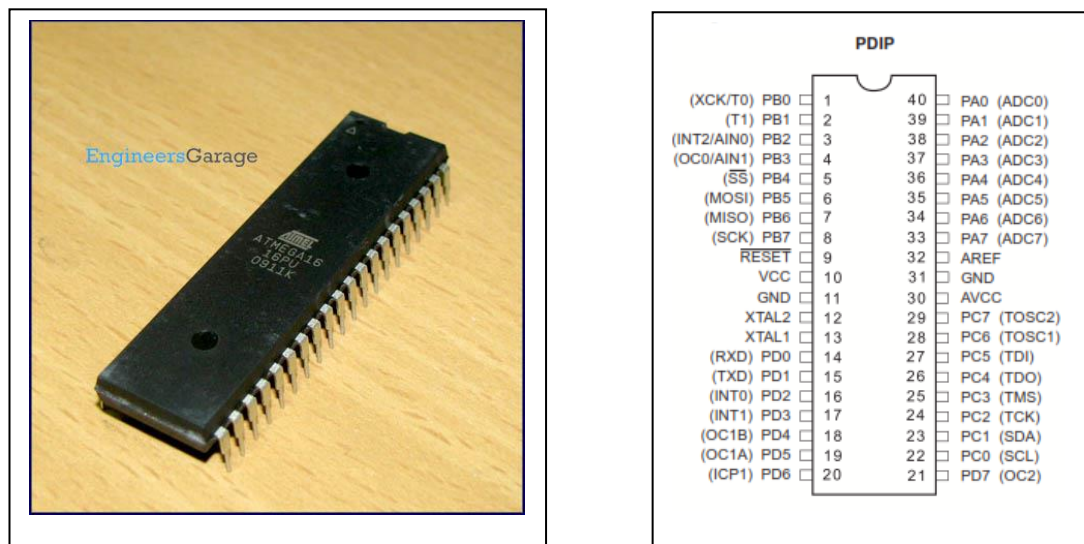


Figure 3.4: block diagram of microcontroller.

3.5.1 Microcontroller Pin Descriptions:

VCC: Digital supply voltage.

GND: Ground.

Port A (PA7..PA0): Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0

to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B (PB7..PB0): Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B 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 pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port B also serves the functions of various special features of the ATmega16.

Port C (PC7..PC0): Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. Port C also serves the functions of the JTAG interface and other special features of the ATmega16.

Port D (PD7..PD0) :Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port D also serves the functions of various special features of the ATmega16.

RESET: Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in Table15 on page 36. Shorter pulses are not guaranteed to generate a reset.

XTAL1: Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2: Output from the inverting Oscillator amplifier.

AVCC: AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to Vcc, even if the ADC is not used. If the ADC is used, it should be connected to Vcc through a low-pass filter.

AREF: AREF is the analog reference pin for the A/D Converter.

3.6 Global Positioning System (GPS):

It is space based satellite navigation system that provides location and time information in all weather conditions any where on or near the earth where there is unobstructed line of sight to four or more GPS Satellites. Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS system in addition to GPS other systems are in use or under development. The design of GPS is based partly on similar ground based Radio Navigation systems the first Navigation satellite system transit was used by US 1960. GPS is owned and operated by United States as a national resource. The satellites carry very stable atomic clocks that are synchronized to each other and to ground clocks A GPS receiver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation

from true time. It is sometimes above is representative of a receiver start-up situation. Most receivers have a track algorithm, sometimes called a tracker, that combines sets of satellite measurements collected at different time-in effect, taking advantage of the fact that successive receiver positions are usually close to each other. After a set of measurements are processed, the tracker predicts the receiver location corresponding to the next set of satellite measurements. When the new measurements are collected, the receiver uses a weighting scheme to combine the new measurements with the tracker prediction. In general, a tracker can (a) improve receiver position and time accuracy, (b) reject bad measurements, and (c) estimate receiver speed and direction. [17]



Figure 3.5: Global positioning system.

3.6.1 Accuracy

Most receiver lose accuracy in the interpretation of the signals and are only accurate to 100 nanoseconds. PS time is theoretically accurate to about 14 nanoseconds [18].

3.6.2 Timekeeping

Leap seconds GPS navigation message includes the difference between GPS time and UTS. As of July 2012, GPS time is 16 seconds ahead of UTS because of the leap second added to UTS June. 30,2012 Receivers subtract this offset from GPS time to calculate UTS and specific time zone values. New GPS units may not show the correct UTS time until after receiving the UTS offset message. The GPS- UTS offset field can accommodate 255 leap second (eight bits) [18].

3.6.3 Error Sources And Analysis

Magnitude of residual errors from these sources depends on geometric dilution of precision. Artificial errors may result from jamming devices and threaten ships and aircraft or from intentional signal degradation through selective availability, which limited accuracy to- 6-12 m, but has now been switched off [18].

3.6.4 STRUCTURE

The space segment is composed of 24 to 32 satellites in medium earth orbit and also includes the payload adapters to the boosters required to launch them into orbit. The control segment is composed of a master control station (MCS), an alternate master control station, and a host of dedicated and

shared ground antennas and monitor stations. The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service and tens of millions of civil, commercial, and scientific user of the Standard Positioning Service The period of the carrier frequency multiplied by the speed of light gives the wavelength, which is about 0.19 meters. Accuracy within 1% of

wavelength in detecting the leading edge reduces this component of pseudo range error to as little as 2 millimeters [18].

3.7 Global System for Mobile Communication (GSM):

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership. GSM is now an international standard for mobile service. It offers high mobility. Subscribers can easily roam worldwide and access any GSM network. [16] GSM is a digital cellular network. At the time the standard was developed it offered much higher capacity than the current analog systems. It also allowed for a more optimal allocation of the radio spectrum, which therefore allows for a larger number of subscribers. GSM offers a number of services including voice communications, Short Message Service (SMS), fax, voice mail, and other supplemental services such as call forwarding and caller ID. Currently there are several bands in use in GSM. 450 MHz, 850 MHz, 900 MHz, 1800 MHz, and 1900 MHz are the most common ones. Some bands also have Extended GSM (EGSM) bands added to them, increasing the amount of spectrum available for each band. [19]

3.7.1 GSM Specifications:

- **frequency band** the frequency range specified for GSM is 1,850 to 1,990 MHz (mobile station to base station).

- **duplex distance** The duplex distance is 80 MHz. Duplex distance is the distance between the uplink and downlink frequencies. A channel has two frequencies, 80 MHz apart.

- **channel separation** The separation between adjacent carrier frequencies. In GSM, this is 200 kHz.

- **Modulation** is the process of sending a signal by changing the characteristics of a carrier frequency. This is done in GSM via Gaussian minimum shift keying (GMSK).

- **transmission rate** GSM is a digital system with an over-the-air bitrate of 270 kbps.

- **access method** GSM utilizes the time division multiple access (TDMA) concept. TDMA is a technique in which several different calls may share the same carrier. Each call is assigned a particular time slot.

- **speech coder** GSM uses linear predictive coding (LPC). The purpose of LPC is to reduce the bit rate. The LPC provides parameters for a filter that mimics the vocal tract. The signal passes through this filter, leaving behind a residual signal. Speech is encoded at 13 kbps.

3.7.2 GSM Network Architecture

A GSM network is made up of multiple components and interfaces that facilitate sending and receiving of signaling and traffic messages. It is a collection of transceivers, controllers, switches, routers, and registers. A Public Land Mobile Network (PLMN) is a network that is owned and operated by one GSM service provider or administration, which includes all of the components and equipment as described below.

