Information and Communication Technologies Engineering

Smart Road System

Bachelor Thesis
Uninettuno University - Helwan University

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3 August 2011

This is to certify that:

(I)The thesis comprises our original work towards the bachelor degree
(II) Due acknowledgment has been made to all other material used.

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August, 2011

Preface

We would like to welcome the reader of this report. After just over nine months we gladly present you our bachelor thesis, containing the results of our graduation project conducted at the Uninettuno University and Helwan University.

It has been a great journey. The support from our (three) supervisors, the colleagues in both University, have all contributed greatly to the amazing experience it has been.

We would like to express a great appreciation to our supervisors
Dr. Dario Assante (Uninettuno University, ROMA), Dr. Mario Antonaci (Owner of Annoluce (CEO & Founder)) and Dr. Sameh A.Salem (Helwan University, Cairo, Egypt) for supporting us all along our graduation project.

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Abstract

In this paper we will discuss RFID Smart Road System as a solution now a day to solve the traffic problems, such as, the number of accidents caused by over speed because it is much more efficient than Radar automatic over speed control.

Also in this paper we will discuss how we can make automatic highway gates & Tolls , automatic speeding tickets and how to Control highways & roads traffic. Finally we will discuss how we can track and stop stolen cars.

Basic knowledge needed about RFID technology (Radio Frequency IDentification), its basic components and applications of RFID, how we can interface it, work on C#, ASP.NET, SQL Server, Proteus, building website driven database.

At the end of this paper we will end up with a good understanding of RFID System, why it is better and efficient than Radar, how we can apply it, what are its drawbacks and how we can advertise the system.

Table of Contents:

1. Introduction ---------- 8
   1.1.Objectives ---------- 9
   1.2.Block Diagram Of The Project(RFID Smart Road System) --------- 14
   1.3.Flow Chart Of The Project(RFID Smart Road System) ---------- 15

2. RFID Technology ---------- ---------- 16
   2.1.RFID(Radio Frequency IDentification) ---------- ---------- 17
   2.2.A basic RFID system consist of three components - ---------- 19
   2.3.RFID offers the following benefits ---------- 26
   2.4.Disadvantages of Radar in comparison with RFID ---------- 26
   2.5.The Advantages of RFID Over Bar Coding ---------- 27
   2.6.How do RFID work? ---------- 28
   2.7.Typical Applications for RFID ---------- 29
   2.8.Common Problems with RFID ---------- 29

3. Hardware of RFID System ---------- 30
   3.1.RFID and its interface ---------- 31
      3.1.1.Introduction ---------- 31
      3.1.2.Features ---------- 31
      3.1.3.Specification ---------- 31
      3.1.4.RFID Reader Interface ---------- 32
      3.1.5.Protocol ---------- 34
      3.1.6.Trouble shooting ---------- 35
      3.1.7.Connection Block Diagram ---------- 36

3.2.Stepper Motor ---------- 37
3.2.1. Objectives ---------- 37
3.2.2. DC motor VS Stepper motor ---------- 37
3.2.3. Stepper motor definition & circuit ---------- 38
3.2.4. Steps of stepper motor operation ---------- 42
3.2.5. Flow chart ---------- 43
3.2.6. Stepping Modes ---------- 44
3.2.7. Prototype ---------- 45

3.3.Infrared sensor ---------- 49
3.3.1. Objectives ---------- 49
3.3.2. Introduction ---------- 49
3.3.3. Active IR sensor V.s Passive IR sensor ---------- 50
3.3.4.Steps of active IR sensor operation ---------- 50
3.3.5.IR sensor Circuit ---------- 52
3.3.6.Pseudo code ---------- 53
3.3.7.IR sensor flow chart ---------- 54
3.3.8.Prototype ---------- 55

4. Software of RFID System ---------- 56
4.1 Program ---------- 57
4.1.1.GUI ---------- 57
4.1.2.Configuring the RFID reader interface ---------- 64
4.1.3. Calculating Speed and Tickets ---------- 65
4.1.4.Sending Emails & SMS ---------- 69
4.2 Database ---------- 71
4.2.1 Introduction ---------- 71
4.2.2 Structured Query Language (SQL) ---------- 72
4.2.3 ADO.NET Object Model ---------- 81

4.3 Website driven database ---------- --- 82
4.3.1 Introduction ---------- 82
4.3.2 Objectives ---------- 83
4.3.3 ASP.NET ---------- 84
4.3.4 Mind Map of 3M.A.N Website ---------- 85
4.3.5 Connect Database with Website ---------- 86
4.3.6 Building Website ---------- 87
4.3.7 Website future Ideas ---------- 102

5. RFID System Network ---------- 103
5.1 Introduction ---------- 104
5.2 Expected Scenario ---------- 106
5.3 System Framework Architecture ---------- 106
5.4 The Main Overview of the System ---------- 110
5.5 The System in the Highway View ---------- 111
5.6 Toll Gate View in the Our system ---------- 112
5.7 How the RFID Reader will work? ---------- 114
5.8 Wireless Connection Link ---------- 115
5.9 Advantages of Choosing the GSM/GPRS ---------- 122
5.10 Coverage Area ---------- 125
5.11 Conclusion ---------- 130

6. Plan and Budget ---------- 131
6.1 Our Project Implementation's Plan and Budget ---------- 132
6.2 Real System Implementation's Plan and Budget ---------- 136

7. Conclusion and Future Ideas ---------- 140
7.1 Summary of Activities ---------- 141
7.2 Summary of findings ---------- 142
7.3 Recommendations ---------- 142
7.4 Future Ideas ---------- 143

Appendices:

Appendix A: World Health Organization report: about road safety in Egypt ---------- 144

Appendix B: RFID datasheet ---------- 147

Appendix C: Software UML ---------- 157

Appendix D: Software's Imported Classes ---------- 169

Appendix E: Metal Tag ---------- 178

Chapter 1 :

Introduction

Preview

We introduce in this chapter the project idea, project objectives and discuss the documentation outline.

Introduction

1.1 Objectives:

Traffic problems are very annoying or in some cases severely dangerous in Egypt & the whole world. In this project we will try to solve some of the traffic problems. The main traffic problems facing our community that we will manipulate are:

A. Over Speeding and Fatal Car Crashes:

Our main target is to solve the traffic severe crashes, which is mainly caused by over speeding. Speed tickets are made to limit the legal permitted speeds, but the problem is that the current system, Radar system, is inefficient and can easily deceived, as shown later in "Speed Calculation" (section 4.1.3).

Over speeding car crashes in Egypt and the entire world on highways are very dangerous and most likely results in bad lose.
A victim can suffer from a variety of serious injuries in a collision caused by over speeding. These injuries can permanently damage one's life and cause him and his family a great deal of pain. Here are some of the common vehicle accident injuries:

- Whiplash
- Spinal Cord Injury
- Head and Brain Injuries
- Broken Bones

Figure 1.1: Car accident

Death from a Car Crash

A wrongful death in a car crash will leave the loved ones of the demised with much distress and pain. They would grieve as their relative has just been a victim of the negligence of a stranger and they would be left with the many problems after the accident.

These relatives and beneficiaries of the victim must file for compensation that would somehow alleviate their burden and put their mind at ease when it comes to finances. There are lawyers who are willing to help High Speed Car Collision victims in attaining their claims and the justice they deserve.

According to published statistics over the internet, there are more than 6 million car accidents per year in the Unites States. In about one-half of those accidents, personal injuries are sustained. Approximately 58,000 fatalities occur per year as a result of motor vehicle accidents.

Motor vehicle accidents are the leading cause of death for people age 33 and younger. As one might expect, most car accidents are caused by drivers in their teens and early 20s as well as those over 75 years old.

Table 1.1 : Car Accident deaths per 100 million vehicle kilometers rate

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

B. Traffic jamming:

The problem of traffic jam is increasing day by day, it became so time wasting and very annoying.

Traffic congestion has a number of negative effects (1):

Figure1: 2: 2 km long tollgate traffic jam near Bogor

- Emergencies: blocked traffic may interfere with the passage of emergency vehicles traveling to their destinations where they are urgently needed.
- Wasting time of drivers and passengers.
- Delays, which may result in late arrival for employment, meetings, and education, resulting in lost business, disciplinary action or other personal losses.

Figure 1:3 Traffic jamming at Cairo's toll gates

- Stressed and frustrated motorists, encouraging road rage and reduced health of motorists.
- Wasted fuel increasing air pollution and carbon dioxide emissions owing to increased idling, acceleration and braking.
- Wear and tear on vehicles as a result of idling in traffic and frequent acceleration and braking, leading to more frequent repairs and replacements.

Highway Toll - Charge System

The highway toll charge - system provides the best opportunity for RFID application. The highway system takes an important role for local economic development. Current manhandling tollbooth is inefficient which can easily cause the traffic jamming. By using the RFID system, the toll fee charge can be handled in almost instantaneous way.

Figure 1.4: Highway Toll Charge System

C. Car Theft:

Table 1.2: Top 5 car theft statistics (Car thefts)

Rank	Countries	Amount
# 1	United States:	1,246,096
# 2	United Kingdom:	348,169
# 3	France:	301,539
# 4	Italy:	232,564
# 5	Canada:	161,506
# 6	Mexico:	141,007

Recovery rates for stolen cars vary, depending on the effort police department puts into recovery, and devices a vehicle has installed to assist in the process. Car tracking is the most efficient way to recover a stolen car, but car tracking is not that easy as installing any devices in the car can be easily powered off.

In some countries, police departments use various methods of recovering stolen vehicles, such as random checks (ANPR) of vehicles that come in front of a patrol unit, checks of all vehicles parked along a street or within a parking lot using automatic number plate recognition (ANPR) or keeping a watch list of all the vehicles reported stolen by their owners.

Figure 1.5: Car theft.

But, by using RFID technology you can track the cars and block them from being smuggled outside the city, by blocking it at the toll gates.

1.2 Block Diagram Of The Project:

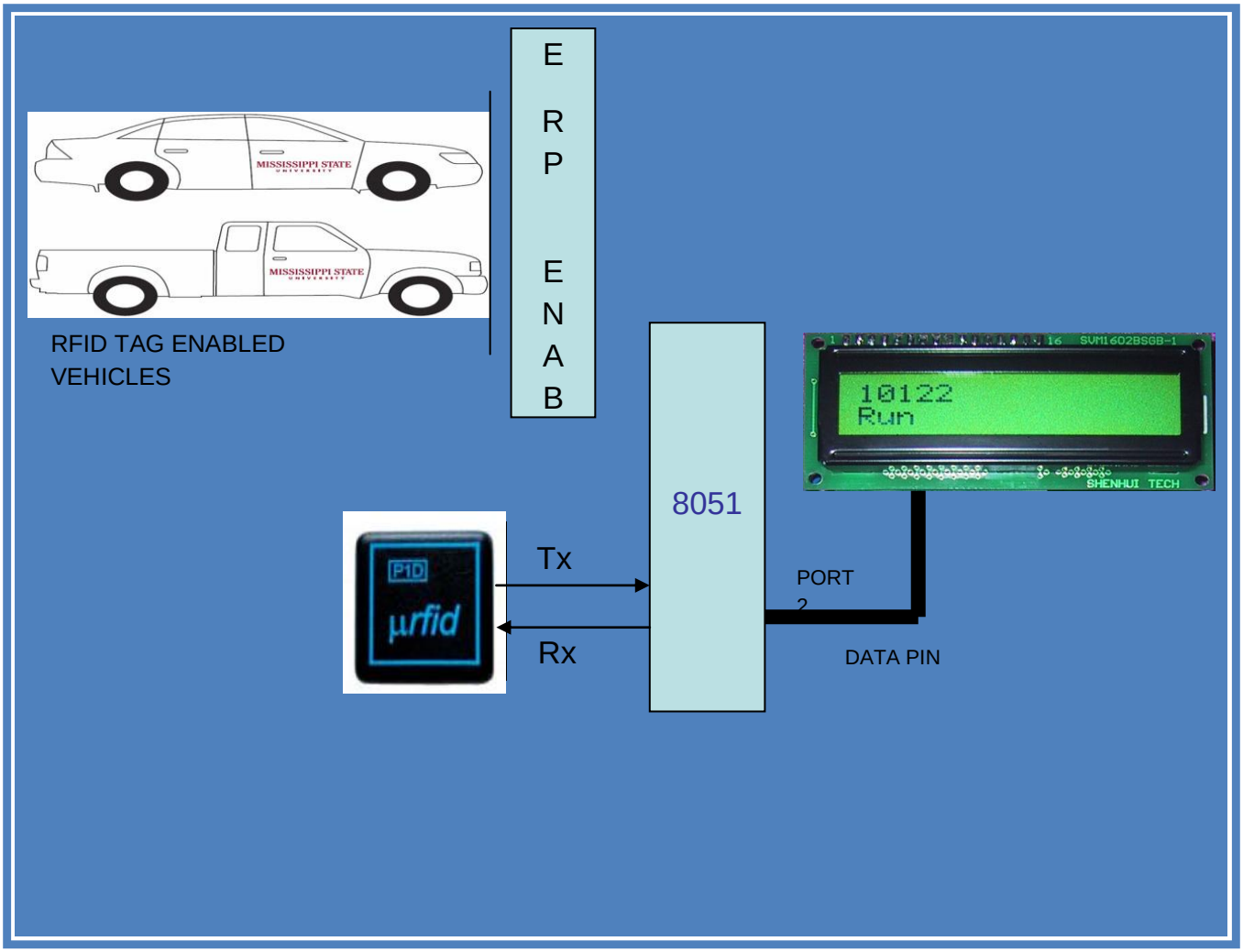


Figure 1.6: Block Diagram of the project

1.3 Flow Chart of The project (RFID Smart Road System)

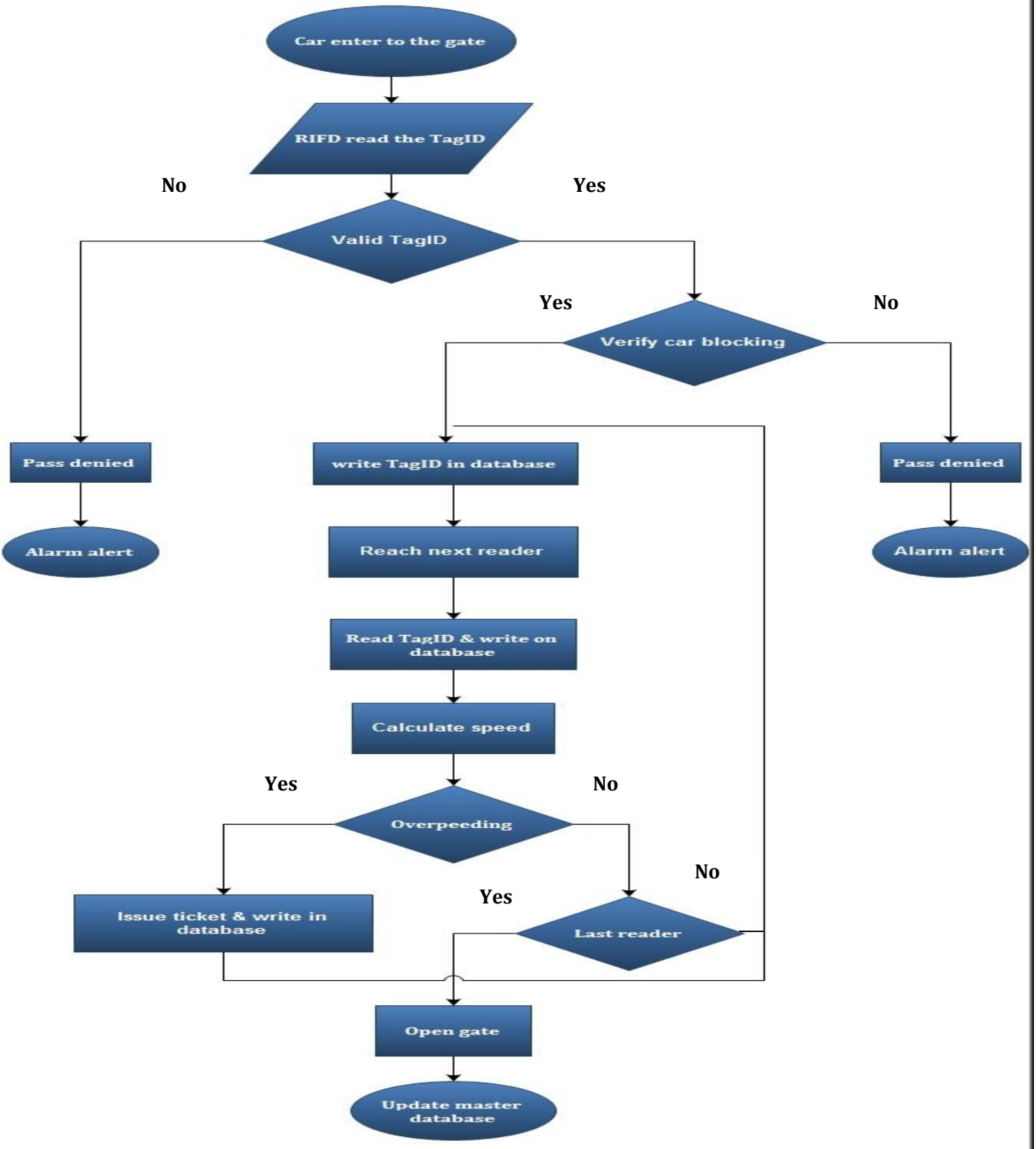


Figure 1.7: Flow Chart of RFID System.

Chapter 2 :

RFID Technology

Preview

We introduce in this chapter RFID technology (Radio Frequency IDentification) , basic components , How RFID works and why it is more efficient than Radar.

RFID Technology

2.1. RFID(Radio Frequency IDentification)

Radio Frequency IDentification (RFID) is one of the new emerging technologies that use radio frequency waves to transfer data between a reader and a moveable item which is tagged, to identify, categorize and track the item. It is fast, reliable, and does not require contact between reader/scanner and the tagged item.

RFID provides a wireless, over-the-air interface. Unlike bar codes, line-of-sight communication is not necessary. RFID uses an integrated microchip and antenna that reads information. The combination of the chip and antenna is called an RFID transponder, tag or inlet. When the RFID transponder is placed in the field of an RFID reader, information is transmitted to the reader and processed by a computer.

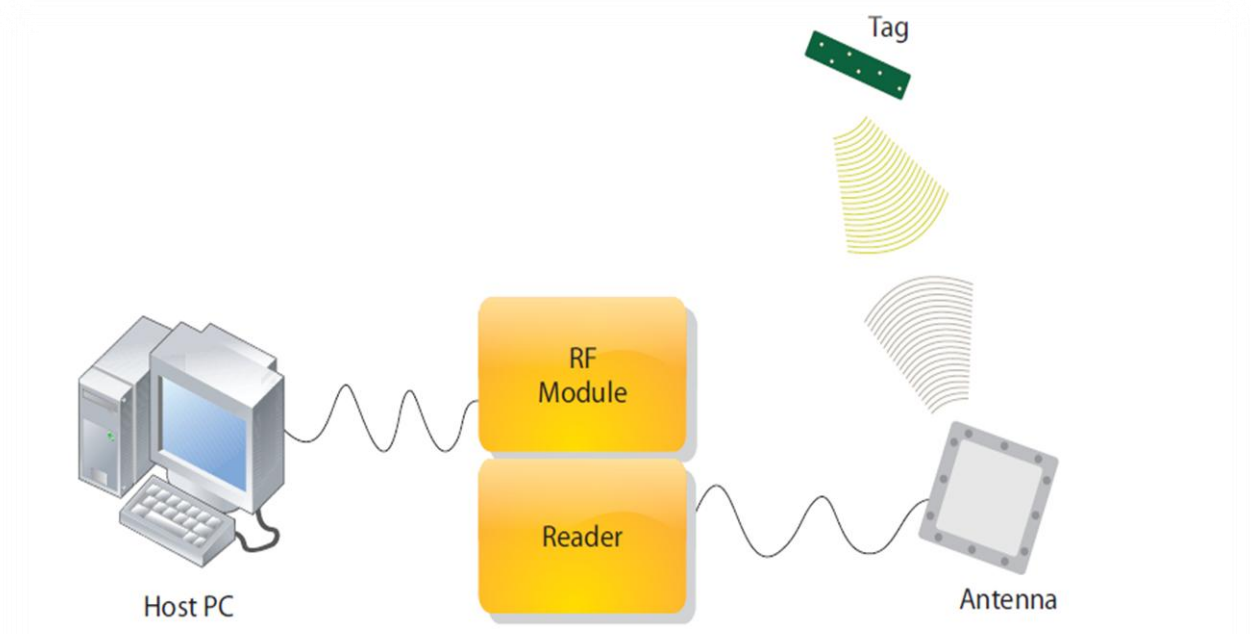


Figure 2.1: RFID System

RFID systems evolved from barcode labels as a means to automatically identify and track products and people. You will be generally familiar with RFID Systems as seen in:

- **Access Control.**

RFID Readers placed at entrances that require a person to pass their proximity card (RF tag) to be "read' before the access can be made.

- **Contact less Payment Systems.**

RFID tags used to carry payment information. RFIDs are particular suited to electronic Toll collection systems. Tags attached to vehicles, or carried by people transmit payment information to a fixed reader attached to a Toll station. Payments are then routinely deducted from a users account, or information is changed directly on the RFID tag.

- **Product Tracking and Inventory Control.**

RFID systems are commonly used to track and record the movement of ordinary items such as library books, clothes, factory pallets, electrical goods and numerous items.

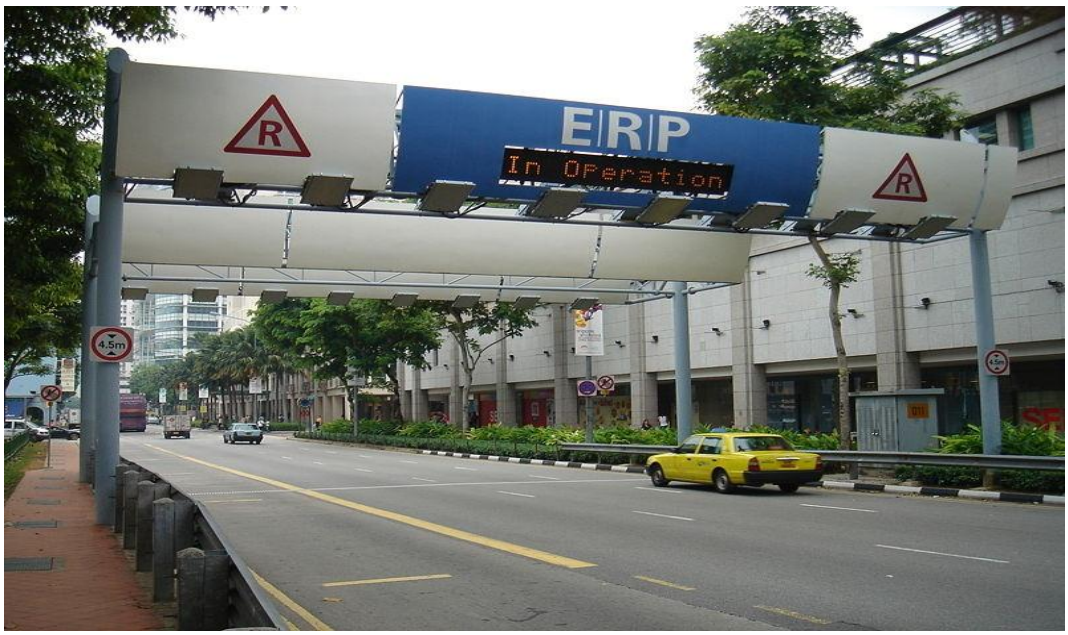


Figure 2.2: Highway in Singapore uses RFID System.

2.2.A basic RFID system consist of three components:

A. Antenna

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate tollbooth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. If constant interrogation is not required, a sensor device can activate the field.

Often the antenna is packaged with the transceiver and decoder to become a reader which can be configured either as a handheld or a fixed-mount device. The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used.

When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

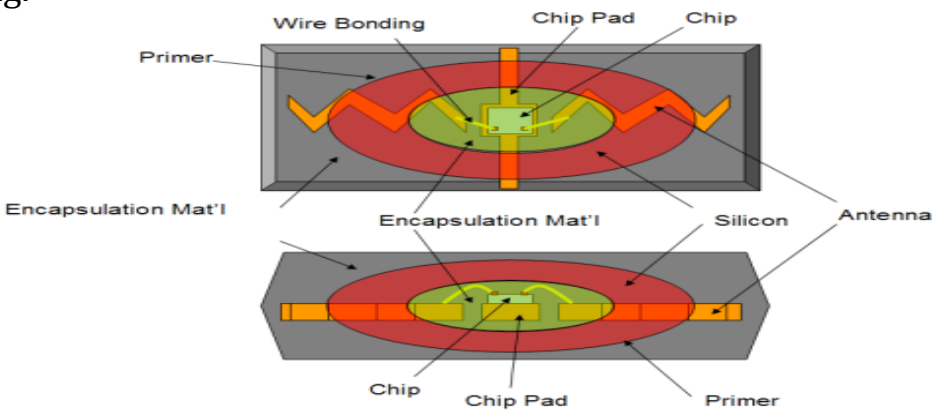


Figure 2.3: RFID components

B. TAGS (Transponders)

The tags contain transponders that emit messages readable by specialized RFID readers. Most RFID tags store some sort of identification number.
A reader retrieves information about the ID number from a database, and acts upon it accordingly. RFID tags can also contain writable memory, which can store information for transfer to various RFID readers in different locations. This information can track the movement of the tagged item, making that information available to each reader.

Tags come in a variety of types, with a variety of capabilities. Key variables include:

There are three options in terms of how data can be encoded on tags:

- **Read-only tags**

Contain data such as a serialized tracking number, which is pre-written onto them by the tag manufacturer or distributor. These are generally the least expensive tags because they cannot have any additional information included as they move throughout the supply chain. Any updates to that information would have to be maintained in the application software.

Figure 2.4: Tags of RFID

- **Full "read-write" tags**

Allow new data to be written to the tag as needed—and even written over the original data. Examples for the latter capability might include the time and date of ownership transfer or updating the repair history of a fixed asset. While these are the most costly of the three tag types and are not practical for tracking inexpensive items, future standards for electronic product codes (EPC) appear to be headed in this direction.

Types of Tags :

RFID tags fall into two general categories, active and passive, depending on their source of electrical power. Active RFID tags contain their own power source, usually an on-board battery. Passive tags obtain power from the signal of an external reader. RFID readers also come in active and passive varieties, depending on the type of tag they read.

a. Passive Tags

A passive tag is an RFID tag that does not contain a battery; the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory.

The advantages of a passive tag :

- The tag functions without a battery; these tags have a useful life of twenty years or more.
- The tag is typically much less expensive to manufacture
- The tag is much smaller (some tags are the size of a grain of rice). These tags have almost unlimited applications in consumer goods and other areas.

The disadvantages of a passive tag:

- The tag can be read only at very short distances, typically a few feet at most. This greatly limits the device for certain applications.

- It may not be possible to include sensors that can use electricity for power.

- The tag remains readable for a very long time, even after the product to which the tag is attached has been sold and is no longer being tracked.

b. Semi-Passive

Semi-passive RFID tags are very similar to passive tags except for the addition of a small battery.

This battery allows the tag IC to be constantly powered. This removes the need for the aerial to be designed to collect power from the incoming signal.

