

RADAR SYSTEM DESIGN

GRADUATION PROJECT

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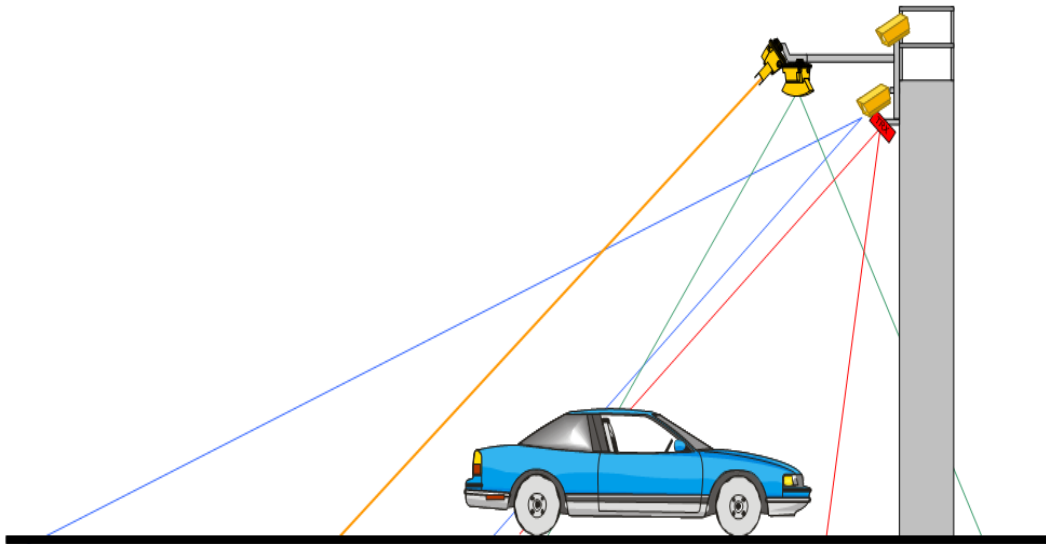
AUGUST 3, 2011

Radar System

Radar
Detection

Hardware
Interface

License Plate
Recognition



Acknowledgments

I am heartily thankful to my supervisor, Dr Ayman Ragab and Dr.Vincenzo Bonifaci for encouragement, guidance and support from the initial to the final level enabled me to develop an understanding of the subject.

Appreciate and thanks to my Family, Professors and colleges who has been so tolerant and supports me all these years. Thanks for their encouragement, love and emotional supports that they had given to me. Lastly, I offer my regards and blessings to all of those who supported me in any respect and lending a hand during the completion of the project.

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Abstract

Over the past years, Egypt has been experiencing a terrifying rate of highway accidents. These accidents have risen to a very high rate over the past years. That a new system of traffic regulation must be used instead of the inefficient methods we currently have in use. Highway accidents obviously have very negative effects, and many people get hurt in the process or even die. Therefore, it is very important to have a new efficient system that will decrease the rate.

Deaths per 100 million vehicle kilometers Rate: an international comparison, safety indicator Countries:

Canada	France	Germany	Italy	UK	USA	Bahrain	Oman	Yemen	Egypt
1.1	1.8	1.5	1.4	0.8	1.1	1.5	4.2	10.66	44.1

The study estimated that in 1999 between 750,000 and 880,000 people died from road crashes on the highway due to over speed.

The idea of our project is to use radar system for detecting the speed of the cars and capture the over speeding cars to extract its numbers and send it to the related authority.

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1 Introduction

Preview

In this chapter we introduce the project idea and motivation, present project objectives and discuss the documentation outline.

1.1 Project idea

We are considering providing a complete radar system that will help to reduce the number of accidents on the highways by implementing a system that is used for car speed detecting and fast recognizing the detail of the plate of the car. This system is considered to be better than the existing road radars and provide new features that will lead to high accuracy, fast detecting, plate recognition and plate's details extraction at every radar unit then send the details to the responsible authority to take the necessary action with the car driver. This System will meet our specifications in a simple way with a simple radar circuit that provide the signal for detecting the cars in an electromagnetic wave, then make a simple hardware circuit that provide the speed of the detected car by calibration to give an order to the camera to picture the over speed cars. After that the license plate of the car will be extracted from the car picture and then extract the ARABIC letters and numbers from the plate, and then send these contents to the responsible authority by an automatic E-mail. In addition to that the old system is considered to be expensive (approx 10,000\$) and this system is considered to be maximum 2000\$ and this value is rising according to road type.

1.1.2 Main Description:

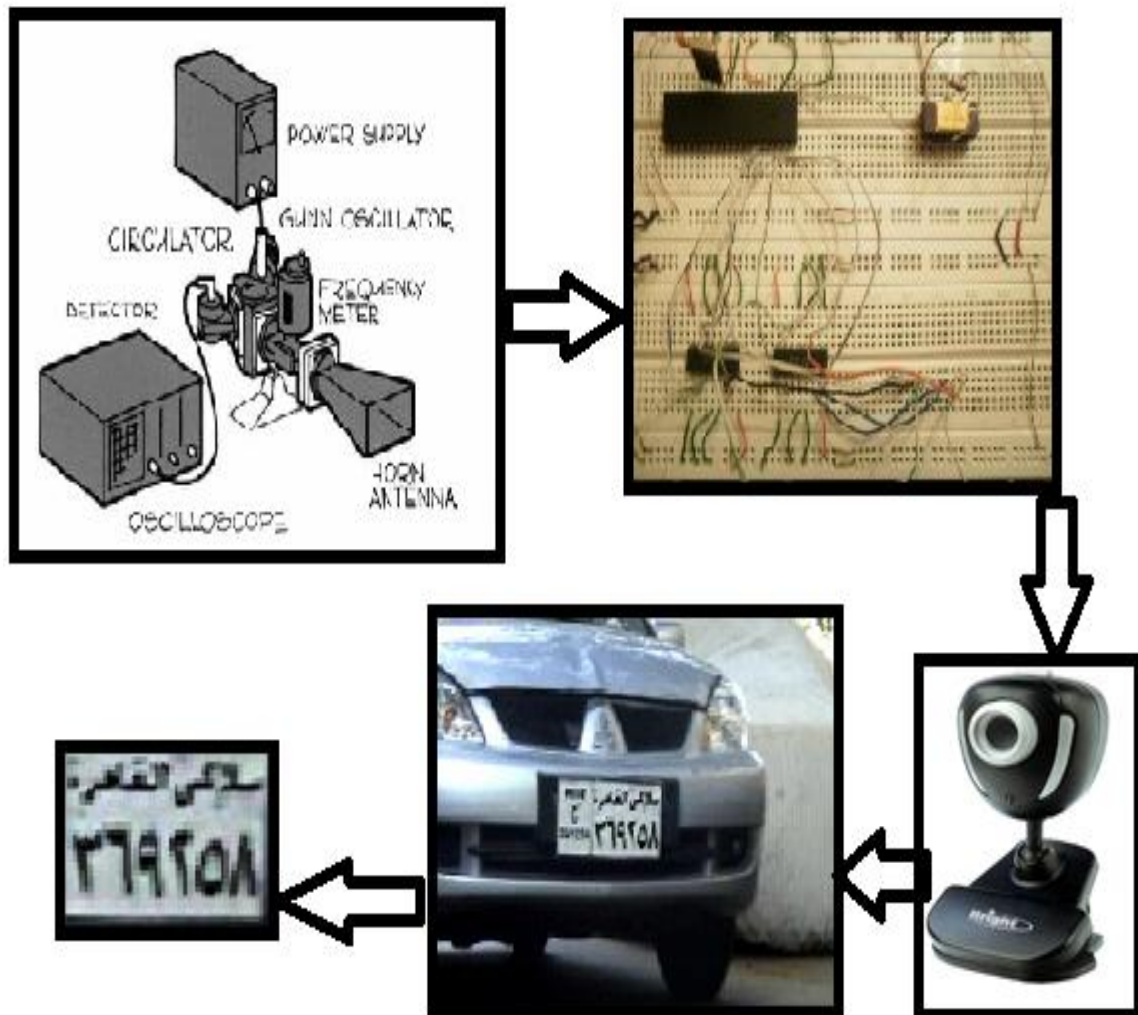
When the car moves in front of the radar circuit, the radar calculates the car's speed by using the main characteristics of Doppler frequencies. The output of the radar is voltage varying from 0 to 50 m volt. Get the output voltage of the radar and turn it into the ADC circuit to convert it from analogue dc volt form to digital output, where the computer can deal with it. The output of the interface will be 8-bits, and then it will vary from 0 to 255. So we need to do our calibration for determining the car's speed with specific software. After detecting the car speed, we have to give an order to the camera to capture this car if it moving over speed and if it's not moving over speed just determines the speed of it. After taking the photo for the car we have to does some processing on it to get recognize the license plate. After recognizing the plates, we extract the information of the plate and report it.

Project Description

The radar system is consists of 4 phases:

- Radar circuit.
- Analogue to digital interface.
- Software's programming for reading the digital input, calibration for the car speed, give an order to the camera to capture the car.

- Finally the image processing software to recognize the plate of the car.



1.1.3 Project requirements:

- Information about Radar system.
- Radar wave generator circuit.

- Analogue to digital interface.
- Software for reading from the parallel port.
- Software for speed calibration.
- Software for image processing and determining the plate's contents.

1.2 Methodology

The main goal of this project is to minimize the number of accidents per years, which occurs all over the roads, by punishing the drivers that cross the speed limits. So we can achieve this goal by following some steps to get this idea. We use the radar to detect a moving car along the road which the radar will be located. After that by the output of the radar circuit, we get the output voltage and convert it to digital form that will be used for measuring the car's speed. Then the next phase is to order the camera by the input value of the speed of the car to Taking a photo for the car if it moving over speed. After saving the image of the car, we make a number of operations that will be helpful for analyzing the image, and detect the plate contents to report it. The last part of the system is to take details of the car's plate after extract the contents of the plate and sending the car details to the responsible authority.

1.3 Project objectives

1.3.1 HARDWARE & NETWORK PLATFORMS:

We will use for converting from analogue to digital a specific hardware elements that will help and make it more simple for implementing the hardware. We will use a microcontroller for converting from analogue to digital.

1.3.2 Programming Languages:

- We will use micro C for the program of the microcontroller which will be used for analogue to digital converter(ADC).
- Proteus for circuit simulation.
- Csharp and Matlab for inetrface.
- Matlab for calibration and license plate recognition(LPR).

1.3.3 KEY PROJECT BENEFITS:

1. Detect the speeding cars automatically.
2. Using radar to measure speed of the car to avoid accident.
3. Reduce human element which reduce errors.
4. Easy handling and low cost.
5. Make the road safer.

Now we will speak about each one of the system components to describe every operation in each part and how it will be connected with the other phase.

Chapter 2 will be about the radar circuit, its components and the doppler shift which is the main idea of the radar operation. In chapter 3, chapter 4 we will mention in it how to design the hardware interface and how it will operate to convert the output analogue signal from the radar circuit to digital form to can be easily recognized by the computer by attached the parallel cable with the interface and the computer.

Chapter 5 will be about when the camera will picture the moving cars, recognizing information of the plate of the car and send these information automatically by e-mail to responsible authority.

At chapter 6 , software engineering is about the flow chart of the system, constraints and the duration and tasks implementation.

2

Radars

Preview

Radars Types, Block diagram, functions of its blocks, problems & Doppler Effect theory

2.1 Description of radar:

Radar is an object detection system which uses electromagnetic waves—specifically radio waves to determine the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain. The radar dish, or antenna, transmits pulses of radio waves or microwaves which bounce off any object in their path. The object returns a tiny part of the wave's energy to a dish or antenna which is usually located at the same site as the same area.



A radar system has a transmitter that emits radio waves called *radar signals* in predetermined directions.

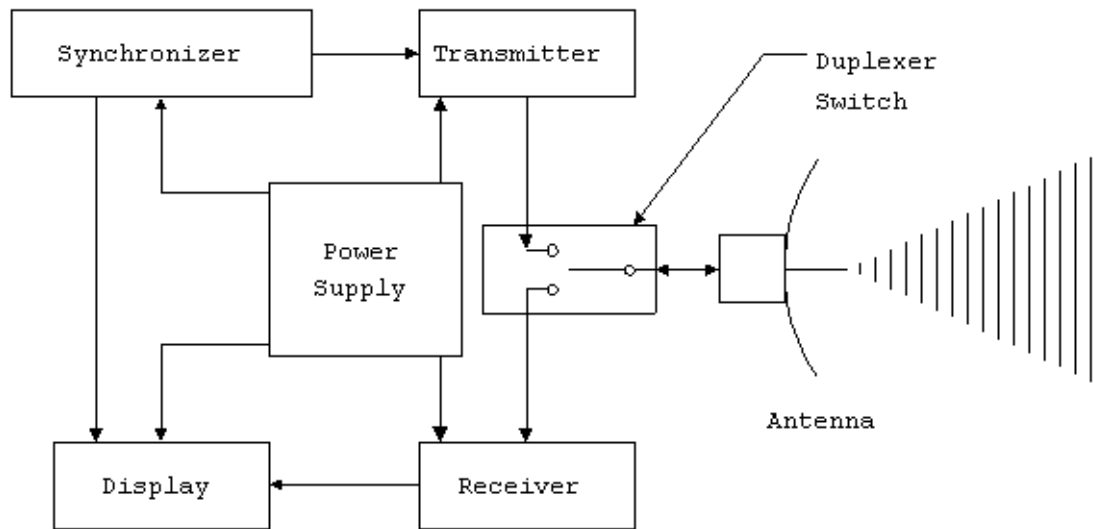
When these come into contact with an object they are usually reflected and/or scattered in many directions. Radar signals are

reflected especially well by materials of considerable electrical conductivity especially by most metals, by seawater, by wet land, and by wetlands. Some of these make the use of radar altimeters possible. The radar signals that are reflected back towards the transmitter are the desirable ones that make radar work. If the object is *moving* either closer or farther away, there is a slight change in the frequency of the radio waves, due to the Doppler Effect.

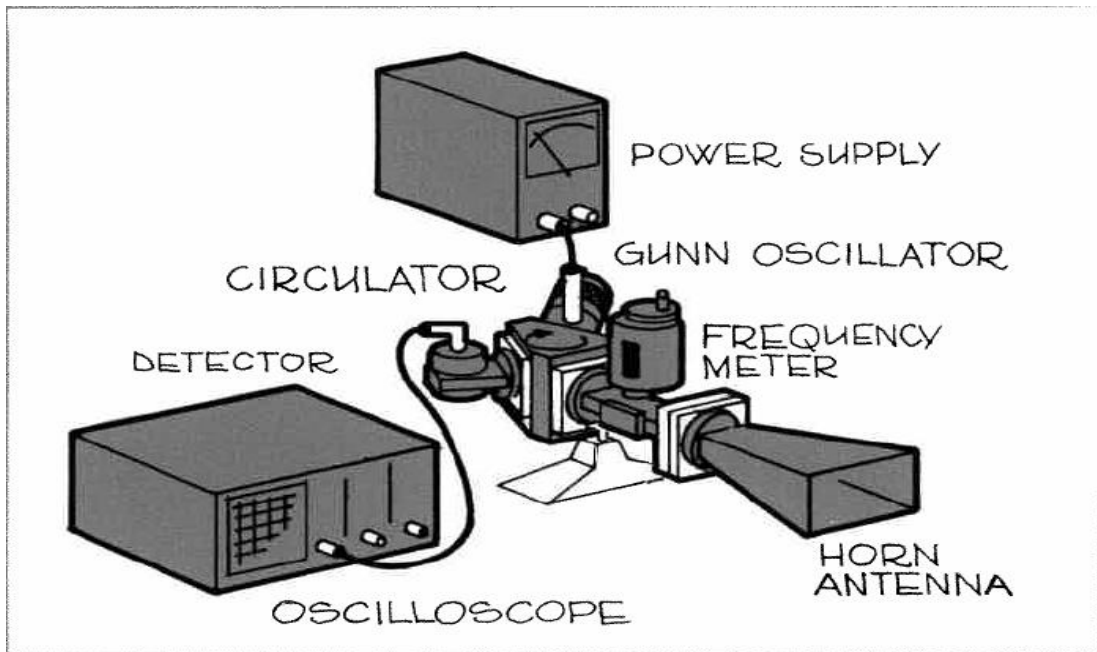
Speed is the change in distance to an object with respect to time. Thus the existing system for measuring distance, combined with a memory capacity to see where the target last was, is enough to measure speed. At one time the memory consisted of a user making grease-pencil marks on the radar screen, and then calculating the speed using a slide rule. Modern radar systems perform the equivalent operation faster and more accurately using computers. However, if the transmitter's output is coherent (phase synchronized), there is another effect that can be used to make almost instant speed measurements (no memory is required), known as the Doppler Effect. Most modern radar systems use this principle in the pulse-Doppler radar system. Return signals from targets are shifted away from this base frequency via the Doppler Effect enabling the calculation of the speed of the object relative to the radar.

The Doppler Effect is only able to determine the relative speed of the target along the line of sight from the radar to the target. Any component of target velocity perpendicular to the line of sight cannot be determined by using the Doppler Effect alone, but it can be determined by tracking the target's azimuth over time. Additional information of the nature of the Doppler returns may be

found in the radar signal characteristics article. It is also possible to make a radar without any pulsing, known as a continuous-wave radar (CW radar), by sending out a very pure signal of a known frequency. CW radar is ideal for determining the radial component of a target's velocity, but it cannot determine the target's range. CW radar is typically used by traffic enforcement to measure vehicle speed quickly and accurately where range is not important.



2.2 Radar unit circuit



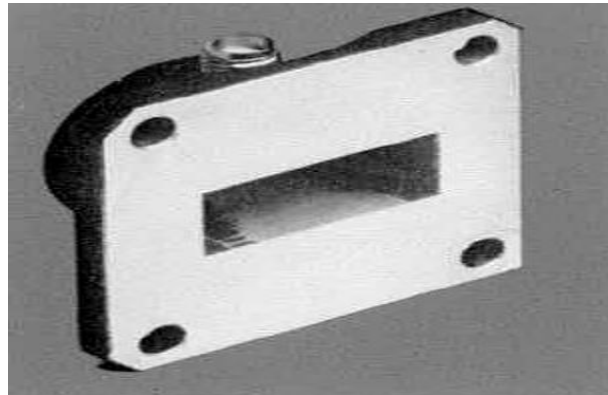
2.2.1 Component descriptions:

-sweep oscillator:



The sweep oscillator PM 7022X is designed for sweep frequency measurement at low cost with the highest accuracy. Only necessary functions have been included in order to keep the price low. The result is a compact, reliable instrument, easy to operate giving a minimum output power of 10 mW over the whole frequency range. It has variable sweep speeds for use with both oscilloscopes and pen recorders.

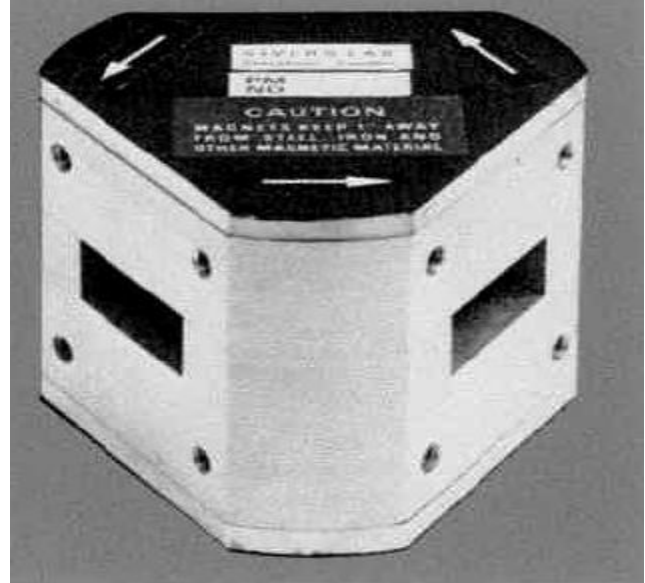
- **coax-waveguide transition:**



PM 7328X is a short transition from waveguide to 3 mm coaxial type SMA. The mismatch is kept low over the entire frequency range.