3.7.2.1 Mobile Station (MS)

The Mobile Station (MS) is made up of two components:

1- Mobile Equipment (ME) This refers to the physical phone itself. The phone must be able to operate on a GSM network. Older phones operated

on a single band only. Newer phones are dual-band, triple-band, and even quadband capable. A quad-band phone has the technical capability to operate on any GSM network worldwide. Each phone is uniquely identified by the International Mobile Equipment Identity (IMEI) number. This number is burned into the phone by the manufacturer. The IMEI can usually be found by removing the battery of the phone and reading the panel in the battery well. It is possible to change the IMEI on a phone to reflect a different IMEI. This is known as IMEI spoofing or IMEI cloning. This is usually done on stolen phones. The average user does not have the technical ability to change a phone's IMEI.

2- Subscriber Identity Module (SIM) The SIM is a small smart card that is inserted into the phone and carries information specific to the subscriber, such as IMSI, TMSI, Ki (used for encryption), Service Provider Name (SPN), and Local Area Identity (LAI). The SIM can also store phone numbers (MSISDN) dialed and received, the Kc (used for encryption), phone books, and data for other applications. A SIM card can be removed from one phone, inserted into another GSM capable phone and the subscriber will get the same service as always. Each SIM card is protected by a 4-digit Personal Identification Number (PIN). In order to unlock a card, the user must enter the PIN. If a PIN is entered incorrectly three times in a row, the card blocks itself and cannot be used. It can only be unblocked with an 8-digit Personal Unblocking Key (PUK), which is also stored on the SIM card [19].

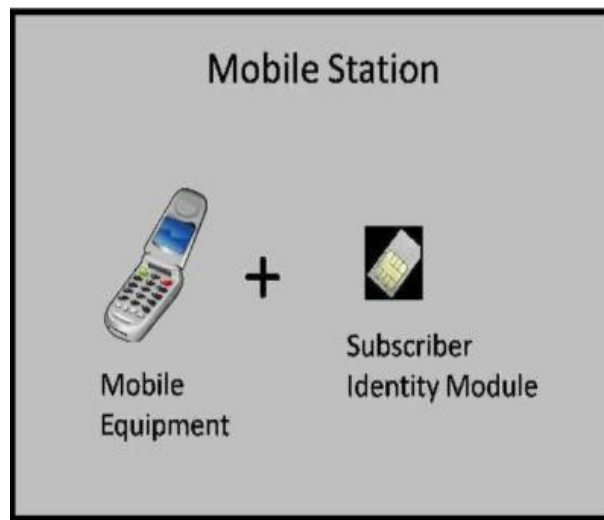


Figure 3.6: describe the mobile station.

3.7.2.2 Base Transceiver Station (BTS)

The BTS is the Mobile Station's access point to the network. It is responsible for carrying out radio communications between the network and the MS. It handles speech encoding, encryption, multiplexing (TDMA), and modulation/demodulation of the radio signals. It is also capable of frequency hopping. A BTS will have between 1 and 16 Transceivers (TRX), depending on the geography and user demand of an area. Each TRX represents one ARFCN. One BTS usually covers a single 120-degree sector of an area. Usually a tower with 3 BTSs will accommodate all 360 degrees around the tower. However, depending on geography and user demand of an area, a cell maybe divided up into one or two sectors, or a cell may be serviced by several BTSs with redundant sector coverage. A BTS is assigned a Cell Identity. The cell identity is 16-bit number (double octet) that identifies that cell in a particular Location Area. The cell identity is part of the Cell Global Identification (CGI), which is discussed in the section about the Visitor Location Register

(VLR). The interface between the MS and the BTS is known as the Um Interface or the Air Interface [19].

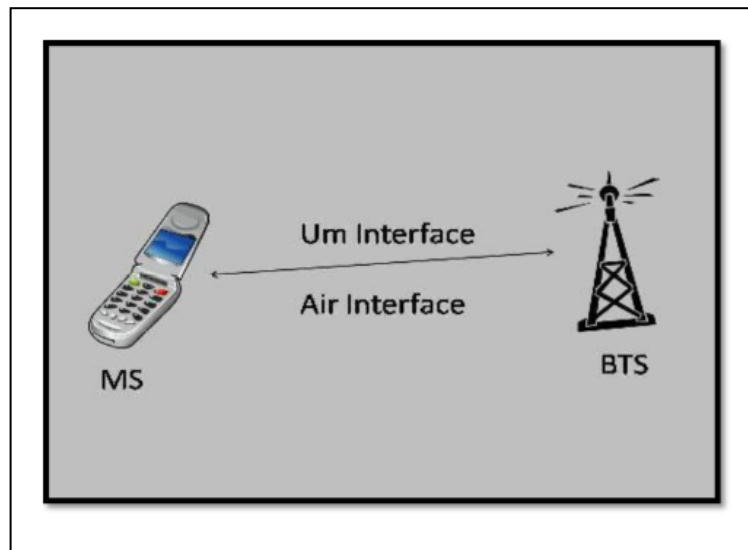


Figure 3.7: The um interface or Air interface

3.8 Liquid Crystal Display (LCD):

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike

in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. [20]

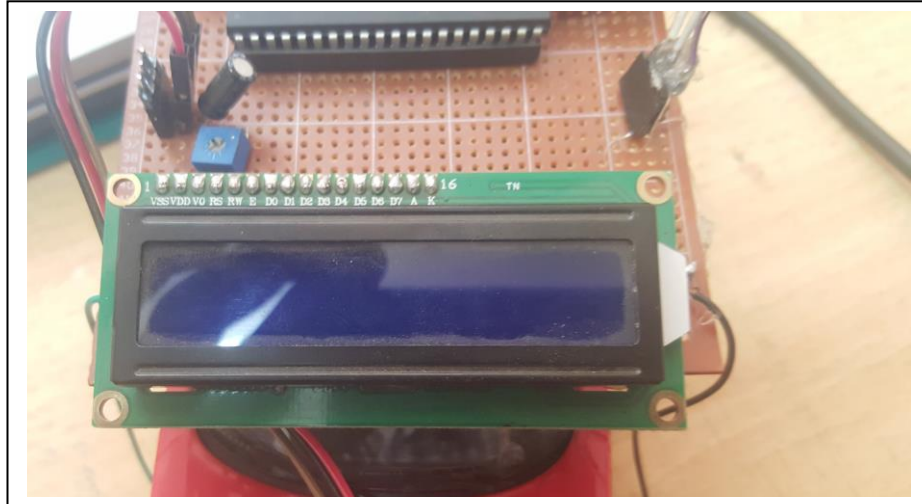


Figure3.8: pins of LCD and distribution how it connect.

3.9 Amplitude-Shift Keying (ASK):

is a form of amplitude modulation that represents digital data as variations in the amplitude of a carrier wave. In an ASK system, the binary symbol 1 is represented by transmitting a fixed-amplitude carrier wave and fixed frequency for a bit duration of T seconds. If the signal value is 1 then the carrier signal will be transmitted; otherwise, a signal value of 0 will be transmitted. Two figure below show the ASK TX and ASK RX [21].

3.10 Vibration Sensor:

The Vibration module based on the vibration sensor SW-420 and Comparator LM393 to detect if there is any vibration that beyond the threshold. The threshold can be adjusted by the on-board potentiometer.

When this no vibration, this module output logic LOW the signal indicates LED light, And vice versa [22].