Aerials can therefore be optimized for the backscattering signal.
Semi-passive RFID tags are faster in response and therefore stronger in reading ratio compared to passive tags.

c. Active Tags

An RFID tag is an active tag when it is equipped with a battery that can be used as a partial or complete source of power for the tag's circuitry and antenna. Some active tags contain replaceable batteries for years of use, others are sealed units.

The advantages of an active tag:

- It can be read at distances of one hundred feet or more, greatly improving the utility of the device
- It may have other sensors that can use electricity for power.

The disadvantages of an active tag:

- The tag cannot function without battery power, it limits the lifetime of the tag.
- The tag is more expensive.
- The tag is physically larger, which may limit applications.
- The long-term maintenance costs for an active RFID tag can be greater than those of a passive tag if the batteries are replaced.
- Battery outages in an active tag can result in expensive misreads.

RFID Active tags have these features:

- ❖ longest communication range of any tag
- ❖ the capability to perform independent monitoring and control
- ❖ the capability of initiating communications
- ❖ the capability of performing diagnostics
- ❖ the highest data bandwidth
- ❖ Active RFID tags may even be equipped with autonomous networking; the tags autonomously determine the best communication path.

d. Extended Capability

These chips are very high capacity of more than the basic capabilities of the RFID chips as pallets or license as an alternative to vertical modulation technique (Bar-code), these chips are characterized by: -

- ❖ Their ability to send and receive data distances is very high.
- ❖ Their ability to work in difficult environments.
- ❖ Storage capacity is very high on the card.
- ❖ Ability to integrate with sensors.
- ❖ Ability to communicate with external devices.
- ❖ Ability to withstand fluctuations in weather.

e. Other types of Tags

There are other types of these Tags :

- ❖ Tags antenna (Antenna types).
- ❖ Tags are associated with the card (Tag attachment).
- ❖ Tags that determine the sites (Tagging Position).

EPC Tags

EPC refers to "electronic product code," an emerging specification for RFID tags, readers and business applications first developed at the Auto-ID Center at the Massachusetts Institute of Technology. This organization has provided significant intellectual leadership toward the use and application of RFID technology.

EPC represents a specific approach to item identification, including an emerging standard for the tags themselves, including both the data content of the tag and open wireless communication protocols. In a sense, the EPC movement is combining the data standards embodied in certain bar code specifications, such as the UPC or UCC-128 bar code standards, with the wireless data communication standards that have been developed by ANSI and other groups.

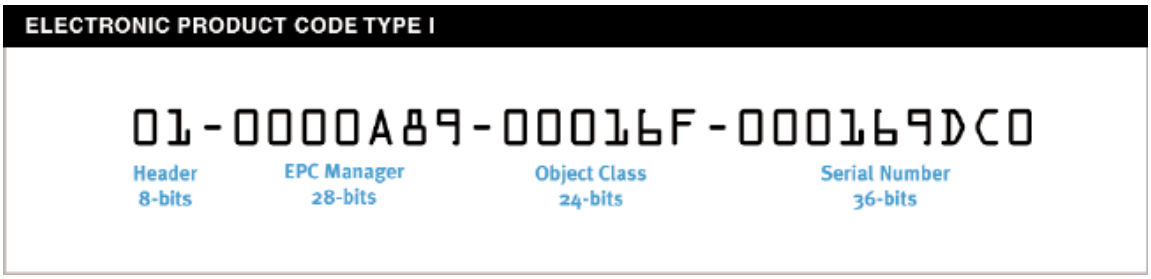


Figure 2.5: Electronic product code (EPC)

C. RF Transceiver:

The RF transceiver is the source of the RF energy used to activate and power the passive RFID tags. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment. When provided as a separate piece of equipment, the transceiver is commonly referred to as an RF module. The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives. The transceiver filters and amplifies the backscatter signal from a passive RFID tag.

RFID Frequencies:

There are many different types of RFID systems out in the market. They are categorized according to these frequency ranges. Some of the most commonly used RFID kits are as follows:

1) Low-frequency (30 KHz to 500 KHz)
2) Mid-Frequency (900 KHz to 1500MHz)
3) High Frequency (2.4GHz to 2.5GHz)

Figure 2.6: RFID on the car

2.3. RFID offers the following benefits:

- Identification without visual contact
- Read/write capability
- Cluster reading
- Secure communication
- Withstanding harsh industrial environment
- Reliability and speed
- Reusability
- Data storage at point-of-origin

Figure 2.7: PDA RFID Reader

2.4. Disadvantages of Radar in comparison with RFID:

- Measures instantaneous speed.
- Line of Sight needed.
- Easy to detect using some devices from long distance.
- Easily tricked by people.
- Does not differentiate between different car categories.
- High processing time & Network traffic.
  (Due to high quality pictures).

Figure 2.8: Radar

2.5. The Advantages of RFID Over Bar Coding

1.No "line of sight" requirements:

Bar code reading can sometimes be limited or problematic due to the need to have a direct "line of sight" between a scanner and a bar code. RFID tags can be read through materials without line of sight.

2.More automated reading:

RFID tags can be read automatically when a tagged product comes past or near a reader, reducing the labor required to scan product and allowing more proactive, real-time tracking.

3.Improved read rates:

RFID tags ultimately offer the promise of higher read rates than bar codes, especially in high-speed operations

4. Greater data capacity:

RFID tags can be easily encoded with item details such as lot and batch, weight, etc.

5."Write" capabilities:

Because RFID tags can be rewritten with new data as supply chain activities are completed, tagged products carry updated information as they move throughout the supply chain.

2.6. How do RFID work ?

In every RFID system the transponder Tags contain information. This information can be as little as a single binary bit, or be a large array of bits representing such things as an identity code, personal medical information, or literally any type of information that can be stored in digital binary format.

Shown is a RFID transceiver that communicates with a passive Tag. Passive tags have no power source of their own and instead derive power from the incident electromagnetic field. Commonly the heart of each tag is a microchip. When the Tag enters the generated RF field it is able to draw enough power from the field to access its internal memory and transmit its stored information.
When the transponder Tag draws power in this way the resultant interaction of the RF fields causes the voltage at the transceiver antenna to drop in value. This effect is utilized by the Tag to communicate its information to the reader. The Tag is able to control the amount of power drawn from the field and by doing so it can modulate the voltage sensed at the Transceiver according to the bit pattern it wishes to transmit.

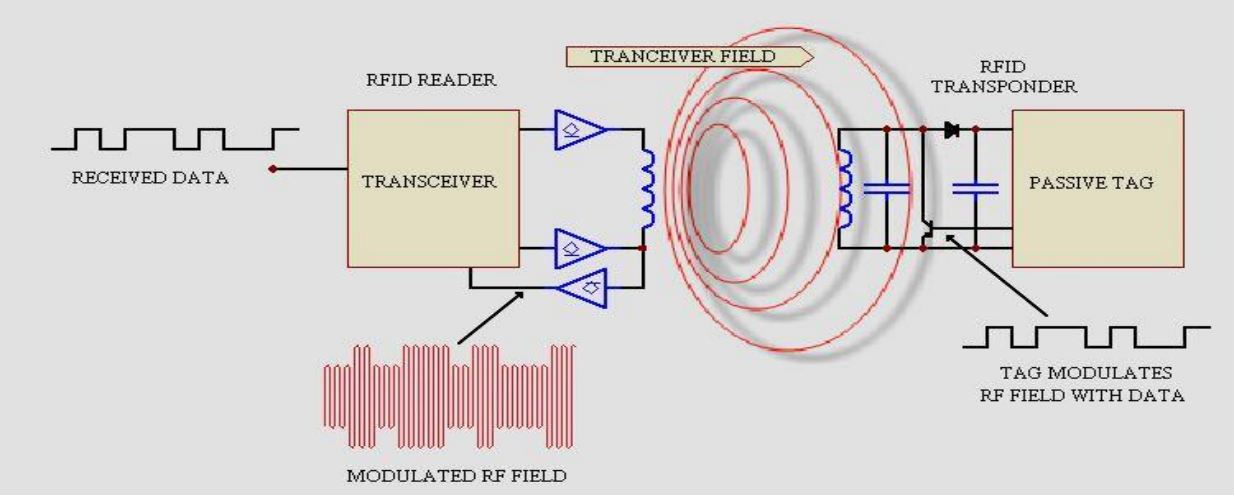


Figure 2.9: RFID reading technique

2.7. Typical Applications for RFID

- Automatic Vehicle identification
- Inventory Management
- Work-in-Process
- Container/ Yard Management
- Document/ Jewelers tracking
- Patient Monitoring

2.8. Common Problems with RFID

Some common problems with RFID are reader collision and tag collision. Reader collision occurs when the signals from two or more readers overlap. The tag is unable to respond to simultaneous queries. Systems must be carefully set up to avoid this problem. Tag collision occurs when many tags are present in a small area; but since the read time is very fast, it is easier for vendors to develop systems that ensure that tags respond one at a time. See Problems with RFID for more details.(See Appendix E)

Chapter 3 :

Hardware of RFID System

Preview

We introduce in this chapter RFID using in the project and its interface, stepper motor and Infrared Sensor.

Hardware of RFID System

3.1 RFID and its interface :

3.1.1 Introduction

125K-R-LR-232 is a low cost and high performance proximity reader for reading ID code from EM4100 or compatible read-only tags. It features an extended reading range up to 90-100 cm.
It is ideally suited to be applied in automatic parking system, personal identification, access control and production control systems etc.

3.1.2 Features:

- High sensitivity and reliable performance.
- Built-in transceiver antenna for max. performance .
- Maximum effective distance up to 90-100cm.
- Less than 100ms decoding time.
- Low power dissipation with single power supply.
- Built-in buzzer and LED .

3.1.3 Specification:

Table 3. 1: RFID reader specifications

Power Requirements	Linear regulated 12VDC at 300mA typical, 500mA max.
Interface	RS232
Max. Read Range	90-100cm (with special 125Khz long range card) - 125K-LR-T2 (86x54x1.8)mm
Frequency	125Khz typical / EM4100 or compatible
RFID card requirement	High Q 125K long range Read only card
Audio/visual Indication	Built-in Buzzer and LED
Operating Temp.	0°C -70°C
Dimension	24 X 24 X4 (cm)

3.1.4 RFID Reader Interface:

Interfacing any device with a computer can be done via two categories of interfacing:

- Wireless (such as: Wi-Fi, Bluetooth, GSM mobile Network)
- Wired (Cables)

The interface of the device should be compatible with the computer ports.

Wired connection:

The interface is used to transfers data and control signals between the device (RFID Reader) and the computer.

The data can be sent through two types of interfacing ports:

- Parallel Ports: Where the data is sent byte by byte (8-data lines)
- Serial Ports: Where the data is sent serially bit by bit (1-data line + 1 ground), such as USB Port, RS232 Serial Port, Fax modem port or LAN modem port.

Our RFID reader has the following wires for interface:

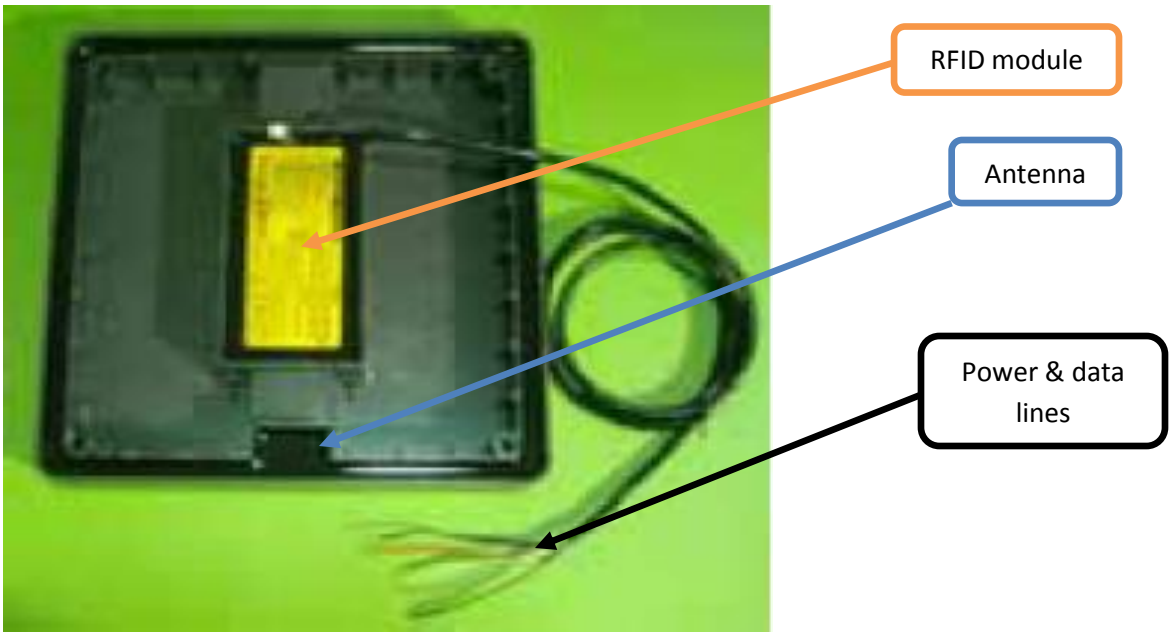


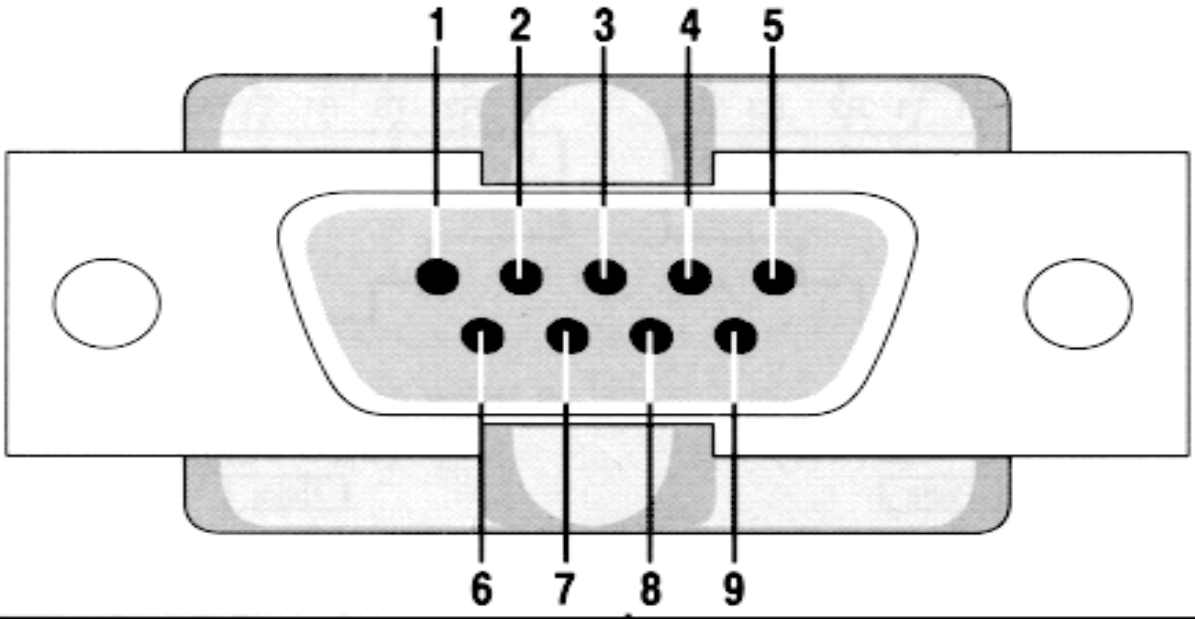
Figure 3. 1: RFID reader

Color	Reader wires Description	PC `s com port (DB9)
Red	+12VDC To power supply	
Black	Power (-ve) To power supply	
Brown	TXD-Transmit	Pin2
White	GND	Pin5
Green	NC	
Gray	NC	
Blue	NC	
Yellow	NC	

Figure 3.2: Wirings

The red & black coloured wires are the power supply of the RFID reader, it is connected to a power supply that supplies the reader with 12 v and 0.5 A. While the brown & white wires are for data transmission, they are connected to the serial port pins 2 & 5.

For our RFID reader, the type of interface is RS232 serial wired interface, through a USB-to-RS232 converter. RS232 consists of 9 pins:



Pin	Signal	Pin	Signal
1	Data Carrier Detect	6	Data Set Ready
2	Received Data	7	Request to Send
3	Transmitted Data	8	Clear to Send
4	Data Terminal Ready	9	Ring Indicator
5	Signal Ground		

Figure 3.3: RS232 pin configuration

3.1.5 Protocol:

Band Rate : 9600,N,8,1

STX (02 HEX)	DATA (10 HEX)	CR	LF	ETX (03 HEX)

3.1.6 Trouble shooting

When powered up , the reader takes a self-test to ensure the best reading performance with the buzzer beeping continually. When the self-test ends, the buzzer will give out a long beep and enter the normal working mode.
If the buzzer continue beeping without stop for a long time, Pls turn off the power and check out the environment and power supply to ensure locating the reader in a good working condition.

In case of problems the following procedure should be followed:
1. Turn off the power.

2. check the power input connections making sure that they are not reversed.

3. check the power supply complying with the specifications.

4. if the supply has a current limit, set this to > 500 mA.

5. make sure to install the reader in a environment without large area conductors nearby or mounting on a conductive surface. In self-test state, do not apply any tags in the reader functional area.

6. Try to change the installment to another place to check if the trouble still exists.

3.1.7 Connection Block Diagram:

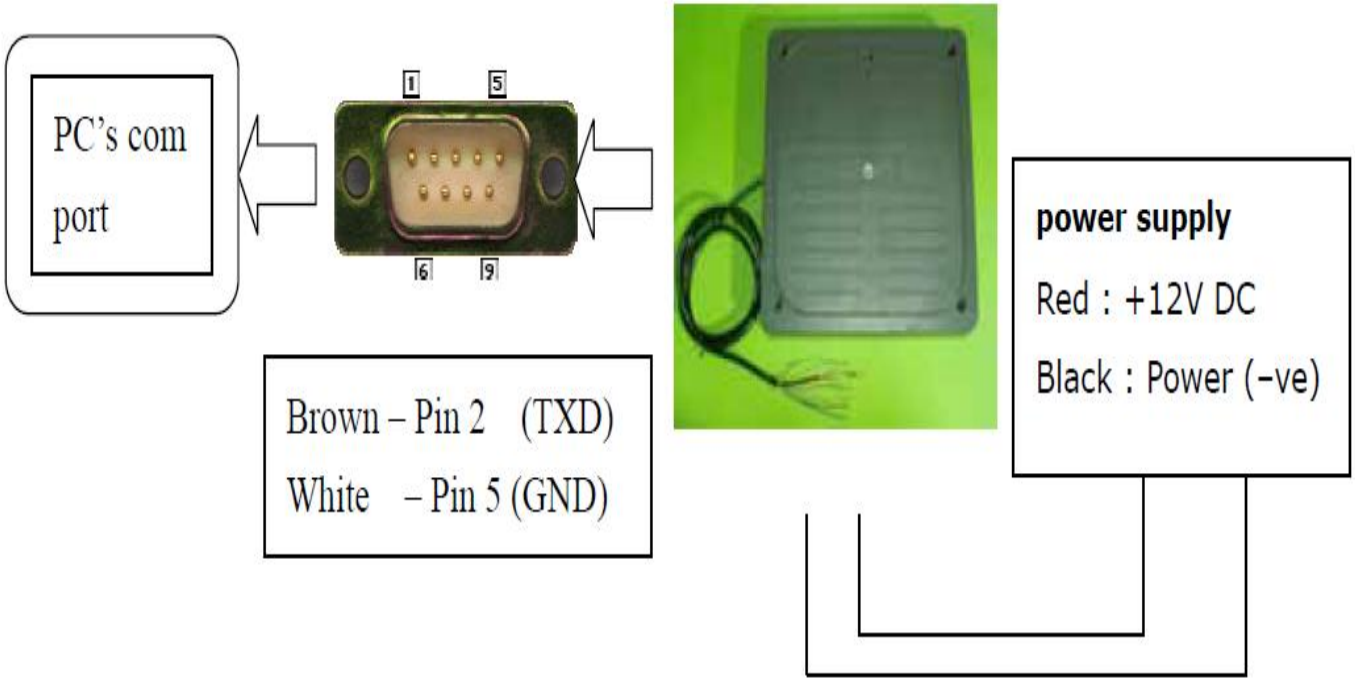


Figure 3.4: Connection block diagram

3.2. Stepper Motor :

3.2.1. Objectives:

Simulate automatic toll gates that will be between cities on highways because a traditional gate takes a lot of time and causes traffic jam, so we are thinking about transforming the traditional gate system to an automatic one.

We used stepper motor in the project for automatic opening gates on highways, after a tag is read from reader at gate, the program that designed to control gates after authenticating the tag and verifying the car, it will automatically active the stepper motor that will open to pass cars then check an active IR sensor, when sensor indicate that the car has gone, so the gate can now only close.

3.2.2. DC motor VS Stepper motor:

1. Stepper motors are operated open loop, while most DC motors are operated closed loop.
2. Stepper motor (2) are easily controlled with microprocessors, however logic and drive electronics are more complex.
3. Stepper motors are brushless and brushes contribute several problems.
4. DC motors have a continuous displacement and can be accurately positioned, whereas stepper motor motion is incremental and its resolution is limited to the step size.
5. Stepper motors can slip if overloaded and the error can go undetected.(A few stepper motors use closed-loop control.)
6. Feedback control with DC motors gives a much faster response time compared to stepper motors.

Figure 3.5: DC Motor

Figure 3.6: Stepper Motor

3.2.3. Stepper motor definition & circuit:

A stepper motor (2) is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The motors rotation has several direct relationships to these applied input pulses. The sequence of the applied pulses is directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied.

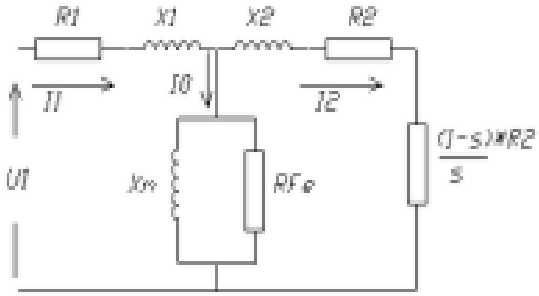


Figure 3.7: Stepper motor equivalent circuit

Figure 3.8: Stepper motor

3.2.3.1.Stepper Motor Types

There are three basic stepper motor (3) types. They are:

- Variable-reluctance
- Permanent-magnet
- Hybrid

3.2.3.2. Stepper Motor Advantages and Disadvantages (3)

The advantages of Stepper Motor

1. The rotation angle of the motor is proportional to the input pulse.

2. The motor has full torque at standstill (if the windings are energized).

3. Precise positioning and repeatability of movement since good stepper. Motors have an accuracy of 3 – 5% of a step and this error is non cumulative from one step to the next.

4. Excellent response to starting, stopping, reversing.

5. Very reliable since there are no contact brushes in the motor. Therefore The life of the motor is simply dependant on the life of the bearing.

6. The motors response to digital input pulses provides open-loop control, making the motor simpler and less costly to control.

7. It is possible to achieve very low speed synchronous rotation with a load that is directly coupled to the shaft.

8. A wide range of rotational speeds can be realized as the speed is proportional to the frequency of the input pulses.

The disadvantages of Stepper Motor :

1. Resonances can occur if not properly controlled.

2. Not easy to operate at extremely high speeds.

3.2.3.3.Two-phase stepper motors:

There are two basic winding arrangements for the electromagnetic coils in a two phase stepper motor: (2) bipolar and unipolar.

A. Unipolar motors:

A unipolar stepper motor has two windings per phase, one for each direction of magnetic field. Since in this arrangement a magnetic pole can be reversed without switching the direction of current, the commutation circuit can be made very simple (e.g. a single transistor) for each winding. Typically, given a phase, one end of each winding is made common: giving three leads per phase and six leads for a typical two phase motor. Often, these two phase commons are internally joined, so the motor has only five leads.

B. Bipolar motor: (that we used in the project)

Bipolar motors have a single winding per phase. The current in a winding needs to be reversed in order to reverse a magnetic pole, so the driving circuit must be more complicated; typically with an H-bridge arrangement (however there are several off the shelf driver chips available to make this a simple affair). There are two leads per phase, none are common.