- **Ferrite circulator:**

The circulator PM 7050X has a Y configuration with the ferrite material in the center of the symmetrical junction formed by the three symmetrically spaced waveguides.



2.2.2 Problems of Radar

1. Interference

Radar systems must overcome unwanted signals in order to focus only on the actual targets of interest. These unwanted signals may originate from internal and external sources, both passive and active. The ability of the radar system to overcome these unwanted signals defines its signal-to-noise ratio (SNR). SNR is defined as the ratio of a signal power to the noise power within the desired signal.

2. Noise:

Signal noise is an internal source of random variations in the signal, which is generated by all electronic components. Noise typically appears as random variations superimposed on the desired echo signal received in the radar receiver. The

lower the power of the desired signal, the more difficult it is to discern it from the noise (similar to trying to hear a whisper while standing near a busy road). Noise figure is a measure of the noise produced by a receiver compared to an ideal receiver, and this needs to be minimized.

3. Clutter

Clutter refers to radio frequency (RF) echoes returned from targets which are uninteresting to the radar operators. Such targets include natural objects such as ground. Clutter may also be returned from man-made objects such as buildings and, intentionally, by radar countermeasures such as chaff.

4. Jammer:

Radar jamming refers to radio frequency signals originating from sources outside the radar, transmitting in the radar's frequency and thereby masking targets of interest.

Jamming may be intentional, as with an electronic warfare (EW) tactic. Jamming is considered an active interference source, since it is initiated by elements outside the radar and in general unrelated to the radar signals.

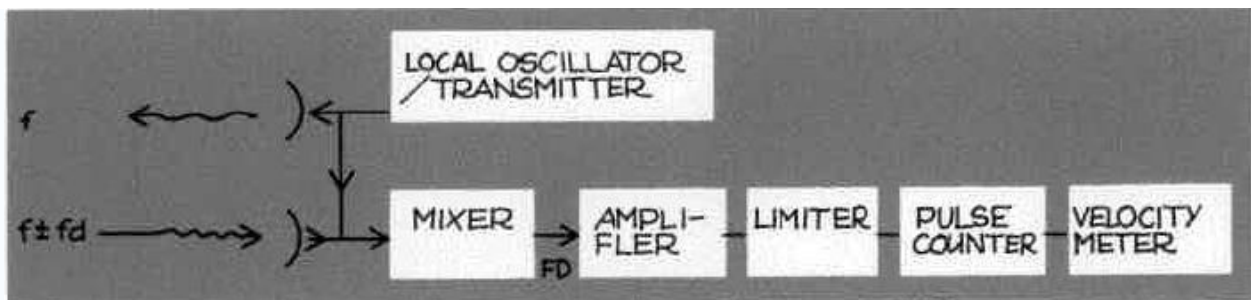
2.2.3 Doppler radar



Compare Speed of Car with Default speed if the Speed of Car Higher than Default Speed gives a pulse trigger to camera to capture image to the car. It is radar that makes use of the Doppler Effect to produce data about objects at a distance. It does this by beaming a microwave signal towards a desired target and listening for its reflection, then analyzing how the original signal has been altered by the object(s) that reflected it. Variations in the frequency of the signal give direct and highly accurate measurements of a target's velocity relative to the radar source and the direction of the microwave beam.

Doppler radars are used in air defense, air traffic control, sounding satellites, police speed guns and radiology.

2.2.4 Doppler Effect



It is the change in frequency of a wave for an observer moving relative to the source of the waves. It is commonly heard when a vehicle sounding a siren approaches, passes and recedes from an observer. The received frequency is higher (compared to the emitted frequency) during the approach, it is identical at the instant of passing by, and it is lower during the recession. For waves that propagate in a medium, such as sound waves, the velocity of the observer and of the source is relative to the medium in which the waves are transmitted. The total Doppler Effect may therefore result from motion of the source, motion of the observer, or motion of the medium.

2.2.5 Moving targets

Stationary targets such as earth ground clutter (land, buildings, etc) will be dominant in the low Doppler frequencies, while moving targets will produce much higher Doppler shifts. The radar processor can be designed to mask out clutter by the use of Doppler filters (digital or analogue) around the main spectral line (called the clutter-notch), which will result in the display of moving targets only (in relation to the radar). If the radar itself is moving, such as on a fighter aircraft, or a surveillance aircraft, then much more processing will be required, as the clutter in the filters will be based on platform speed, terrain under the radar, antenna depression angle, and antenna rotation/steered angle.

2.3 Radar equation:

The power P_r returning to the receiving antenna is given by the radar equation:

$$P_r = \frac{P_t G_t A_r \sigma F^4}{(4\pi)^2 R_t^2 R_r^2}$$

Where

- P_t = transmitter power
- G_t = gain of the transmitting antenna
- A_r = effective aperture (area) of the receiving antenna
- σ = radar cross section or scattering coefficient, of the target
- F = pattern propagation factor
- R_t = distance from the transmitter to the target
- R_r = distance from the target to the receiver.

In the common case where the transmitter and the receiver are at the same location, $R_t = R_r$ and the term $R_t^2 R_r^2$ can be replaced by R^4 , where R is the range. These yields:

$$P_r = \frac{P_t G_t A_r \sigma F^4}{(4\pi)^2 R^4}$$

This shows that the received power declines as the fourth power of the range, which means that the reflected power from distant targets is very, very small. The equation above with $F = 1$ is a simplification for vacuum without interference. The propagation factor accounts for the effects of multipath and shadowing and depends on the details of the

environment. In a real-world situation, path loss effects should also be considered.

2.3.1 Analysis:

The frequency of the sounds that the source *emits* does not actually change. To understand what happens, consider the following analogy. Someone throws one ball every second in a man's direction. Assume that balls travel with constant velocity. If the thrower is stationary, the man will receive one ball every second. However, if the thrower is moving towards the man, he will receive balls more frequently because the balls will be less spaced out. The inverse is true if the thrower is moving away from the man. So it is actually the *wavelength* which is affected.

As a consequence, the received frequency is also affected. It may also be said that the velocity of the wave remains constant whereas wavelength changes; hence frequency also changes. If the source moving away from the observer is emitting waves through a medium with an actual frequency f_0 , then an observer stationary relative to the medium detects waves with a frequency f given by

$$f = \left(\frac{v}{v + v_s} \right) f_0$$

Where v_s is positive if the source is moving away from the observer, and negative if the source is moving towards the observer. A similar analysis for a moving *observer* and a stationary source yields the observed frequency (the receiver's velocity being represented as v_r):

$$f = \left(\frac{v + v_r}{v} \right) f_0$$

Where the similar convention applies: v_r is positive if the observer is moving towards the source and negative if the observer is moving away from the source. These can be generalized into a single equation with both the source and receiver moving.

$$f = \left(\frac{v + v_r}{v + v_s} \right) f_0$$

With a relatively slow moving source, $v_{s,r}$ is small in comparison to v and the equation approximates to

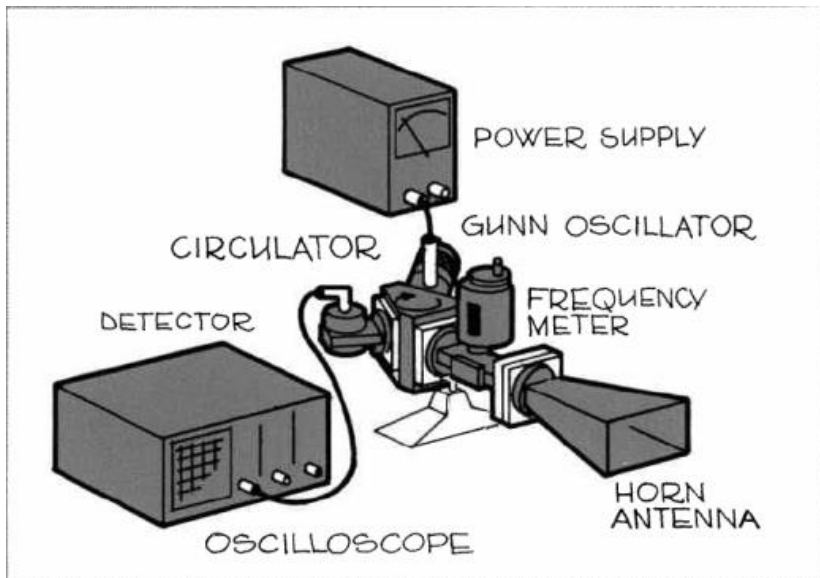
$$f = \left(1 - \frac{v_{s,r}}{v} \right) f_0$$

Where $v_{s,r} = v_s - v_r$

However the limitations mentioned above still apply. When the more complicated exact equation is derived without using any approximations (just assuming that source, receiver, and wave or signal are moving linearly relatively to each other) several interesting and perhaps surprising results are found. For example, as Lord Rayleigh noted in his classic book on sound, by properly moving it would be possible to hear a symphony being played backwards. This is the so-called "time reversal effect" of the Doppler Effect. Other interesting conclusions are that the Doppler effect is time-dependent in general (thus we need to know not only the source and receivers' velocities, but also their positions at a given time), and in some circumstances it is possible to receive two signals or waves from a source, or no signal at all. In addition there

are more possibilities than just the receiver approaching the signal and the receiver receding from the signal.

2.3.2 Testing Radar circuit



Connecting the radar parts:

Procedures:

1. Setup the equipment as shown in the figure. Start the GUNN-OSCILLATOR and tune it to approx. 9.0 GHz. The bias should not exceed 9 volts.
2. DC-couple the OSCILLATOR with a vertical sensitivity of 50 mV/cm.

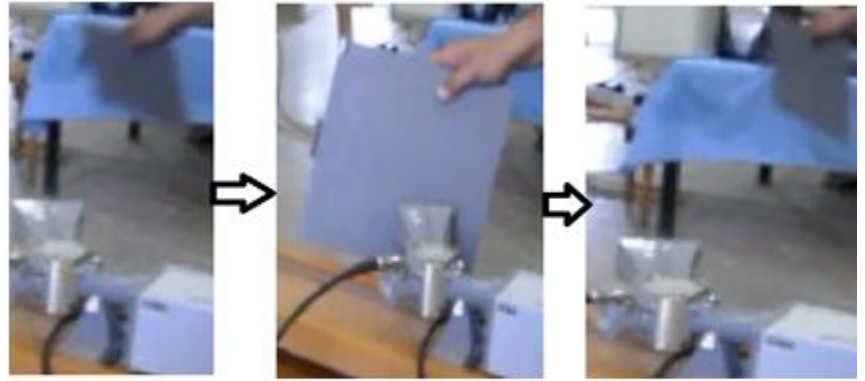
The LO power to the detector will now give us a DC-offset on the screen.

3. Set the frequency meter to exactly 9,000 MHz and tune the Gunn-oscillator until a sharp decrease in the DC-offset will occur. The oscillator frequency is now 9.0 GHz.

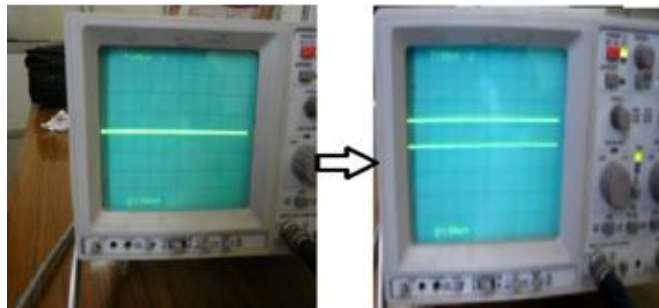
4. Detune the frequency meter at least 50 MHz

Set the actual target in motion-couple the OSCILLOSCOPE and increase the vertical sensitivity until it is possible to study the sinusoidal trace of the Doppler frequency on the screen. Choose a suitable setting of the time/div. on the oscilloscope and measure the time of the complete periods.

After the testing we have got that the maximum output voltage from the radar when moving target to detect it with the maximum speed is 50mvolt.



moving metal plate in front of
the radar horn



Oscillator indicates
voltage change

3 Interface

Hardware Interface

Preview

Represent each task that I have to do, and how to operate it and the results of each task.

3.1 Electronics components:

- PIC 16f788A

PIC16f877A is an important type of microcontroller which is has an inner ADC with 50HZ oscillation that helps to synchronous the speed of the microprocessor of the microcontroller. This microcontroller takes a voltage value and according to the program on it, it performs as specific operation. According to our project we will design a program to activate its ADC feature.



- Parallel cables:

Parallel, on the other hand, is a way to speed up the connection by transferring more data at the same time in the same direction over multiple wires. It is like adding more lanes of traffic to get more data to flow.

Reasons of Using Parallel Port Interfacing:

- 1-Direct connection between Radar and Pc.
- 2-Easier in implementation.
- 3-Easier in programming.
- 4-Minimum Cost.

- Oscillator

This part is used to provide the input pulses for the microcontroller to make the PIC capable to could interact with the variance and periodically change of the voltage.

- Variable resistance

Variable resistors consist of a resistance track with connections at both ends and a wiper which moves along the track as you turn the spindle. The track may be made from carbon or a coil of wire (for low resistances). The track is usually rotary but straight track versions, usually called sliders, are also available.

- Adaptor

We used an adaptor that providing an output volt 5.5 volt with 300mA. This adaptor is used for feeding the whole circuit with the ground and 5 volt supply to operate microcontroller.

- LEDS

This LEDS is used for indication for the output voltage. We used 8 LEDS to indicate the 8 digital outputs. If the LED lights so it means (1) or 5 volt, if not so it means (0) or 0 volt.

3.2 Wiring hardware:

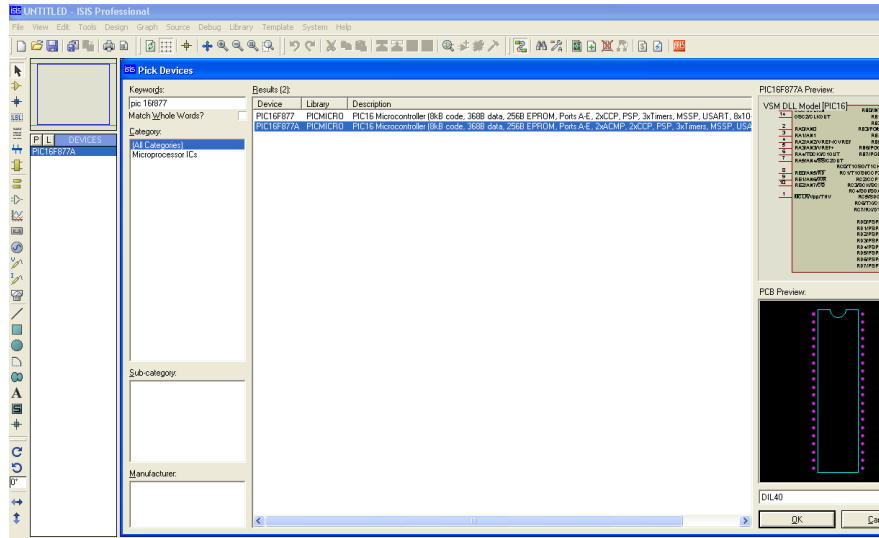
For wiring the interface, we have worked on Proteus software. This gives a simulation for the circuit components to wire it over the software and testing the wiring.

The PIC is consisting of output and input ports that that we can attach the voltage of the radar to the input port and we will get the digital from 8 pin output ports.

3.2.1The steps for wiring the hardware:

1-Proteus:

First we have tested the hardware circuit diagram on Proteus by choosing the required microcontroller on it (PIC 16f877).



We put the microcontroller on the simulation test board and started to attach the required components.

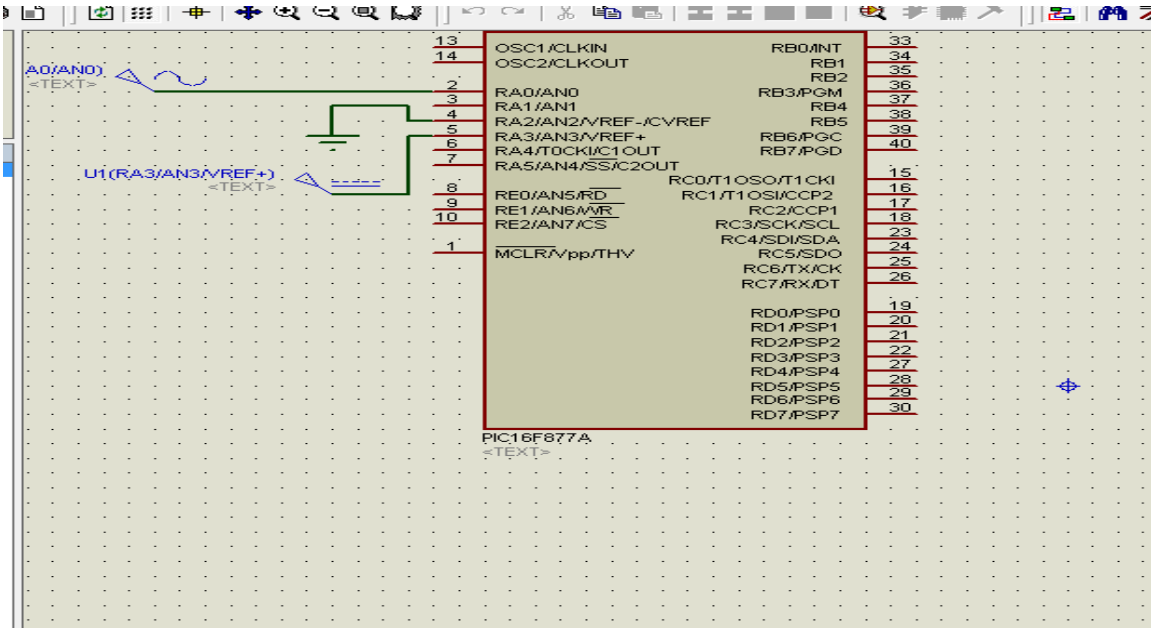
RA0/AN0: input signal (dc voltage)

RA2/AN2/VREF-: ground

RA3/AN3/VREF+: maximum volt applied (1 volt)

These inputs are the input signal which comes out from the radar, the maximum and minimum voltage that the microcontroller will compare with.

Then we tested the program that we have already wrote for operates the microcontroller.