3.10.1 Application:

- Vibration detecting
- Burglary protection system

3.10.2 Features:

- The default state of the Switch is close
- Digital output
- Supply voltage: 3.3V-5V
- On-board indicator LED to show the results
- On-board LM393 chip
- Dimension of the board: 3.2cm x 1.4cm

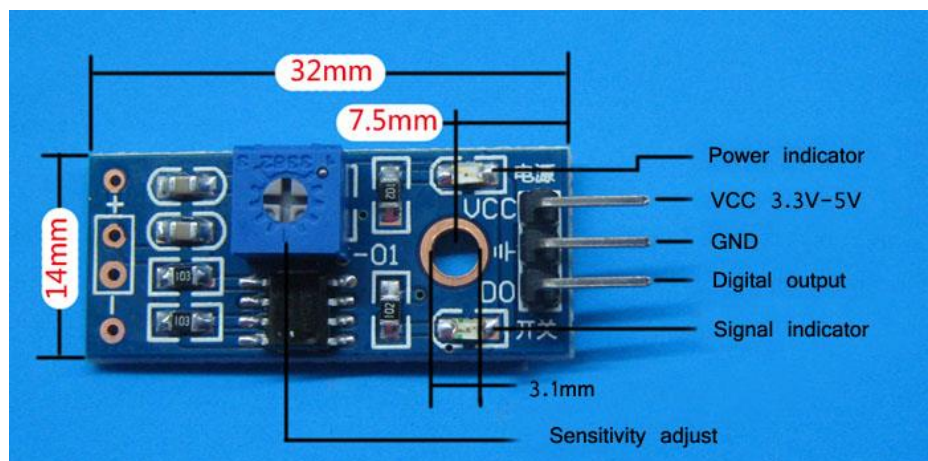


Figure 3.9: Vibration Sensor block diagram.

CHAPTER FOUR

Simulation and Hardware Implementation

4.1 Preface:

Programs for the Alf and Vegard's RISC processor (AVR) series of microcontrollers can be written in assembly (AVR ASM), C and BASIC. AVR Studio, Win AVR etc. are some free development software's for programming the AVR Microcontrollers. Win AVR is used for programming and AVR Studio for simulating (Simulation means debugging the code on software, one can virtually give the input and check the output for that code). In win AVR programmers Notepad is written C code, after compilation it generates '**.hex**' file that is a hardware level code. [23].

4.2 Block Diagram of Basic Operations

4.2.1 Collision Unit:

Figure (4.1) shows the micro controller which represent the brain of the collision unit, it coordinates between the four components of the collision unit The first component is the vibration sensor shown in figure (4.1) which detect the accidents then send a signal to the micro controller notifying it of the accident. Then the micro controller uses the GPS modem shown in figure (4.1) to accurately determine the location of the accident and then send the accident notification along with the location to the appropriate authorities using the GSM card shown in figure (4.1). The collision unit is also equipped with a LCD screen that displays the status of the car.

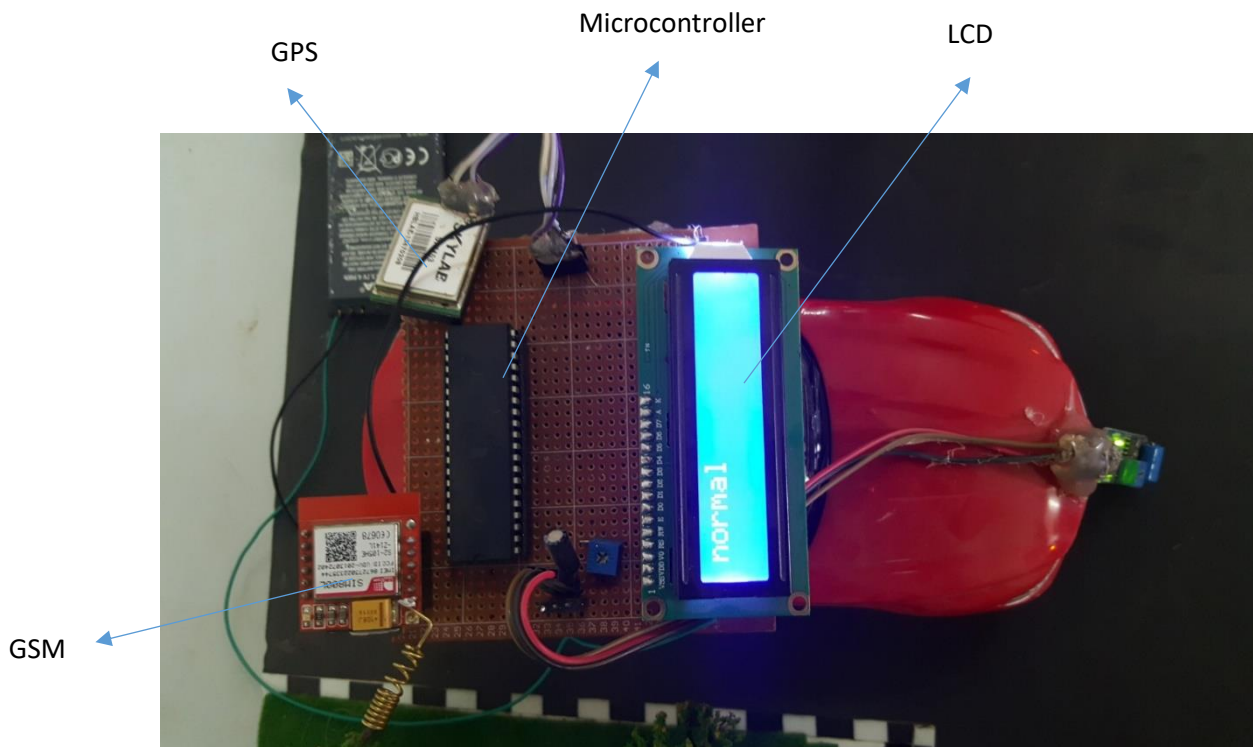


Figure 4.1 Collision detection Unit block diagram's.

4.2.2 Ambulance Unit:

Figure 4.2 shows the Ambulance unit (Remote controller). When the driver is faced with a red light he/she pushes a button, the button then sends one of four variations accordingly to the encoder which then send the signal to the FSK transmitter to be transferred to traffic light unit (FSK receiver).

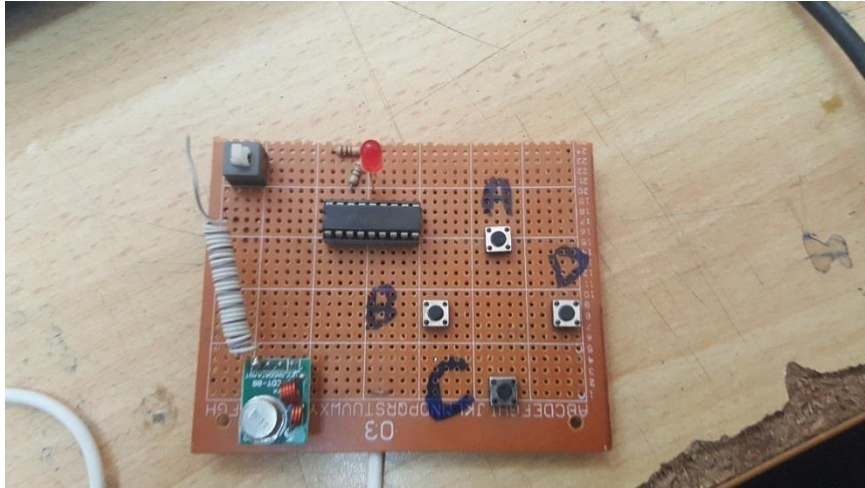


Figure 4.2: Ambulance Unit remote controller block diagram's.

Each button turns a specific light green and the rest of the light s turn red as follows:

Case 1:

Button A: the encoder receives the following code (0111) from the button and turn the first light green and the rest red as in figure 4.3



Figure 4.3: Case one at the traffic light.