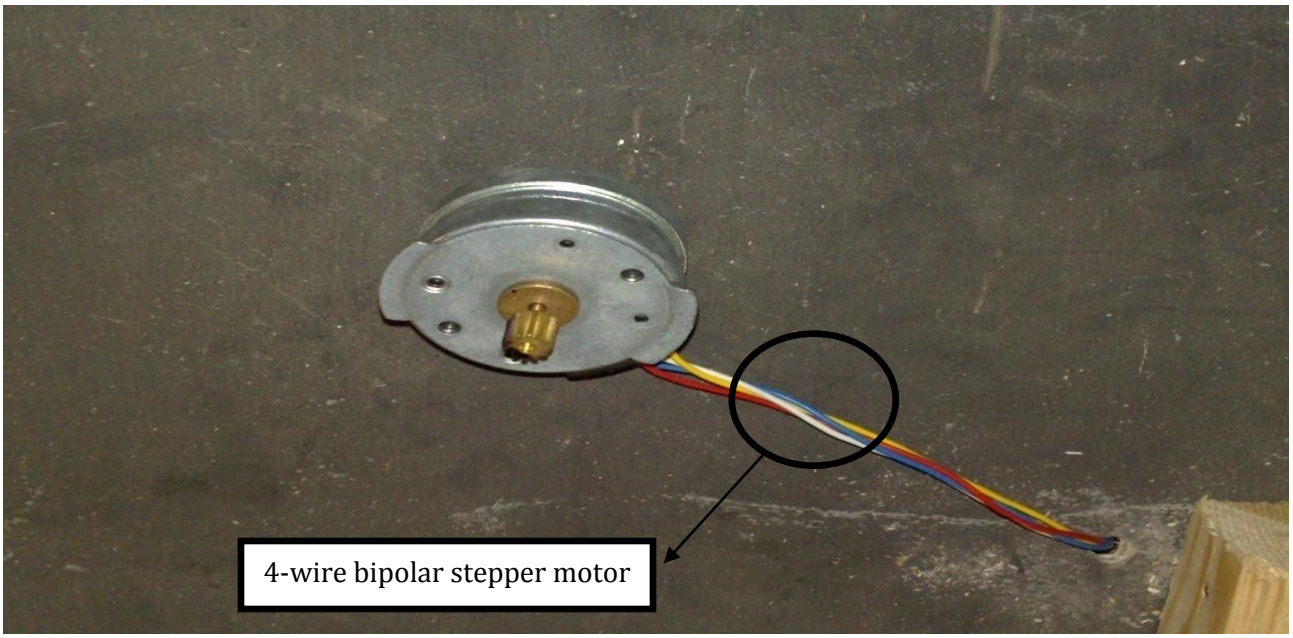


Figure 3.9: 4 wire bipolar Stepper Motor

3.2.3.4. Stepper motor circuit:

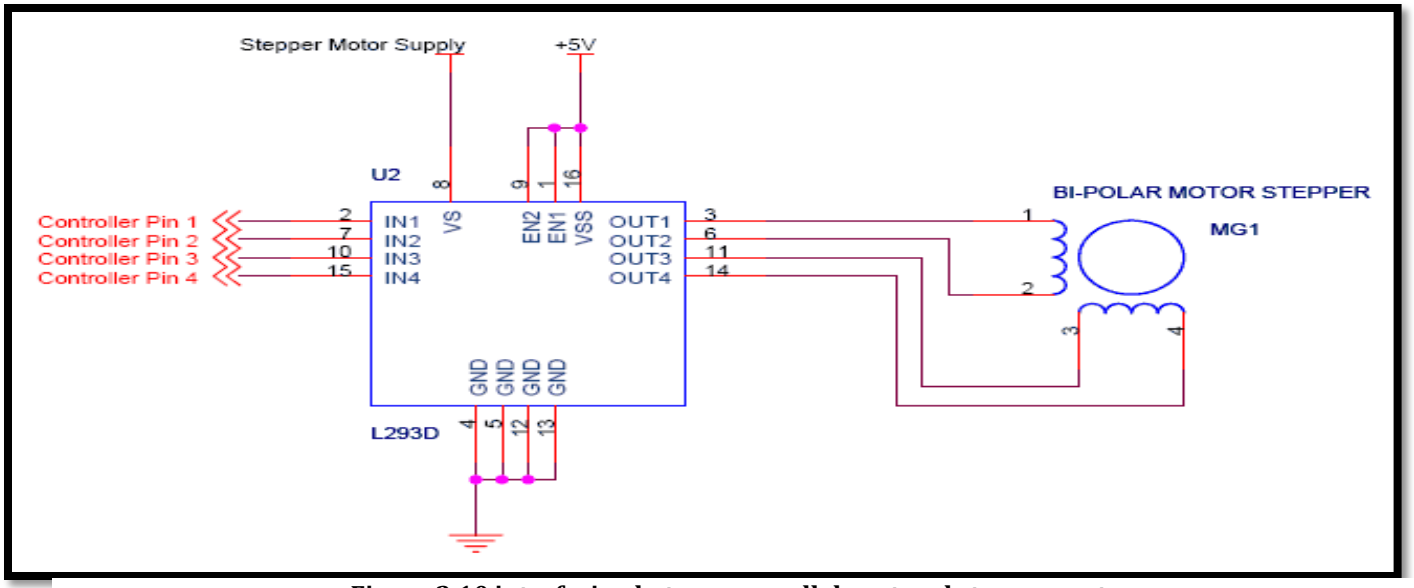


Figure 3.10 interfacing between parallel port and stepper motor

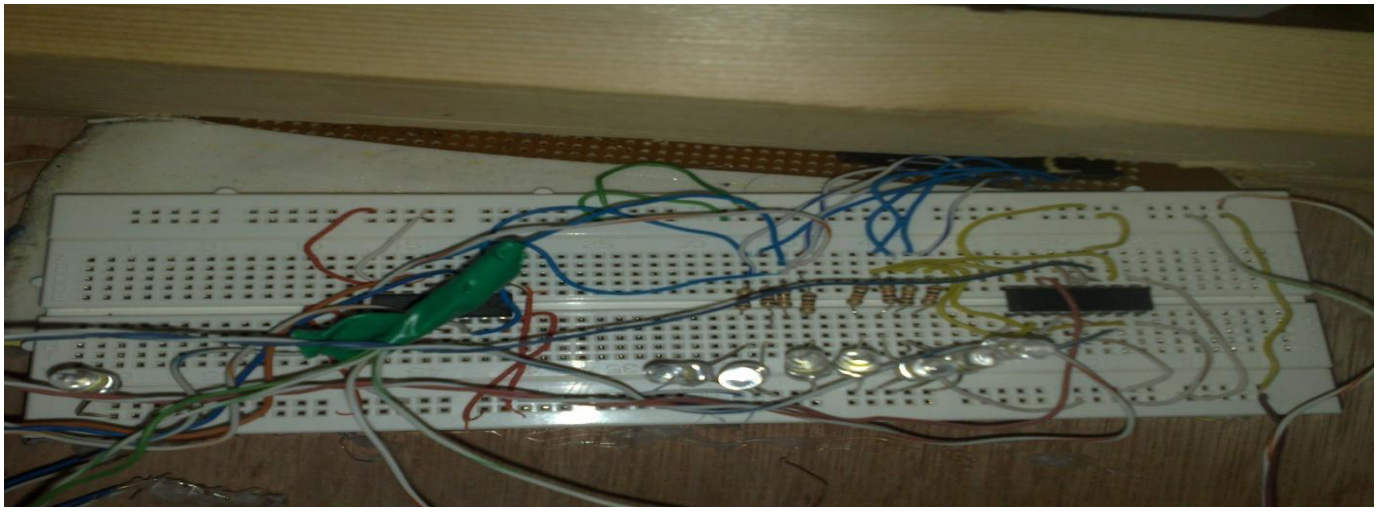


Figure 3. 11: implementation on test board

Circuit consists of:

1. Parallel cable (25 pin)
2. Stepper motor (Bipolar – 4 wires)
3. Adapter (up to 12 V): to operate the motor
4. L293D chip

3.2.3.5. L293D motor driver chip:

The L293D (contains two H-bridges) is a popular motor driver IC that is usable from 6 to12V, at up to 1A total output current. By itself, the IC is somewhat difficult to wire and use, but the Compact L293D Motor Driver makes it much more convenient to use. We use L293D for driving stepper motor for supporting high current and it allows the polarity of the power applied to be controlled independently.

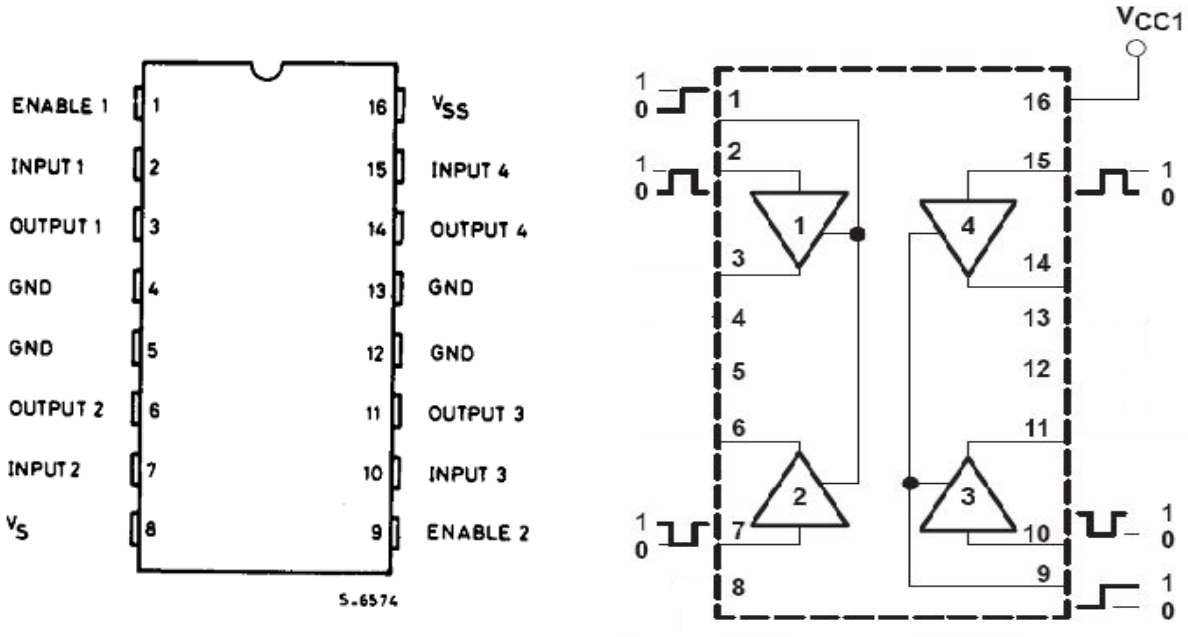


Figure 3.12: L293D motor driver chip

3.2.4. Steps of stepper motor operation :

a. After reader read tag that put in car before from reader gate then send tag ID to computer by using parallel cable (pin2 2-9 data pins) to enter authentication algorithm that consist of tow level:

   1. Run a validation algorithm to confirm this tag belong to us.
   2. Run verification algorithm that verify this tag has legal pass from gate (determine if this tag block or not).

b. After confirmation from past algorithm we now on the first mechanical step that contain sending binary sequences from computer by using parallel port (pins 2-9) with timing synchronization for not missing any sequence step.

c. Holding gate after ending opening (300 µsec) then check status of flag to determine if car has gone or not yet so we have two scenarios:

1. Flag indicate that there is something under the gate then stepper motor will hold for (300 µsec) to recheck again.
2. Flag indicate that there are nothing under the gate so now can close safely by sending binary sequences from computer by using parallel port (pin 2-9) with also timing synchronization.

3.2.5.Flow chart:

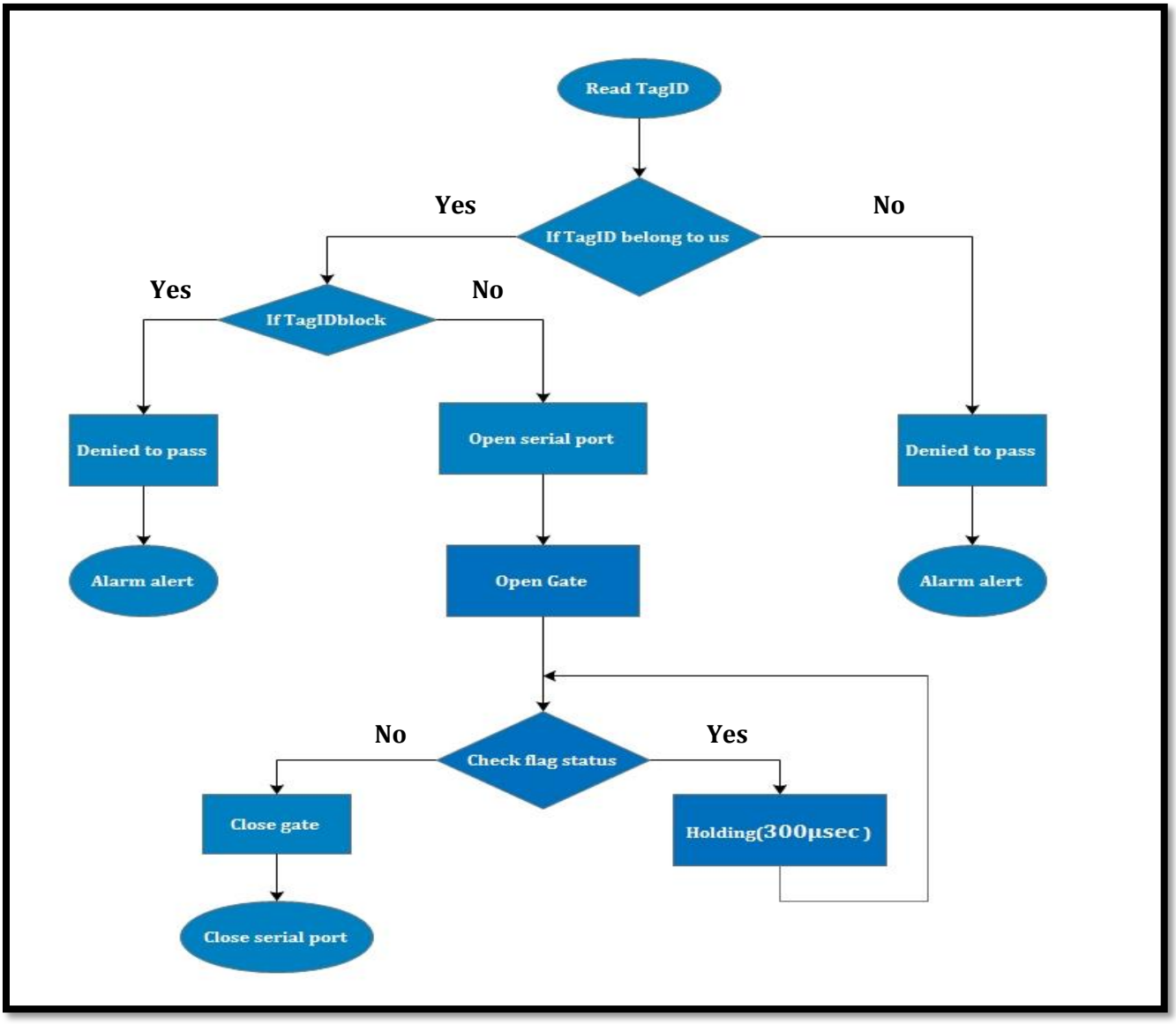


Figure 3. 13: Flow chart of the stepper motor

3.2.6.Stepping Modes:

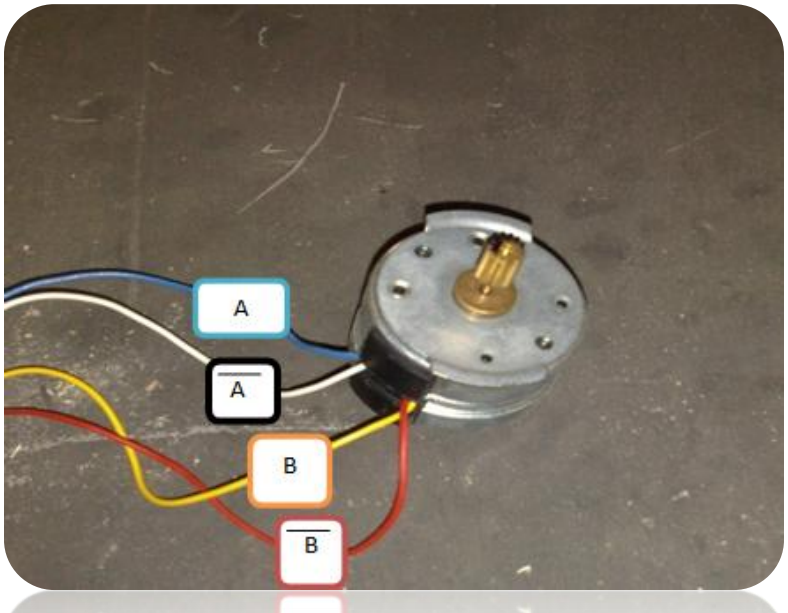


Figure 3. 14: Stepper wires

Table 3. 2: Stepper motor operation mode

	Openning Gate				Closing Gate			
Phase	1	2	3	4	1	2	3	4
A	•							
B		•						
$\overline{A}$							•	
$\overline{B}$								•

Stepping mode of the motor showing the code for opening, closing the gate and determine the direction of motion also can define the speed of the motor that defined the operating angle of the one step.

3.2.7. Prototype:

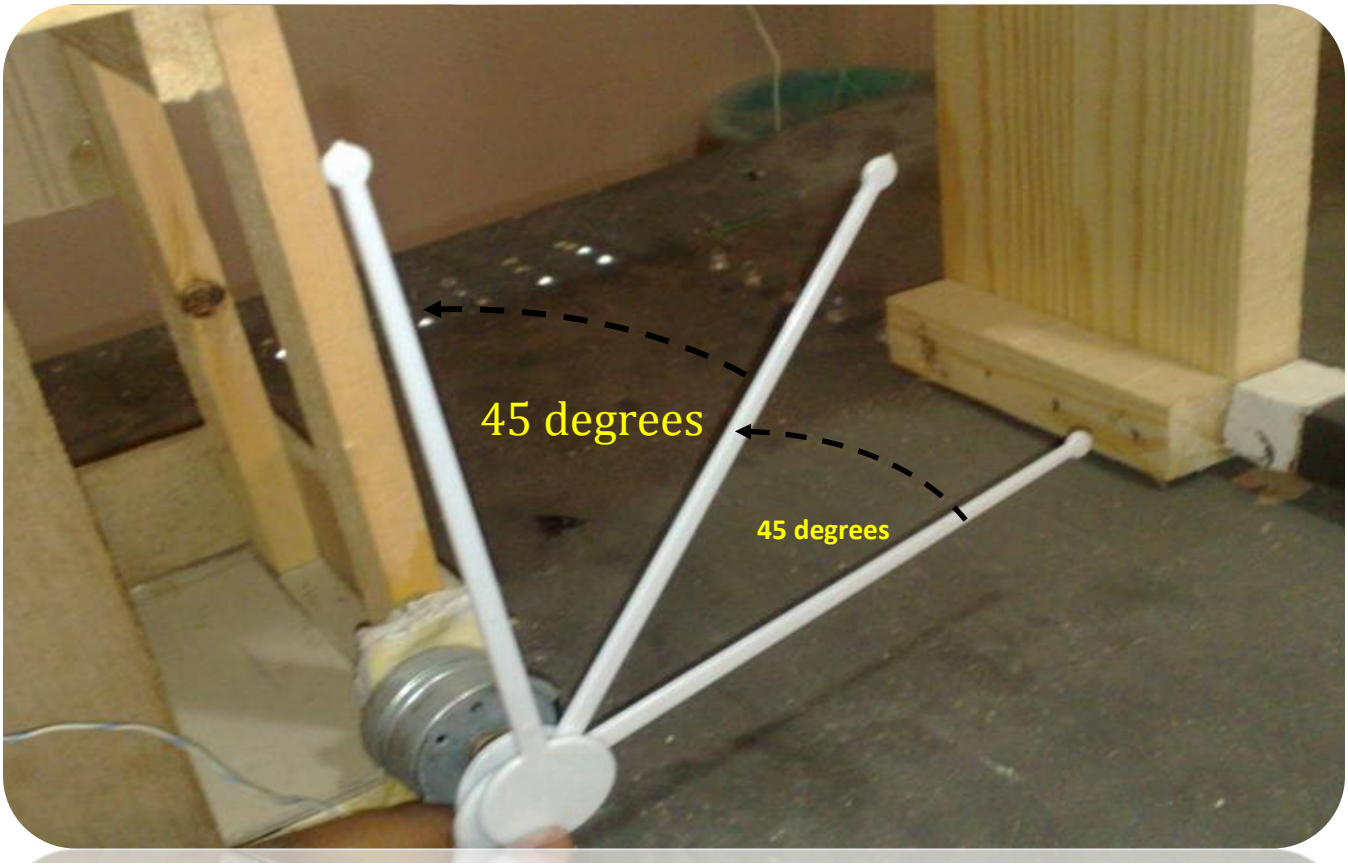


Figure 3.15: Stepper motor while opening gates. Opens using 45 degrees angles

3.2.7.1. Opening gate:

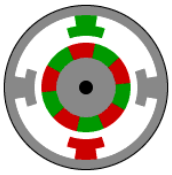


Figure 3.16: Step 1 while opening gate

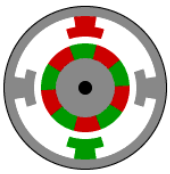


Figure 3.17: Step 2 while opening gate

Table 3. 3: Code to open gate

Phase / Step	A	B	$\overline{A}$	$\overline{B}$
1	1	0	0	0
2	0	1	0	0

Code of gate opening:

```
for (int i = 0; i < 3; i++)
                    {
                       NTPort.Outport(0x378, 1);
                       System.Threading.Thread.Sleep(300);
                       NTPort.Outport(0x378, 2);
                       System.Threading.Thread.Sleep(300);
                       NTPort.Outport(0x378, 0);
        }
```

Figure 3. 18: Stepper motor while closing gates. Closes using 45 degrees angles

3.2.7.2. Closing gate:

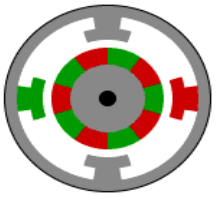


Figure 3. 19: Step 1 while closing gate

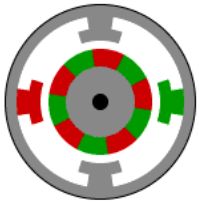


Figure 3. 20: Step 2 while closing gate

Table 3. 4 : Code to close gate

Phase / Step	A	B	$\overline{A}$	$\overline{B}$
1	0	0	1	0
2	0	0	0	1

Code of gate closing:

```
for (int i = 0; i < 3; i++)
        {
          NTPort.Outport(0x378, 4);
          System.Threading.Thread.Sleep(300);
          NTPort.Outport(0x378, 8);
          System.Threading.Thread.Sleep(300);
          NTPort.Outport(0x378, 0);
        }
```

3.3. Active IR sensor

3.3.1. Objectives:

Simulate what will if we have any emergency situation.

Protecting due to any problem causes to cars under gate after it opened, when sensor sense that there are something under the gat it will send hold signal to program for holding closing the gate until under gate to be empty.

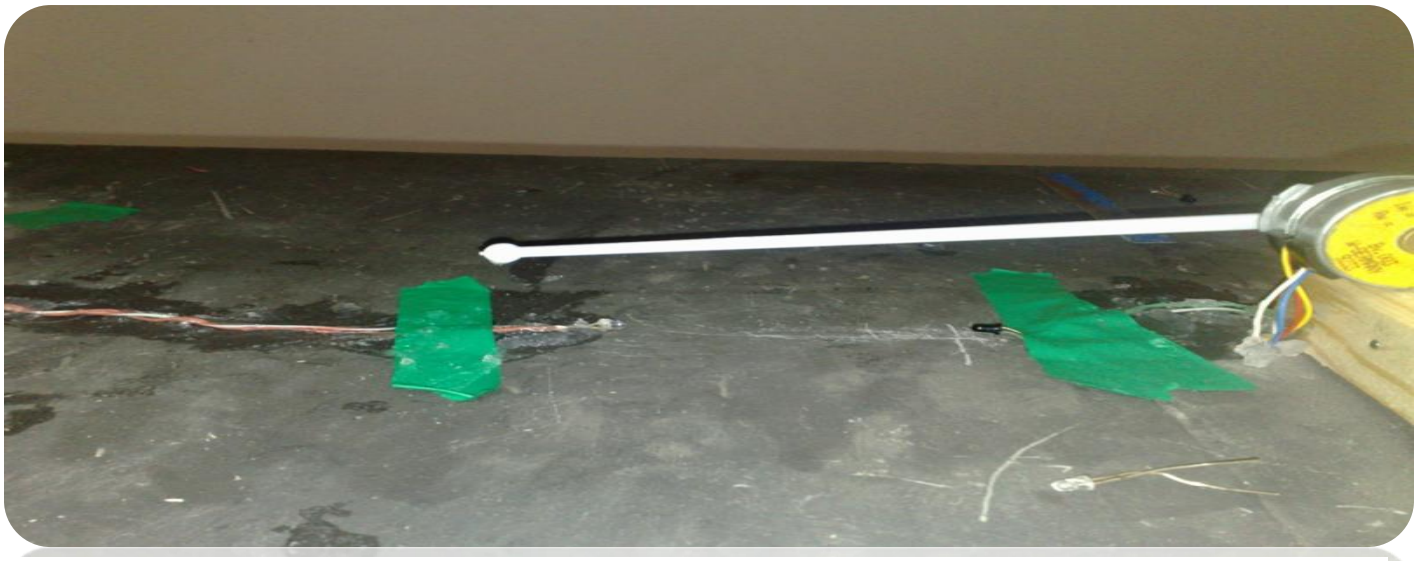


Figure 3. 21 : IR sensor under gate to prevent closing gate if there is something under the gate

3.3.2. Introduction:

"Infra" meaning below our ability to detect it visually, (4) and "Red" because this color represents the lowest energy level that our eyes can sense before it becomes invisible. Thus, infrared means below the energy level of the color red, and applies to many sources of invisible energy.

3.3.3. Active IR sensor V.s Passive IR sensor:

Active IR sensor

In active infrared sensors, (4) an infrared laser shoots pulses of infrared light at the CdS cell, which is attached to a detector circuit. As the pulses of light come, the resistance of the CdS cell drops, producing a spike in current. As long as the pulses of infrared light continue to produce pulses of current, the detector keeps the alarm off. If someone steps between the infrared laser and the cell, however, it breaks the beam. The current in the detector circuit then drops, triggering the alarm.

Passive IR sensors

Passive infrared sensors also work by detecting changes in infrared but in a more subtle way. A passive infrared sensor absorbs infrared in a large arc. As the sun rises and sets and the day get warmer and colder, the infrared signature changes gradually. If a person suddenly walks past, however, the infrared from his body creates a more drastic change in the infrared being picked up by the sensor. The sensor is programmed to ignore gradual changes, but will trigger the alarm if something changes quickly.

3.3.4. Steps of active IR sensor operation

Active IR sensor mainly depends on:-

- LED (radiate IR beam) act as transmitter.
- Phototransistor (CdS cell) acts as receiver.

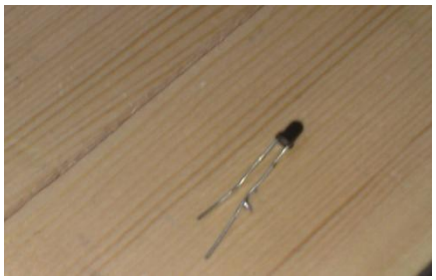


Figure 3. 22: IR receiver

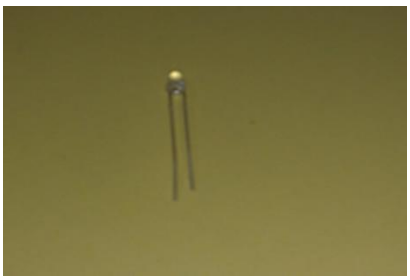


Figure 3. 23: IR transmitter

In active infrared sensors, an infrared beam shoots pulses of infrared light at the Phototransistor, which is attached to a detector. As the pulses of light come, the resistance of the Phototransistor drops, producing a spike in current. As long as the pulses of infrared light continue to produce pulses of current, the detector not do nothing. If something stops between the infrared beam and the Phototransistor, however, it breaks the beam. The current in the detector circuit then drops, triggering the flag in a program, because there is connection between IR sensor circuit and program that control gates by serial port connection (using DTR pin), this pin (DTR pin) act as flag.

If this flag=0 this mean there are nothing under the gate and it can close safely, on other hand if flag=1 it tends to that there are something under the gate so sending holding signal until flag comes to 0 again (checking flag act only after the gate open then rechecking every 300µsec)

In general using an active IR sensor for security, other situation that are not under control and not usually happen.