ISIS Professional

File View Edit Tools Design Graph Source Debug Library Template System Help

P L DEVICES
PIC16F877A

Edit Component

Component Reference: U1 Hidden:

Component Value: PIC16F877A Hidden:

PCB Package: DIL40 Hide All

Program File: Hide All

Processor Clock Frequency: 1MHz Hide All

Program Configuration Word: 0x3FFB Hide All

Advanced Properties:

Randomize Program Memory? No Hide All

Other Properties:

Exclude from Simulation Attach hierarchy module

Exclude from PCB Layout Hide common pins

Edit all properties as text

Buttons: OK, Help, Data, Hidden Pins, Cancel

the directory of the exe file for

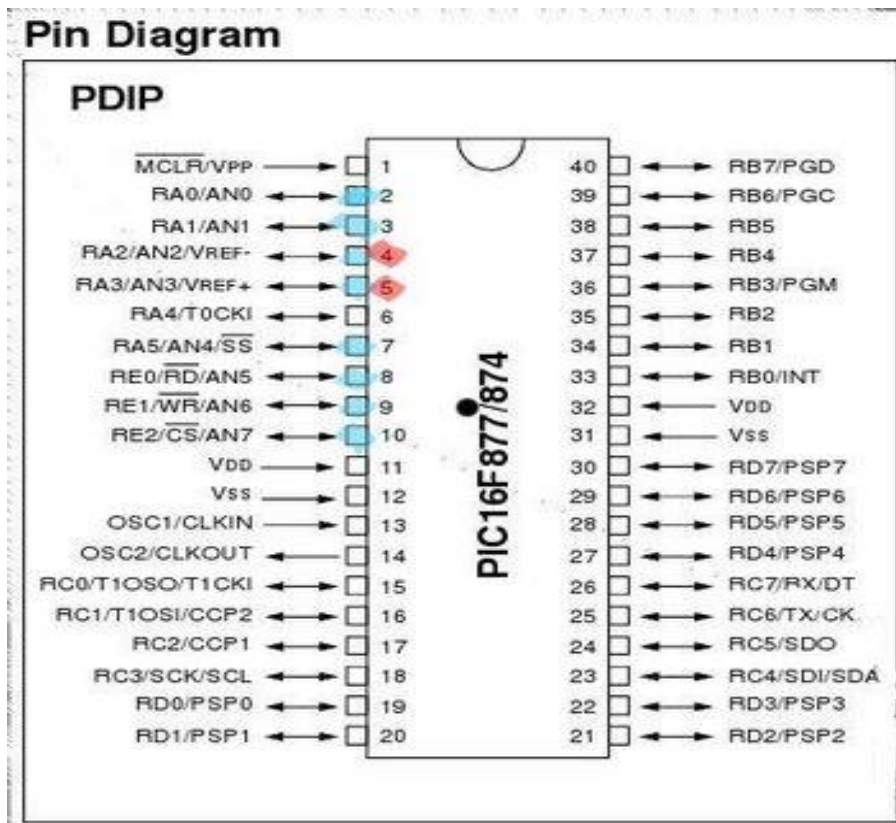
RD0/PSP0 19
RD1/PSP1 20
RD2/PSP2 21

This program is written as follows on Micro-C:

```
Unsigned int x; //defining a register x
Void main() {
ADC_Init();//declaring the ports as outputs and inputs
TRISA=0x01; // define port A as input port
TRISB=0x00; // define port B as out port
TRISC=0x00;//define port C as output port
    do
    {
x=ADC_Get_Sample(0);// it's the function that call the ADC
PORTB=x;//get the data in output port B and put into X
    } while(1);//repeat this operation
}
```

2- Real wiring hardware on test board:

From the data sheet of the microcontroller, we got the information about how to attach the electronics components to the pin's of the microcontroller to make it work properly ad analogue to digital converter.



Data sheet specifications:

Pin1: MCLR → 5 volt

Pin2: RA0/AN0 → input signal

Pin4: RA3/VREF- → ground

Pin5: RA4/VREF+ → 1 volt

Pin11: VDD → ground

Pin12: VSS → 5 volt

Pin 13&pin14 → Oscillator

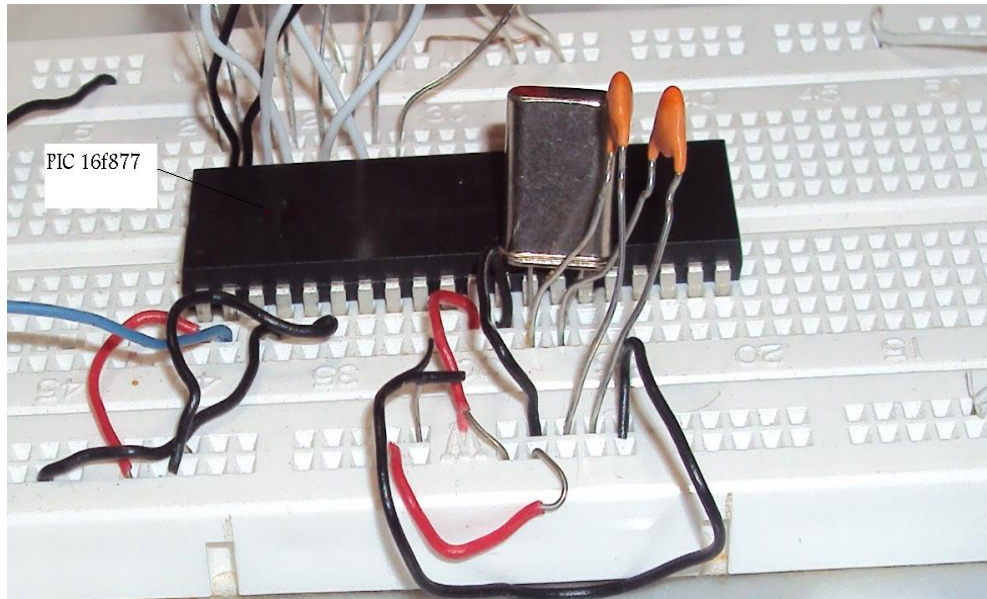
From Pin 40 to Pin 33 output LEDs to show the output

First we worked without the radar circuit, and we get the input signal by ourselves by using a variable resistance which can divide the voltage as we want to get different voltage values.

3-Some pictures for wiring the hardware on the test board:

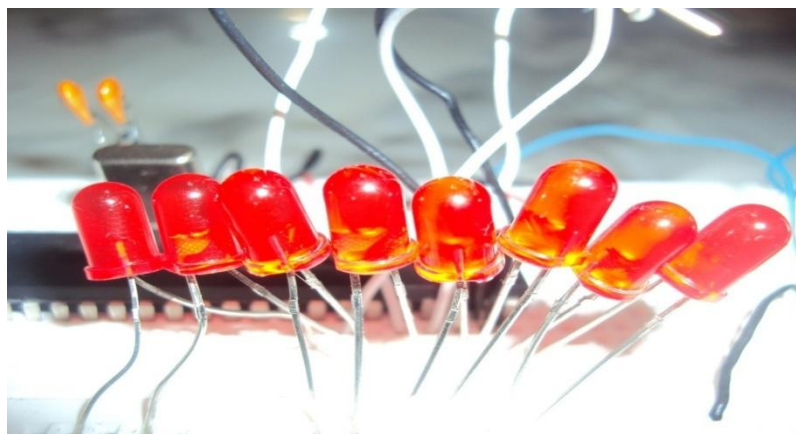
- Pic16f877 wiring on test board.

This is the main part that responsible for analogue to digital converting, according to the burning program on it. There are some pins must be grounded and other pins must be attached to the voltage Vcc.



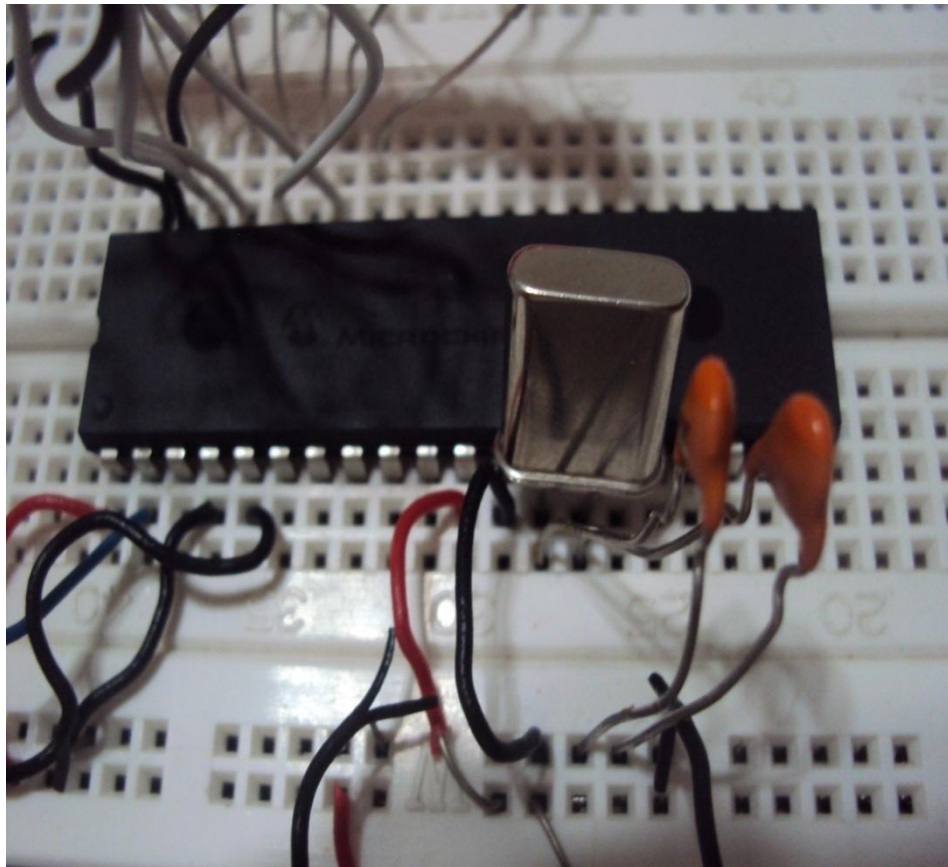
- **Output LEDs:**

These LEDs are used to indicate the output of the converter to show the different codes. There are 8 pins representing the 8 output that indicate from 0 to 255.



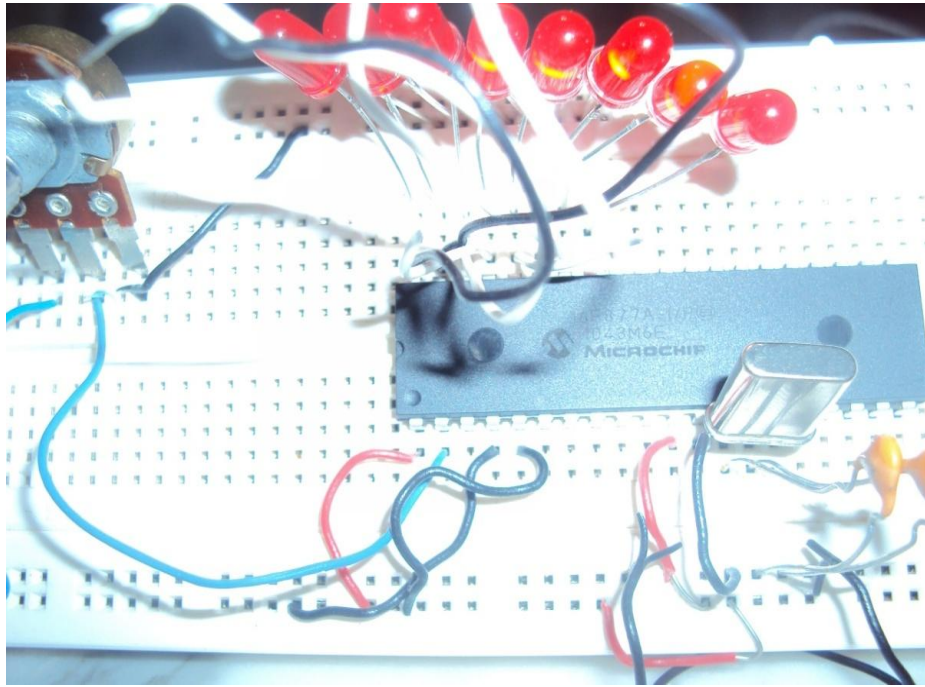
- **Oscillator wiring:**

This component is used for giving a timing clock pulse for the microcontroller to operate. And it must be linked with two capacitors to its legs and to the ground.

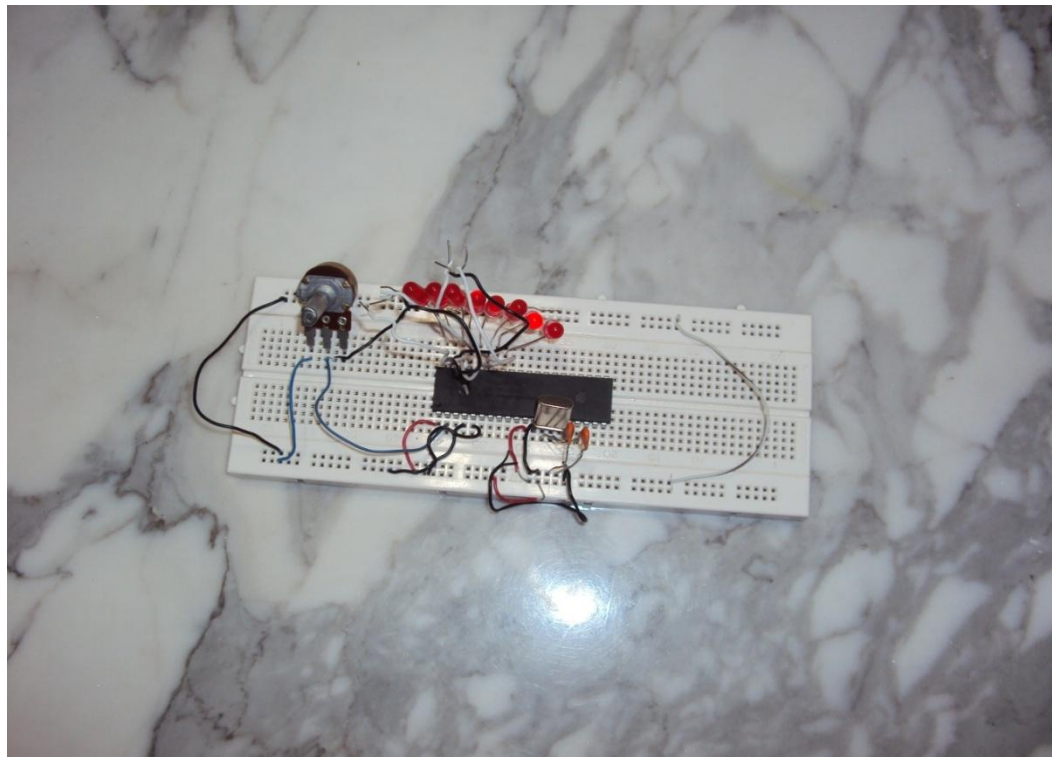


- **variable resistance:**

We just used the variable resistance at testing level, to get different voltage to indicate the variable speed of the car.



-Overall hardware wiring on the test board:



3.3 Testing hardware:

Firstly, we had to test the hardware before attaching it with the radar circuit to make sure that the interface is working properly. After wiring the hardware interface we had to input a signal which acts as the input voltage to the interface, and we had to input the reference voltage (5volt). We got the reference volt from an adapter by monitoring it on 5 volt, and attached it with the reference + pin. After that we have to get a variable voltage for representing the change in voltage to get change in the output digital code.

We got that by using variable resistance, by changing the value of the resistance which will lead to change in the voltage drop on that resistance and will aid to get different voltage for the input signal. After varying the resistance I got variable codes as we change the value of the resistance. To make sure that the code is right, by increasing the resistance to the maximum, the 8 LEDS turned on representing maximum code (255).After decreasing the value of resistance to minimum, the 8 LEDS turned off representing minimum code (0).

3.4 Conclusion of Testing

We attached the radar circuit with the hardware interface, the operation failed because of some problems:

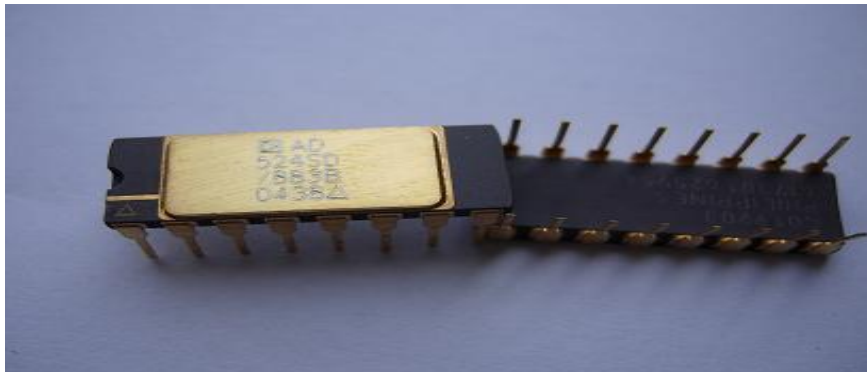
- 1- The maximum output of the radar is 50mvolt, and this is a big problem that the microcontroller can't recognize that small voltage.
- 2- The microcontroller made a big drop for the voltage before it reaches the parallel cable, so the parallel cable can't recognize the output.

3.4.1 Solving the problems:

First small output voltage:

We have solved this problem by using an amplifier that enables us to amplify the output voltage from 50mvolt to 5 volt, so we will need an amplifier with gain 100.

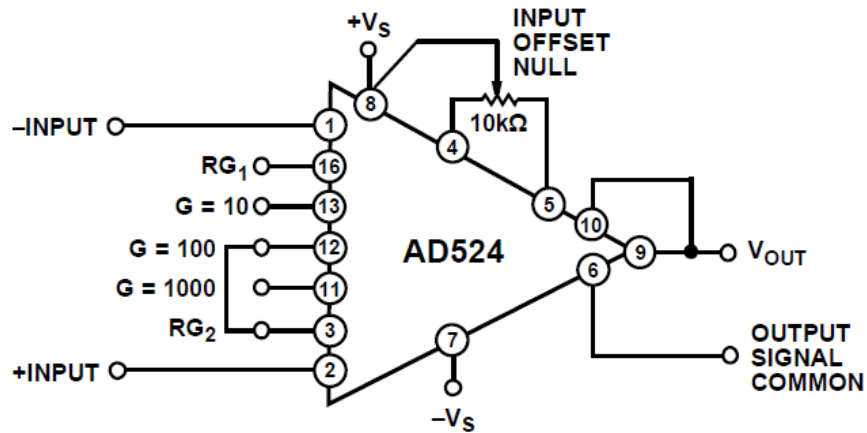
The Amplifier:



A device used to increase the power of electric signals. Since the amplified signals are variations in time, or oscillations, of voltage or current, a signal amplifier is, essentially, an amplifier of electric oscillations. Signal amplifiers may be divided into such classes as low-or high-frequency amplifiers, video amplifiers, and DC amplifiers. Signal amplifiers also include instrument amplifiers,