Case 2:

Button B: the encoder receives the following code (1011) from the button and turn the second light green and the rest red as in figure 4.4

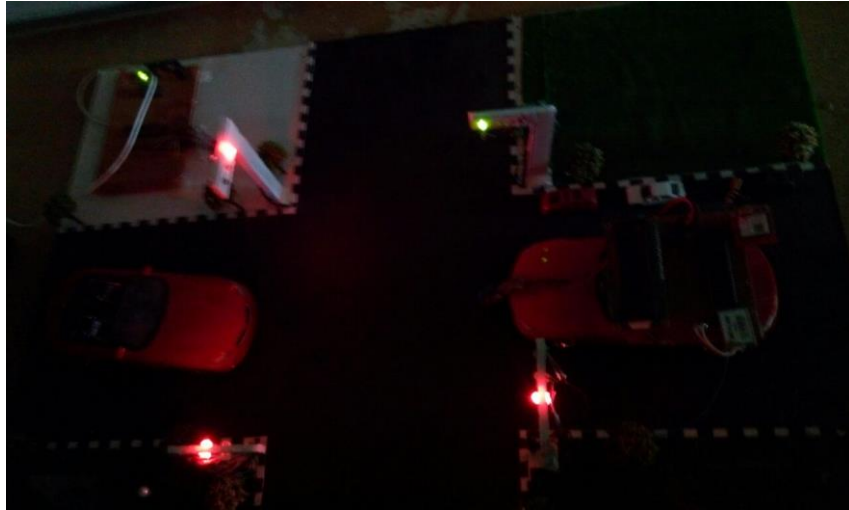


Figure 4.4: Case two at the traffic light.

Case 3:

Button C: the encoder receives the following code (1101) from the button and turn the third light green and the rest red as in figure 4.5



Figure 4.5: Case three at the traffic light.

Case 4:

Button D: the encoder receives the following code (1110) from the button and turn the fourth light green and the rest red as in figure 4.6

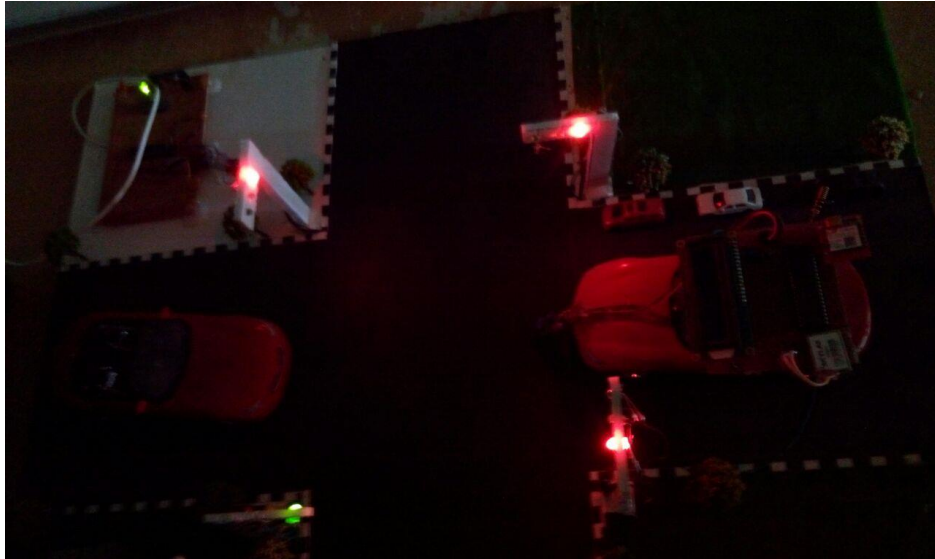


Figure 4.6: Case four at the traffic light.

4.2.3 Traffic Unit:

The signal sent from the ambulance unit is received by the Traffic unit to turn it green in favor of the ambulance. The signal is received by FSK RX as shown in figure 4.7, and then decoded by the decoder to be handled by the microcontroller to turn the desired light green.

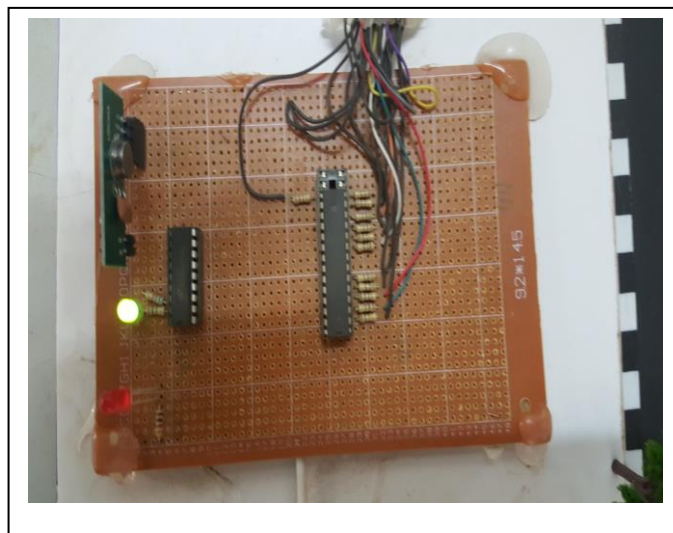


Figure 4.7 Traffic Unit block diagram.

4.3 Circuit Diagram:

4.3.1 Collision Unit:

The output signal of the vibration sensor is an input for the microcontroller, the signal represents if there is a collusion or not. The circuit diagram of collision unit.

The tenth pin of the microcontroller was connected with the power supply, and the eleventh pin was connected to ground. Pin 14 was connected to the GPS transmitter TXD, and the other ports of the GPS were connected to the ground and Vcc.

The GSM receiver was connected to the microcontroller at pin 15 and the fifth portal of the GSM was connected to Vcc, the first portal was connected to ground.

LCD first portal was connected to ground and portal two was connected to Vcc, portal three was connected to variable resistance and the second end of the variable resistance was attached to ground, portals four, six, eleven, twelve, thirteen, and fourteen of the LCD were connected to pins one, three, five, seven, and eight of the microcontroller respectively. As shown in figure 4.8.

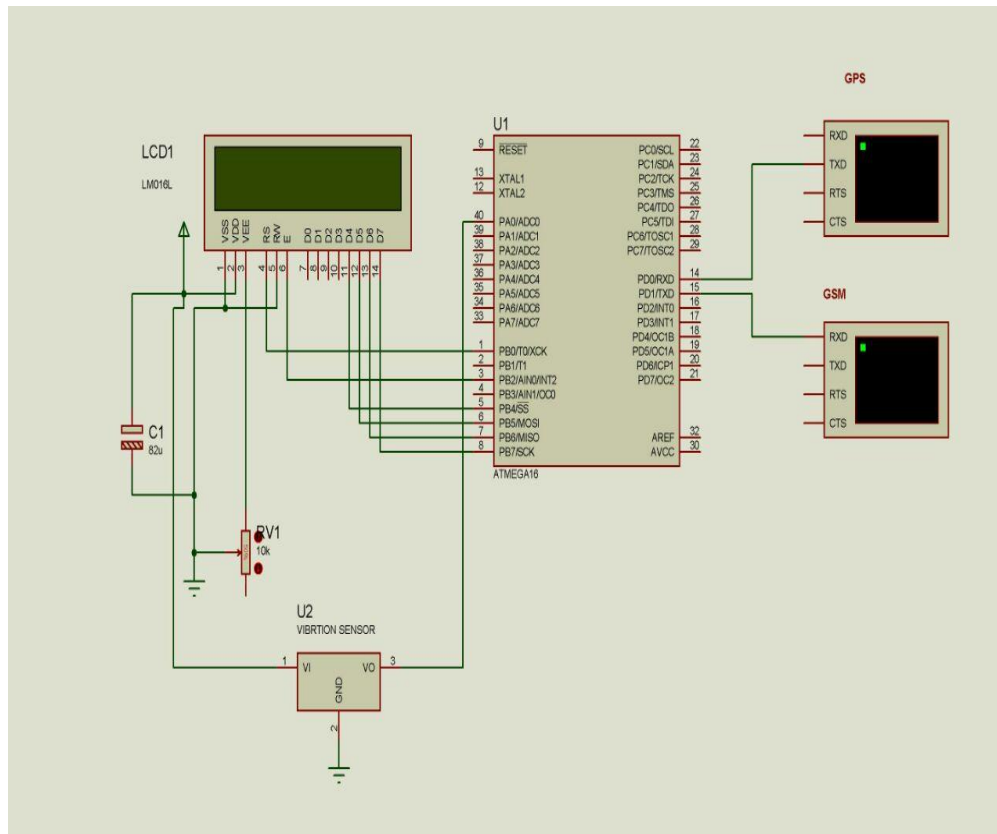


Figure 4.8: The circuit diagram of the Collusion unit.