3.3.5. IR sensor Circuit:

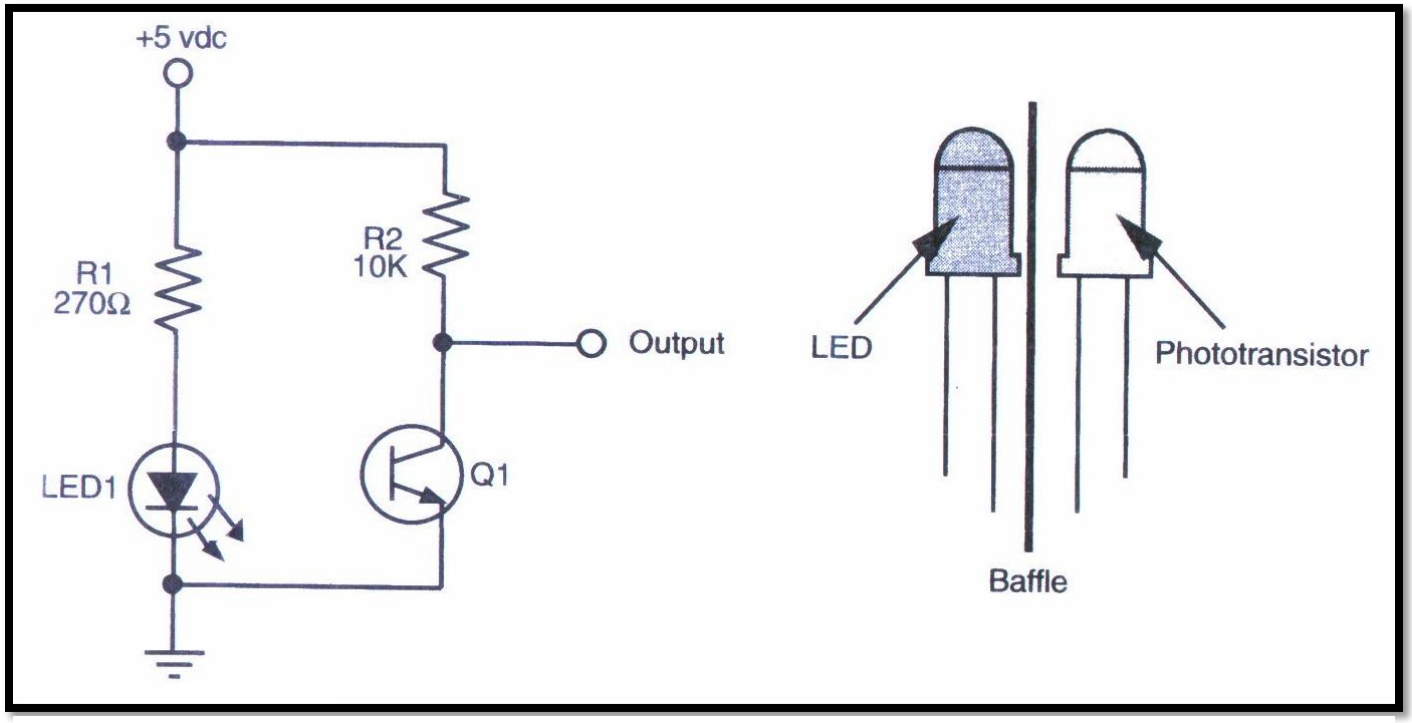


Figure 3. 24: circuit diagram IR transmitter (left) and receiver (right)

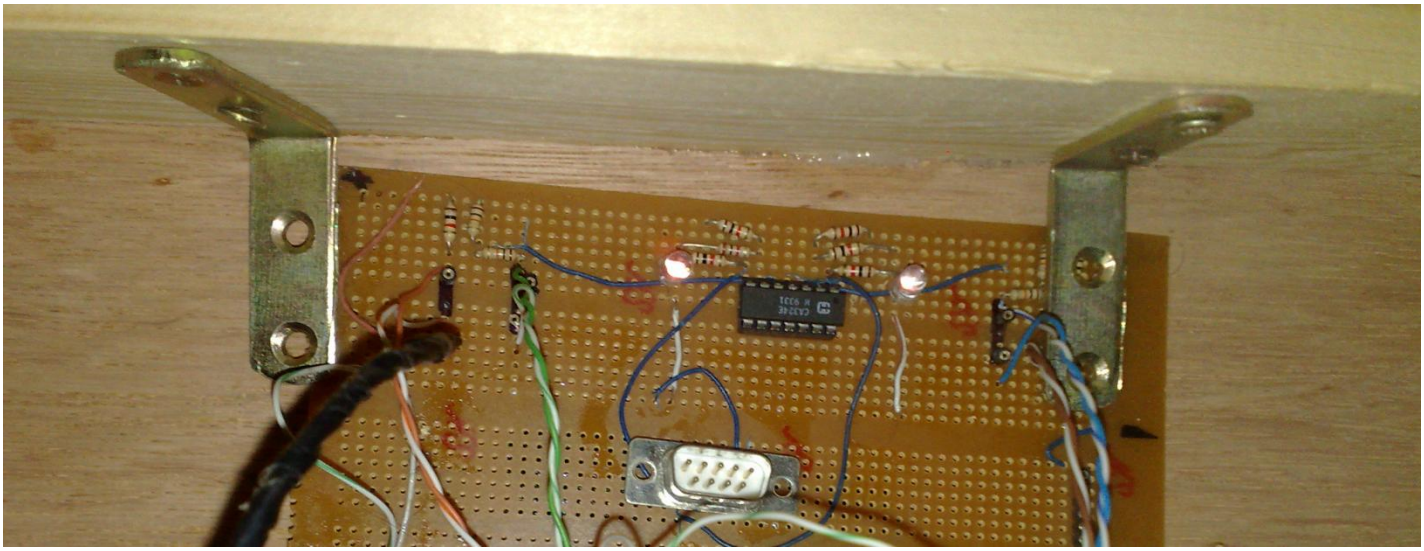


Figure 3. 25: Real implementation of IR sensor circuit

IR circuit consists of:

1. IR LED (radiate IR beam) act as transmitter.
2. Phototransistor acts as receiver.
3. Two resistance and its value depend on sensitivity of sensor (means what is distance that sensor work?)
4. Serial cable (RS232-9 pin) using DTR pin.
5. Wires
6. Voltage source (up to 5 V)

3.3.6. Pseudo code:

1. Open serial port
2. Open gate
3. While true
4. If flag=1
5. Send holding signal (300 μsec)
6. Else
7. Close gate
8. Close serial port
9. Break

3.3.7. IR sensor flow chart:

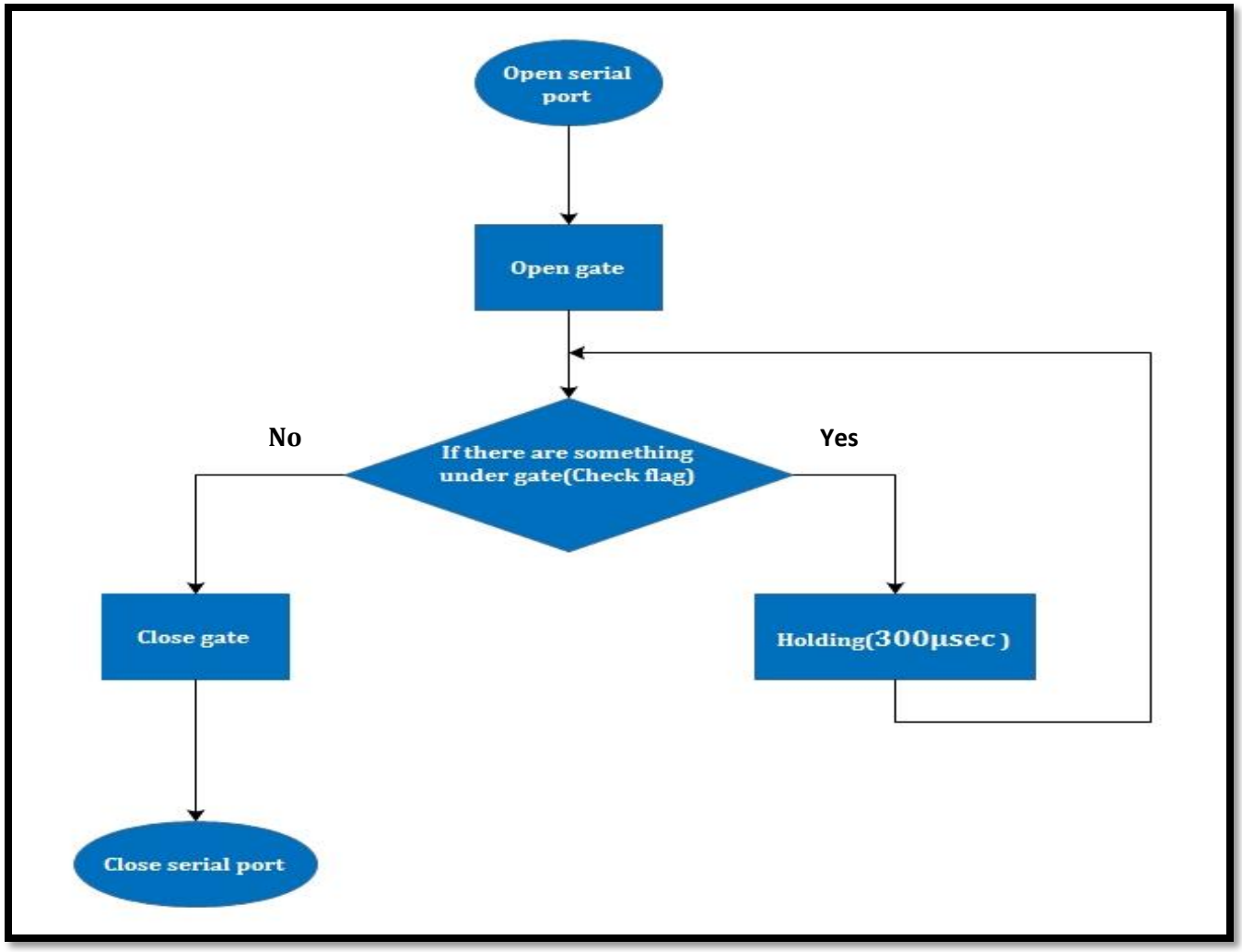


Figure 3.26: Flow Chart of Infrared Sensor

3.3.8. Prototype:

Figure 3. 27: Gate opened when detected car near

Figure 3. 28: Gate is holding on cause car stop under it

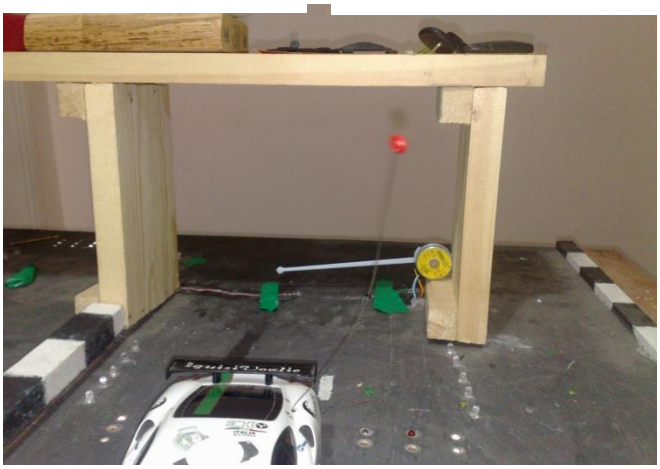


Figure 3. 29: Gate closed after car has gone

```
private void IRWait()
      {Boolean x = true;
         using (SerialPort sp = new SerialPort("COM1", 19200))
         {sp.Open();
            while (x == true)
            {this.statusBar1.Text = "Waiting the car to go.";
               x = sp.CtsHolding;
               Console.WriteLine(x);
               this.statusBar1.Text = "Waiting the car to go...";
            }
                  sp.Close();
}
      }
```

Chapter 4 :

Software of RFID System

Preview

We introduce in this chapter Program, database and Website and how we connect website with database.

4.Software of RFID System

4.1 Program

4.1.1 The Program's GUI

4.1.1.1 Main Form:

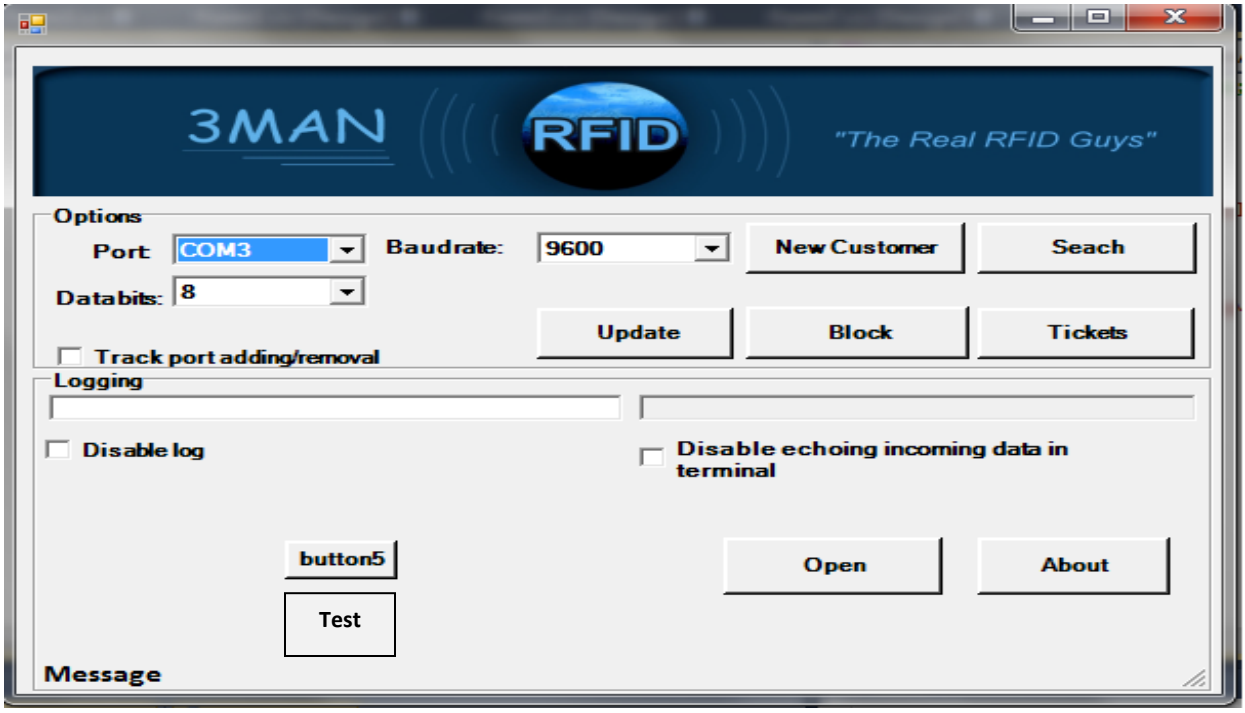


Figure 4. 1: Snapshot of Main Form

This is the main form, it is used for:

- Configuring the options of RFID reader's port
- Opening connection with RFID reader (COM Port)
- Logging of all events taking place
- Buttons to access other features:
  - Registering new car license
  - Searching for car details
  - Updating car license information
  - Blocking cars
  - Searching & Printing Tickets
  - Information about program & the programmers
  - Test button, to test any group of commands

4.1.1.2 Registering New Car License:

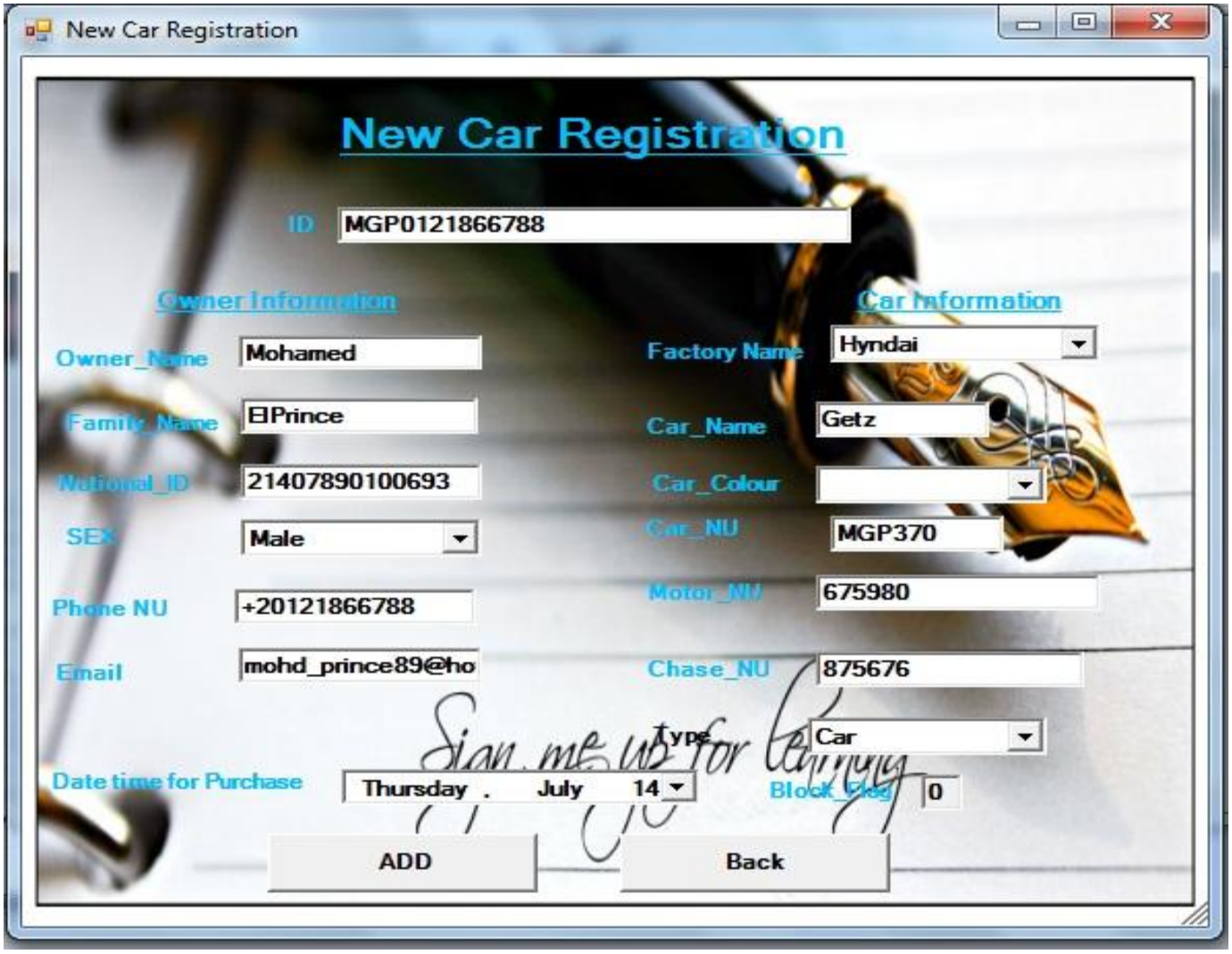


Figure 4. 2: Snapshot of Register New Car

This form is used to register the new car details and its owner's details. It is done when issuing the new car's license. The Tag ID, Owner's information & Car information is entered by the officer, these data is registered in the database.

4.1.1.3 Searching for car details:

Figure 4. 3 : Snapshots of Searching for car details

When any information is needed to be extracted from the database, for any reason (eg. Liscence renewal or issuing statement of data).

4.1.1.4 Updating license information:

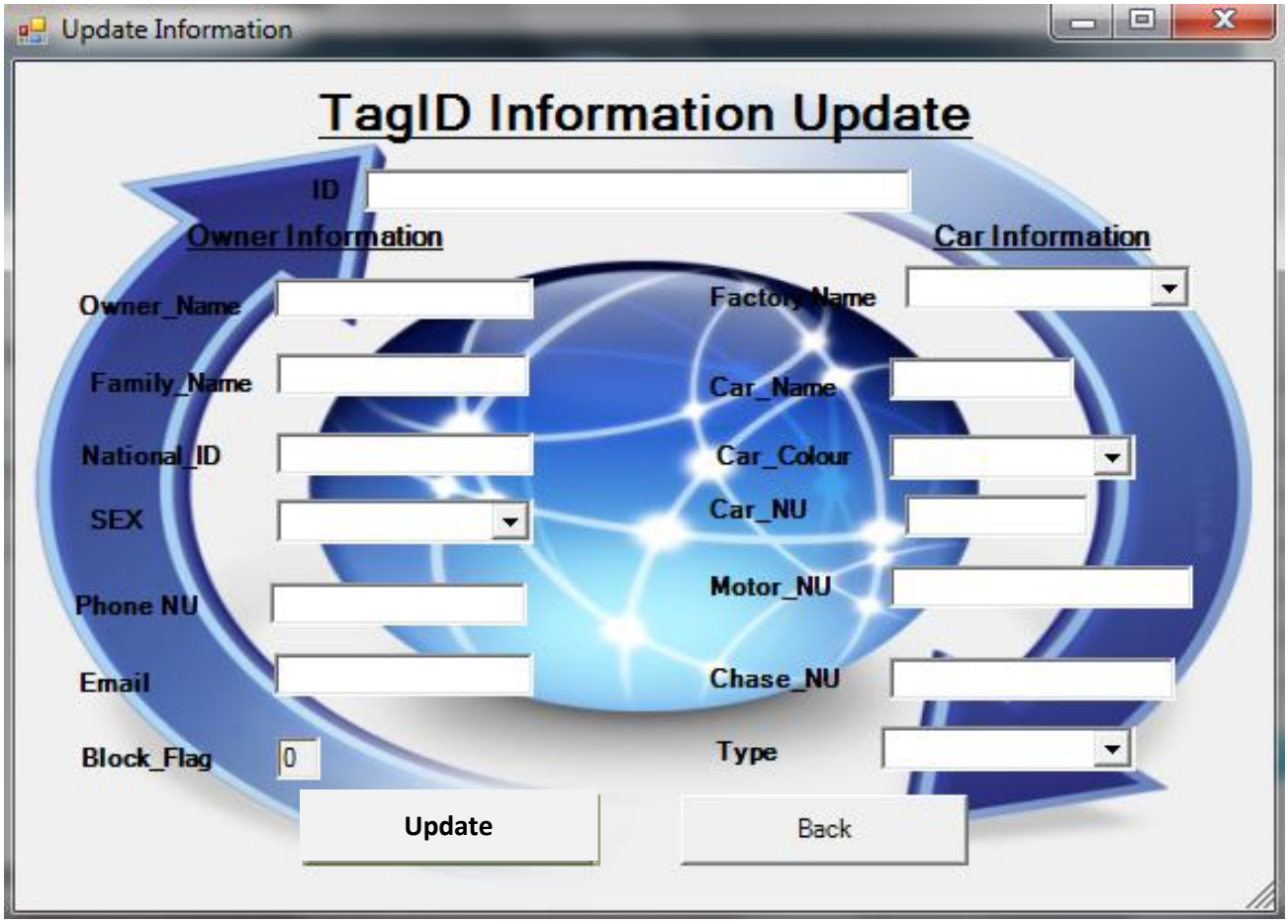


Figure 4. 4 : Snapshot of updating license information

This form is used to update the registered information, in case of any mistaken information, changing car owner or updating the owner's information.

4.1.1.5 Blocking a car:

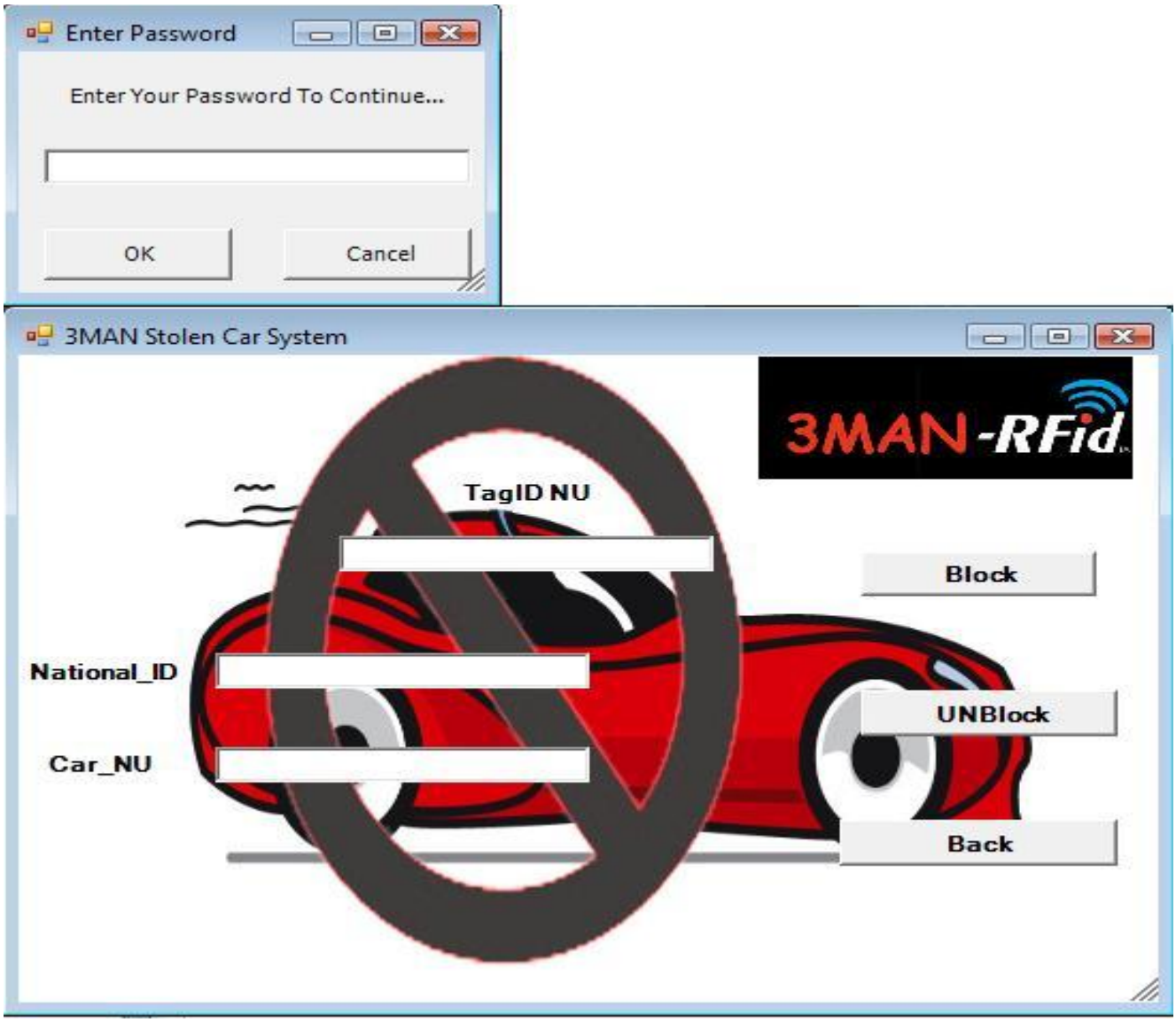


Figure 4. 5 : Snapshot of Blocking Car

To access this form you should have an administrator password.

This form is used to Block or Unblock a car's tag ID, if a car is stolen, its owner should contact the general administration of traffic and give all the car's details. The car is then is registered as blocked.

This will make the system track this car, and at highway gates the gates will not open and an alarm is started.

By this way, it will facilitate the retrieving stolen cars. If the car is retrieved the car is set unblocked again.