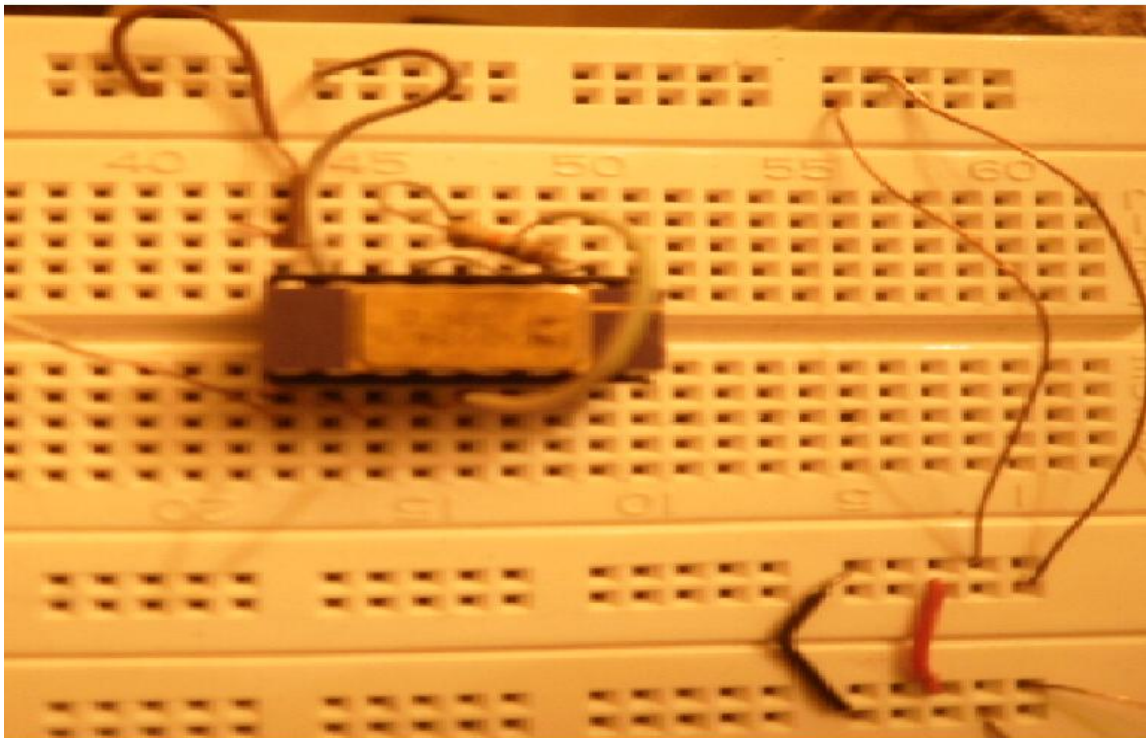
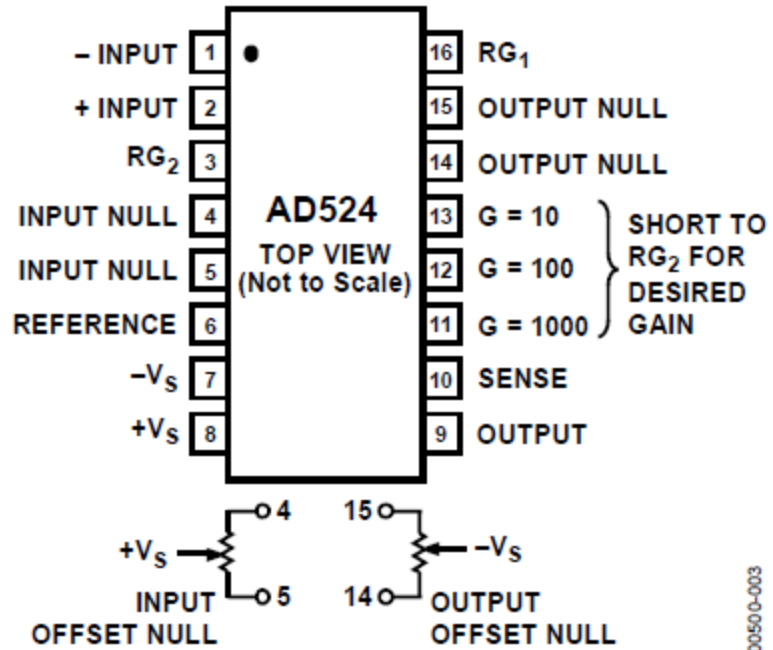
which are used as components of such measurement apparatus as electronic voltmeters, oscilloscopes, potentiometers, and instruments that use bridges. An instrument amplifier makes possible increased sensitivity and accuracy in the measurement of both electrical and nonelectrical quantities. The primary requirement of such an amplifier-that it provide a fixed gain-is satisfied owing to its large amount of negative feedback. Moreover, in a number of instruments, such as voltmeters and oscilloscopes, the amplifier must ensure normal operation of the instrument over a wide frequency range that sometimes extends from zero to several giga hertz's.

The amplifier that we have used is AD524 that produce a gain from 1 to 1000. From the data sheet of the amplifier we can get gain 100 as follows:



Operating Connections for G = 100

CONNECTION DIAGRAMS



Second problem: voltage drop due to microcontroller. Due to voltage drop of voltage due to microcontroller which is goes to 0.5 volt which can't be recognized by the parallel cable. We have solved that problem by using a comparator which is measure an input volt to it and compare it with the threshold (0 volt) and output voltage by value 5 to be recognized by the parallel cable. This comparator is L293D.

The comparator L293D:

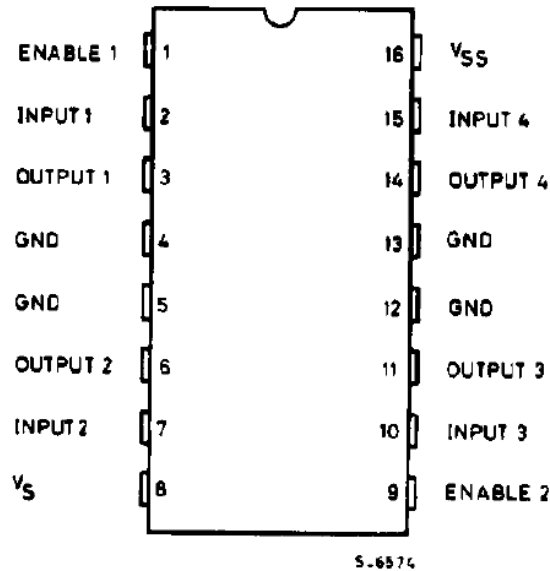


The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads and switching power transistors.

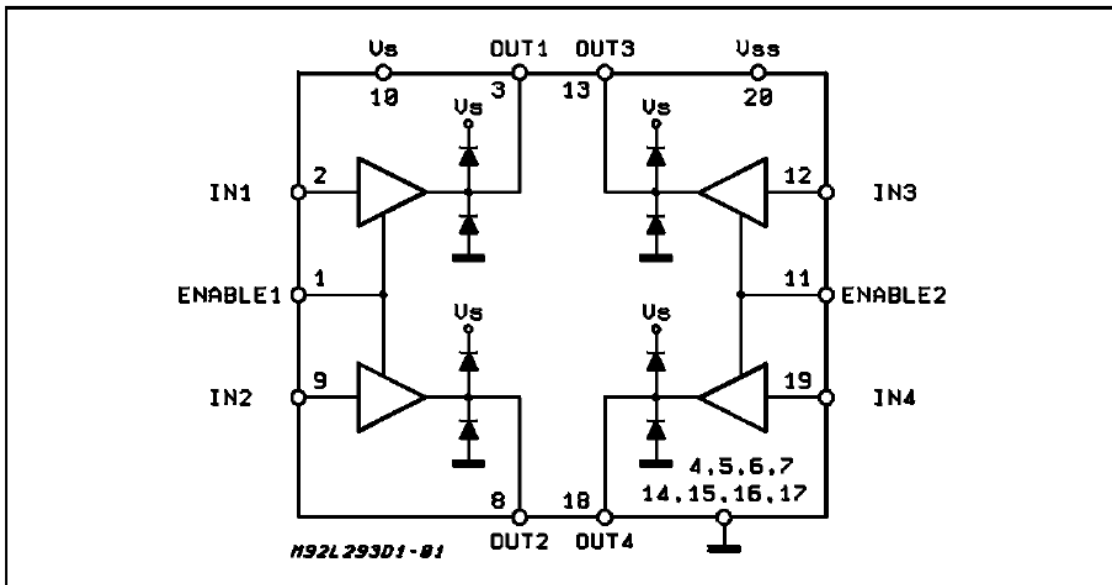
To simplify use as two bridges each pair of channels are equipped with an enable input. A separate Supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz.

This comparator is used for only 4 input-output, so we will need 2 comparators to perform the 8 output bins.

➤ We have wired the comparator as in data sheet.



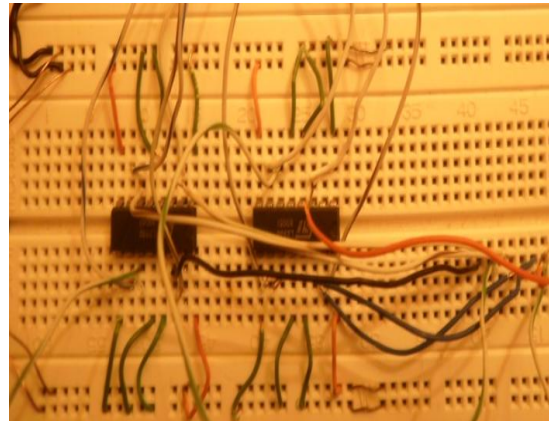
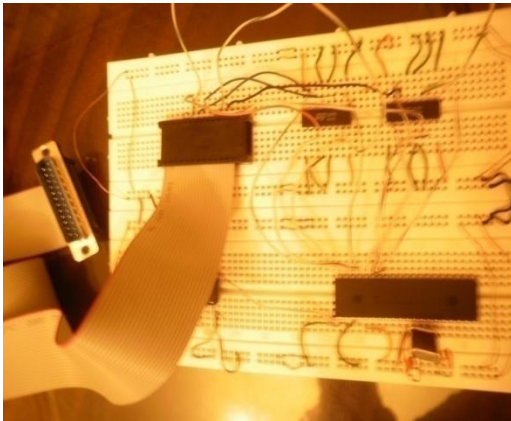
BLOCK DIAGRAM

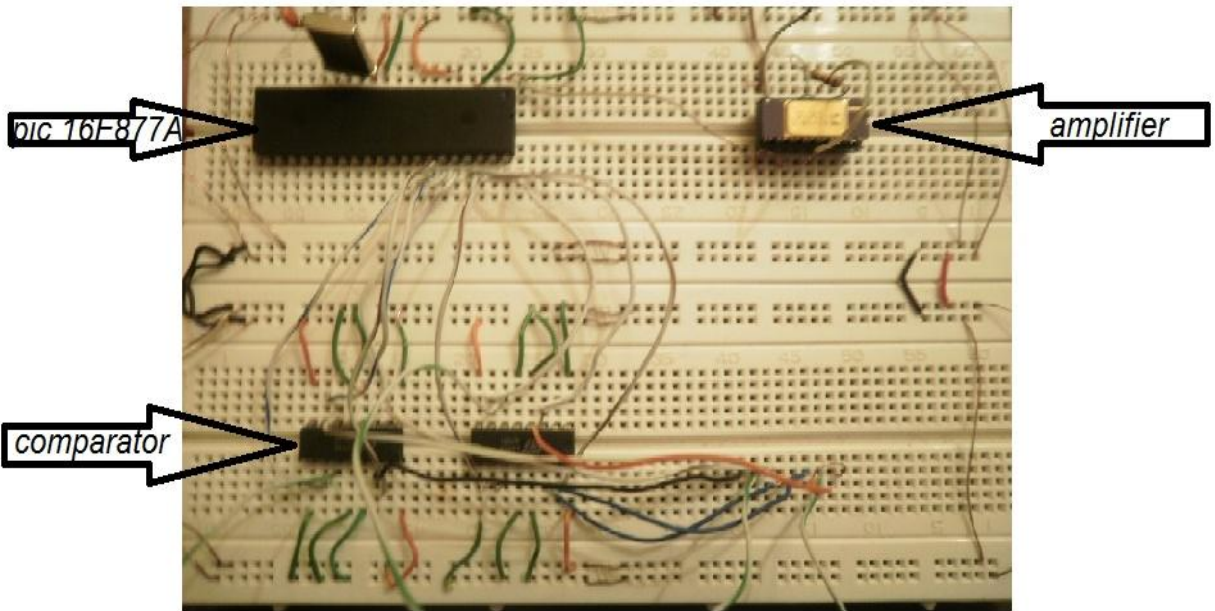


➤ Testing hardware interface after solving problems

We tried to represent an output signal of the radar in a manual way, by the circuit with 5 volts and using variable resistance we can get variable voltages from 0 to 5 volt. Then the microcontroller will receive the variable voltage and converting it into digital form from (0 255), Then the output will be separated into two parts each on four bins and then apply each four bins (outputs) on a comparator. A comparator will compare the input and the threshold it has and produce 0 or 5 volt then we will test these outputs' on LEDS to indicate the variance of the output code.

▶ **Wired hardware interface:**





4

Interface

Software interface

Preview

At this chapter we introduce the software program that will be used to read digital value from parallel cable.

4.1 Reading from parallel port:

4.1.1 Introduction

Parallel port is a simple and inexpensive tool for building computer controlled devices and projects. The simplicity and ease of programming makes parallel port popular in electronics hobbyist world. The parallel port is often used in Computer controlled robots, Atmel/PIC programmers, home automation, etc... Here a simple tutorial on parallel port interfacing and programming with some examples. The primary use of parallel port is to connect printers to computer and is specifically designed for this purpose. Thus it is often called as printer Port. It is a 25 pin female (DB25) connector (to which printer is connected). On almost all the PCs only one parallel port is present, but you can add more by buying and inserting ISA/PCI parallel port cards. The programs, circuits and other information found in this tutorial are compatible to almost all types of parallel ports and can be used without any problems.

4.1.2 Hardware

Testing parallel cable:

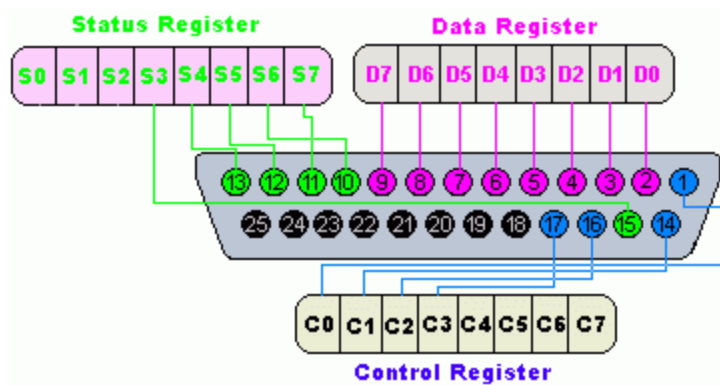
Parallel cable contains 25 pins. We have tested the parallel cable if it works or not, First we apply voltage source of 5 volts wire to one of the data pins (2→9) and the ground wire

on the ground pins (18 → 25). Then change the 5 volt on the data bins and watch the NT port program variation. If there is a variation on the output of the NT port class (hexadecimal code), then the parallel cable work properly.

To test the parallel cable we have to use the voltmeter and but the branches of it at the same bins of the two branches of the cable, if it give a beep so it works.

Note: We must define the port address of the data pins that we read from. Usually the port address is from (DE00, DE02).

The pin outs of DB25 connector is shown in the picture below We have at the parallel cable 3 types of bins: the data pins and it consist of 8 pins, status pins and it consist of 5 pins and the other pins , 4 of them is for control and the other pins are grounded.

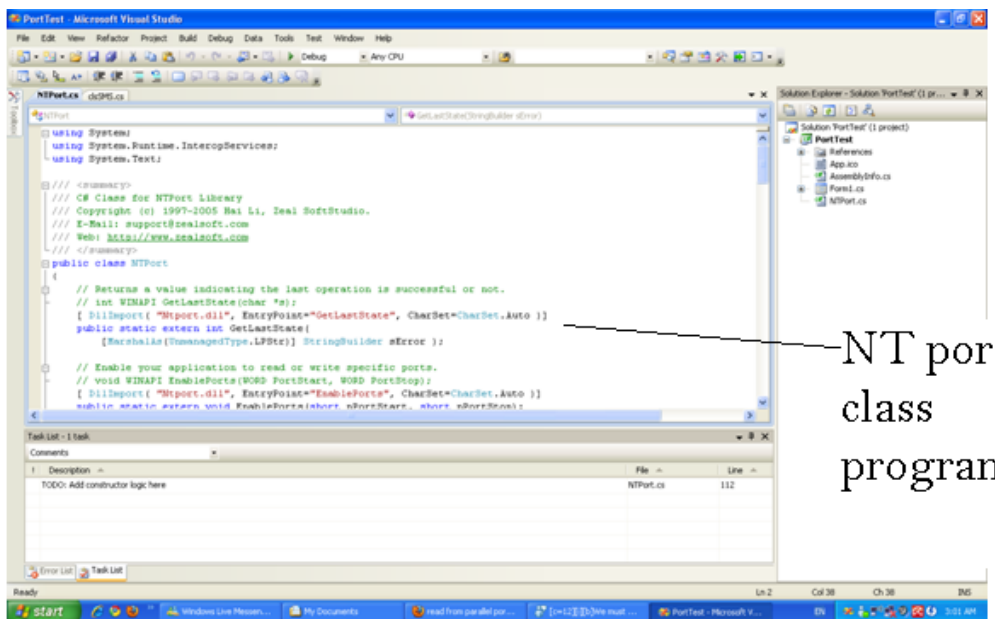




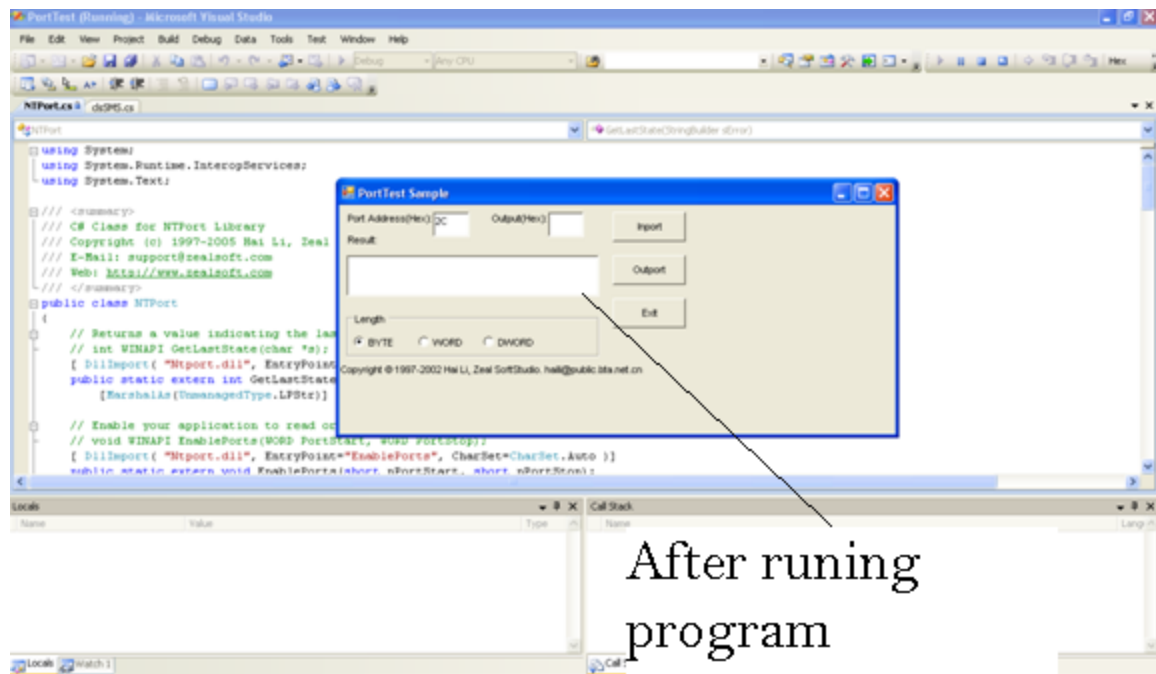
4.1.3 Software Program(C#)

There is a class that used for reading from parallel port, this class is called NTPORT. This class allows the user to take digital output from the interface and convert it to identified number from 0 to 255. This program is written in C# programming language. After determining the digital value, we will take this value and do another program to make an equivalent calibration to the real speed of the car, then use this speed to take the necessary action to the webcam. NTPort Library enables your Win32 application to real-time direct access to PC I/O ports without using the Windows Drivers Development Kit(DDK) - NTPort Library provides support for Windows 95/98/ME and Windows NT/2000/XP/Server 2003/Vista (x86 and x64). NTPort Library is easy to use. Under Windows NT, NTPort Library driver can be loaded and unloaded dynamically, so you need not any configuration. NTPort Library is also an ideal replacement of old BASIC INP or OUT statement. The tool also supports getting the base address of LPT ports. You need administrative rights to

install this product. After installation, any users can use this product. This version supports both administrator and non-administrator accounts. Visual Basic, Visual Basic.NET, Visual C#, Visual C++, Delphi, Delphi for .NET, Borland C++ Builder, C#Builder, JBuilder, Eclipse and PowerBASIC samples are included. Matlab, Borland C++, Visual Fortran, Visual J++.