4.3.2 Ambulance Unit:

The circuit diagram of the Ambulance Unit is shown in figure 4.9

Pins 8,9,15 of the decoder were connected to ground. A $1M\Omega$ resistance was connected to pins 17,16 encoder. Push bottoms were connected as follows:

The first end of all push bottoms was connected to the encoder at pins 11,12,13,14 and the second ends were connected to ground

Pin 1 of ASK TX was connected to pin 18 in encoder and pin 2 was connected to ground and pin 3 was connected with Vcc.

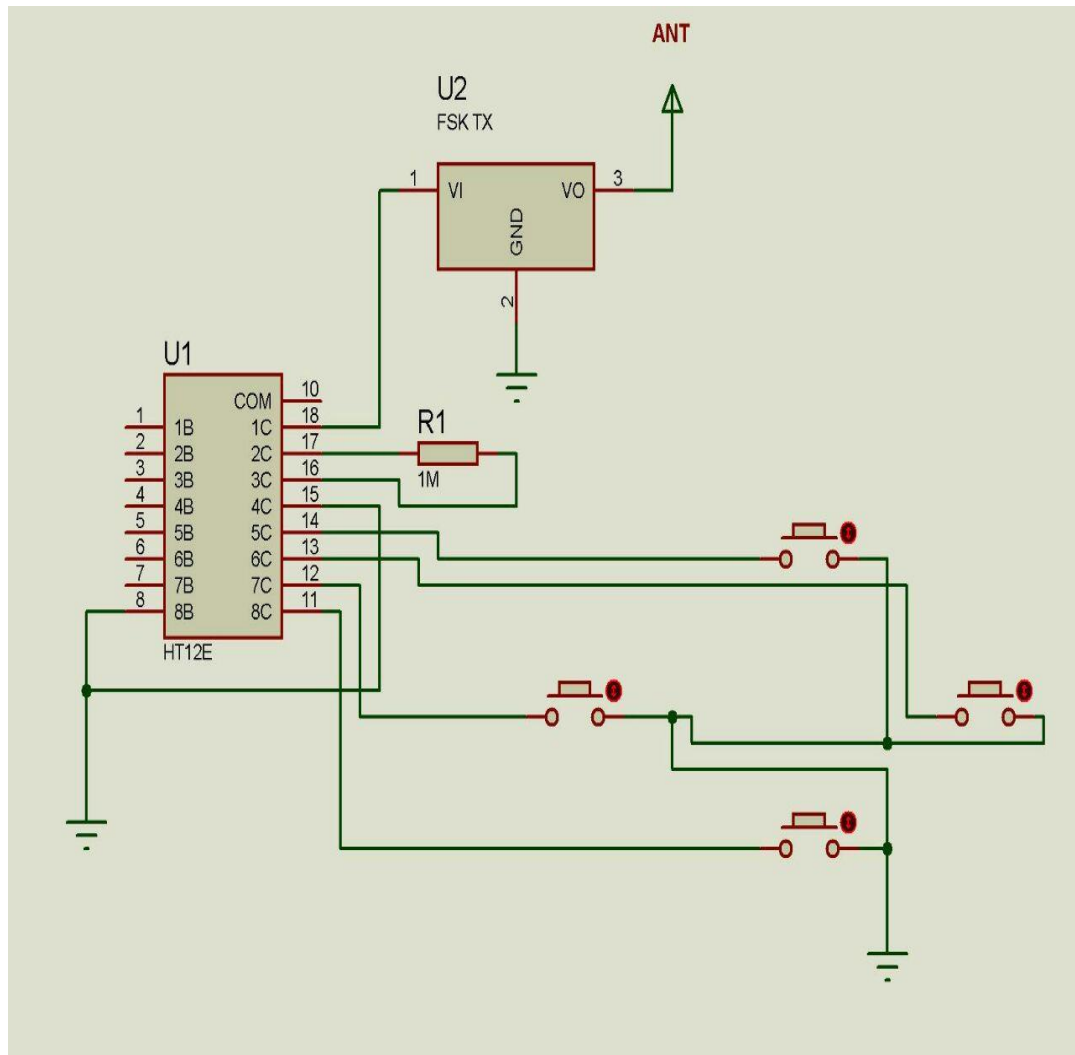


Figure 4.9: The circuit diagram of the Ambulance Unit.

4.3.3 Traffic Unit:

The circuit diagram of the Traffic Unit is shown in figure 4.10

Pins 7 and 8 were connected to Vcc and ground respectively, traffic light A was connected to pins 2,3,4 of the microcontroller, traffic B was connected to pins 5,6,7, traffic C was connected to pins 14,15,16, and traffic D was connected to pins 17,18,19.

The first and the third portals of ASK receiver were connected to ground and Vcc respectively, and the second portal was connected to pin 14 in the decoder. Pin 8 and 9 of the decoder were connected to ground and pin 18

to Vcc, pins 10,11,12,13 of the decoder were connected to pins 26,25,24,23 of the microcontroller respectively.

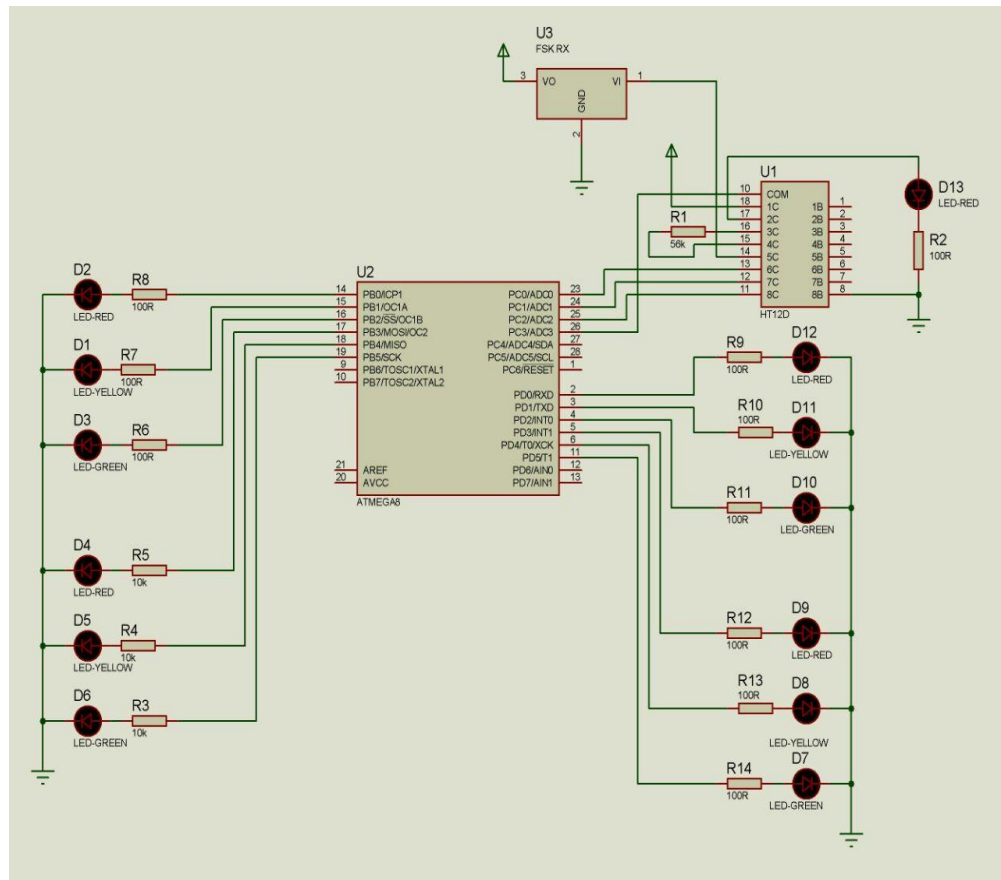


Figure 4.10: The circuit diagram of the traffic unit.