4.1.1.6 Searching & viewing tickets:

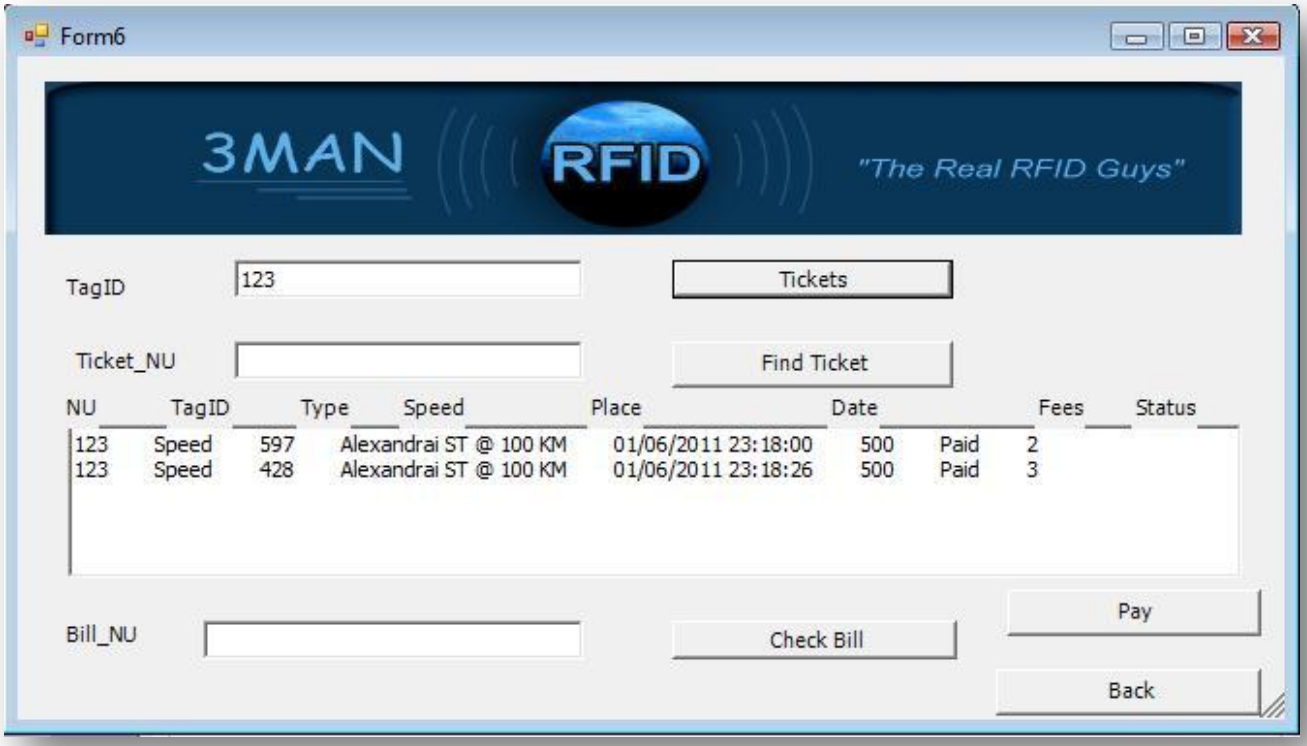


Figure 4. 6 Snapshot of Searching & Viewing tickets

This form is used for viewing and paying the car's tickets, you can search for all cars' tickets by using the car's TagID, or you can search for a specific ticket by its Ticket number.

If you choose to pay the tickets the program calculates the sum of all unpaid tickets and print a receipt containing the paid tickets with the sum to be paid.

4.1.1.7 About:

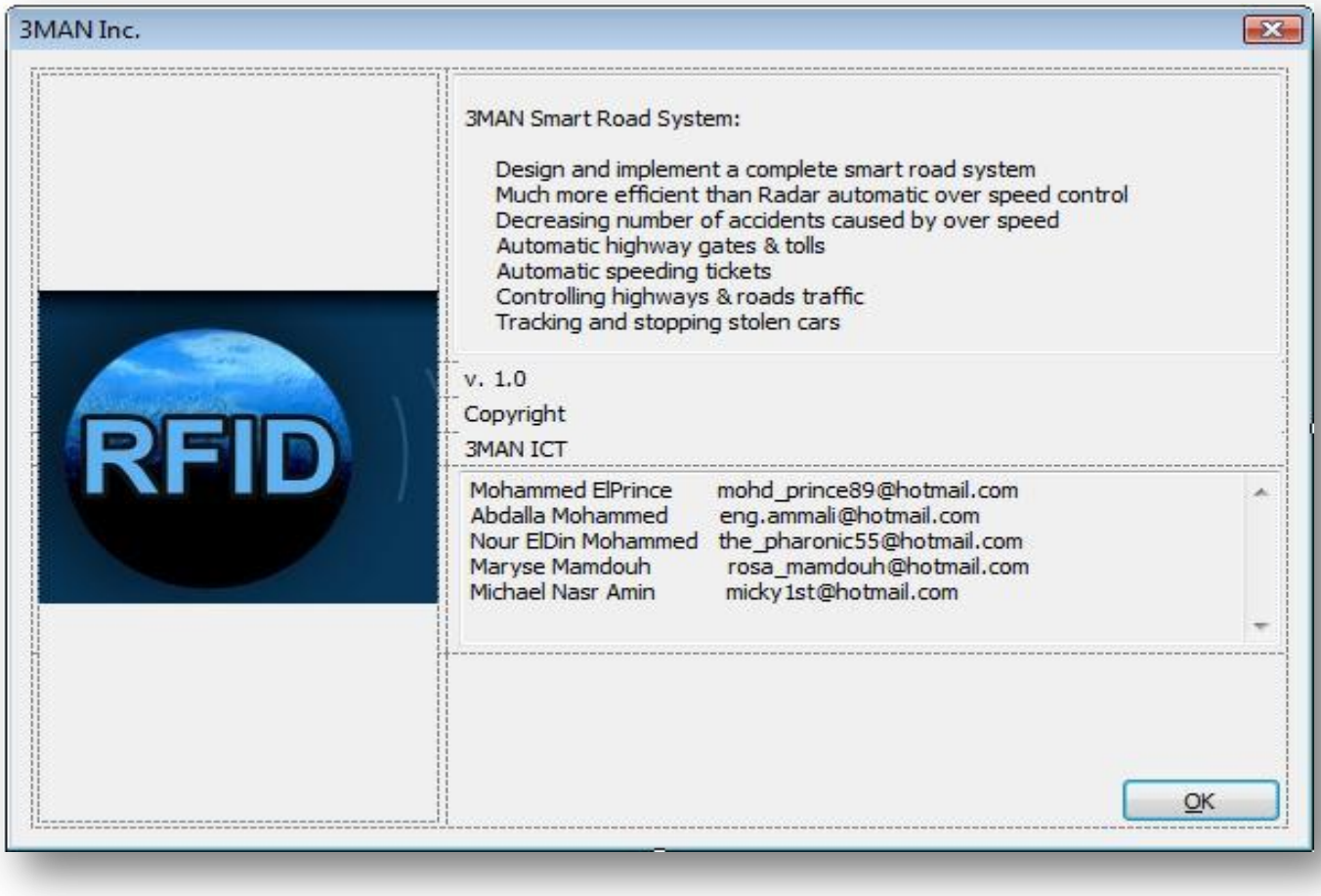


Figure 4. 7 : Snapshot of About 3MAN Smart Road System

This form is a hint about the program & the project's objectives and the developers.

4.1.2 Configuring RFID reader interface:

4.1.2.1 Serial port configuration:

Band Rate : 9600,N,8,1

Figure 4. 8 Serial Port Configuration

4.1.2.2 Opening Serial Port:

Figure 4. 9 : Open Port Button

axSPortAx1.Open(ComboPort.Text)

Where "ComboPort.Text" is the Port number which the RFID reader is connected to.

Reading Tag ID:

STX (02 HEX)	DATA (10 HEX)	CR	LF	ETX (03 HEX)

The Tag ID is the 10 HEX data bits, so we will exclude the unnecessary information we do not need, such as: STX, CR, LF & ETX.

4.1.3 Speed Calculations & Tickets

The main goal of this project is to overcome the disadvantages of the Radar system, and the worst thing about the Radar is that people knows the place of the Radar devices & that it measures instantaneous speed at certain points on the road.

Thus they can drive over speed all through the way and slow down at the points of radar devices, by this way they will never be caught over speeding. The following pictures show such an example of tricking a Radar system.

Figure 4. 10 Snapshot of Video showing limitation of Radar System

We thought of an idea to measure the average speed in between readers, instead of instantaneous speeds at certain points. By this way it is nearly impossible to trick the system.

To do this we need to give each car a unique ID which must be read at every reader, regardless of his driving speed. This can be done using RFID technology, each car will have an attached tag with unique ID registered at the General Administration of Traffic's database, and Radar devices will be replaced by RFID readers.

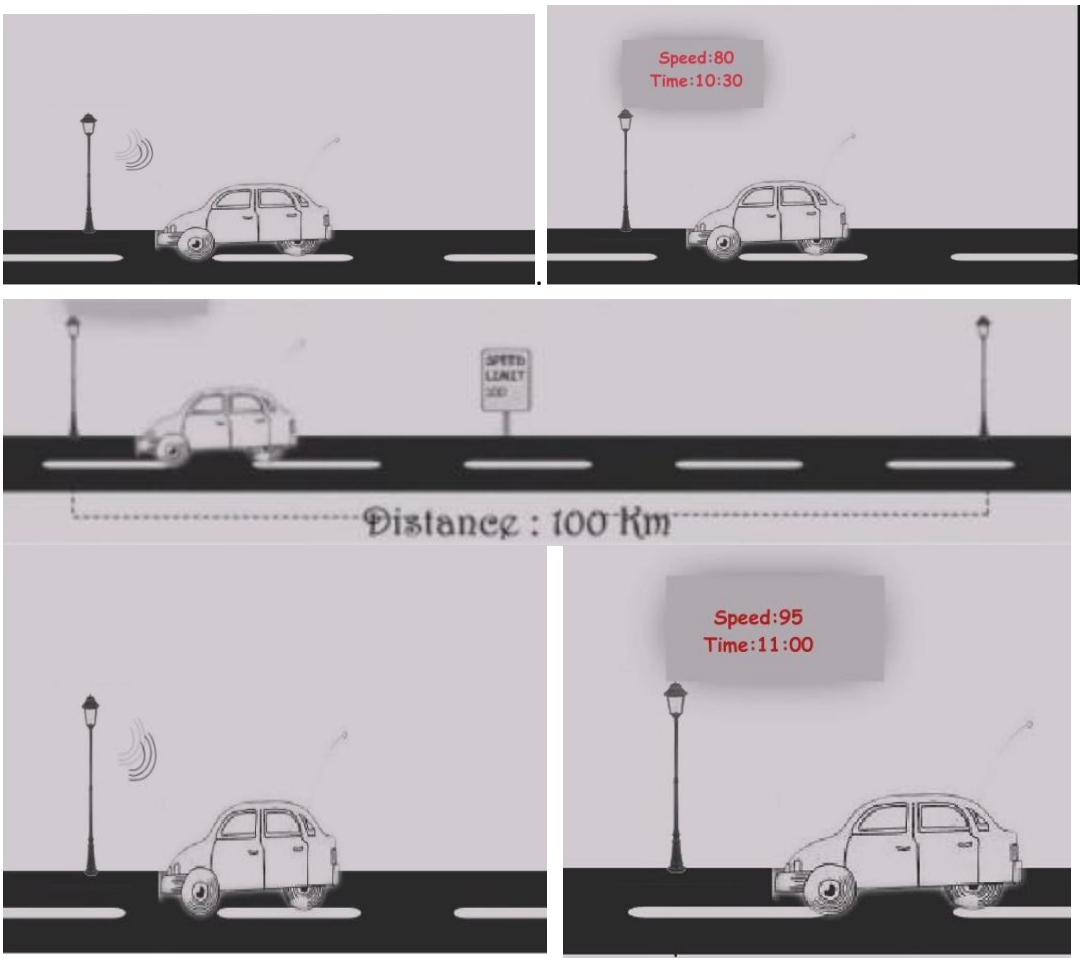


Figure 4. 11 Snapshot from simulation showing how our system calculate speed

Speed Ticket Issuing:

- When the car is read for the first time on the road, its tag ID is registered in the road's database, with the time it passed through the reader at point A for example.
- When the car passes through the second reader B, it is registered in the road's database, and the speed is calculated as follows:
  - $AverageSpeed = \frac{PositionB - PositionA}{TimeB - TimeA}$
  - Code:
    - SpeedCalc sc = new SpeedCalc();
    - int[] speed = sc.SpeedCal(t1, t2, "Car");
    - int speed = Convert.ToInt32(dist * 60 / t3.TotalMinutes);
    - int overdrive = speed - legalSpeed;
    - int[] x = {speed, 0};
- If the car was over speeding, then a speed ticket is issued and registered in the ticket's database.
  - Code:

```
if (overdrive <= 0){
System.Windows.Forms.MessageBox.Show("Legal Speed"); x[1] =
0;}
else if(overdrive<=10){
System.Windows.Forms.MessageBox.Show("Speed bill 50 L.E.");
x[1] = 50;}
else if(overdrive<=20){
System.Windows.Forms.MessageBox.Show("Speed bill 100 L.E.");
x[1] = 100;}
else if(overdrive<=30){
System.Windows.Forms.MessageBox.Show("Speed bill 200 L.E.");
x[1] = 200;}
else{ System.Windows.Forms.MessageBox.Show("Speed bill 500
L.E."); x[1] = 500;}
```

- ❖ The ticket detail is sent to the car owner via SMS & email.
  - (See the next topic)
- ❖ When a ticket is paid, the ticket is printed & registered as paid in the database.
  - Print using PCPrint class
  - Example:

TagID : 123
Owner_Name: 1 Car_No: 2

NU	Type	Speed	Ticket_Place	Date	Fees	Status
2	Speed	597	Alexandrai ST @ 100 KM	01/06/2011 23:18:00	500	Paid
3	Speed	428	Alexandrai ST @ 100 KM	01/06/2011 23:18:26	500	Paid

---

Total Fees :1000 LE

Figure 4. 12: An example of printed ticket bills

4.1.4 Sending Emails & SMS

After registering the speed ticket, the car's owner is notified about the ticket and its value on his registered E-mail and mobile number. When the ticket is issued, an E-mail and SMS is automatically generated and sent via SMTP and a GSM modem to the owner.

4.1.4.1 E-mail:

a. Code:

```
//..................... Send Email .....................

String sms = "You've received a speeding ticket!
\nSpeed: " + speed[0] +
"\nPlace: Alexandrai ST @ 100 KM\nTime: " + DateTime.Now +
"\nBill: " + speed[1];
SendMail(sms, x2);//
this.statusBar1.Text = "Email ticket sent to the car owner";
```

b. Example:

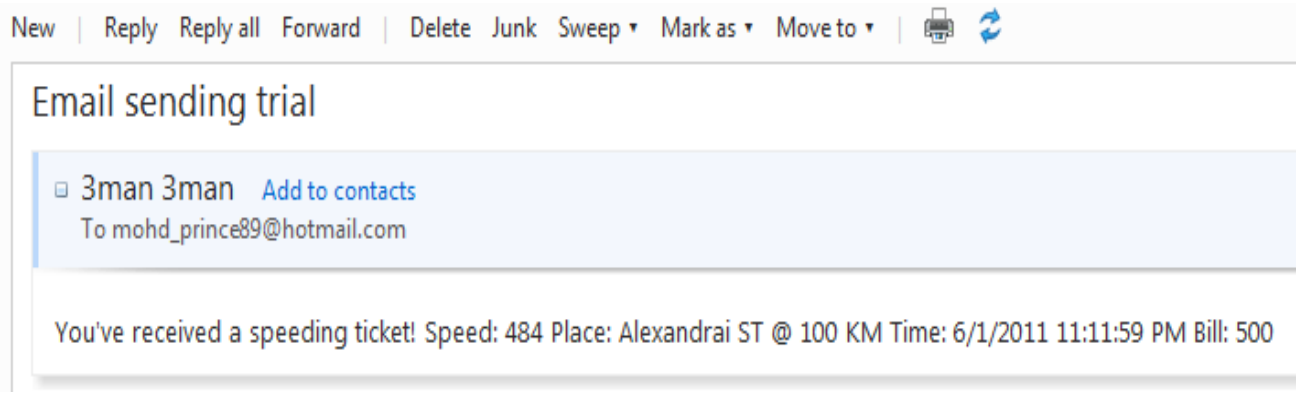


Figure 4. 13: A ticket Email sending

4.1.4.2 SMS:

a. Code:

```
//..... Send SMS .....

String sms = "You've received a speeding ticket!
\nSpeed: " + speed[0] +
"\nPlace: Alexandrai ST @ 100 KM\nTime: " + DateTime.Now +
"\nBill: " + speed[1];
sendSMS("COM10", x1, sms);//
this.statusBar1.Text = "SMS ticket sent to the car owner";
```

b. Example:

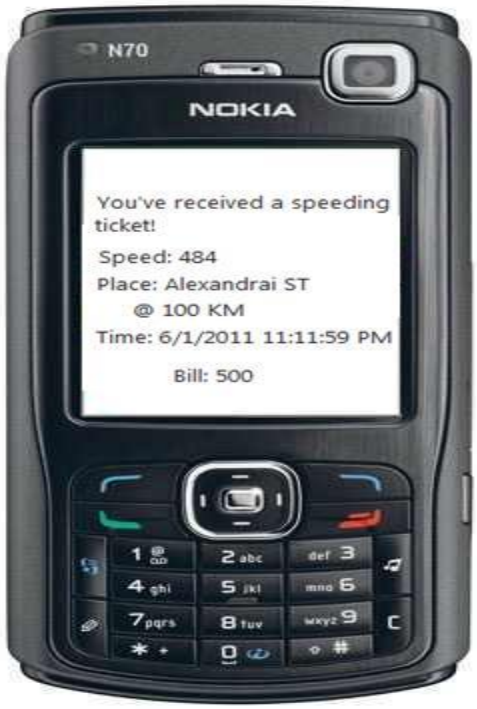


Figure 4. 14 A ticket SMS sending

4.1.5 Unified Modeling Language (UML) of the program:

(See appendix C)

4.2 Database :

4.2.1 Introduction:

A database is an integrated collection of data. Many different strategies exist for organizing data in databases to facilitate easy access to and manipulation of the data (5).A database management system (DBMS) provides mechanisms for storing and organizing data in a manner that is consistent with the database's format. Database management systems enable programmers to access and store data without worrying about the internal representation of databases.

Today's most popular database systems are relational databases. Almost universally relational databases use a language called Structure Query Language (SQL) to perform queries (i.e., to request information that satisfies given criteria) and to manipulate data.

Some popular, enterprise-level relational database systems include Microsoft SQL server, Oracle, Sybase, DB2, Informix and MySQL.

A programming language connects to, and interacts with a relational database via an interface-software that facilitates communication between a database management system and a program. C# programmers communicate with databases and manipulate their data through Microsoft ActiveX Data Objects (ADO), ADO.NET.

4.2.2 Structured Query Language (SQL)

Table 4. 1 :Structured Query Language (SQL)

SQL keyword	Description
SELECT	Select (retrievers) field from one or more tables.
FROM	Specifies tables from which to get fields or delete records. Required in every SELECT & DELETE statement.
WHERE	Specifies criteria that determine the row to be retrieved.
INNER JOIN	Joins records from multiple tables to produce a single set of records.
GROUP BY	Specifies criteria for grouping records.
ORDER BY	Specifies criteria for ordering records.
INSERT	Insert data into a specified table.
UPDATE	Updates data in specified table.
DELETE	Deletes data from a specified table.

4.2.2.1 Basic SELECT Query

A typical SQL query selects information from one or more tables in a database. Such selections are performed by SELECT Queries.

The basic format for SELECT query is:

SELECT * FROM table-name

In this query, the (*) indicates that all columns from the table-name of the database should be selected.

Example:

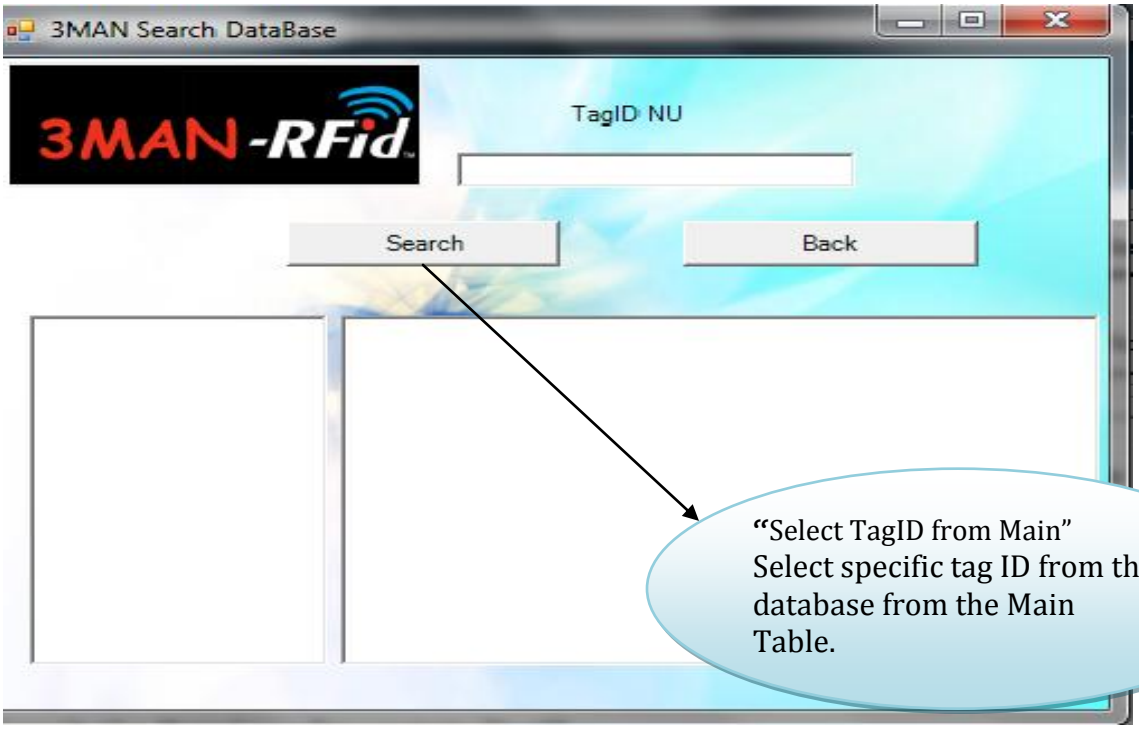


Figure 4. 16 : Snapshot of 3MAN Search Database

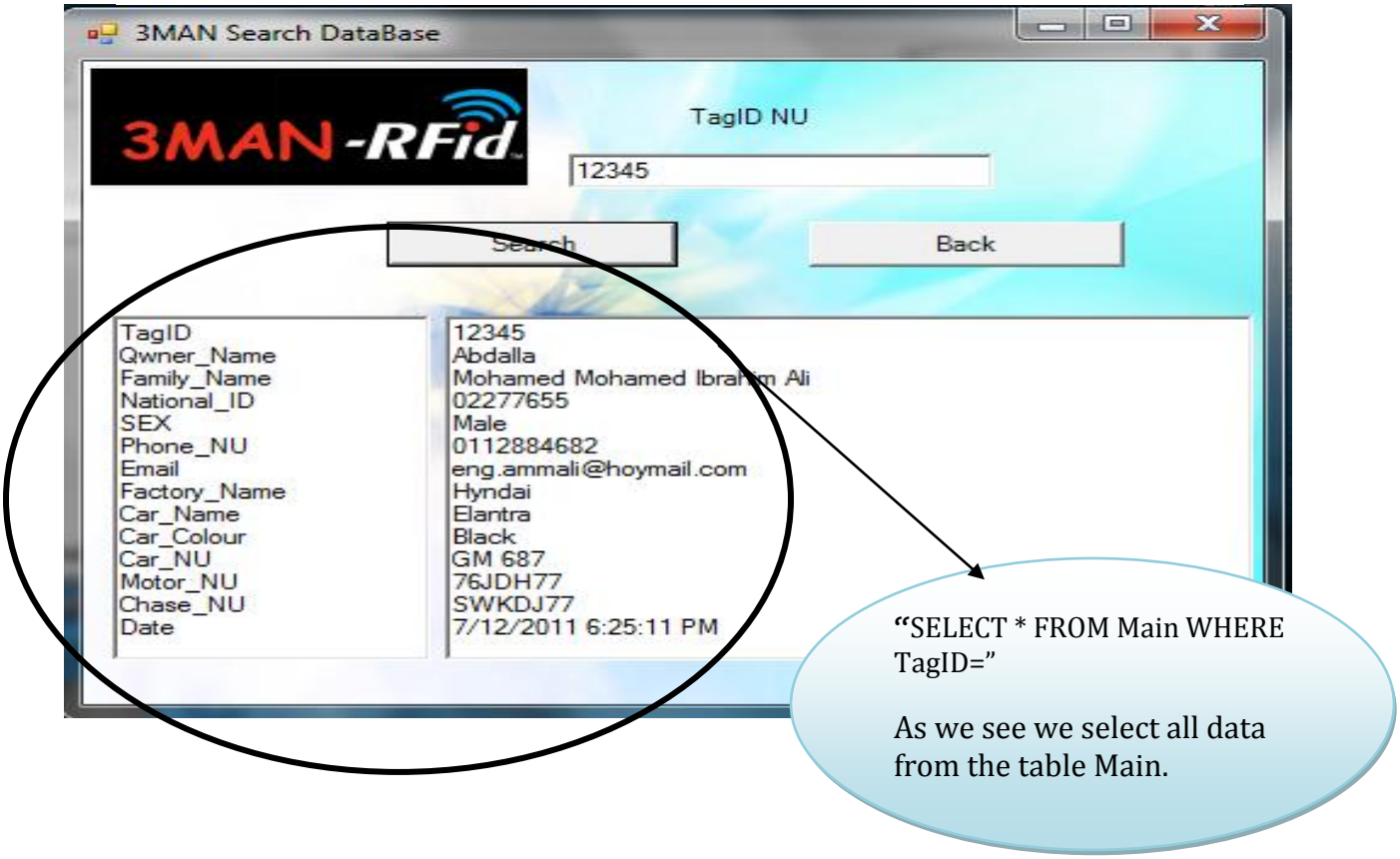


Figure 4. 15: show that (Select *) take all the data from the table.

Table 4. 2 : Show data in the database table.

TagID	Qwner_Name	Family_Name	National_ID	SEX	Phone_NU	Email	Factory_Name	Car_Name	Car_Colour	Car_NU	Motor_NU
123	1	1	1	Female	2	mohd_prince89...	BMW	2	Red	2	2
12345	Abdalla	Mohamed Moh...	02277655	Male	0112884682	eng.ammali@h...	Hyndai	Elantra	Black	GM 687	76JDH77

To select specific fields from a table, replace the (*) with a comma-separated list of the field names to select.

Example

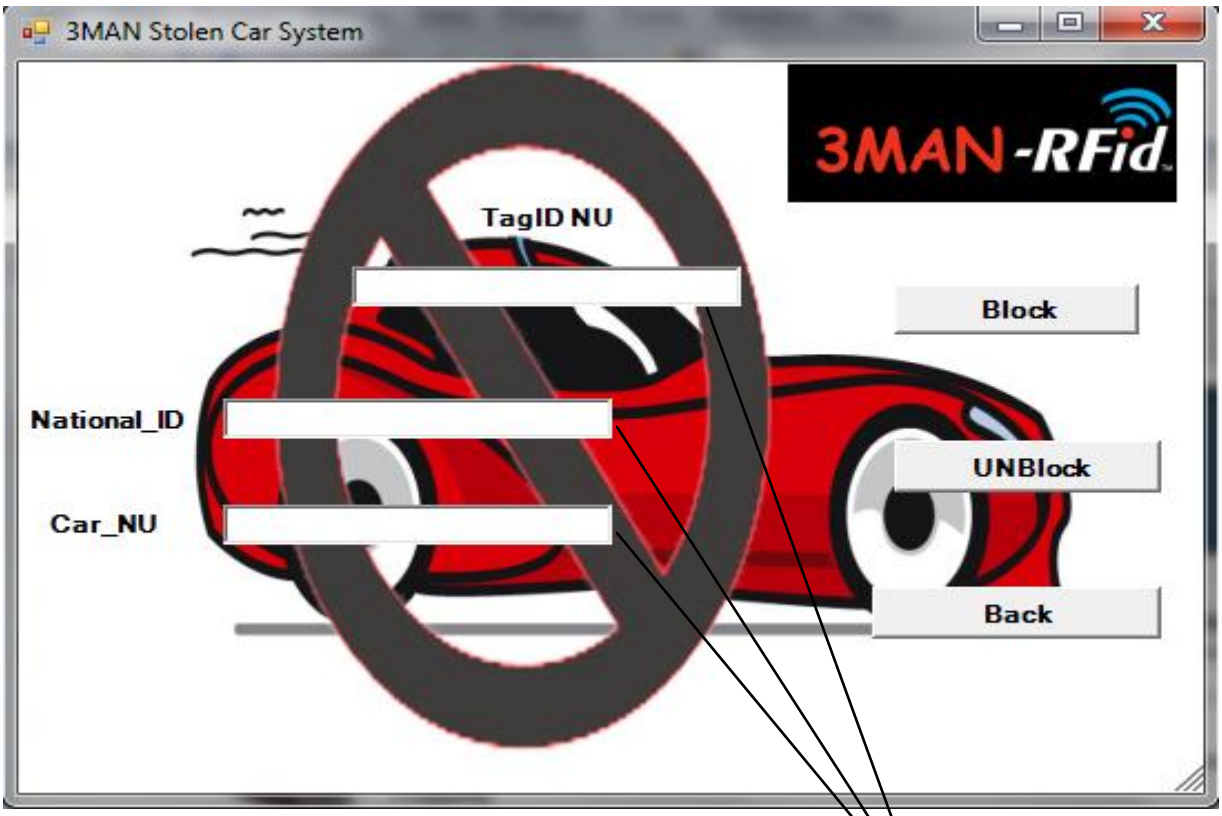


Figure 4. 17 : show select for specific fields.