After running the program this toolbox is shown, it asked the user to enter the address of the port address. Then press inport to read from the parallel cable, the results maybe shown in byte , word or decimal form.



4.1.4 Software program(matlab)

Now we are consider to make the software proragm to read from the parallel cable by matlab to make it easy to link between the programs. Reading from the parallel port we have to know the name of the port so type

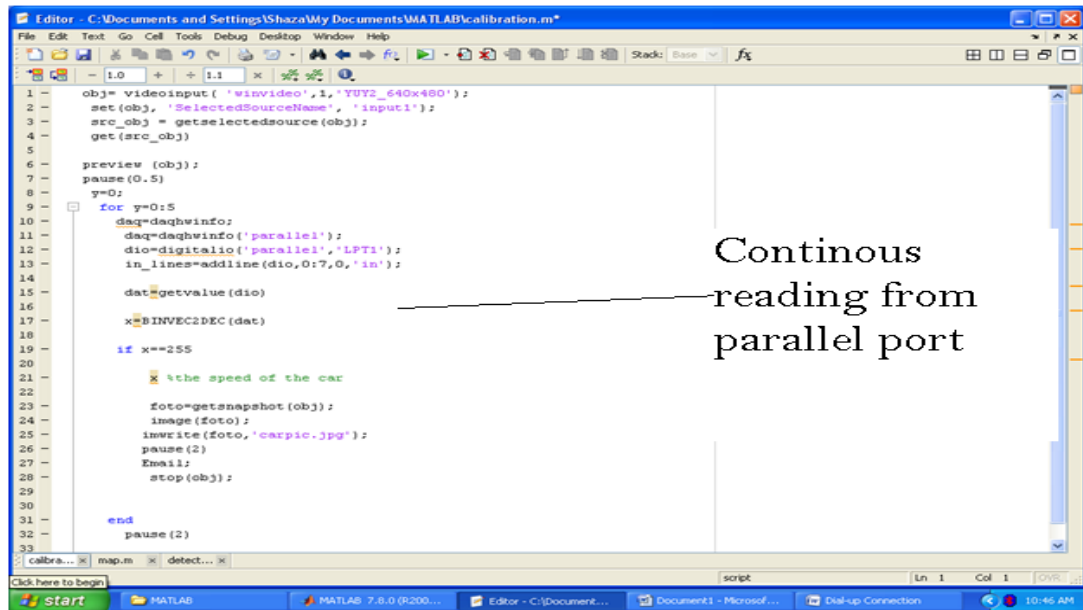
```
>>daq=daqhwinfo('parallel')
```

Then create an object with the name of the port and the character parallel using “digitalio” function and adding line to read from the data line port 0. And to order the program to read data from the pins 2 to 9 which represent the data lines from D0 to D7.

```
>>dio=digitalio('parallel','LPT1');
```

```
>>in_line=addline(dio,0:7,0,'in');%
```

Then get the value and convert the binary into decimal number for entering the next stage. Third Stage, The program receives codes from the parallel port (radar interface) ranges from 0 to 255. And compare it with if condition to decide whether it's over speed or not, for example the maximum acceptable code is 150 so if the program receives more than 150.



```
1 obj= videoinput('winvideo',1,'YUY2_640x480');
2 set(obj,'SelectedSourceName','input1');
3 src_obj = getselectedsource(obj);
4 get(src_obj)
5
6 preview(obj);
7 pause(0.5)
8 y=0;
9 for y=0:5
10     daq=daqhwinfo;
11     daq=daqhwinfo('parallel');
12     dio=digitalio('parallel','LPT1');
13     in_lines=addline(dio,0:7,0,'in');
14
15     dat=getvalue(dio)
16     x=BINDEC2DEC(dat)
17
18     if x==255
19
20         % the speed of the car
21
22         foto=getsnapshot(obj);
23         image(foto);
24         imwrite(foto,'carpic.jpg');
25         pause(2)
26         Email;
27         stop(obj);
28
29
30 end
31 pause(2)
32
33
```

Continuous reading from parallel port

Appendix

Source code for NTPORT class

```
using System;
using System.Drawing;
using System.Collections;
using System.ComponentModel;
using System.Windows.Forms;
using System.Data;
using System.Text;
using System.Globalization;
public class Form1 : System.Windows.Forms.Form
{
    public System.Windows.Forms.ListBox List1;
    public System.Windows.Forms.TextBox Text2;
    public System.Windows.Forms.TextBox Text1;
    public System.Windows.Forms.GroupBox Frame1;
    public System.Windows.Forms.RadioButton optDWord;
    public System.Windows.Forms.RadioButton optWord;
    public System.Windows.Forms.RadioButton optByte;
    public System.Windows.Forms.Button btnExit;
    public System.Windows.Forms.Button btnWrite;
    public System.Windows.Forms.Button btnRead;
    public System.Windows.Forms.Label Label3;
    public System.Windows.Forms.Label Label1;
    public System.Windows.Forms.Label Label4;
    public System.Windows.Forms.Label Label2;
    private System.ComponentModel.IContainer components;

    public Form1()
    {
        //
        // Required for Windows Form Designer support
        //
        InitializeComponent();

        //
        // TODO: Add any constructor code after
InitializeComponent call
        //
    }

    /// <summary>
    /// Clean up any resources being used.
    /// </summary>
    protected override void Dispose( bool disposing )
    {
```

```

        if( disposing )
        {
            if (components != null)
            {
                components.Dispose();
            }
        }
        base.Dispose( disposing );
    }
    static void Main()
    {
        Application.Run(new Form1());
    }

    private void btnExit_Click(object sender, System.EventArgs
e)
    {
        this.Close();
    }

    private void btnRead_Click(object sender, System.EventArgs
e)
    {
        int nInNum;
        short nPortID;

        nPortID = short.Parse(Text1.Text,
NumberStyles.AllowHexSpecifier);
        if(optByte.Checked)
            nInNum = NTPort.Inport(nPortID);
        else if(optWord.Checked)
            nInNum = NTPort.InportW(nPortID);
        else
            nInNum = NTPort.InportD(nPortID);

        // Get Error Information
        StringBuilder errorBuffer = new StringBuilder(30);
        NTPort.GetLastState(errorBuffer);

        List1.Items.Add("In 0x" + Text1.Text + ", 0x" +
            nInNum.ToString("X"));
        List1.Items.Add(errorBuffer.ToString());
        List1.SelectedIndex = List1.Items.Count - 1;
    }

    private void btnWrite_Click(object sender, System.EventArgs
e)
    {
        int nOutNum;
        short nPortID;

```

```

        nPortID          =          short.Parse(Text1.Text,
NumberStyles.AllowHexSpecifier);
        nOutNum          =          short.Parse(Text2.Text,
NumberStyles.AllowHexSpecifier);

        if(optByte.Checked)
            // Byte
            NTPort.Outport(nPortID, (short)nOutNum);
        else if(optWord.Checked)
            // Word
            NTPort.OutportW(nPortID, (short)nOutNum);
        else
            // DWord
            NTPort.OutportD(nPortID, nOutNum);

        // Get Error Information
        StringBuilder errorBuffer = new StringBuilder(30);
        NTPort.GetLastState(errorBuffer);

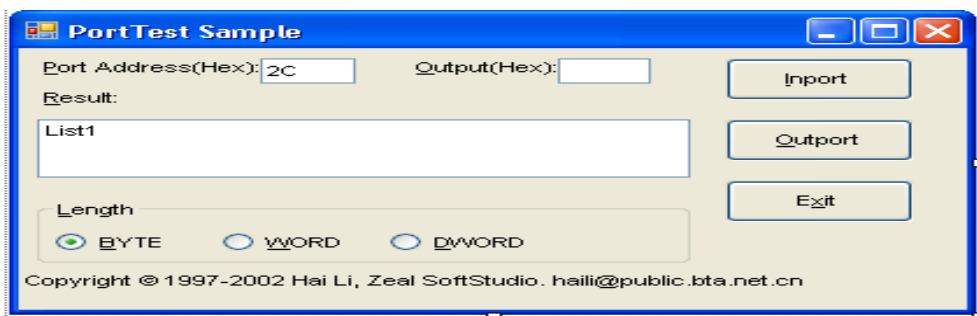
        List1.Items.Add("Out 0x" + Text1.Text + ", 0x" +
Text2.Text);

        List1.Items.Add(errorBuffer);
        List1.SelectedIndex = List1.Items.Count - 1;
    }

    private void Form1_Load(object sender, System.EventArgs e)
    {
        // After register NTPort Library,
        // place your registration information here.
        NTPort.LicenseInfo("Your Name", 0);
    }

    private void Text1_TextChanged(object sender, EventArgs e)
    {
    }
}
}
}

```



5 Segmentation & LPR

Camera, LPR and Features

Preview

We want the camera to shoot the over speed cars. Segmentation is important process before OCR, it use a lot of operation to get the plate segmented.

5.1 Car picturing

This is the first stage of the software so we have some requirements to achieve. First, we have connected the webcam through the USB and got information about installed devices to know the device that we have used. Second, getting more information about the device (camera) that provides the name of the device, Device ID and Supported format. Third, we use the “objectConstructor” to create video object that takes continuous frames for the site and preview it, at this point we are entering the next stage. Second stage, Reading from the parallel port we have to know the name of the port so type

```
>>daq=daqhwinfo('parallel')
```

Then create an object with the name of the port and the character parallel using “digitalio” function and adding line to read from the data line port 0

```
>>dio=digitalio('parallel','LPT1');
```

```
>>in_line=addline(dio,0:7,0,'in');
```

Then get the value and convert the binary into decimal number for entering the next stage. Third Stage, The program receives codes from the parallel port (radar interface) ranges from 0 to 255. And compare it with if condition to decide whether it's over speed or not, for example the maximum acceptable code is 150 so if the program receives more than 150.

After detecting the car speed and send the equivalent bits for the speed we now approximate this speed or bits to acceptable speed and decide if we have to picture the passing car or not ,We take continuous frames as video viewing the site so whenever we have to take picture for a passing car that exceeded the limit the cam captures this car and saves the picture and send this picture to process it and recognize the plates number in order to give this car a legal violation most commonly by paying money. This stage is called Image acquisition.



5.1.1 Image acquisition

The first stage of the system is the image acquisition. Image acquisition is the process of obtaining or capturing image before image will be process to another stage. There are several ways to obtain image.

The followings are the ways to acquire image of car

- Using a conventional analogue camera and scanner.
- Using the digital camera.
- Using a video camera and frame grabber (capture card to select).

The first method is clearly not appropriate for LPR system. It is due to the procedure to follow need a lot of time or on other words, its time consuming. The first method is also tedious and impractical. The second method is suitable to use in this project since this method is more practical and cost effective one. In addition, in this method, the equipment was readily available. For the third method, is the one that has been applied in the real life system as everything can be automated through the computer and it suitable for the real time processing. There are some important things that need to put in consideration while obtaining image in this stage such as the behavior of light and the illumination characteristics.

5.2 Car picturing implementation

Now we have to design a program to use the external webcam to take a photo for the car after receiving and order from the parallel cable that indicates that there is a speed that have been passed the threshold. Then there are some steps to detecting the attached webcam device and to control on it to take the image for the car.

First, we have to get information about installed devices type to could control on its port and use it for the necessary operation. We can get this information from function

```
>>imaqwinfo
```

This function results outputs that define the attached device and the name of it

```
ans =
```

```
InstalledAdaptors: {'coreco' 'winvideo'}
```

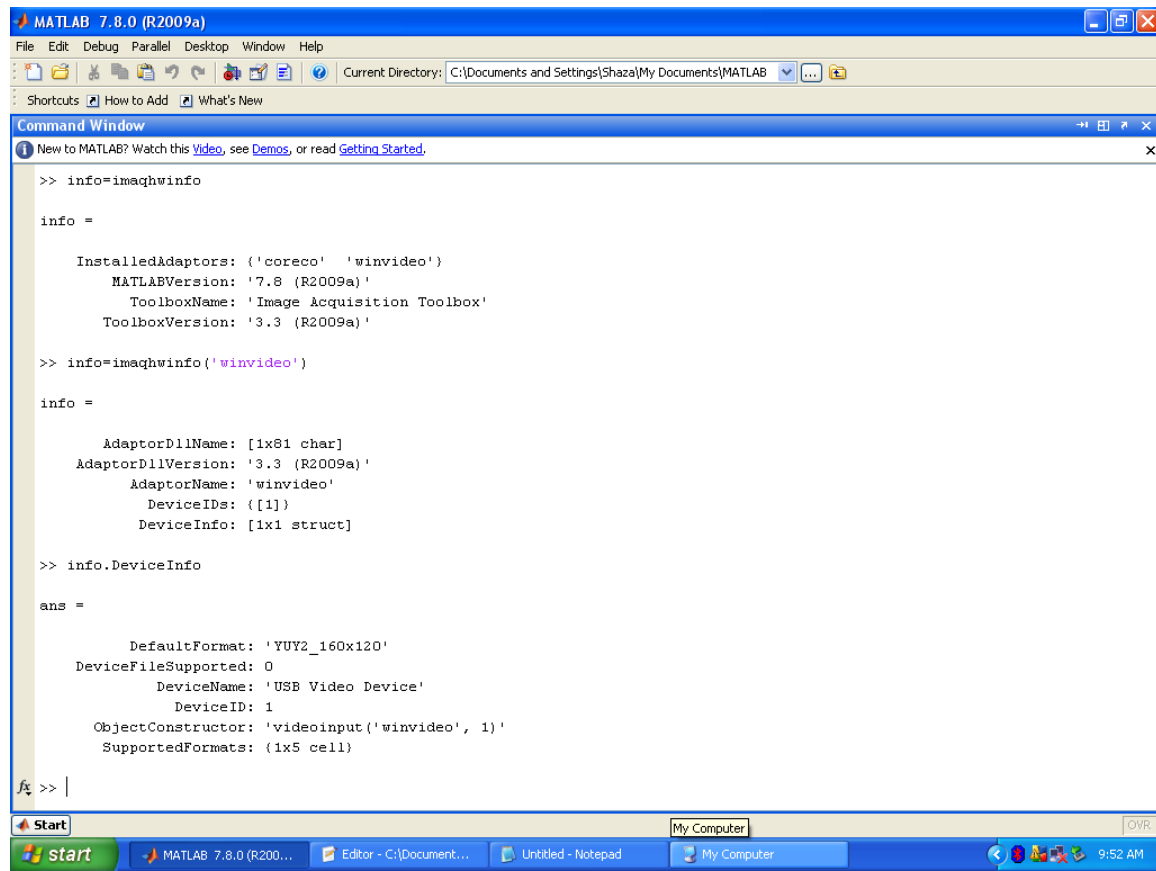
```
MATLABVersion: '7.6 (R2008a)'
```

```
ToolboxName: 'Image Acquisition Toolbox'
```

```
ToolboxVersion: '3.1 (R2008a)'
```

\Second, we have to get more information about the device (camera) we will use to use the device ID and address to be defined at the usage function. Then we connect the webcam through the USB and get the required information such as Device ID, Supported Formats as shown In fig 1

```
>>info=imaqhwinfo('winvideo');
```

```
MATLAB 7.8.0 (R2009a)
File Edit Debug Parallel Desktop Window Help
Current Directory: C:\Documents and Settings\Shaza\My Documents\MATLAB
Shortcuts How to Add What's New

Command Window
New to MATLAB? Watch this Video, see Demos, or read Getting Started.

>> info=imaqhwinfo

info =

    InstalledAdaptors: ('coreco' 'winvideo')
    MATLABVersion: '7.8 (R2009a)'
    ToolboxName: 'Image Acquisition Toolbox'
    ToolboxVersion: '3.3 (R2009a)'

>> info=imaqhwinfo('winvideo')

info =

    AdaptorDllName: [1x81 char]
    AdaptorDllVersion: '3.3 (R2009a)'
    AdaptorName: 'winvideo'
    DeviceIDs: {[1]}
    DeviceInfo: [1x1 struct]

>> info.DeviceInfo

ans =

    DefaultFormat: 'YUY2_160x120'
    DeviceFileSupported: 0
    DeviceName: 'USB Video Device'
    DeviceID: 1
    ObjectConstructor: 'videoinput('winvideo', 1)'
    SupportedFormats: {1x5 cell}

fx >> |
```

We use the object Constructor to create video object that takes continuous frames for the site and preview it. The program receives codes from the parallel port (radar interface) ranges from 0 to 255. For example the maximum acceptable code is 150 so if the program receives more than 150. The attached camera captures frame from the operating video at this time and saves this picture to view it and send it to second stage.

```
1 obj= videoinput('winvideo',1,'YUY2_640x480');
2 set(obj, 'SelectedSourceName', 'input1');
3 src_obj = getselectedsource(obj);
4 get(src_obj)
5
6 preview(obj);
7
8 %%int flage=1;
9 %%while flage==1;
10 %x=read from Parallel port
11 x=249;
12 if x==249
13 %printf x's speed =110
14 pause(1);
15 foto=getsnapshot(obj);
16 image(foto);
17 imwrite(foto,'carpic.jpg');
18 stop(obj);
19 %Segmet foto
20 else
21 % if 100>x>55
22 % %printf x's speed 80 km/hour
23 % else
24 %
25 % %printf x's speed 30 km/hour
26 %
27 % end
28 % end
29
```

5.3 Plate recognition

This program takes the saved image and processes it according to the following concept Process of plate extraction involved the following process.

- Edge Detection
- Histogram equalization
- Image Threshold

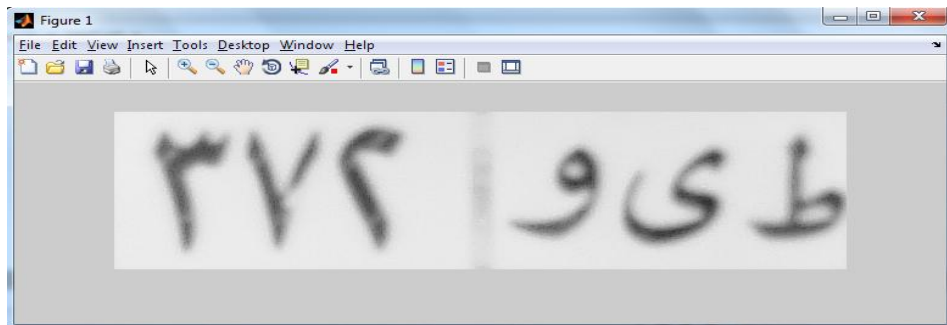
The main steps:

- Determine the plate place by certain algorithm where the common property is that the plate color is white
- For turning the image into grey the image colors are represented by levels of white and black where for example
 - Approximately from zero to 150 is dark black by increasing the level you get lighter color of black, till you reach pure white approximately from 230 to 250. So when you have grey image you have matrix of numbers from 0 to 250 indicates the degree of colors of the original image where you can represent each color by certain value.



- For determining the plates place you can use the common property that its color is white and determine it by searching for the degree of white color in column or row.

This is the idea we used where the plates is white and it's approximately pure degree of white so we will sum certain degree of white color in column and rows which ranges from 230 to 250 .We will find that the column which have higher sum of pure degrees of white pixels is the edge of the plate.The same for the rows the higher sum of pixels is the top of the plate, So we will search the columns from the right-left and from the left-right to find the edges of the plate and search the rows from the top-bottom and the bottom-top to find the top and bottom rows of the plate. After determining the edges columns, top and bottom rows of the plate we now can extract the plate as an image from the original image.