4.4 Flow Chart Sequence Operation of Collision Unit:

The sequences of operations shown in figure 4.11 shows the steps of how the design of the unit work, and it can be summarized into the following points:

- 1- Initially the processing units make sure if there is a collision or not, if there is no collision the system is ready this case is normal operation, but if there was a collision the system go to next sequences.
- 2- Display the change of status from normal to crash on the LCD screen.

- 3- The Global Positioning System detect the location of the collision.
- 4- The GSM card then sends a SMS to the mobile of the authorities with the location of the accident.
- 5- The SMS is received by the mobile.
- 6- The system goes back to the normal operation.

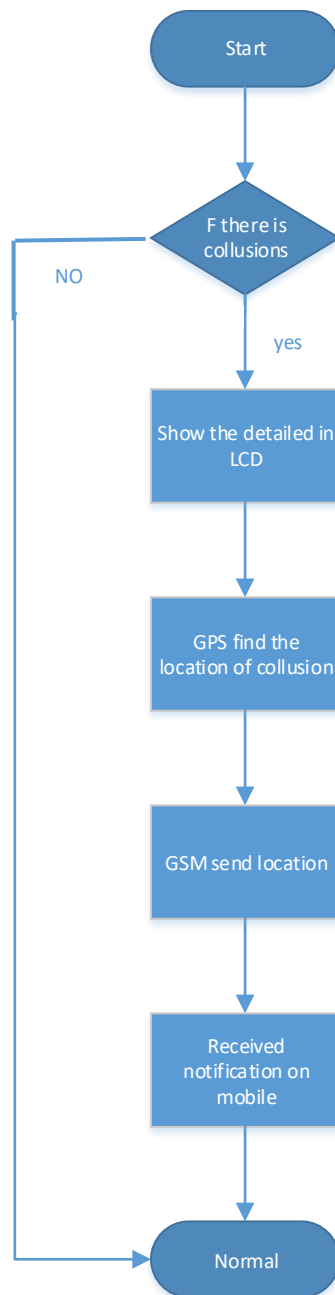


Figure 4.11: Flow chart Sequences Operation of collusion unit.

4.5 Flow Chart Sequence Operation of Ambulance and Traffic

Units:

Due to the fact that those two units are closely related and operate in a connective manner they are both shown in the same flow chart in figure 4.12. And can also be summarized in a few points:

- 1- The driver checks if the traffic light is red or green, if it's green the system stays in normal operation, if it's red the system got next step.
- 2- The driver pushes a button accordingly.
- 3- A signal is sent from the ASK TX.
- 4- The signal is received by the ASK RX.
- 5- The traffic light change to green.
- 6- The system goes back to the normal operation.

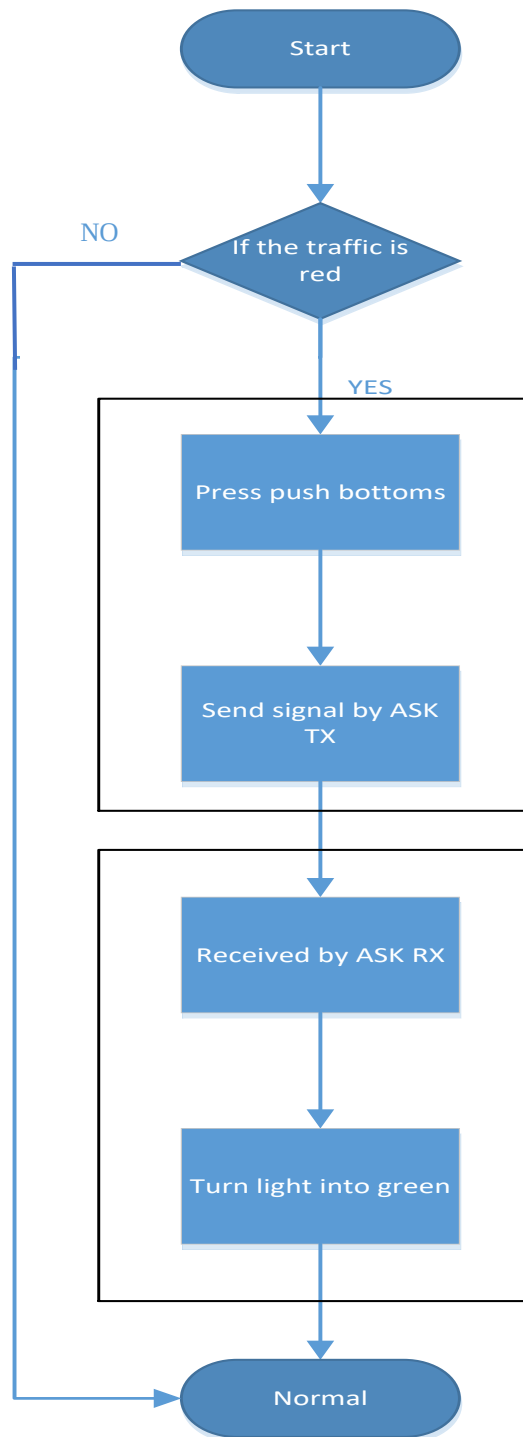


Figure 4.12: Flow chart Sequences Operation of Ambulance and Traffic units.

4.6 Hardware Operation:

The operation starts with the system on the normal mode as shown in figure 4.13

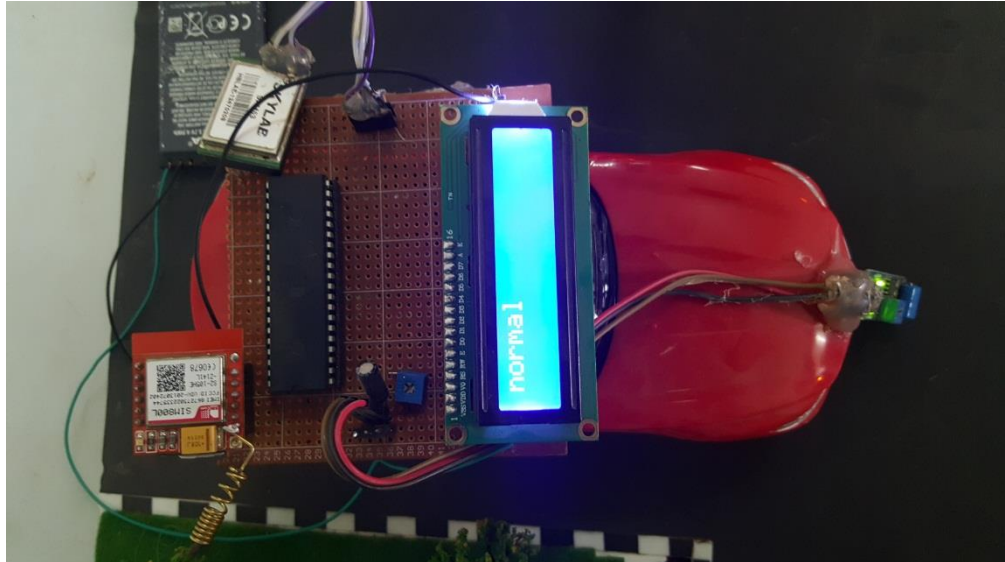


Figure 4.13: Normal Mode of operation.