"SELECT TagID , National_ID , Car_NU
FROM MAN"

Select TagId, NationalID and Car_NU to compare with entered data.

4.2.2.2 WHERE Clause

In most cases, users search a database for records that satisfy certain selection criteria. Only records that match the selection criteria are selected. SQL uses the optional WHERE clause in a SELECT query to specify the selection criteria for the query. The simplest format for a SELECT query that includes selection criteria is :

SELECT fieldName1, fieldName2 FROM table-Name WHERE criteria.

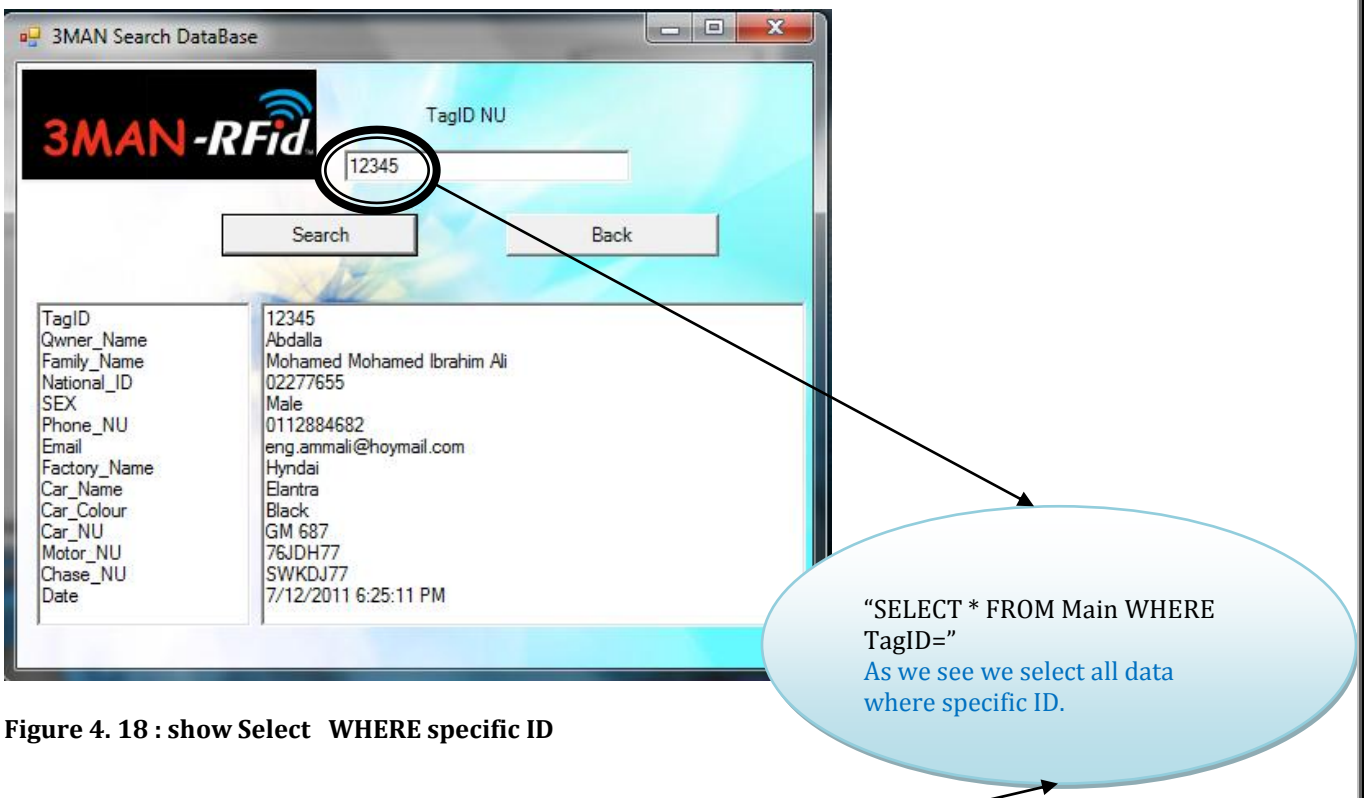


Figure 4. 18 : show Select WHERE specific ID

Table 4. 3 show selection for the same ID in the last Figure.

TagID	Qwner_Name	Family_Name	National_ID	SEX	Phone_NU	Email	Factory_Name	Car_Name	Car_Colour	Car_NU	Motor_NU
123	1	1	1	Female	2	mohd_prince89...	BMW	2	Red	2	2
12345	Abdalla	Mohamed Moh...	02277655	Male	0112884682	eng.ammali@h...	Hyndai	Elantra	Black	GM 687	76JDH77

The WHERE clause condition can contain operators <,>, <=,>=, =, <> and LIKE. Operator LIKE is used for pattern matching with wildcard characters, asterisk (*) and question mark (?).

4.2.2.3 ORDER by Clause

The result of a query can be arranged in ascending or descending order using the optional ORDER BY clause. The simplest forms for an ORDER BY clause are:

SELECT fieldName1, fieldName2, ...FROM table-Name ORDER BY field ASC

SELECT fieldName1, fieldName2, ……FROM table-Name ORDER BY field DESC

Example

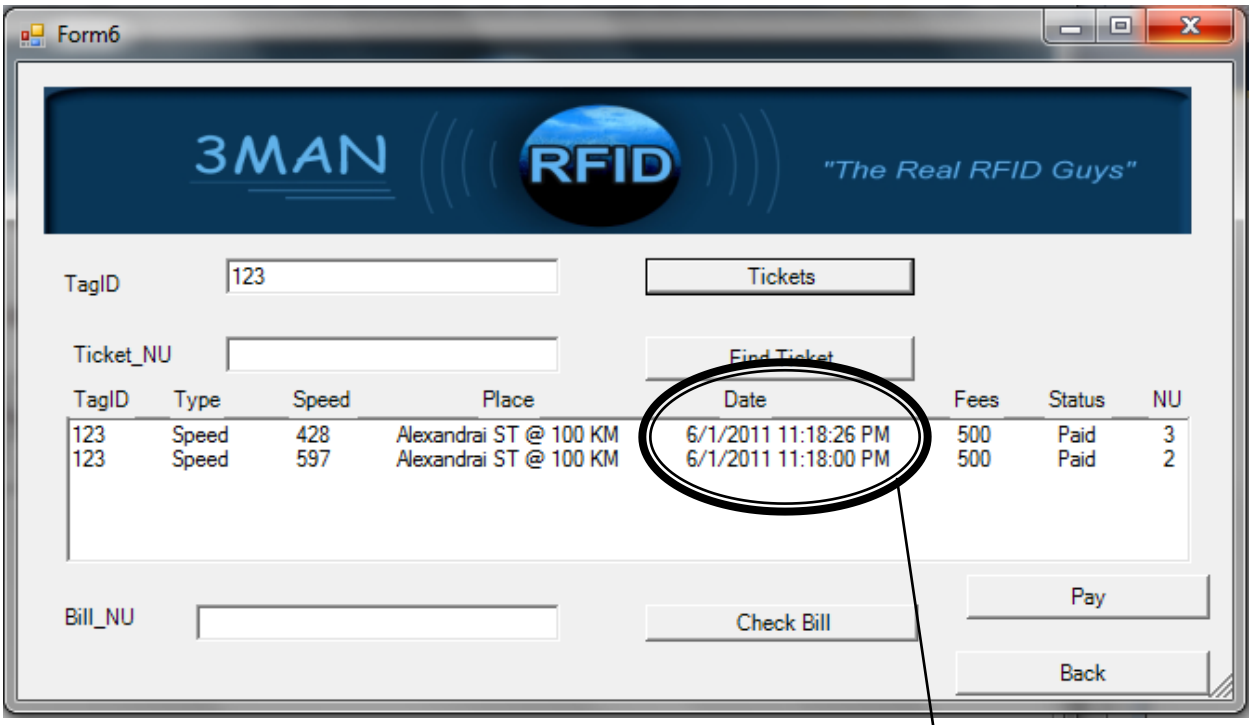


Figure 4. 19 : sorting the data descending.

"SELECT * FROM Ticket WHERE TagID='" +
ID + "'ORDER BY Date DESC"
As you can see it is ordered according to date.

4.2.2.4 INSERT STATEMENT

The insert statement inserts a new record in a table. The simplest form for this statement is:

INSERET INTO table-name (fieldName1, fieldName2, fieldName3… fieldName N)

VALUES (value1, value2, ……,valueN)

Where table-Name is the table in which to insert the records. The table-Name is followed by a comma-separated list of field names in parentheses. The list of field names is followed by the SQL keyword values and a comma-separated list of values in parentheses. The specified values in this list must match the field names listed after the table name in both order and type.

Example

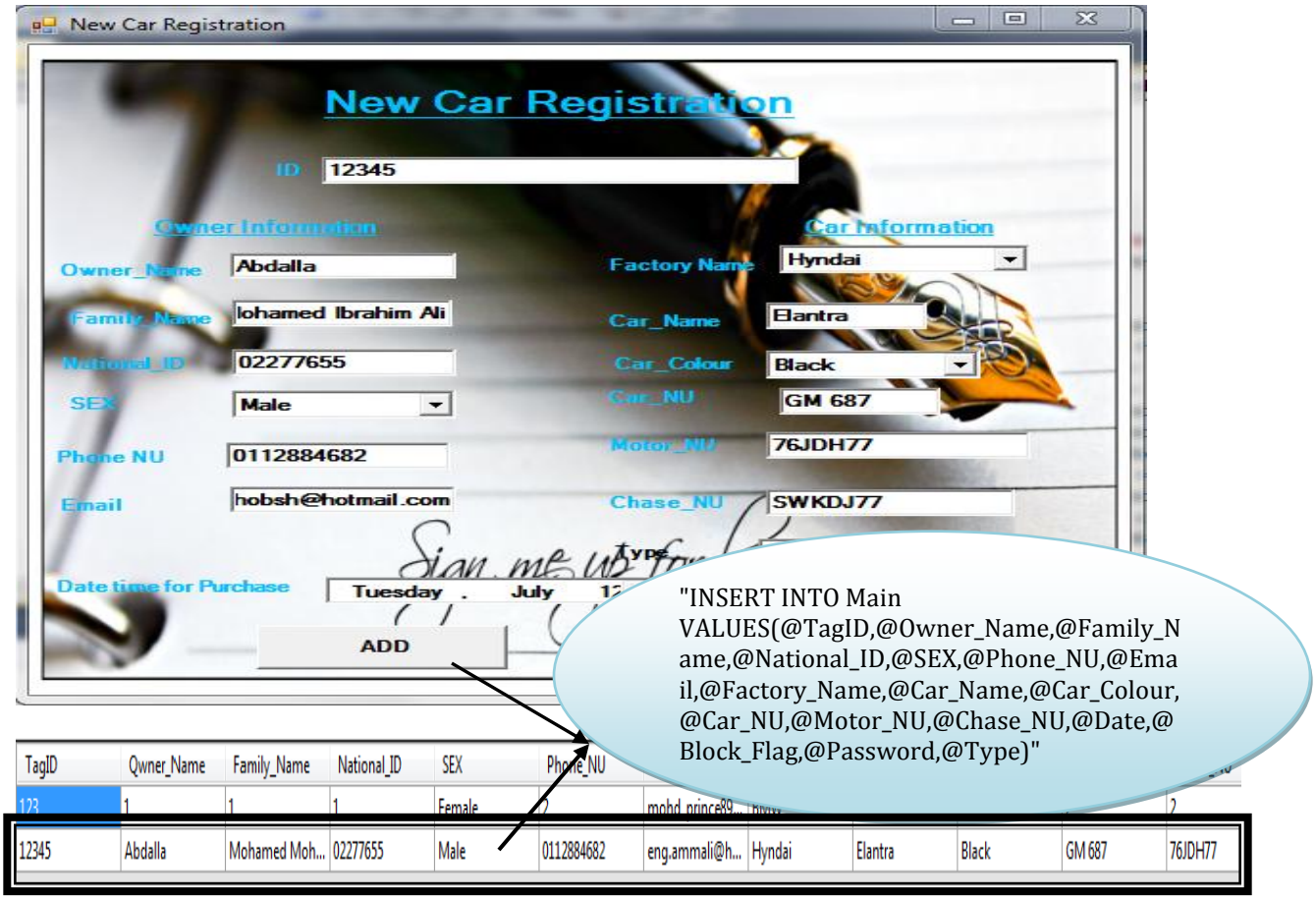


Figure 4. 20 : Show inserts statement

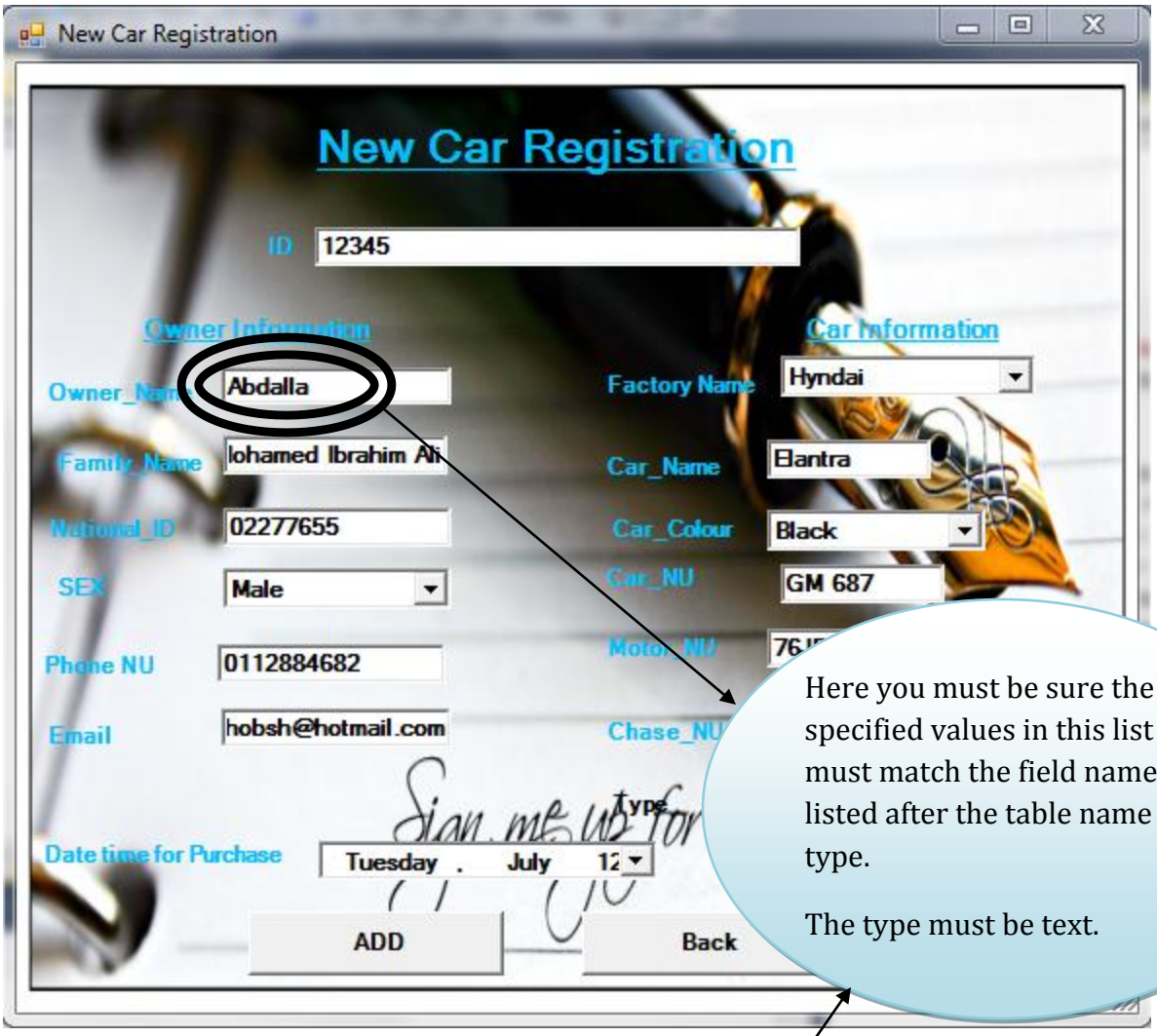


Figure 4. 21 The data entered must be like the type of the field in the database.

```
db.InsertCommand.Parameters.Add("@TagID", SqlDbType.Int).Value = textBox1.Text;
db.InsertCommand.Parameters.Add("@Family_Name", SqlDbType.NText).Value = textBox8.Text;
db.InsertCommand.Parameters.Add("@National_ID", SqlDbType.NText).Value = textBox10.Text;
db.InsertCommand.Parameters.Add("@SEX", SqlDbType.NText).Value = comboBox1.Text;
db.InsertCommand.Parameters.Add("@Phone_NU", SqlDbType.NText).Value = textBox4.Text;
db.InsertCommand.Parameters.Add("@Email", SqlDbType.NText).Value = textBox7.Text;
db.InsertCommand.Parameters.Add("@Factory_Name", SqlDbType.NText).Value = comboBox2.Text;
db.InsertCommand.Parameters.Add("@Car_Name", SqlDbType.NText).Value = textBox2.Text;
db.InsertCommand.Parameters.Add("@Car_Colour", SqlDbType.NText).Value = comboBox3.Text;
db.InsertCommand.Parameters.Add("@Car_NU", SqlDbType.NText).Value = textBox3.Text;
db.InsertCommand.Parameters.Add("@Motor_NU", SqlDbType.NText).Value = textBox6.Text;
db.InsertCommand.Parameters.Add("@Chase_NU", SqlDbType.NText).Value = textBox5.Text;
db.InsertCommand.Parameters.Add("@Date", SqlDbType.DateTime).Value = dateTimePicker1.Value;
db.InsertCommand.Parameters.Add("@Block_Flag", SqlDbType.Int).Value = textBox9.Text;
db.InsertCommand.Parameters.Add("@Password", SqlDbType.NText).Value = x;
db.InsertCommand.Parameters.Add("@Type", SqlDbType.NText).Value = comboBox4.Text;
```

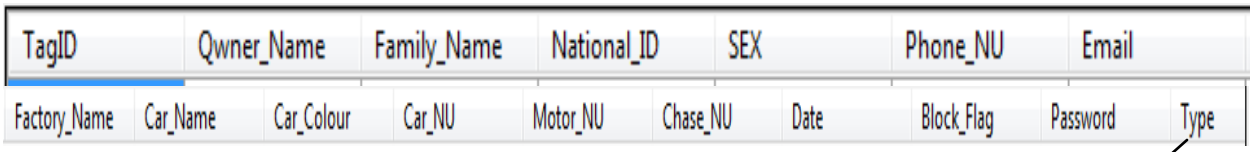


Figure 4. 22 : The data must be sorted like in the Database .

The specified values in this list must match the field names listed after the table name in order.

```
db.InsertCommand.Parameters.Add( @TagID", SqlDbType.Int ).Value = textBox1.Text;
db.InsertCommand.Parameters.Add( @Owner_Name", SqlDbType.NText).Value =richTextBox1.Text;
db.InsertCommand.Parameters.Add( @Family_Name" SqlDbType.NText).Value = textBox8.Text;
db.InsertCommand.Parameters.Add( @National_ID" SqlDbType.NText).Value = textBox10.Text;
db.InsertCommand.Parameters.Add( @SEX", SqlDbType.NText).Value = comboBox1.Text;
db.InsertCommand.Parameters.Add( @Phone_NU", SqlDbType.NText).Value = textBox4.Text;
db.InsertCommand.Parameters.Add( @Email", SqlDbType.NText).Value = textBox7.Text;
db.InsertCommand.Parameters.Add( @Factory_Name", SqlDbType.NText).Value = comboBox2.Text;
db.InsertCommand.Parameters.Add( @Car_Name", SqlDbType.NText).Value = textBox2.Text;
db.InsertCommand.Parameters.Add( @Car_Colour", SqlDbType.NText).Value = comboBox3.Text;
db.InsertCommand.Parameters.Add( @Car_NU", SqlDbType.NText).Value = textBox3.Text;
db.InsertCommand.Parameters.Add( @Motor_NU", SqlDbType.NText).Value = textBox6.Text;
db.InsertCommand.Parameters.Add( @Chase_NU", SqlDbType.NText).Value = textBox5.Text;
db.InsertCommand.Parameters.Add( @Date", SqlDbType.DateTime).Value = dateTimePicker1.Value;
db.InsertCommand.Parameters.Add( @Block_Flag", SqlDbType.Int).Value = textBox9.Text;
db.InsertCommand.Parameters.Add( @Password", SqlDbType.NText).Value = x;
db.InsertCommand.Parameters.Add( @Type", SqlDbType.NText).Value = comboBox4.Text;
```

4.2.2.5 Update Statement

An UPDATE statement modifies data in a table. The simplest form for an UPDATE statement is:

UPDATE table-Name

SET fieldName1= Value1, fieldName2= Value2,……, fieldname N= Value N

WHERE criteria

Where table-Name is the table in which to update a record (or records).The table-Name is followed by keyword SET and a comma-separated list of field name /value pairs written in the format, field-name=value. The where criteria used to determine which records to update.

Example:

"UPDATE Time4Speed SET Time1=Time2 , Time2=@Time2 , Street_Name= @Street_Name WHERE TagID = @TagID"

Before UPDATE

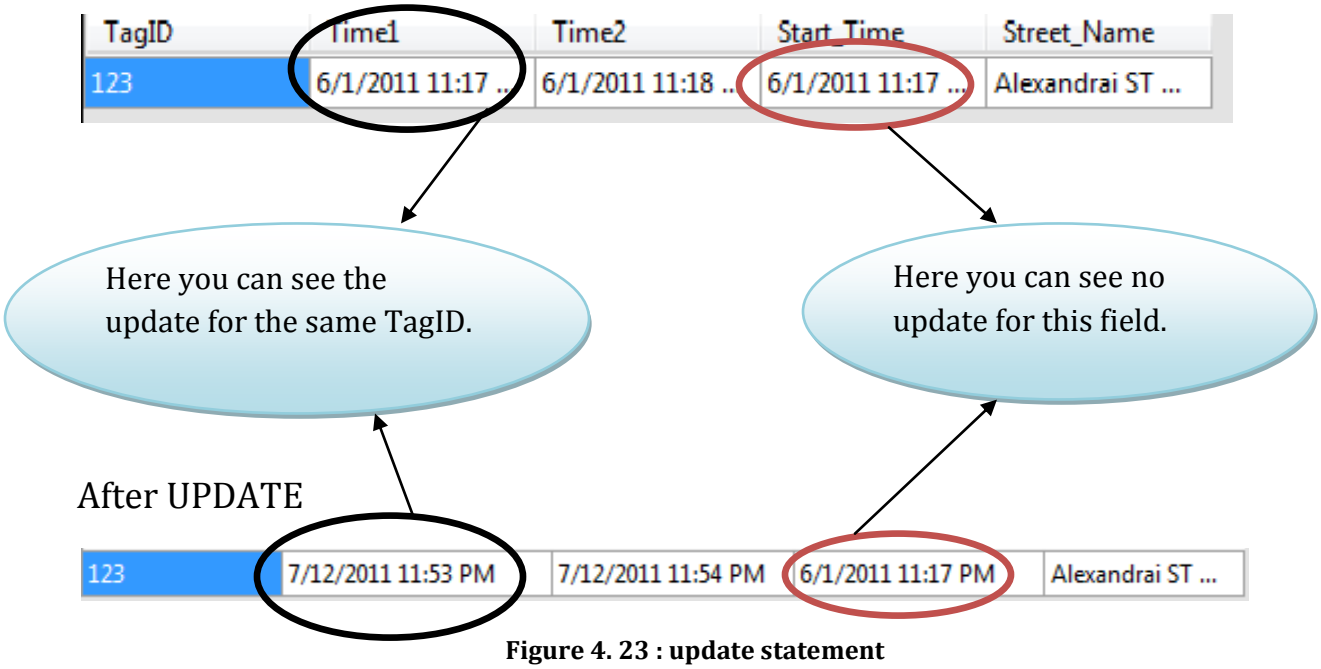


Figure 4. 23 : update statement

4.2.3 ADO.NET Object Model

The ADO.NET object model provides an API for accessing database programmatically. ADO .NET was created for the .NET framework and is the next generation of ActiveX data objects (ADO) (5).

Namespace system. Data is the root namespace for the ADO .NET.API. The primary namespace for (ADO .NET .System. Data.01eDb) and (System. Data. Sqlclient), contain classes that enable programs to connect with and modify data sources. Namespace (System. Data. 01eDb) contains classes that are designed to work with any data source, whereas the (System. Data. Sqlclient) namespace contain classes that are optimized to work with Microsoft SQL server 2000 databases.

Instances of class (System. Data. Dataset) which consist of a set of data tables and relationships among those Data Tables represents caches of data -— data that a program stores temporarily in local memory. The structure of a dataset mimics the structure of a relational database. (5) An advantage of using class dataset is that it is disconnected ___ the program does not need a persistent connection to the data source to work with data in a dataset. The program connects to the data source only during the initial population of the dataset and then to store any changes made in the dataset. Hence, the program does not require any active. Permanent connection to the data source.

Instances of class oleDbconnection (namespace System. Data. OLeDb) represent connections to a data source. An instance of class oleDbconnection and can populate a dataset with data from that data source. We discuss the details of creating and populating datasets. An instance of class oleDbcommand (namespace System. Data. oleDb) represents an arbitrary SQL command to be executed on a data-source a program can use instances of class oledbcommand to manipulate a data-source through an oladbconnection. (5) The programmer must close the active connection to the datasource explicitly once no further changes are to be made. Unlike dataset. Oledbecommend objects do not cache data in local memory.

4.3 Website Driven Database

4.3.1 Introduction:

Population of Egypt has increased in an incredible manner nowadays, so traditional techniques in many fields of our life are inefficient to get an acceptable grade of service.

Since that internet has invaded about 50% of Egypt's population and it becomes an undeniable part of the human's life as it is now applied in many fields like travel booking, e-learning, getting health information and even shopping.