5.3.1 Edge detection

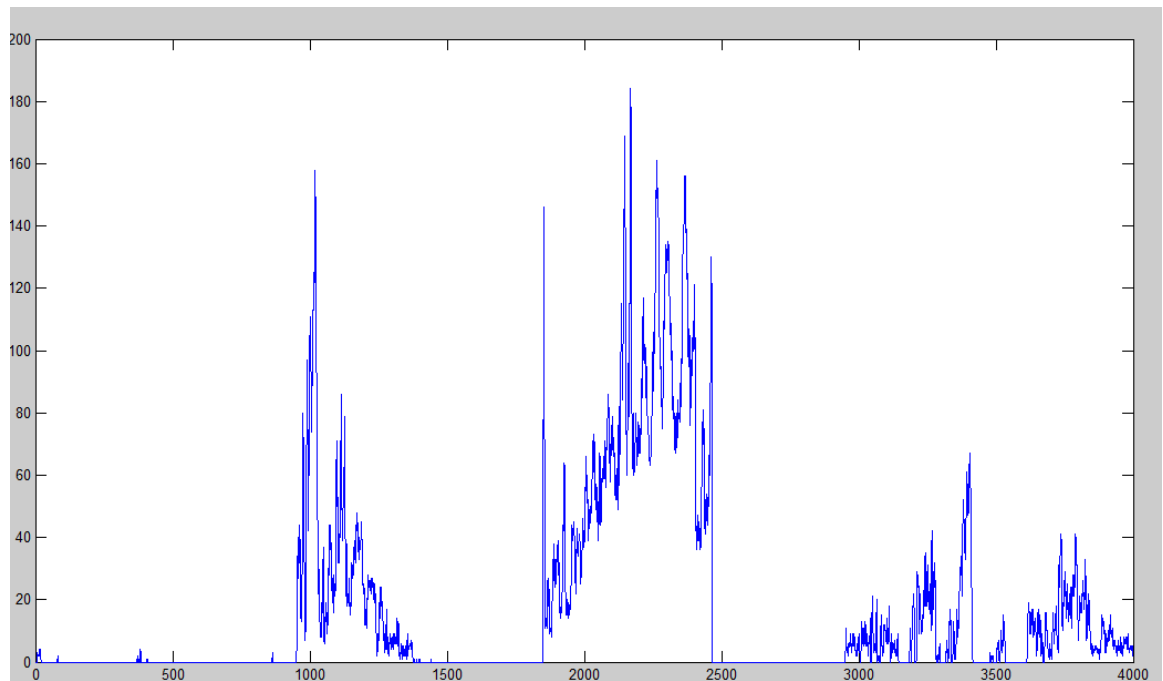
Edge detection is an image processing technique that used to detect the edges of the picture. There are several types of edge detection algorithms. Edges are the significant local changes of intensity in an image and edges typically occur on the boundary between two different regions in an image. The goal of edge detection is to identify the important feature that will be useful for plate extraction phrases. Actually in edge detection, there are four step involved. The followings are the step of edge detection.

- Smoothing: the edge detection process of eliminating as much noise as possible.
- Enhancement: the edge detection process of applying filter to enhance the quality of the edges in the image (sharpening).
- Detection: the edge detection process of determining which edge pixels should be discarded as noise and which should be retained (usually threshold provides the criterion used for detection).
- Localization: the edge detection process determining the exact location of an edge (sub-pixel resolution might be required for some applications, that is, estimate the location of an edge to better than the spacing between pixels).

Edge thinning and linking are usually required in this step.

5.3.2 Histogram equalization

Histogram equalization is an image processing technique that used to contrast the image using it histogram. It is also an image transformation that computes a histogram of every intensity level in a given image and stretches it to obtain a more sparse range of intensities. This manipulation yields an image with higher contrast than the original. The candidate selection process utilizes the guaranteed contrast between the characters and the license plate. Therefore, it is crucial for us to contrast the image at preprocessing stage. In order to increase the contrast of the gray scale image from the PC, histogram equalization is used.



5.3.3 Image Threshold

Pixels are classified into two categories when process of image threshold occurs. Actually the result of image threshold is Binarized Image will convert to black and white pixels. There are two types of threshold: Global threshold and local threshold. Global threshold also known as axed threshold.

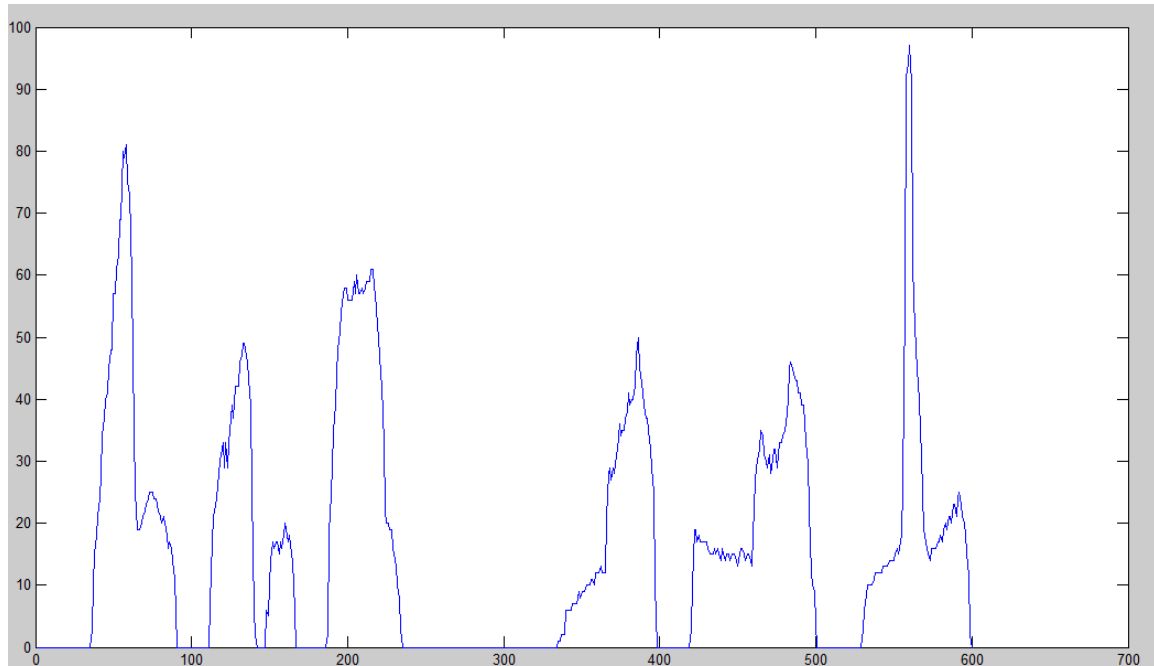
In axed threshold, the threshold value is held constant throughout the image.

$$g(x, y) = \begin{cases} 0 & f(x, y) < T \\ 1 & f(x, y) > T \end{cases}$$

Meanwhile, local threshold depends on the position of the image. The image is divided into overlapping sections which are threshold one by one.

5.4 Image segmentation

After detecting the plate edges and determining the plates place we now is going to segment the image of the plates to get segmented image of the plates number by using the reverse idea of detecting the plates the characteristic of the numbers is that it's black so we will histogram the image but in the black region approxitly from 30 to 150.



Search the rows for the maximum black you get or the first edge of the letter from both sides and cut it . Search the columns for the first black value you met which is the start of the letter till the first zero and cut in between you will get a letter

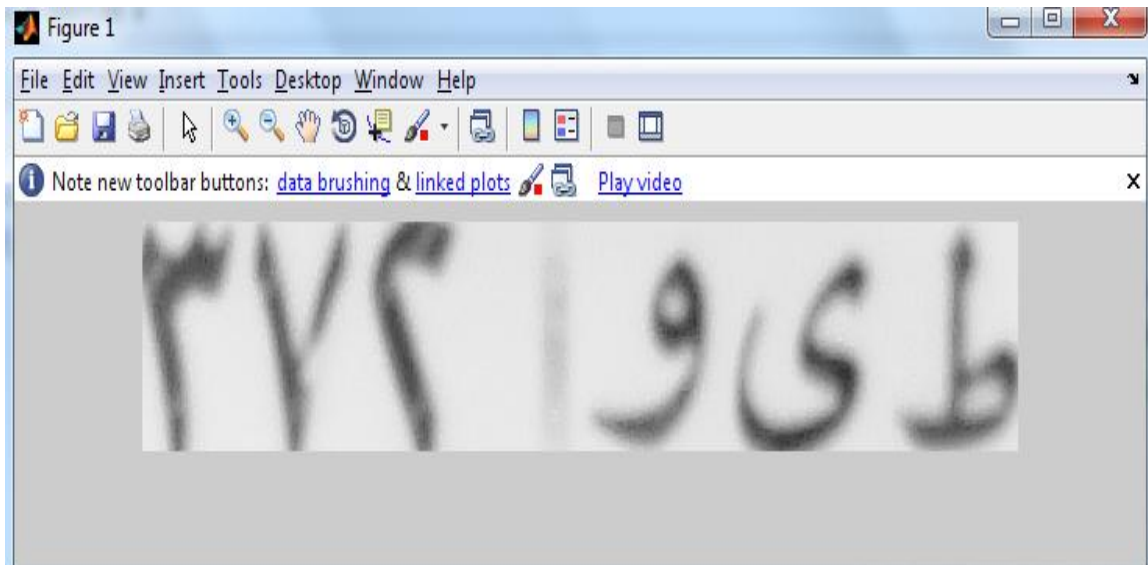


And then do the same for the rest starting from the column of the last zero you get search for the first black value you see till the next zero.

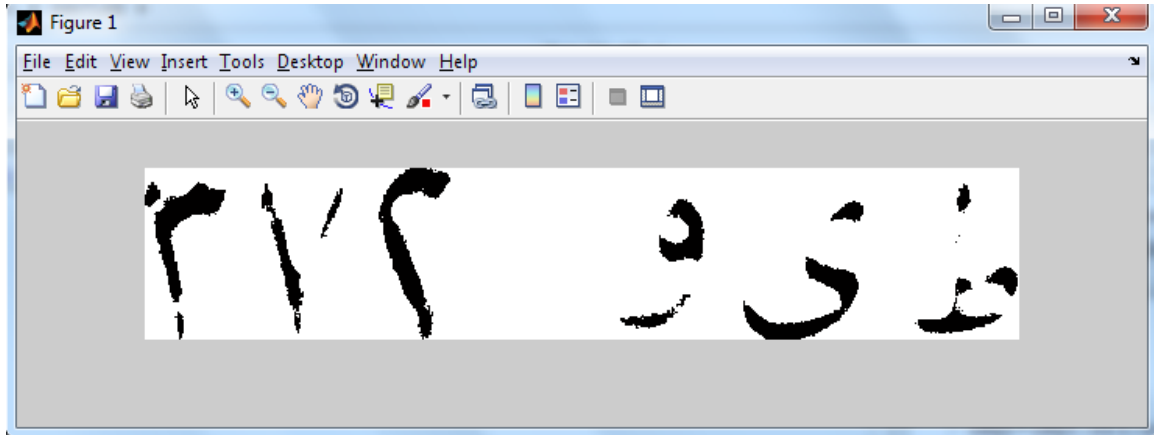
So we will be able to make a data base by saving each segmented letter and number by its name and whenever we segment a letter or number we search in this data base or matrix till it finds the equivalent image and write the equivalent name in a text file. Do the same for each segmented letter or number you will get the plate number written in a text file.

5.5 Plate segmentation

Before determining the transition points we will determine the exact edges of the plate number we will use a for loop for columns and rows to find the exact edges like that.

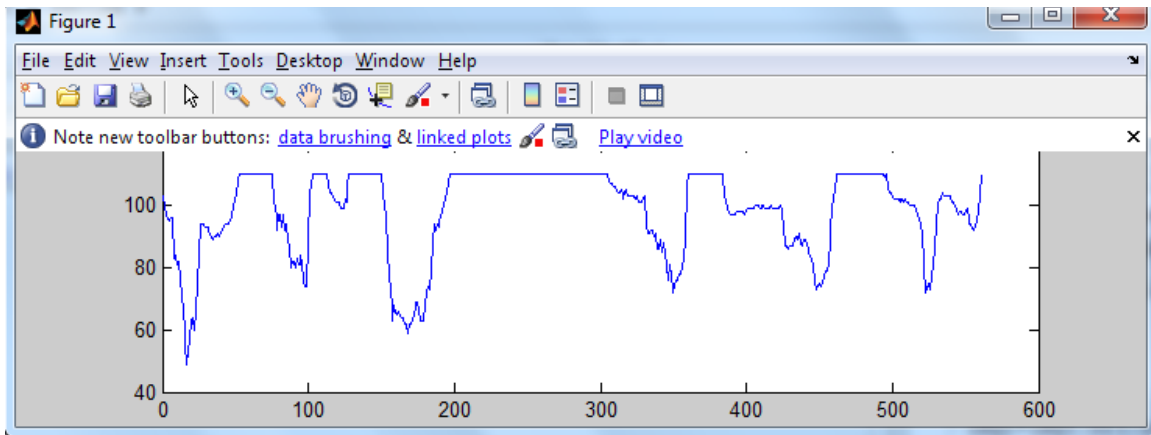


We use the determined row edge(the two rows up&down)as the same for all letters or numbers and we now have to determin the exact column to cut each letter simply we convert the extracted plate image into binary image where we can have clear vision of black and white so we will have our image like that



As shown in figure we notice that the white places are represented by constant value and whenever it faces a black value it begins to decrease below the constant value so we now have to know the points of transition between black and white and vice versa, we used a for loop also to detect the exact place or column of the letter it searches for the transition by subtracting the following column from the current one and compares the result if the result is not zero so it stills in the letter area if it's equal to zero so we have two options either it's the small space in the letter (as in each letter it's written with white color the word "arabic republic of egypt") so it's the same letter we have to ignore this little space or it's the real space between the letters so we have to consider it.

As the end of the current letter and search for the next transition we distinguish between the two cases by using a counter to count how many zeros we found if it's more than the accepted so it's real space other wise it's the same letter whenever it's real space we show the segmented letter before entering the search stage for next transition by that we result segmented images from the segmented plate image which we can save each segmented image by the name of it's character to make a data base for arabic letters and number in-order to be easy to identify each letter to recognize it in any other image or save it in a text file for any other following processes.



5.6 Features of System

5.6.1 Introduction

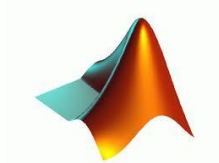
After detecting the over speed car and do our operation on the resulting image by extracting the license plate, we can send this information to the responsible

authority to add this information to the main data base which includes all the plates with their owners.

5.6.2 Sending e-mail Algorithm

For implementing this feature, Matlab program will be used. By using the Matlab's function 'sendmail.'

`sendmail(recipients,subject)`



`sendmail(recipients,subject,message)`

`sendmail(recipients,subject,message,attachments)`

5.6.3 Algorithm

`sendmail(recipients,subject)` sends e-mail to recipients with the specified subject. The recipients input is a string for a single address, or a cell array of strings for multiple addresses.

`sendmail(recipients,subject,message)` includes the specified message. If message is a string, sendmail automatically wraps text at 75 characters. If message is a cell array of strings, each cell represents a new line of text.

`sendmail(recipients,subject,message,attachments)` attaches the files listed in the string or cell array attachments. The sendmail function does not support HTML-formatted messages. However, you can send HTML files as

attachments. If sendmail cannot determine your e-mail address or outgoing SMTP mail server from your system registry, specify those settings using the setpref function.

For example:

```
setpref('Internet','SMTP_Server','my_server.example.com');
```

```
setpref('Internet','E_mail','my_email@example.com');
```

To identify the SMTP server for the call to setpref, check the preferences for your electronic mail application, or consult your e-mail system administrator. If you cannot easily determine the server name, try 'mail', which is a common default, such as:

```
setpref('Internet','SMTP_Server','mail');
```

By default, the sendmail function does not support e-mail servers that require authentication. To support these servers, change your system settings and set preferences for the SMTP user name and password, with commands in the following form:

```
props = java.lang.System.getProperties;
```

```
props.setProperty('mail.smtp.auth','true');
```

```
setpref('Internet','SMTP_Username','myaddress@example.com');
```

```
setpref('Internet','SMTP_Password','mypassword');
```

Gmail servers require authentication and an encrypted connection (SSL) on port 465. Change your system settings to use your Gmail server and send a test message to your Gmail account:

```
% Modify these two lines to reflect
% your account and password.

myaddress = 'myaddress@gmail.com';
mypassword = 'mypassword';

setpref('Internet','E_mail',myaddress);
setpref('Internet','SMTP_Server','smtp.gmail.com');
setpref('Internet','SMTP_Username',myaddress);
setpref('Internet','SMTP_Password',mypassword);
sendmail(myaddress, 'Gmail Test', 'This is a test message.');
```

5.6.4 Implementation

Program

For testing the program we have write down an e-mail address of any person to check the validity of that code. The image of the car's license plate will be attached to this mail to the responsible authority to take the necessary action with the car owner.

These codes are the main codes and their description.

%define in matlab using e-mail feature and define the mail of the sender.

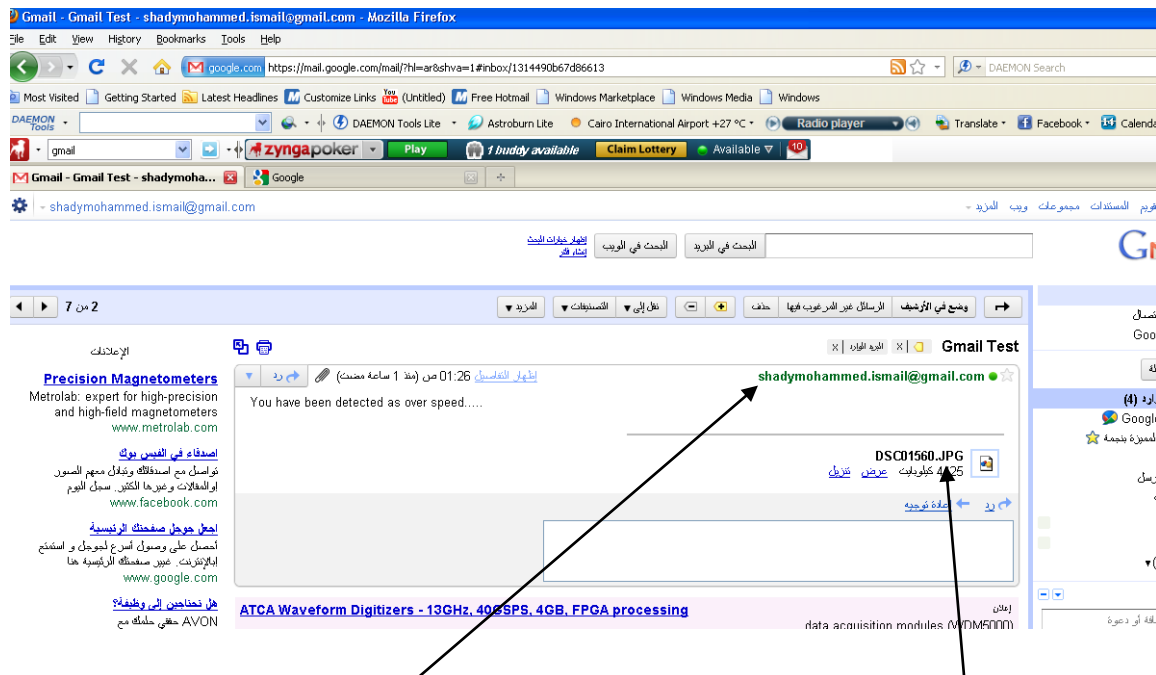
```
setpref('Internet','E_mail','shadymohammed.ismail@gmail.com');
```

% defines the receiver e-mail, text message and the attached file.

```
sendmail('shadymohammed.ismail@gmail.com', 'Gmail Test', 'You have been detected as over speed.....', 'C:\Documents and Settings\A2m\My Documents\Downloads\DSC01560.JPG');
```

Results

As shown here, this is the inbox page of my e-mail webpage to show how the textmessage will be received with the attached image of the plate of the car.