When an accident accrues the mode of operation change from normal to crash mode as shown in figure 4.14



Figure 4.14: Crash Mode of operation.

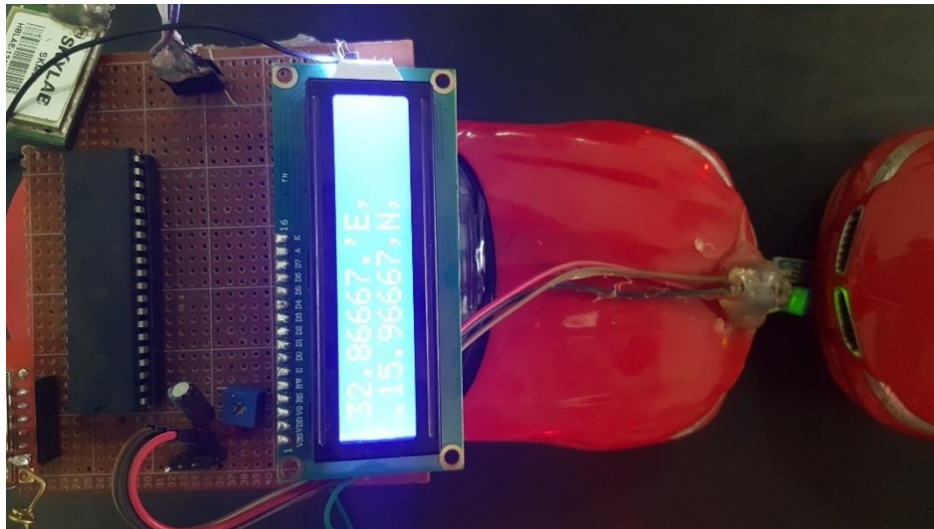


Figure 4.15: The collision location.

We then move to the Ambulance unit, when the button is pushed the traffic light turn green and a small red LED light is connected to the circuit board to indicate if the power supply is connected or not as shown in figure 4.16

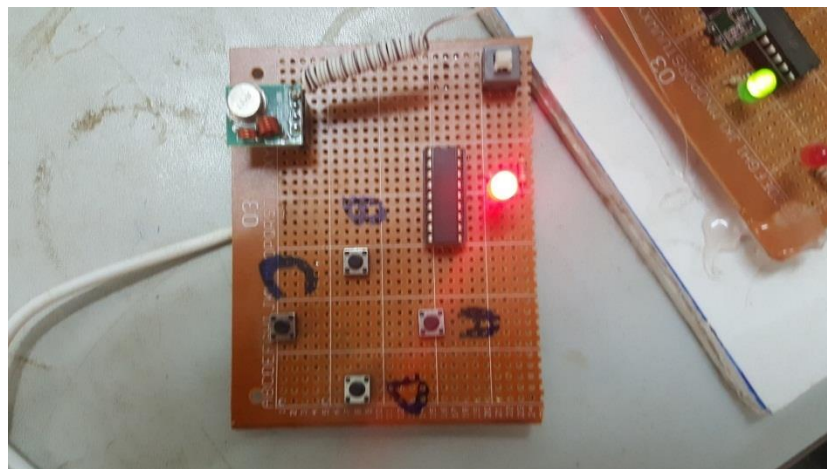


Figure 4.16: The Ambulance Unit when it operates.

4.7 Programming (Code):

Writing programs using BASCOM-AVR is four programs in one package, it is known as an IDE (integrated development environment); it includes the Program Editor, the Compiler, the Programmer and the Simulator all together. the code of this system shown on appendix.

CHAPTER FIVE

Conclusion and Recommendations

5.1 Conclusion

This thesis targeted the minimization of human casualties resulting from car accidents by equipping cars with vibration sensors to detect collisions and then accurately locating the accident place using GPS modem installed in the car; then send the accident place in a SMS using a GSM card to the appropriate authorities to notify first responders and emergency vehicles. The thesis also recognizes traffic problems specially during rush hours due to traffic lights, and propose a solution to this problem by equipping emergence vehicles with remote controller that consist from four simple push buttons with distinguished labels to turn traffic light into green light in favor of the emergence vehicles and red light for other vehicles to facilitate traffic and help first responders reach the accident site in the minimum time possible.

5.2 Recommendations

I recommend for future work:

Firstly: connecting the device with internet service to detected the location exactly by using Google mapping application.

Secondly: using a Main server (control unit) to organize data flow between different car accidents and emergence responders.

Thirdly: equip cars with a device that can detect the severity of the accident so that only necessary help will be notified.

Fourthly: replace the GSM card with a satellite link to avoid connection problems in areas with low to non-mobile network.

.

References:

- [1]. Global Burden of Disease Study 2013, Collaborators (22 August 2015). "Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013.". *Lancet* (London, England) 386 (9995): 743–800. PMID 26063472.
- [2]. Augarten, Stan (1983). *The Most Widely Used Computer on a Chip: The TMS 1000. State of the Art: A Photographic History of the Integrated Circuit*. New Haven and New York: Ticknor & Fields. ISBN 0-89919-195-9. Retrieved 2009-12-23
- [3]. National Research Council (U.S.). Committee on the Future of the Global Positioning System; National Academy of Public Administration (1995). *The global positioning system: a shared national asset: recommendations for technical improvements and enhancements*. National Academies Press. p. 16. ISBN 0-309-05283-1. Retrieved August 16, 2013., [//books.google.com/books?id=FAHk65slfY4C&pg=PA16](http://books.google.com/books?id=FAHk65slfY4C&pg=PA16)
- [4]. "Factsheets : GPS Advanced Control Segment (OCX)". *Losangeles.af.mil*. October 25, 2011. Retrieved November 6, 2011.
- [5]. "Russia Launches Three More GLONASS-M Space Vehicles". *Inside GNSS*. Retrieved December 26, 2008.
- [6]. Winterberg, Friedwardt (1956). "Relativistische Zeitdilatation eines künstlichen Satelliten (Relativistic time dilation of an artificial satellite)". *Astronautica Acta II* (in German) (25). Retrieved 19 October 2014.
- [7]. *Astronomy.ohio-state.edu*. Retrieved November 6, 2011.
- [8]. The internet resource for mobile and communication

GSMfavorite.com.

- [9]. Vibration measurement Brüel & Kjær, 2850 Naerum, Denmark.
- [10]. "LCD Image Persistence". Fujitsu technical support. Fujitsu. Retrieved December 11, 2011.
- [11]. Jonathan W. Steed and Jerry L. Atwood (2009). Supramolecular Chemistry (2nd ed.). John Wiley and Sons. p. 844. ISBN 978-0-470-51234-0.
- [12]. Manuel Fogue, Piedad Garrido, Francisco J. Martinez, Juan-Carlos Cano, Carlos T. Calafate, and Pietro Manzoni, "Assistance through Communication Technologies and Vehicles", IEEE VEHICULAR TECHNOLOGY MAGAZINE, SEPTEMBER 2012.
- [13]. R. Grzeszczyk, J. Merkisz, P. Bogus, and T. Kaminski, "Methods and Procedures for testing the E-call in-vehicle unit for The purpose of its performance assessment and certification," in Proc. 21st Int. Technical Conf. Enhanced Safety of Vehicles (ESV), Stuttgart, Germany, June 2009, Paper 09-0332
- [14]. Grant McFarland, Microprocessor Design, 2006, by The McGraw-Hill Publishing Companies,
- [15]. Julio Sanchez, Maria P. Canton, Microcontroller Programming The Microchip PIC, 2007, Taylor & Francis Group
- [16]. Datasheets for electronics components, Atmel Corporation 2003, 2503F-AVR-12/03,
- [17]. Zhen W. Chen H, Dai p, and et al. simulation method and test technology of transmission line travelling wave. Electric Power Automation Equipment. 2011;31(6):
- [18]. Positional Protection of Transmission System Using Global

Positioning System by Zhiqian Q.Bo, Geoff Weller, Tom an Miles A.Redfern Lomas.