So these traditional methods are now replaced with internet servicing which are easier to use, more efficient and easily accessed from anywhere (no crowded places which result in undesired delay).

The Advantages of having a website are :

1. You can publicize your business, service or products to millions of potential customers, having a web site can increase your sales.

2. You can update your web site with your latest news or prices much easier and cheaper than printing a based media. A web site can save you a lot of money in communication and administration costs.

3. You can link your web site with other advertising campaigns therefore creating brand awareness.

4. Your business can advertise and publicize on the internet 24 hours a day, 365 days of the year.

5. Websites are easier and cheaper to change / update, than conventional print based media. Content Management Systems can be set-up so that you can update any section of your web site, whenever you want as often as you want.

4.3.2 Objectives

All you need is just a pc which is supported by any type of internet service. That's why 3M.A.N Website is created to make such objectives have achieved.

As 3M.A.N Website enables live connection with the user's vehicle to check up his speed weather it beyond the allowable limits or not, it even affords the user a required ticket in case of using in proper speed which is already mentioned in our project (each route is mentioned with its allowable speed). Also any suggestions are taken into consideration to improve our service via the text area.

Our 3Man's website main objective is to decrease the pressure resulted from the great number of vehicle users on the general administration of traffic offices, as it supports the user with many helpful information by just several clicks on our website via the internet.

As this information includes the user status weather he/she has any type of tickets for exceeding the drive speed, parking in a no parking area.....etc

Also our site provides a full paying service such that the user can pay the service fees or tickets by means of credit card and other paying options via the internet at home.

So there is no need to get to traffic facility and get the place crowded in there.

Also any complements or suggestions are welcomed and being taken into consideration via our text area in 3M.A.N website.

4.3.3 ASP.Net :

First, I have to choose ASP.NET with c# that I will use to build 3M.A.N Website.

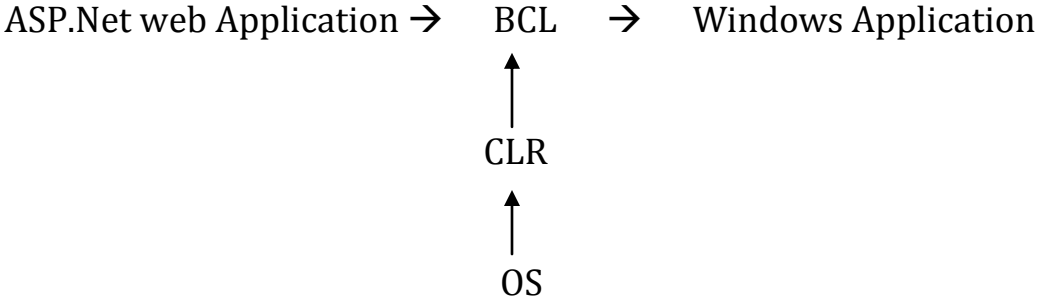
4.3.3.1 Introduction about ASP.NET:

- ASP.NET is a web application framework developed and marketed by Microsoft to allow programmers to build dynamic web sites, web applications and web services .

- ASP.Net using c# or VB.net
  Database → SQL Server, Xml
  It is used for web development

In 3M.A.N System Website we have choose to use C# as programming Language and SQL Server as Database.

4.3.3.2 ASP.Net Architecture



BCL → Base class language
CLR → Common Language Runtime
OS → Operating System

4.3.3.3 Why we use ASP.NET ?

1. Powerful.
2. Reusability.
3. For web application not for desktop.

4.3.4 Mind Map of 3M.A.N Website

Building a website is such a detailed job and it is easy to get lost amongst the list of jobs to do.

Wondering what to do first is a major problem, so we developed a mind map for me to help us find what to do first.

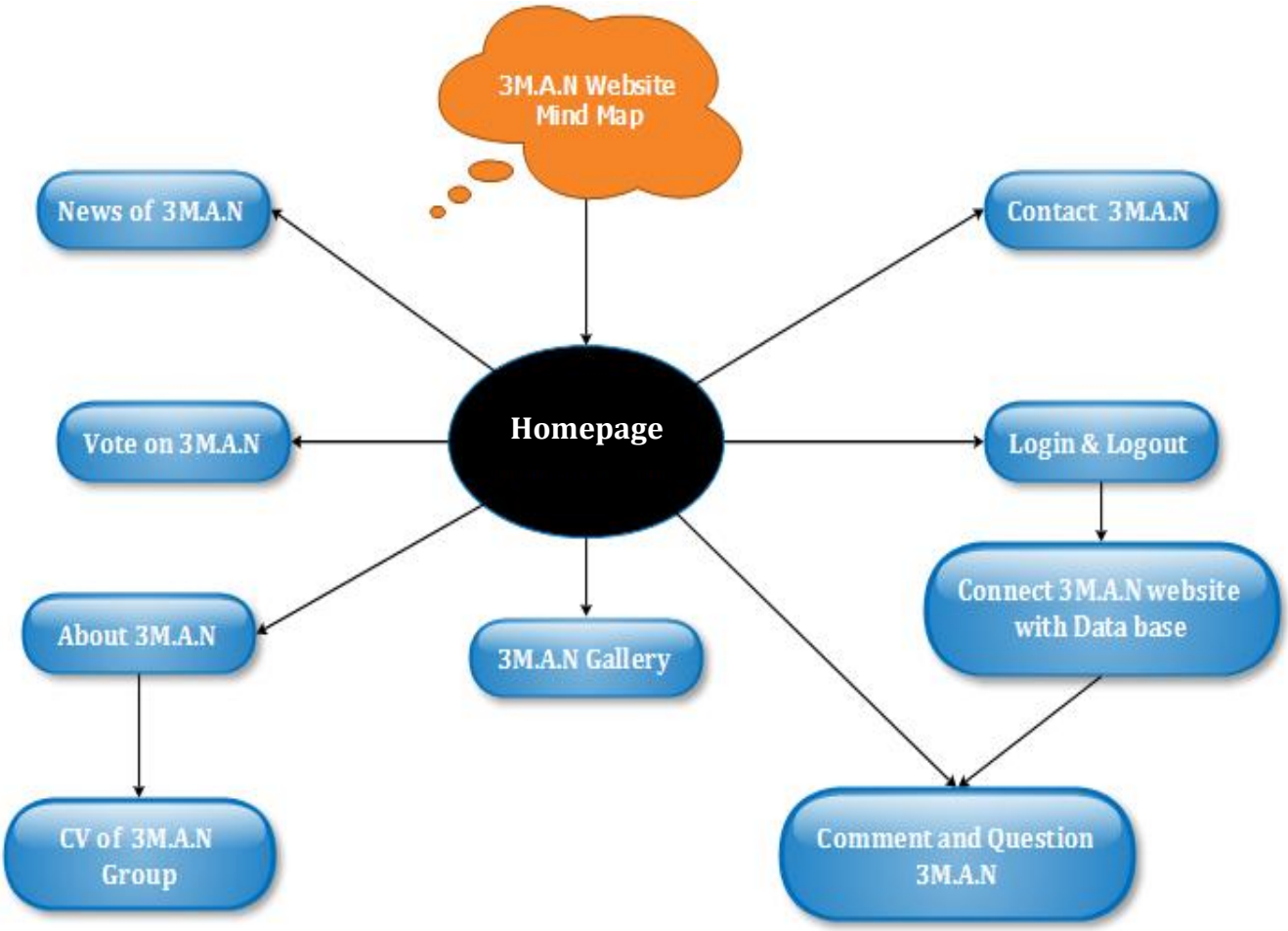


Figure 4. 24 : Mind Map of 3M.A.N System Website

4.3.5 Connect Database with 3M.A.N website

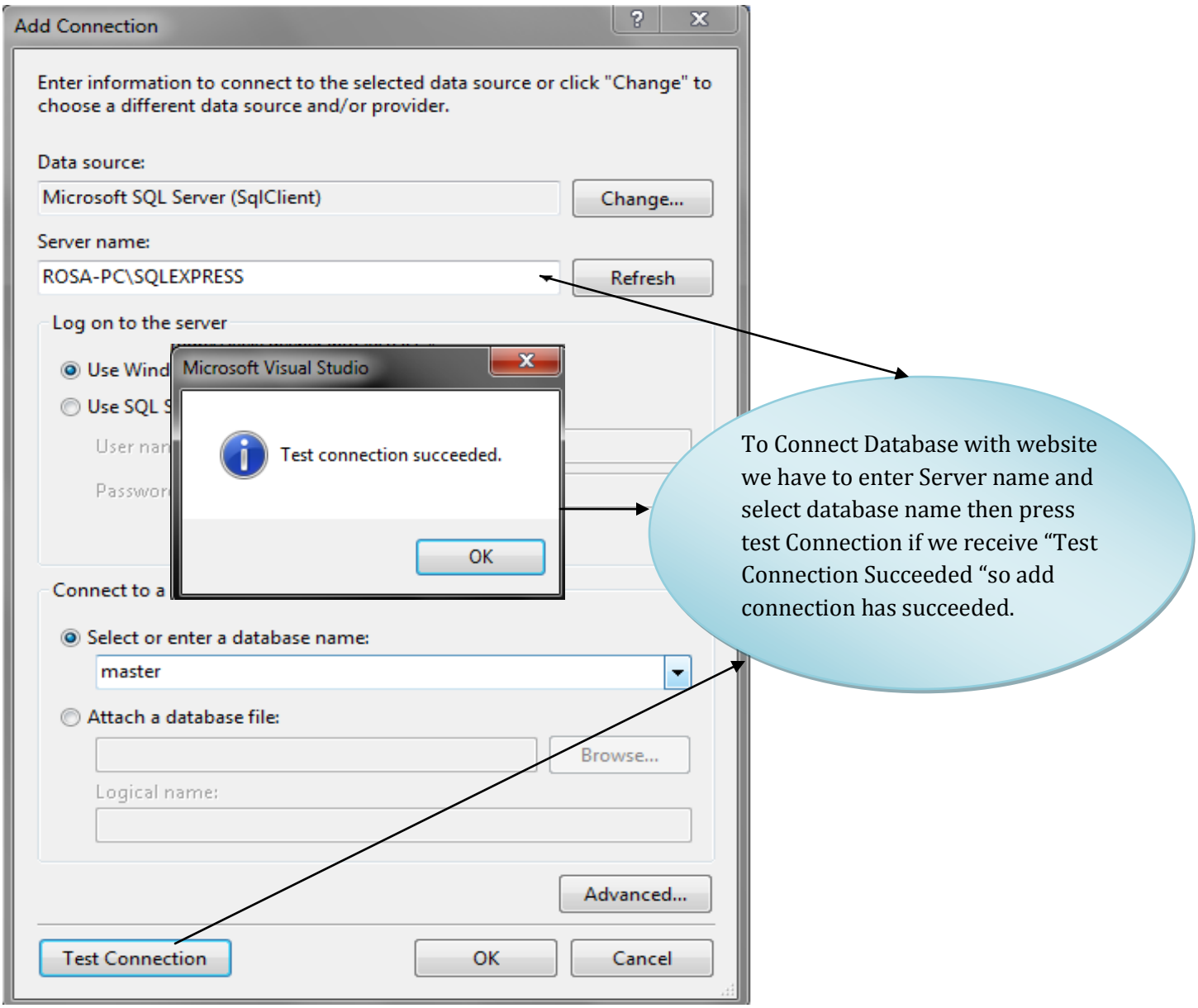


Figure 4. 25 Add database connection to website

```
SqlConnection cm = new
SqlConnection(ConfigurationManager.ConnectionStrings["ConnectionString"].
ConnectionString);
cm.Open();
```

4.3.6 Building 3M.A.N Website

So let us first start with the description of some pages of 3M.A.N website.

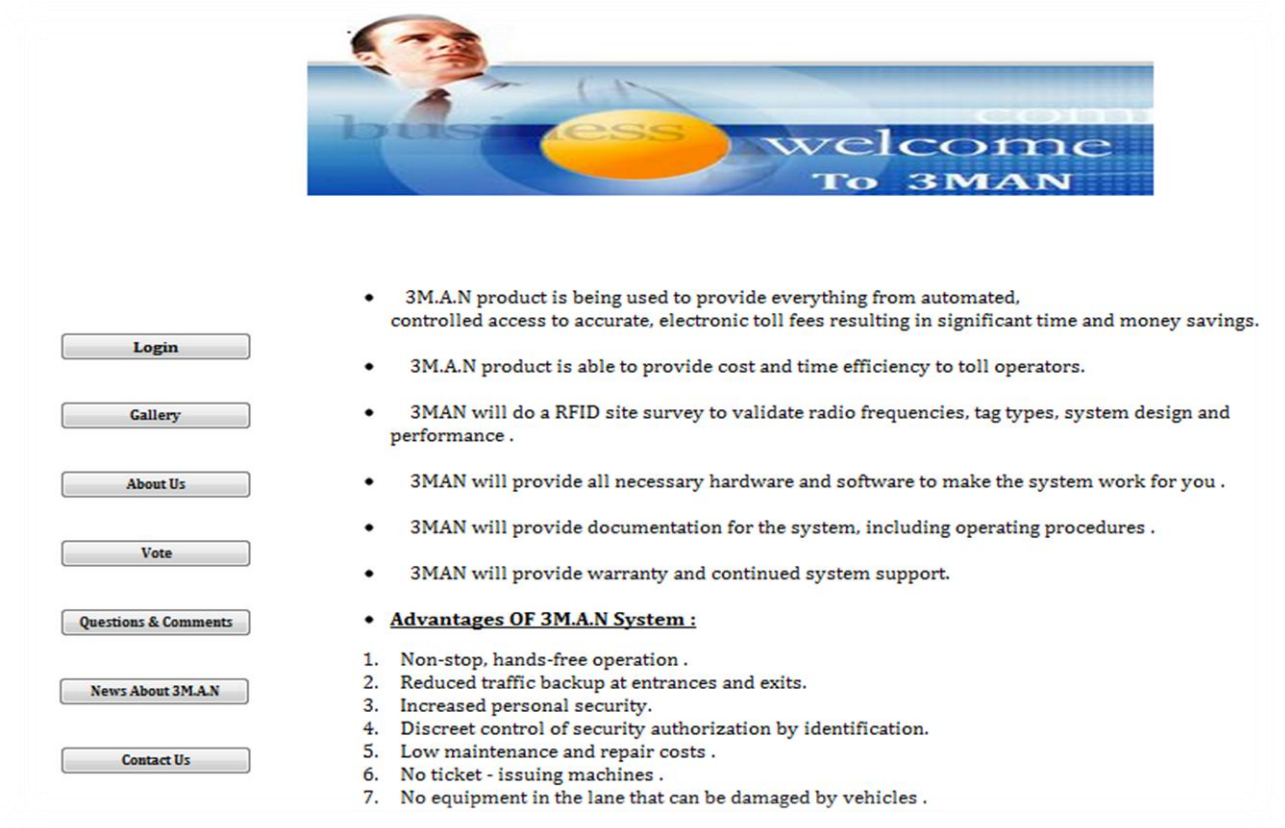


Figure 4. 26: Snapshot of the Homepage of 3M.A.N Website

When you first open this 3MAN website to know your ticket fees, you'll find this page which contain the description of the 3MAN system as well as some tabs:

a. Login.
b. Gallery.
c. About us.
d. Vote.
e. Questions and comments.
f. News about 3MAN.
g. Contact us.

- We will identify each tab in different images.

a. Login

Figure 4. 27 : Snapshot Login to 3M.A.N Website

Objective:

The user needs to log in 3MAN website using his username and password, to check ticket fees of all his irregularities and whether he has paid it or not.

Idea :

a. When the user enters his username and password he presses login, in this step the program will search for the entered username in the text box in the column of the username of the database of 3MAN.

b. As the program is searching for the username in its database, if not found a message will appear to the user telling him that it is invalid username, if found a comparison will take place between the password entered in the text box and the password saved in the database related to the entered username.

c. In the comparison between the two passwords shown before, there will be two possibilities, first the password doesn't match so a message will appear informing the user that the password is invalid, so the second possibility is matching with the saved password in the password column of the database, in this case user login is done and a page containing all his data will be opened.

So we have started with creating a small database as a test and we connected it to the website, and then after finishing the website, the website is connected with the large database of 3MAN.

Table 4. 4 : Test Database Table

Column Name	Data Type	Allow Nulls
[Owner Name]	varchar(50)	☐
[Family Name]	varchar(50)	☐
Sex	varchar(50)	☑
username	varchar(20)	☐
Nationality	varchar(50)	☑
[Phone Number]	int	☑
Email	varchar(50)	☐
[Tag ID]	int	☐
Factor_Name	varchar(50)	☐
Car_Name	varchar(50)	☐
Car_color	varchar(50)	☐
Car_Num	int	☐
password	int	☐
[Ticket Type]	varchar(50)	☑
Speed	int	☑
[Ticket Place]	varchar(50)	☑
Date	datetime	☑
[Ticket Fees]	money	☑
Status	varchar(50)	☑
[Ticket Number]	int	☑

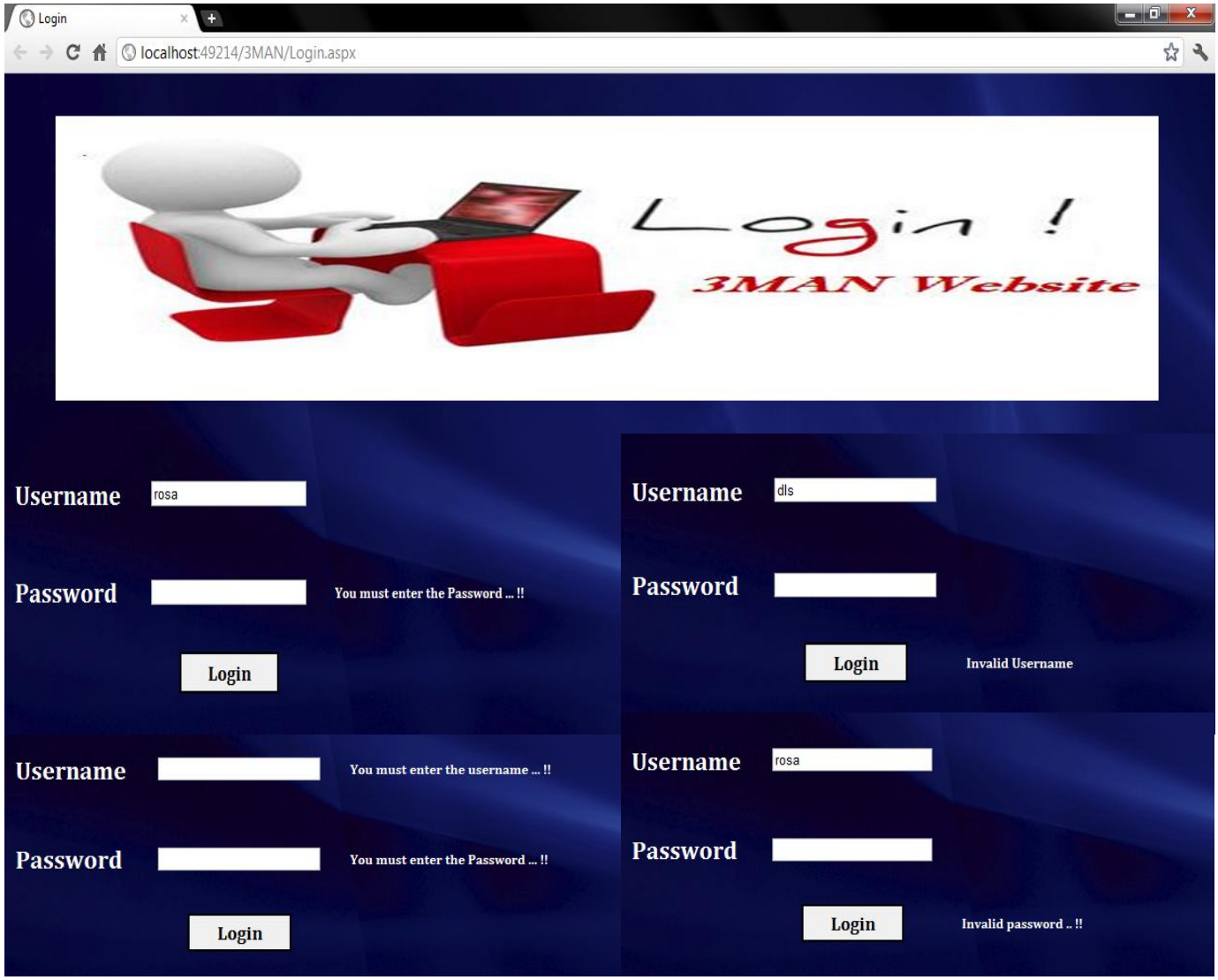


Figure 4. 28 : Snapshots of all possible situation of Login failure

If you enter your username and forget to type your password it appear you must enter the password and vice versa

If you enter wrong username or password it appears “Invalid”.

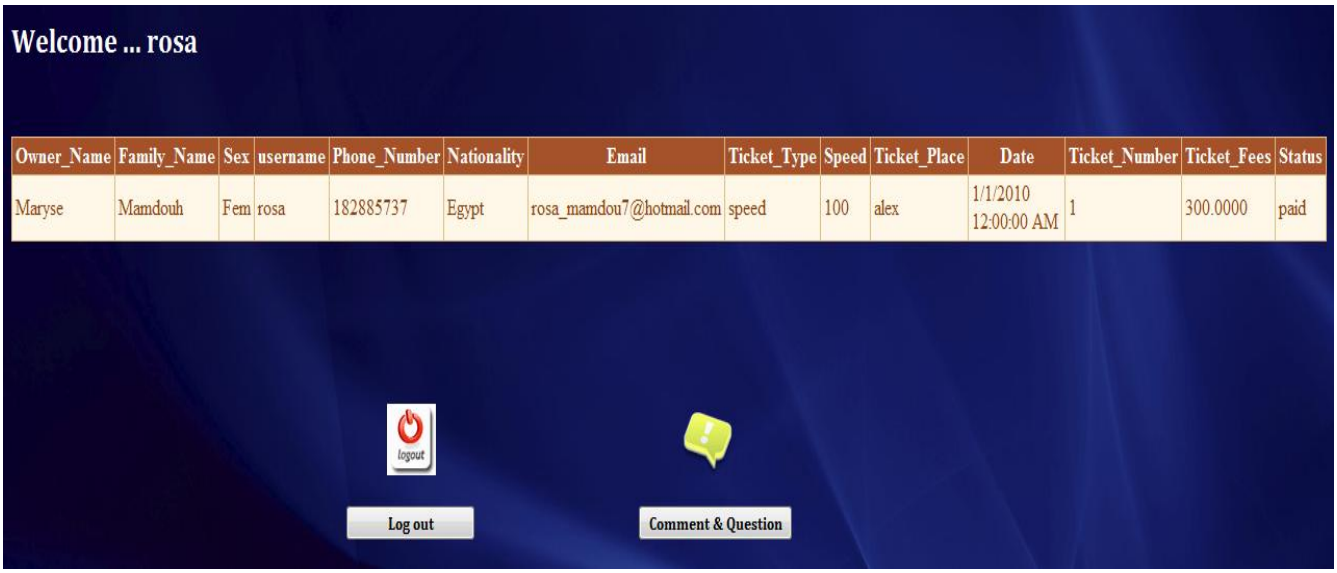


Figure 4. 29 : Snapshot of User information Page

As shown in the figure, this page contains data related to the user which are:

- Owner name.
- Family name.
- Sex.
- Username.
- Phone number.
- Nationality.
- E-mail.
- Password.
- Ticket type.
- Date.
- Ticket number.
- Ticket fees.
- Status.

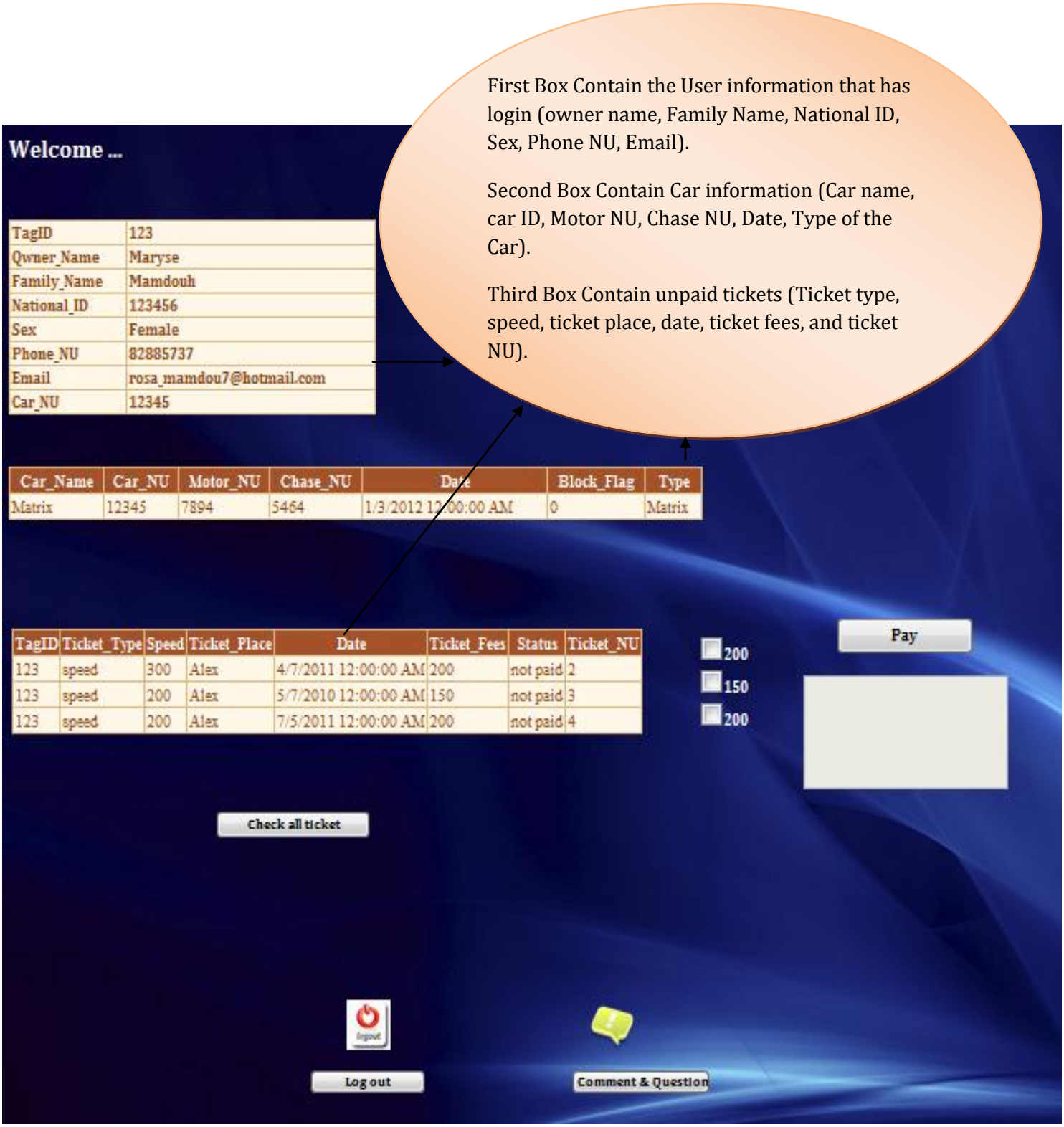


Figure 4. 30 : Snapshots after Connecting 3M.A.N Website with the Main Database

When the user select which fees he wants to pay and press pay button it sum up them and make the total fees in the text area.