Authority e-mail

Attached imag

Appendix

Detection Program:

```
clc
close all

%%img=imread('DSC01591.jpg');
%%img=imread('DSC01589.jpg');
%%img=imread('DSC01586.jpg');
%%img=imread('DSC01582.jpg');
%%img=imread('DSC01617.jpg');
%%img=imread('DSC01614.jpg');
%%img=imread('DSC01598.jpg');
%%img=imread('DSC01596.jpg');
%%img=imread('DSC01563.jpg');
%%img=imread('DSC01578.jpg');
%%img=imread('DSC01569.jpg');
img=imread('DSC01560.jpg');%%tet3rd
%%img=imread('DSC01549.jpg');
imshow(img)
pause(0.5);
img=rgb2gray(img);
counter=0;
[r,c]=size(img);
i=0;
x1c=0;
x2c=0;
x1r=0;
x2r=0;
%%x=histc(img,[220 230]);
x=img;

close all;
for i=1:c
    [a,b]=find((x(:,i)>=230&x(:,i)<=250));
    counter=sum(a);
    if counter>250000
        x1c= i;
        break
    end
end
counter

for i=c:-1:1
    [a,b]=find((x(:,i)>=230&x(:,i)<=250));
    counter=sum(a);
```



```

        if counter>=100000
            x2c=i;
        break
    end
end
counter
%

for i=1:r
    [a,b]=find((x(i,:)>=230&x(i,*)<=250));
    counter=sum(a);
    if counter>=250
        x1r= i;
        break
    end
end
for i=r:-1:1

    [a,b]=find((x(i,:)>=230&x(i,*)<=250));
    counter=sum(a);
    if counter>=300
        x2r=i;
        break
    end
end
%x1r=1280;
%x2r=1550;
x1r
x2r
x1c
x2c

img1=img(x1r:x2r,x1c:x2c);
z=img1;
%%plot(x(1,:));

imshow(img1)
pause(0.5);
l=histc(img1,[0 150]);
plot(l(1,:))
[f,d]=size(img1);
d=0;
xc1=0;
xc2=0;
xr1=0;
xr2=0;
for k=1:d
    [a,b]=find((z(:,k)>=0&z(:,k)<=150));
    counter=sum(a);

```

```

        if counter>=50
            xc1= k;
        break
    end
end
counter

for k=d:-1:1
    [a,b]=find((z(:,k)>=0&z(:,k)<=150));
    counter=sum(a);
    if counter>=30
        xc2=k;
        break
    end
end
counter
%
for k=1:f
    [a,b]=find((z(k,:)>=0&z(k,:)<=150));
    counter=sum(a);
    if counter>=100
        xr1= k;
        break
    end
end
for k=f:-1:1

    [a,b]=find((z(k,:)>=0&z(k,:)<=150));
    counter=sum(a);
    if counter>=300
        xr2=k;
        break
    end
end
xc1
xc2
xr1
xr2
img2=img1(xr1:xr2,xc1:xc2);

```

Sending e-mail program:

```
myaddress = 'shadymohammed.ismail@gmail.com';
mypassword = 'gunners3';
setpref('Internet','E_mail','shadymohammed.ismail@gmail.com');
setpref('Internet','SMTP_Server','smtp.gmail.com');
setpref('Internet','SMTP_Username','shadymohammed.ismail@gmail.com');
setpref('Internet','SMTP_Password','gunners3');

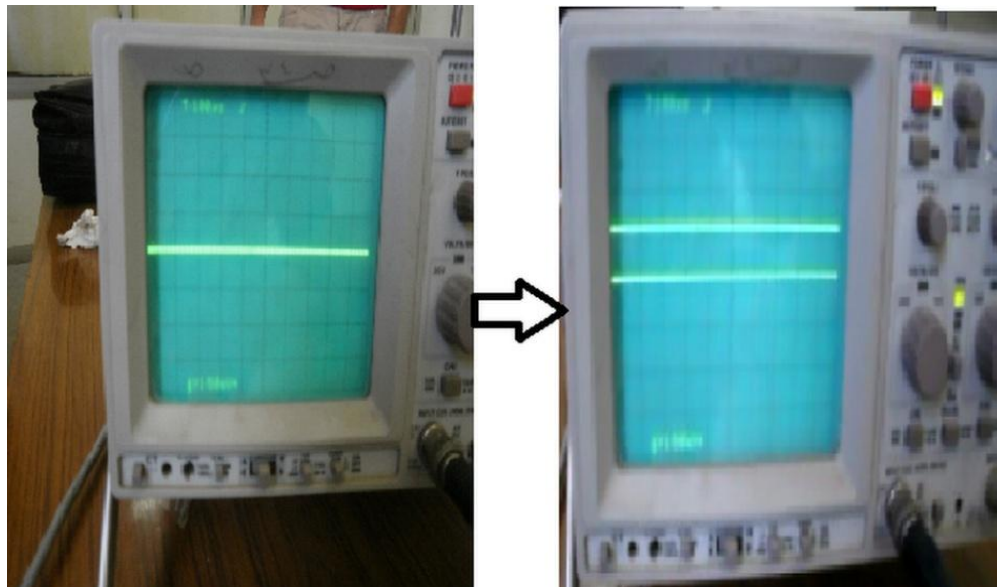
props = java.lang.System.getProperties();
props.setProperty('mail.smtp.auth','true');
props.setProperty('mail.smtp.socketFactory.class', ...
    'javax.net.ssl.SSLSocketFactory');
props.setProperty('mail.smtp.socketFactory.port','465');

sendmail('shadymohammed.ismail@gmail.com', 'Gmail Test', 'You have been
detected as over speed.....','C:\Documents and Settings\A2m\My
Documents\Downloads\DSC01560.JPG');
```

Implementation of the system

1-Radar circuit

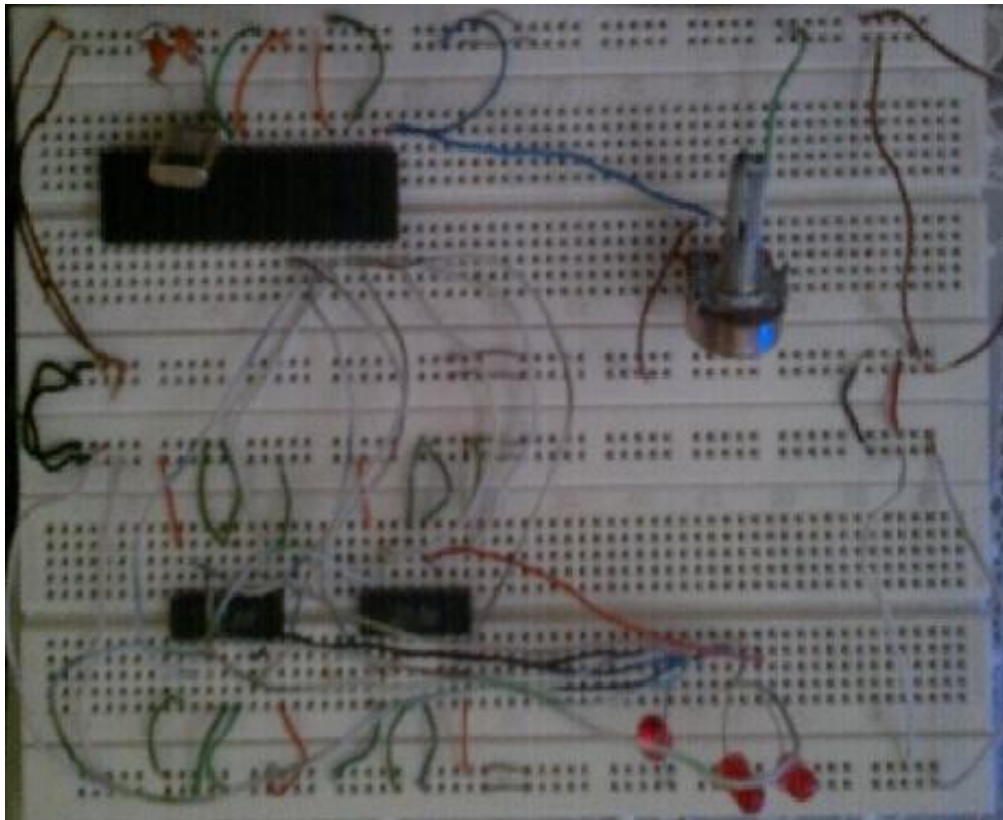
Now we are considering testing the whole system components and connecting the all phases and implement them with each other. As results from the radar circuit that we had, we get the maximum output signal dc volt from the radar is 50 mvolt. So we could attach the hardware interface with the radar circuit or any power supply that provide the voltage dc range from 0 volt to 50 mvolt.



Voltage change indication on the oscilloscope

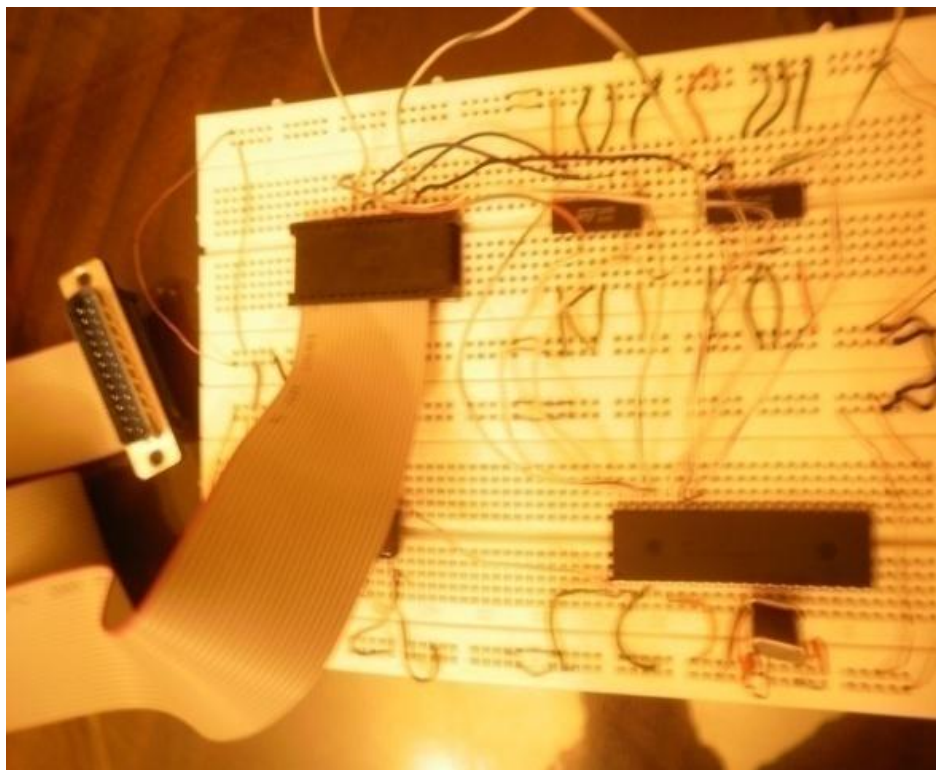
2-Hardware interface

First, we attach the hardware interface (ADC) with an adaptor that provides 5 volt, then we attached the adaptor with the circuit to feed the microcontroller and the devices of the interface, and we have put a variable resistance that divides the input voltage from the adaptor to small voltages which indicates the output of the radar.



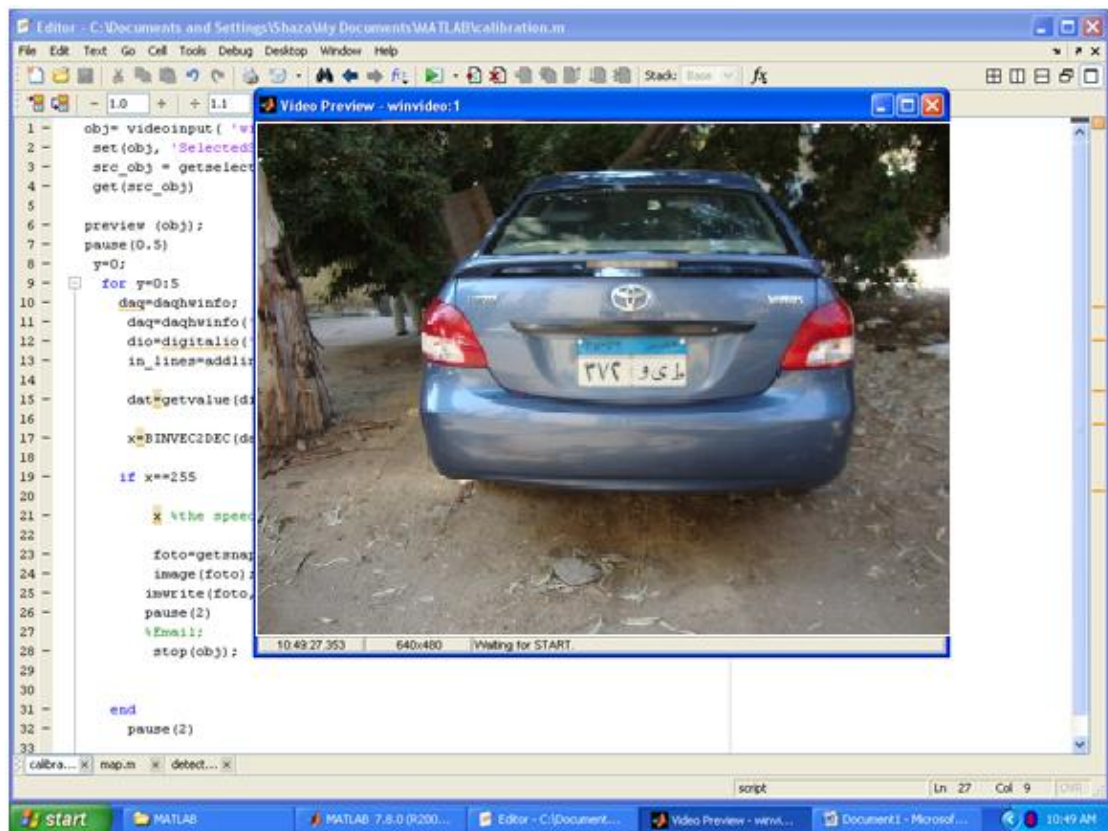
3-Attaching parallel cable

When the resistance value is changed the input voltage will be changed, so when the input voltage entered the microcontroller it will provide a digital output on the first 8 pins. But these output voltage values have been dropped its value by the microcontroller to 1.5 volt, so the parallel cable couldn't provide and identification that small value. Here comes the importance of the comparator, we attached the output 8 pins with 2 comparators, each one gives and 4 input-output. These comparators compares the input volt to it with a threshold then provide 5 volt for (1) or zero volt for (0). Now we have 8 pins representing the output digital values.



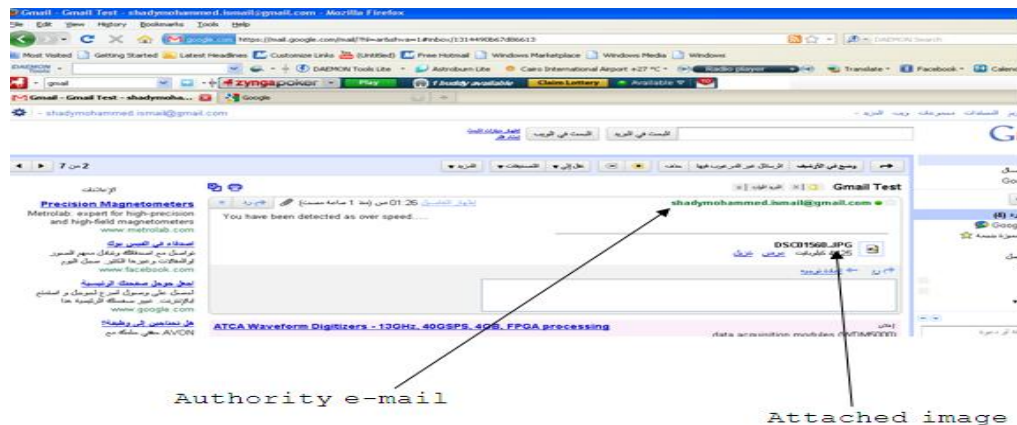
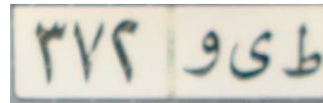
4-Picturing

We attached the parallel cable with the output pins and the computer, and then we run the software program for reading the input value to the computer. By Matlab we have designed a program to take the input value from parallel cable and compare it with a threshold value, if the values have been passed the threshold the program give an order to the camera to get a snap shot for the moving target and save it in a specific directory.



5-LPR & Send e-mail

Now we have a picture for the moving target have been saved in a specific directory. We have made two operations on this picture. First, we get this picture and put it automatically on the LPR program the extract the plate from the moving car and provide it on the screen as an indication for the over speed car. Secondly, there is another program that we have designed; this program is sending an automatic e-mail to the responsible authority to inform it about the car that has been pictured.



Finally, after this implementation we have a full complete system, starting with the moving car that will be detected by the radar, then convert the radar output signal to a definite digital signal that gives an indication for the camera to take a photo for the car at specific speed and finally detect the car plate and send it to the responsible authority.

6

Software Engineering

Preview

In this chapter we describe user and system requirements (functional and nonfunctional requirements), define system assumptions and constraints, discuss tasks assignment, duration and dependencies, analyze system risks, and estimate the costs and present system models

6.1 Requirements Specification

6.1.1 User Requirements

➤ The government and large companies

This system could be used by large companies and the government for implementing new projects or to help in a specific task. The user can browse a captured image of car through the program interface and click on Execute button, then the plate number will be displayed on the screen, also he can save this number and can connect it with database server

6.1.2 System Requirements

6.1.2.1 Functional Requirements

System Input: output signal from the radar circuit

Processing: when the signal the ADC, it converts the signal to digital form. Then we use this digital value to give and automatic order to the camera to capture the over speed cars. The system works to enhance the image (show unclear details in the image), then the system begins to segment, the segment character can be sent to recognize the plate place and give the plate in a picture.

System Output: image that has number of car (car's ID). We used **Microsoft visual C#.Net 2008** and **MATLAB R2009b** mathematical package tools.

6.1.2.2 Nonfunctional Requirements

➤ Usability requirements:

- The system provides a simple interface through which user can interact with the system easily and efficiently.
- System users don't need any training.

➤ Efficiency requirements:

▪ Performance requirements:

- The system doesn't need special hardware in order to run, so it achieves a high performance at any computer.

▪ Space requirements:

- One of our concerns is the space of the system so we tried to make the system doesn't need a large space, however it performs a lot of functions.

➤ Reliability requirements:

- The program is developed to be reliable so that it can avoid any failure, which makes the system trusted by companies.

➤ Portability requirements:

- The system can be operated under the platform of the following operating systems:
 - ✓ Windows 98
 - ✓ Windows ME
 - ✓ Windows XP
 - ✓ Windows Vista
 - ✓ Windows 7 Ultimate

➤ **Interoperability requirements:**

- The system doesn't dependent on any other systems and doesn't make any conflict with other systems.

➤ **Privacy requirements:**

- We don't need any security because it is used only by users.

➤ **Safety requirements:**

- There is no need for safety requirements because the system is implemented so that it doesn't cause any dangerous or harmful effect on human life.

6.2 Assumptions and Constraints

- The input image must be captured from the axial or coronal view of Car.
- The input image must be captured by high definition camera.
- The input image must contain only the entire car back.
- The car color can't be white.
- We have to use very high definition camera.