- [19]. Introduction to GSM ,web side
<http://www.gsmfordummies.com>
- [20]. 16 x 2 Character LCD-016M002B Vishay, Document Number: 37217,Revision 01-Oct-02, Datasheets for electronics components.
- [21]. M. Schwartz, Information Transmission, Modulation and Noise, 4/e, McGraw Hill, 1990.
- [22]. <http://www.elecrow.com/vibration-sensor-module-sw420-p-525.html>
- [23]. B. Collis - Mount Roskill. Bascom-avr-theory, An Introduction to Microcontrollers and Software Design, MRGS Technology Electronics, Grammar School 2003-2009

Appendix:

Collision unit:

\$regfile = "m16def.dat"

\$crystal = 8000000

\$baud = 9600

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 ,
Databits = 8 , Clockpol = 0

Config Lcd = 16 * 2

Config Lcdpin = Pin , Db4 = Portb.4 , Db5 = Portb.5 , Db6 = Portb.6 ,
Db7 = Portb.7 , E = Portb.2 , Rs = Portb.0

Enable Interrupts

Enable Urxc

On Urxc Display1

Cls

Lcd "GPS System and GSM"

Lowerline

Lcd " GPS"

Waitms 100

Dim S As String * 200

Dim Srr As String * 200

Dim Ca As String * 50


```

Cls

Dim V As Word

Config Adc = Single , Prescaler = Auto , Reference = Internal

Start Adc

Dim T As Word

    Do

        T = Getadc(0)

        If T < 100 Then

            Locate 1 , 1

            Lcd "normal      "

            Waitms 200

        End If

        If T > 100 Then

            Locate 1 , 1

            Lcd "crach      "

            Print Srr

            Waitms 100

            Print S

            Waitms 100

            Printbin &H1A

            Waitms 500

```

```

    Print Sr
Waitms 100
Print S
    Waitms 100
Printbin &H1A
S = ""
Locate 1 , 1
Lcd S
Waitms 100
S = ""
Waitms 100
End If
Loop
Display1:
Inputbin Bt
If Bt <> &H0A Then
If Bt <> &H0D Then
S = S + Chr(bt)
End If
End If
Return

```


Ambulance unit and traffic unit :

\$regfile = "m8def.dat" ' specify the used
micro

\$crystal = 8000000 ' used crystal
frequency

Config Pinc.1 = Input

Config Pinc.2 = Input

Config Pinc.3 = Input

Config Pinc.4 = Input

Config Portd.0 = Output

Config Portd.1 = Output

Config Portd.2 = Output

Config Portd.3 = Output

Config Portd.4 = Output

Config Portb.6 = Output

Config Portb.7 = Output

Config Portd.5 = Output

Config Portd.6 = Output

Config Portd.7 = Output

Config Portb.0 = Output

Config Portb.1 = Output

Dim R As Word

Dim Y As Word

Dim G As Word

R = 6000

Y = 2000

G = 6000

Do

Portd.0 = 1

Portd.1 = 0

Portd.2 = 0

Portd.3 = 0

Portd.4 = 0

Portb.6 = 1

Portb.7 = 1

Portd.5 = 0

Portd.6 = 0

Portd.7 = 0

Portb.0 = 0

Portb.1 = 1

Gosub Rf

Waitms R

Portd.0 = 0

Portd.1 = 1

Portd.2 = 0

Portd.3 = 0

Portd.4 = 1

Portb.6 = 0

Portb.7 = 0

Portd.5 = 1

Portd.6 = 0

Portd.7 = 0

Portb.0 = 1

Portb.1 = 0

Gosub Rf

Waitms Y

Portd.0 = 0

Portd.1 = 0

Portd.2 = 1

Portd.3 = 1

Portd.4 = 0

Portb.6 = 0

Portb.7 = 0

Portd.5 = 0

Portd.6 = 1

Portd.7 = 1

Portb.0 = 0

Portb.1 = 0

Gosub Rf

Waitms G

Portd.0 = 0

Portd.1 = 1

Portd.2 = 0

Portd.3 = 0

Portd.4 = 1

Portb.6 = 0

Portb.7 = 0

Portd.5 = 1

Portd.6 = 0

Portd.7 = 0

Portb.0 = 1

Portb.1 = 0

Gosub Rf

Waitms Y

Loop

Rf:

If Pinc.1 = 0 And Pinc.2 = 1 And Pinc.3 = 1 And Pinc.4 = 1 Then

Portd.0 = 0

Portd.1 = 1

Portd.2 = 0

Portd.3 = 0

Portd.4 = 1

Portb.6 = 0

Portb.7 = 0

Portd.5 = 1

Portd.6 = 0

Portd.7 = 0

Portb.0 = 1

Portb.1 = 0

Waitms 600

Portd.0 = 0

Portd.1 = 0

Portd.2 = 1

Portd.3 = 1

Portd.4 = 0

Portb.6 = 0

Portb.7 = 1

Portd.5 = 0

Portd.6 = 0

Portd.7 = 1

Portb.0 = 0

Portb.1 = 0

Waitms 6000

End If

If Pinc.1 = 1 And Pinc.2 = 0 And Pinc.3 = 1 And Pinc.4 = 1 Then

Portd.0 = 0

Portd.1 = 1

Portd.2 = 0

Portd.3 = 0

Portd.4 = 1

Portb.6 = 0

Portb.7 = 0

Portd.5 = 1

Portd.6 = 0

Portd.7 = 0

Portb.0 = 1

Portb.1 = 0

Waitms 600

Portd.0 = 1

Portd.1 = 0

Portd.2 = 0

Portd.3 = 0

Portd.4 = 0

Portb.6 = 1

Portb.7 = 1

Portd.5 = 0

Portd.6 = 0

Portd.7 = 1

Portb.0 = 0

Portb.1 = 0

Waitms 6000

End If

If Pinc.1 = 1 And Pinc.2 = 1 And Pinc.3 = 0 And Pinc.4 = 1 Then

Portd.0 = 0

Portd.1 = 1

Portd.2 = 0

Portd.3 = 0

Portd.4 = 1

Portb.6 = 0

Portb.7 = 0

Portd.5 = 1

Portd.6 = 0

Portd.7 = 0

Portb.0 = 1

Portb.1 = 0

Waitms 600

Portd.0 = 1

Portd.1 = 0

Portd.2 = 0

Portd.3 = 1

Portd.4 = 0

Portb.6 = 0

Portb.7 = 0

Portd.5 = 0

Portd.6 = 1

Portd.7 = 1

Portb.0 = 0

Portb.1 = 0

Waitms 6000

End If

If Pinc.1 = 1 And Pinc.2 = 1 And Pinc.3 = 1 And Pinc.4 = 0 Then

Portd.0 = 0

Portd.1 = 1

Portd.2 = 0

Portd.3 = 0

Portd.4 = 1

Portb.6 = 0

Portb.7 = 0

Portd.5 = 1

Portd.6 = 0

Portd.7 = 0

Portb.0 = 1

Portb.1 = 0

Waitms 600

Portd.0 = 1

Portd.1 = 0

Portd.2 = 0

Portd.3 = 1

Portd.4 = 0

Portb.6 = 0

Portb.7 = 1

Portd.5 = 0

Portd.6 = 0

Portd.7 = 0

Portb.0 = 0

Portb.1 = 1

Waitms 6000

End If

Return