6.3 Tasks Assignment

Task	Description	Member(s)
T1	Collect data about the project (study the radar Constructions)	1-Marwa Moustafa Hedayah 2-Mostafa Mohsen Mostafa Kamal 3-ShadyMohammed Mahmoud
T2	Write the project proposal	1-Marwa Moustafa Hedayah 2-Mostafa Mohsen Mostafa Kamal 3-Lamis Islam Ahmed Zaki 4-ShadyMohammed Mahmoud
T3	Specify user requirements	1-Marwa Moustafa Hedayah

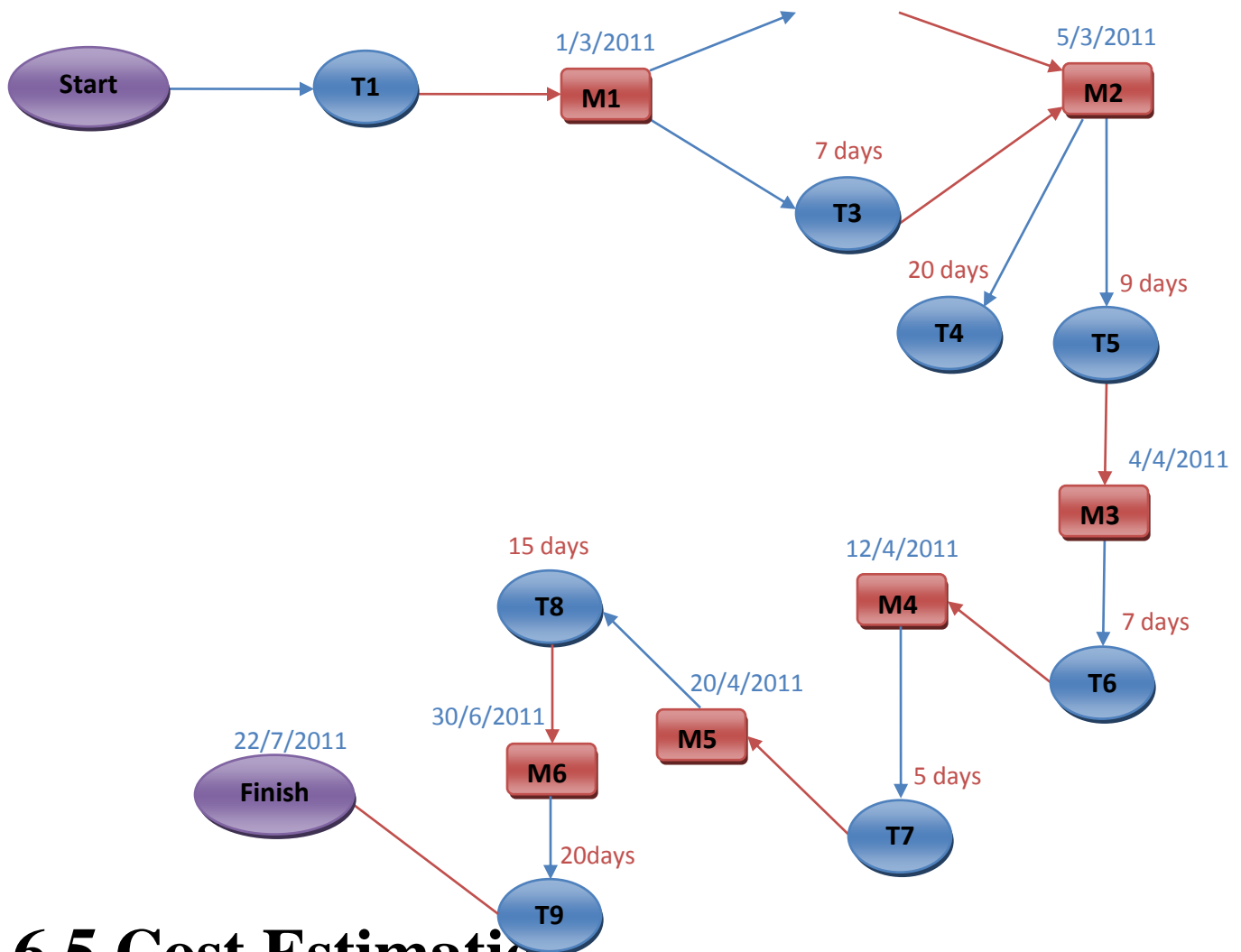
		<p>2-Mostafa Mohsen Mostafa Kamal</p> <p>3-Lamis Islam Ahmed Zaki</p> <p>4-ShadyMohammed Mahmoud</p>
T4	Design hardware interface and testing it	<p>1- Mostafa Mohsen Mostafa Kamal</p> <p>2- Shady Mohammed Mahmoud</p>
T5	Defining and implementing license plate recognition	<p>1-Marwa Moustafa Hedayah</p> <p>2-Lamis Islam Ahmed Zaki</p>
T6	Design system models and write the project documentation	<p>1-Marwa Moustafa Hedayah</p> <p>2-Mostafa Mohsen Mostafa Kamal</p> <p>3-Lamis Islam Ahmed Zaki</p> <p>4-ShadyMohammed Mahmoud</p>
T7	Test the subsystems individually	<p>1-Marwa Moustafa Hedayah</p> <p>2-Mostafa Mohsen Mostafa Kamal</p>
T8	Integrate the subsystems	<p>1-Lamis Islam Ahmed Zaki</p> <p>2-ShadyMohammed Mahmoud</p>

T9	Test the system as a whole	1-Marwa Moustafa Hedayah
		2-Mostafa Mohsen Mostafa Kamal

6.4 Task Durations

<i>Task</i>	<i>Description</i>	<i>Duration (days)</i>	<i>Dependency</i>
T1	Collect data about the project (get ultrasound images and study the medical part)	55	_____
T2	Write the project proposal	4	T1 (M1)
T3	Specify user requirements	7	T1 (M1)
T4	Design hardware interface and testing it.	20	T1,T3 (M2)
T5	Defining and implementing license plate recognition	9	T1,T3 (M2)
T6	Design system models and write the project documentation	7	T5 (M3)

<i>T7</i>	Test the subsystems individually	5	<i>T6 (M4)</i>
<i>T8</i>	Integrate the subsystems	15	<i>T7 (M5)</i>
<i>T9</i>	Test the system as a whole	20	<i>T8 (M6)</i>



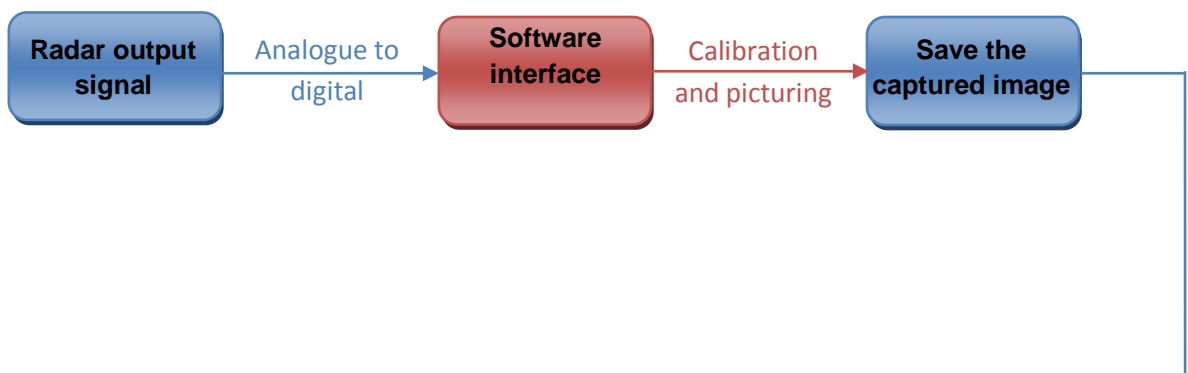
6.5 Cost Estimation

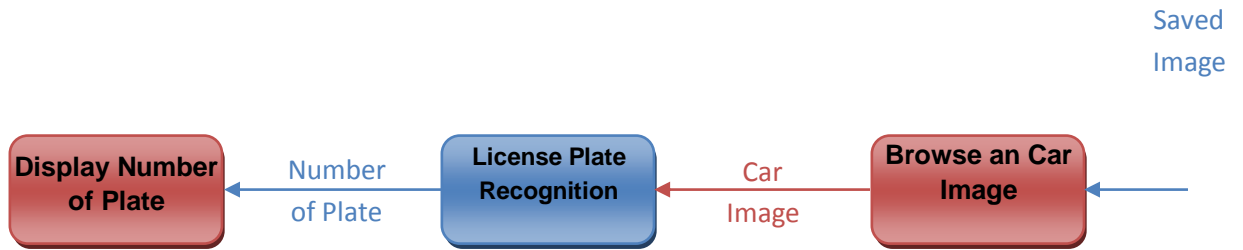
Parameter	Unit	No. of Units	of Time Unit	No. of Times	Unit Cost	Total Cost
-----------	------	--------------	--------------	--------------	-----------	------------

Hardware	Interface	1	—	—	200 LE	200 LE
Hardware	Webcam	1	—	—	75 LE	75 LE
Hardware	Parallel Cable	1	—	—	30 LE	30 LE
Service	Documentation Printing	7	—	—	150	1050 LE
Total Project Cost			1355 LE			

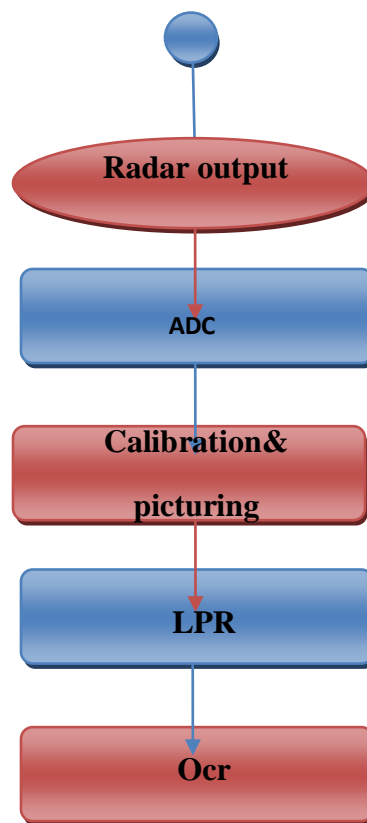
6.6 System Models

6.6.1 Process Diagram





6.6.2 Activity Diagram



7

Conclusion & future work

Preview

In this chapter we will list the main results and features of the system and other tasks that be recommended on the future work

7.1 Conclusion:

Now, we are capable of detecting the moving cars and capture the over speeding cars to recognize the license plate of the car to send it to the related authority. Another feature has been added to the system, is to extract the Arabic numbers to send the license plate contents to the related authority by sending an e-mail with an attached text file which contains the Arabic numbers. This feature will reduce the size of the attached file which will be sent to make it easier and faster to be received by the related authority.

7.2 Future work:

7.2.1 Professional cameras:

1-Professional cameras for face detection:

Nowadays people are aware of the need of vehicle security due to the fact that they are various cases of car robbery. Therefore it is incumbent upon us to increase the level of securities. To make the system more secure, the system is recommended to integrate with face detection. This is means instead of identifying driver with their plate, it also important to identify by her or his face.

We can do this by using a professional camera that contain a face detect applications, nowadays there are growing number of digital cameras now include a Face Recognition mode. The camera detects faces in a scene and then automatically focuses (AF) and optimizes exposure (AE).

2- Professional camera to upgrade the image quality:

We want to use more professional cameras to improve the image quality to be easier to recognize the plate numbers.



Color-ccd-digital camera

3- Hard and waterproof cameras:

We can use hard cameras to avoid damages because they are located in the streets so they can be damaged by any one, but if we use hard material or it can be put in hard box it will be safer to avoid damage. Also, we want to use waterproof cameras because it is located in the open air, so maybe it will be rained.

4-Location of the camera:

The camera to vehicle distance around 40 feet. This system is able to detect license plate area for all the vehicles. We want to put the camera in the middle of the road to be able to detect any vehicles.

7.2.2 Identification of segmented character:

Save the segmented characters and numbers in one text file which may be by comparing the segmented image with an already saved one or compare it to a matrix of images in order to be ready for database.

1-Recognition System of Arabic Characters

At this stage, a recognition system of Arabic characters is presented, using a structural method based on the extraction of primitives (holes, concavities, characters form, existence of points, position of point, and number

of connected components). This stage is performed in two steps;

Characters classification and identification.

a) Characters classification:

The character classification takes as criteria the concavities in different directions, and the holes, which represent the main characteristics (morphological ones). The choice of these characteristics enables the system to work with multi-sized characters without having to perform an eventual normalization.

The inner details of characters such as the presence of holes and concavities are obtained to produce some unique features for some Arabic characters. The holes feature is used to identify some characters or resolve any ambiguity in the recognition phase. The presence or absence of the hole, concavities direction, and dots are powerful features for enhancing the implemented Arabic recognition system.

L: concavities to the left,

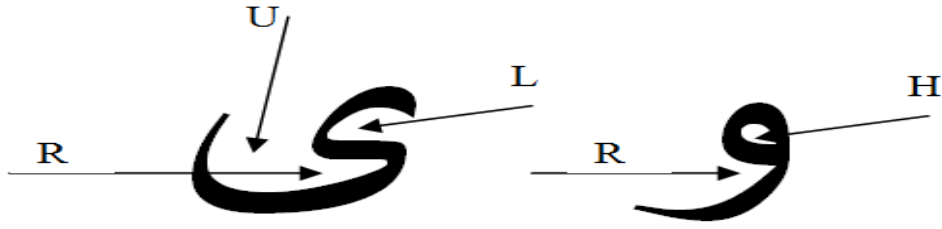
R: concavities to the right,

U: to the top,

H: character containing hole

We can compute each character's class using this formula:

$$\text{Class} = 2^0 H + 2^1 U + 2^2 R + 2^3 L$$



We must study the intensity of top and down parts, if the character has the intensity of top part is smaller or greater than the intensity of the down part.



Intensity of top part > down part	م	ص	س
Intensity of top part < down part	د	ط	ل

b) Characters identification:

-Egyptian new license plates use only 17 characters from 28.

(أ - ب - ج - د - ر - س - ص - ط - ع - ف - ق - ل

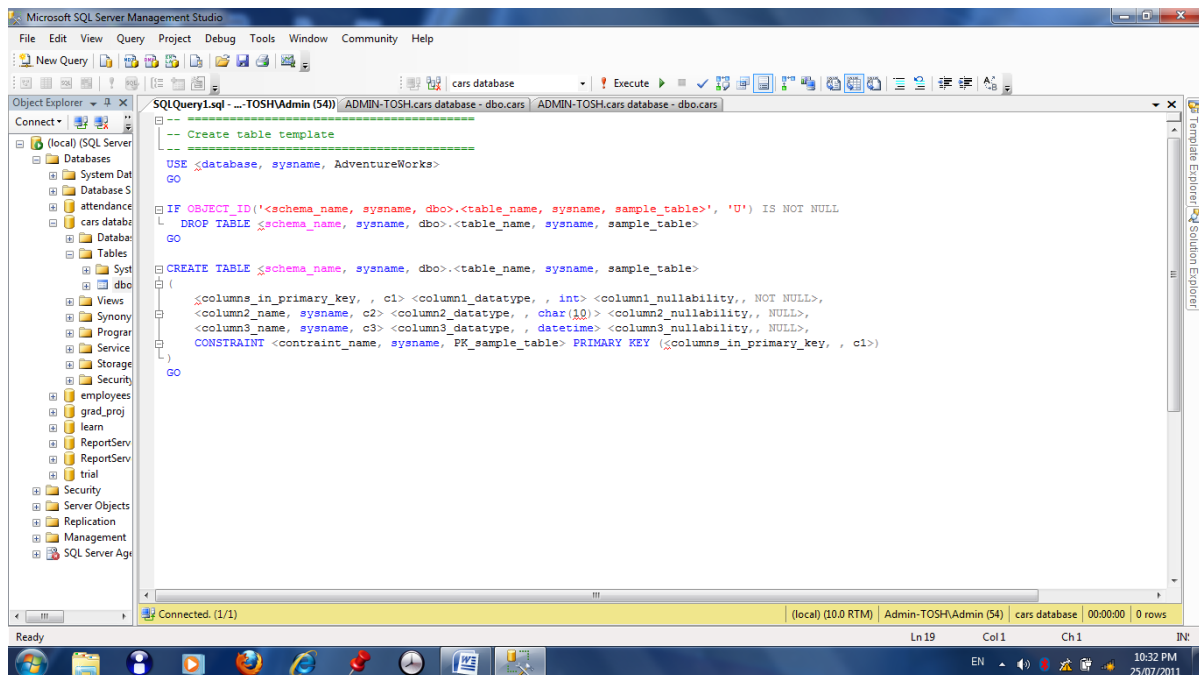
- م - ن - ه - و - ي)

char Feature	ر	د	م	ص	ظ	ع	ل	س	هـ	و	ى
Curve left		1	1							1	1
Hole				1	1				1	1	
Curve right						1					1
Curve up				1	1		1	1			1
(Top/down) Intensity											
Thin											
Down dot location											

After that we can identify any Arabic plate character.

7.2.3 Creating a database of the system:

We use to create a data base for all the cars plate numbers and their owner identity .We use SQL to create a database for the car plate number and the name of the owner and his penalty.



7.2.4 Sending SMS

After building the database system and detecting the license plate numbers, we will use these numbers to compare it with the data base elements to extract the car owner's telephone number. After that we will use a software program to send an automatic SMS to the car owner to inform him that he has been crossed the limit speed. This program will be designed by C# and the main function of the operation will be:

```
String sms = "You've received a speeding ticket!\nSpeed: " + 150 +  
"\nPlace: Alexandrai ST @ 100 KM\nTime: " + DateTime.Now + "\nBill: "  
+ 500 + " LE";
```

```
sendSMS("COM19", "0105471662", sms);
```

We have first to attach the mobile phone to the COM port, and defining it by task manager. Then the SMS will be sent to the required number via the attached mobile phone.

7.2.5 Moving and non moving cars

Use the LPR (license Plate Recognition) in monitoring roads and detect moving parts by using video segmentation this system is used in south Africa where we can catch stolen cars by automatically recognize the car plate and search it in a database, if the passing car is identical with one of those in the black list it sends the location to the authorized persons. Detection of moving vehicles simplifies the processing on subsequent analysis steps.

Due to dynamic changes in natural scenes such as sudden illumination and weather changes, repetitive motions that cause

clutter (tree leaves moving in blowing wind), motion detection is a difficult problem to process reliably. Frequently used techniques for moving vehicle detection are background subtraction, statistical methods, temporal differencing and optical flow. In case we used the Background subtraction which is particularly a commonly used technique for motion segmentation in static scenes, it attempts to detect moving regions by subtracting the current image pixel-by-pixel from a reference background image that is created by averaging images over time in an initialization period, The pixels where the difference is above a threshold are classified as foreground. After creating a foreground pixel map, some morphological post processing operations such as erosion, dilation and closing are performed to reduce the effects of noise and enhance the detected regions. The reference background is updated with new images over time to adapt to dynamic scene changes. While in case we used Statistical Methods which is more advanced methods that make use of the statistical characteristics of individual pixels have been developed to overcome the shortcomings of basic background subtraction methods. These statistical methods are mainly inspired by the background subtraction methods in terms of keeping and dynamically updating statistics of the pixels that belong to the background image process. Foreground pixels are identified by comparing each pixel's statistics with that of the background model. This approach is becoming more popular due to its reliability in scenes that contain noise, illumination changes and shadow Finally both methods can detect the moving vehicle we can use one of them to reach our target and distinguish between the moving cars and the non-moving ones for any following purposes.

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