And if the user presses on Check all tickets button, all the tickets have taken will appear (Paid tickets and unpaid tickets)

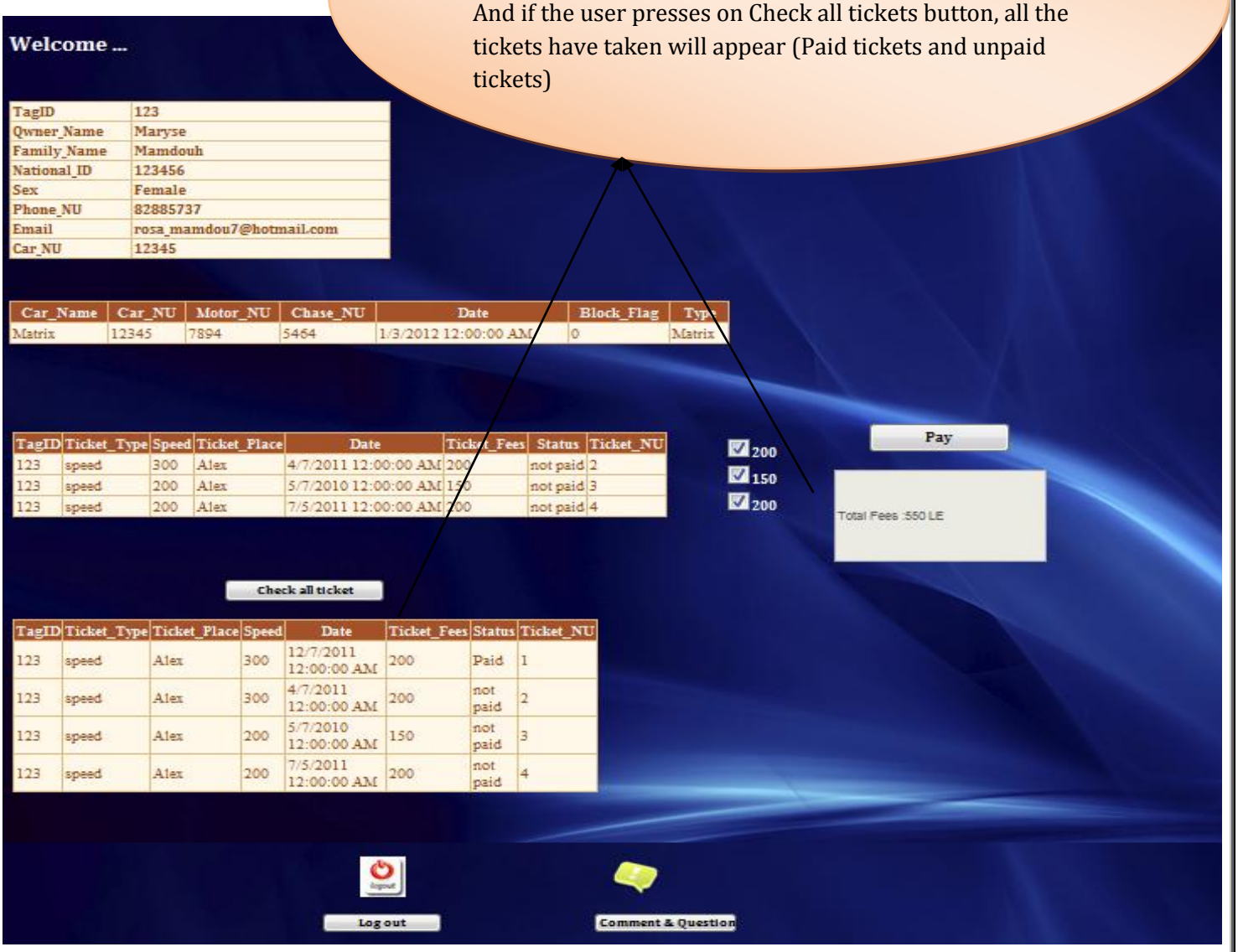


Figure 4. 31: Snapshot after connecting 3M.A.N website with the Main Database

After reading all the information the user needs to know, he'll be able to log out of the site or if he has any comment or question, a tab located besides the log out tab to help him enter the comment and question page to write and send his comment or question to 3MAN.

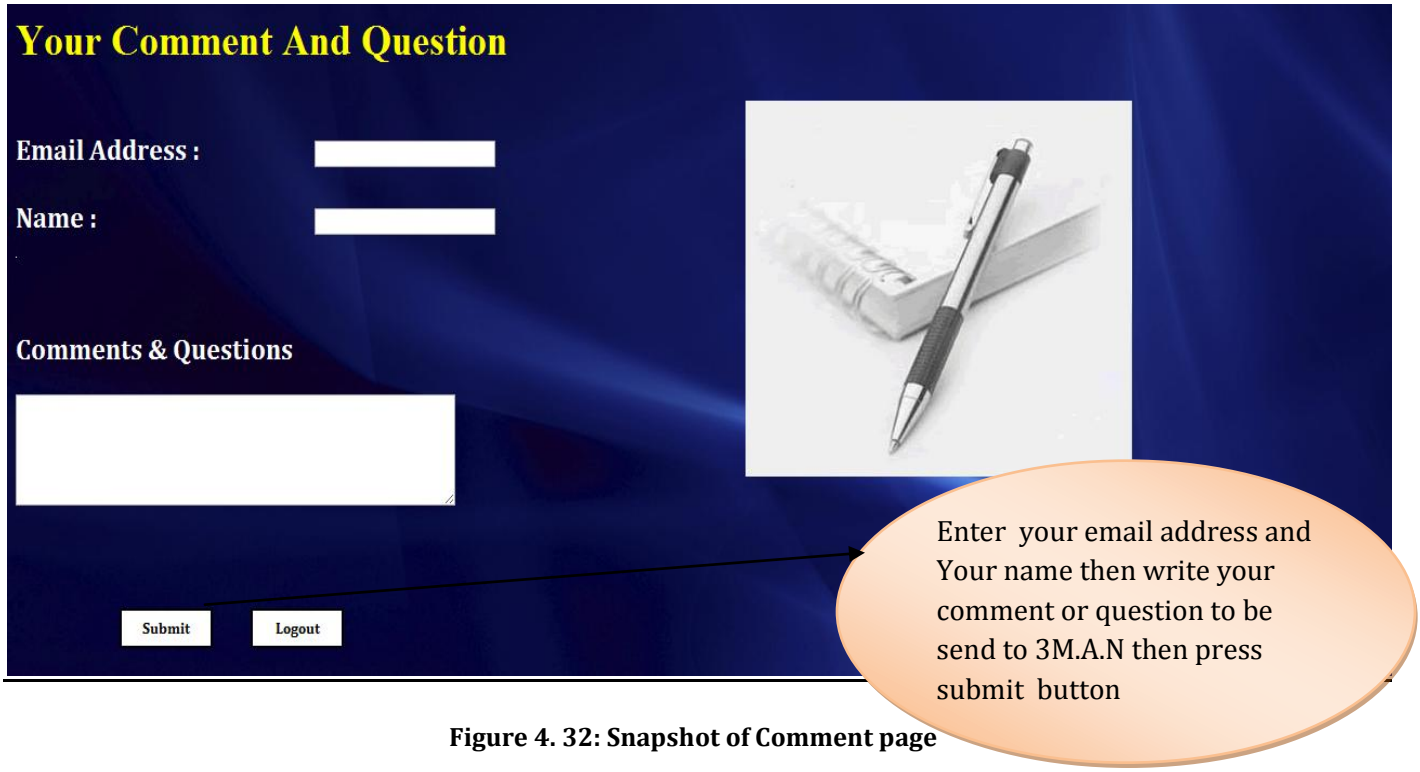


Figure 4. 32: Snapshot of Comment page

From 3M.A.N Website

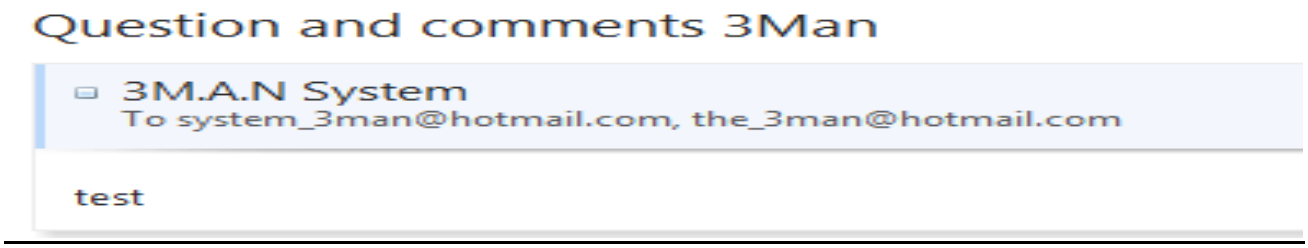


Figure 4. 33 :Example Sending a Test Comment to 3M.A.N

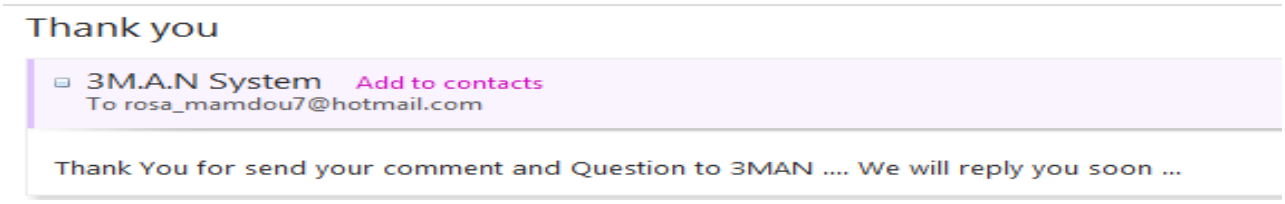


Figure 4. 34 :Example Sending Thanks to the user for his comment

b. Gallery:

We use this page to show brochure of 3MAN to advertise about 3MAN system.

Not the brochure only, but also a link connected to the YouTube to show the visitor a video telling him why should we use the RFID instead of using Radar according to the opinion of the project creators.

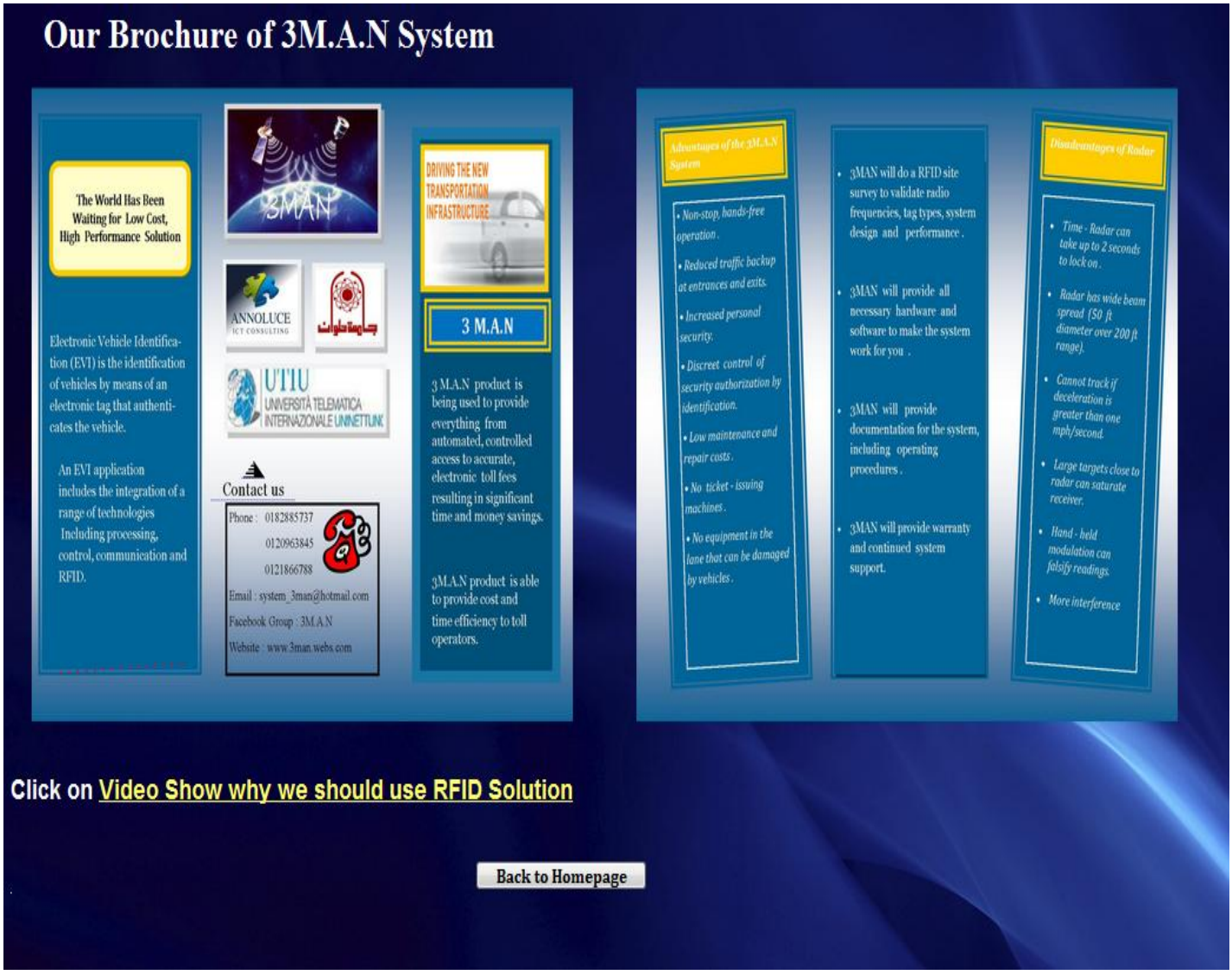


Figure 4. 35 : Snapshot of Gallery of 3M.A.N Website

c. ***About us :***

This page contains information about 3M.A.N :

- General description for the creators of the 3M.A.N system.
- The objectives of 3M.A.N System.
- What the expression 3M.A.N. stands for?
- 3M.A.N. Group contains CV for each one of the creators.

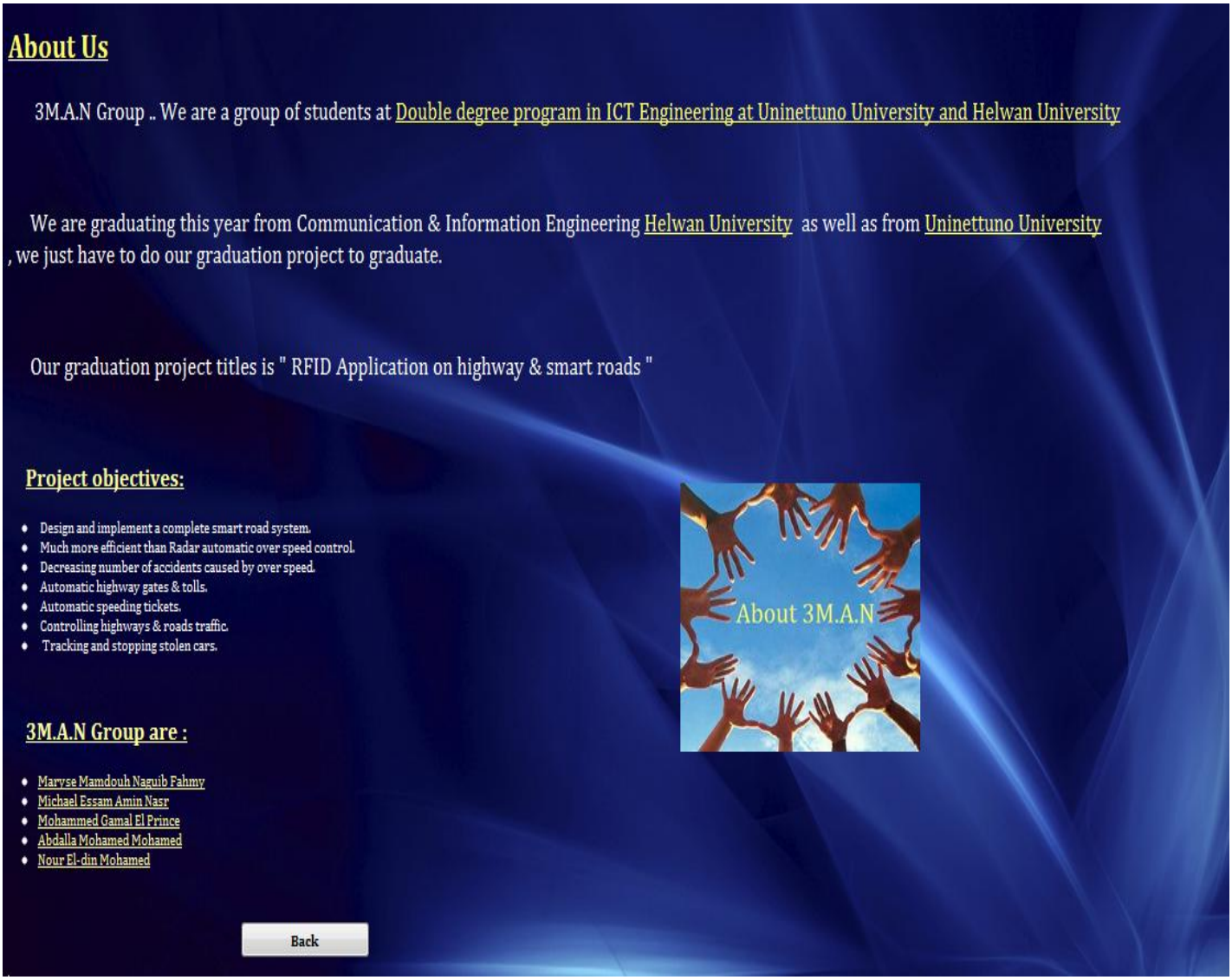


Figure 4. 36 : Snapshot of about 3.M.A.N page

d. Vote:

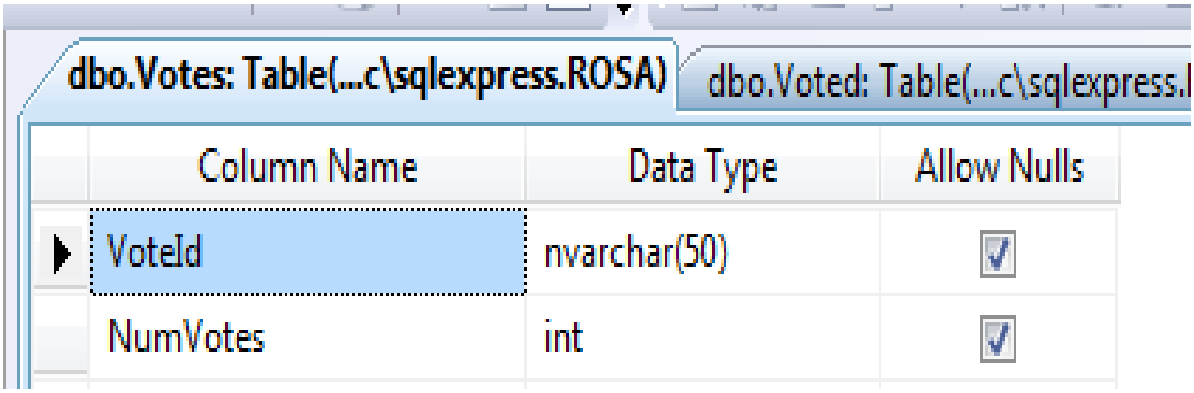
Figure 4. 37 Snapshot of 3M.A.N system vote page

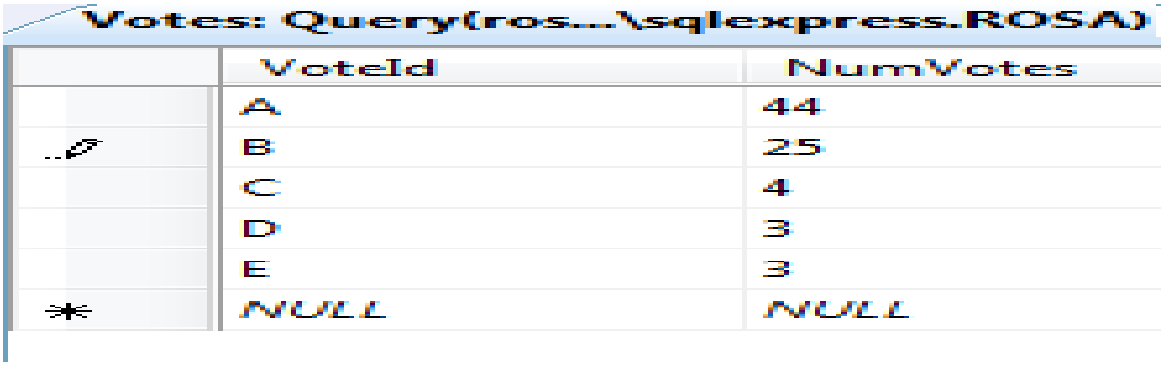
In this page our user has the ability to give his opinion about the service we are presenting to him, he can tell us how he finds the 3MAN website, also if it is excellent, good, fair, or even bad. And the system can calculate how many say excellent, good, fair, or bad.

Idea:

1. We have designed database where types of votes and number of votes stored in.

Table 4. 5 : Votes Database





2. When our user clicks on any of the tabs, an update will take place in the database of the system increasing number of votes by one.

3. Then a label will take the number from the database and show it to the user on the page.

e. Questions and Comments.

Figure 4. 38: Snapshots of comment and Question page from 3M.A.N Website

- May be the user has some questions or comments about the site or any problem he found, so we designed this page to help our user to ask the owners about any information he may need or to send them his comments.

- All he has to do is to write his e-mail and username, then writes his comment or question, after he finishes writing the site automatic will send an e-mail to 3MAN containing the user's question or comment.

- Then an e-mail will be sent to the user containing thanks for sharing his questions or comments, another one will be sent containing a reply to his writings when 3MAN find an answer.

f. News about 3MAN.

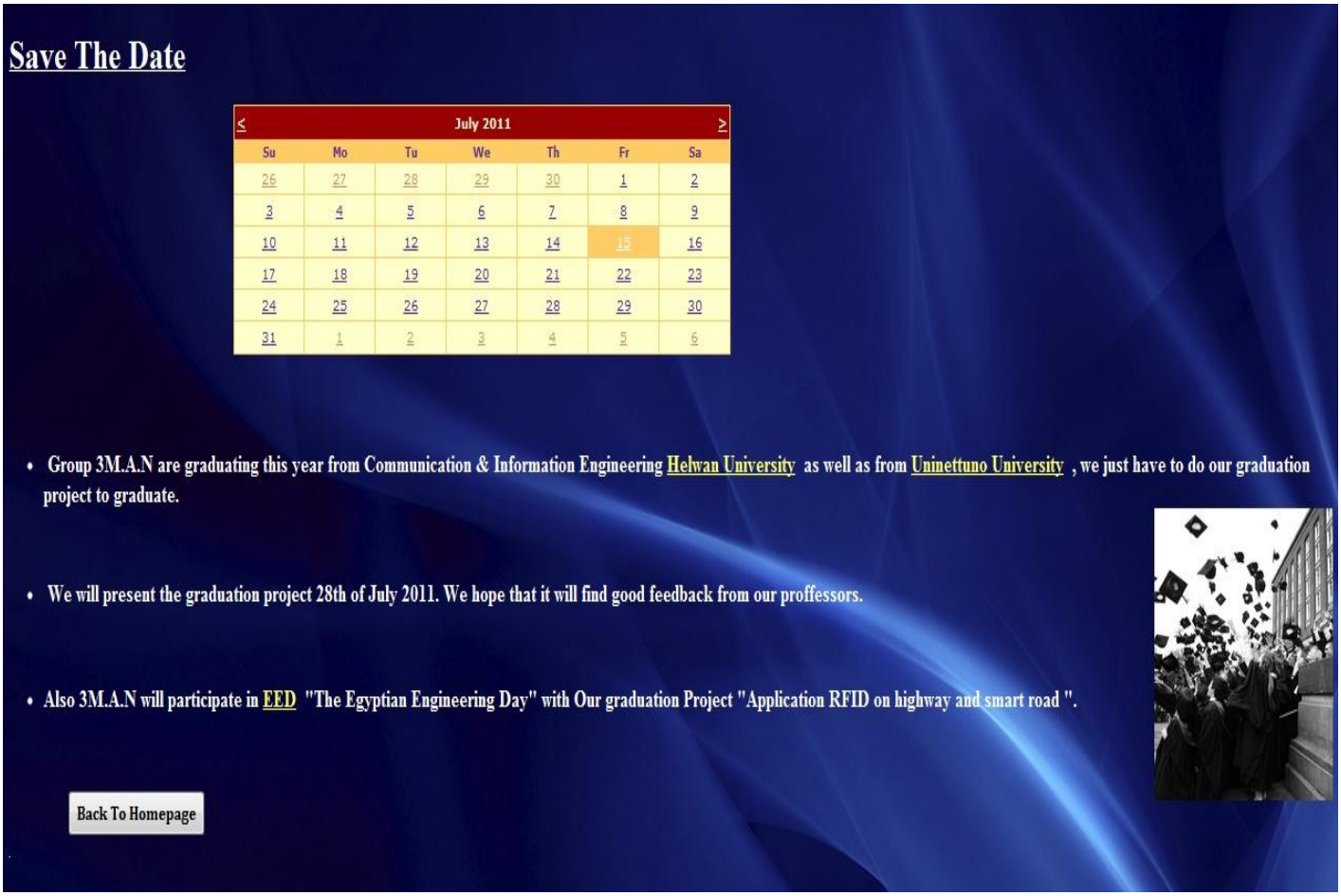


Figure 4. 39 : Snapshot of News page from 3M.A.N Website

This page contains a calendar automatic updated with the date of the day, also contains news about the creators of 3MAN as they are students will graduate this year from Helwan university and Uninettuno university, they are participating in the EED competition, and links connected with the sites of Helwan university or Uninettuno university or EED.

g. About Us:

Figure 4. 40 : Snapshot of Contact 3M.A.N

This page is designed to help the user know any information he would like to know about the creators of 3MAN and also it helps him if he wants to contact them as it contains each one telephone number, his/her e-mail, facebook.

4.3.7 3M.A.N Website Future Ideas :

a. A tab called “Forget password”, may be the user forgets his password so this tab is used to return back his password which make it easier to login again to the website.

Idea:

When the user clicks this tab, he will be asked to insert his username and e-mail address, if the username entered is valid, and matches with the saved username in the username column of the database, as well as with the e-mail address saved in the e-mail address column of the database, then an e-mail will be sent to his address containing his forgotten password.

b. Tab linked to Google map to show the place of the car at the instant of logging.

Idea:

As the car will passes through the first RFID it will identify the place of the car at this instant then after a while it’ll pass through the second RFID which will do the same work as the first one, finally Google map will locate the place of the car to the user.

c. Another tab called “Change username or password”.

Idea:

- After the user login to the website, he may need to change his username or password, so this tab will be used to make the user change his data in the database of 3MAN.

- After login to the website another page will be opened.

d. Online ticket Payment (The user can pay all his ticket unpaid online).

Chapter 5 :

Infrastructure Architecture

Preview

We introduce in this chapter the infrastructure of The network connecting all the RFID readers with The database servers.

Infrastructure Architecture

5.1 Introduction

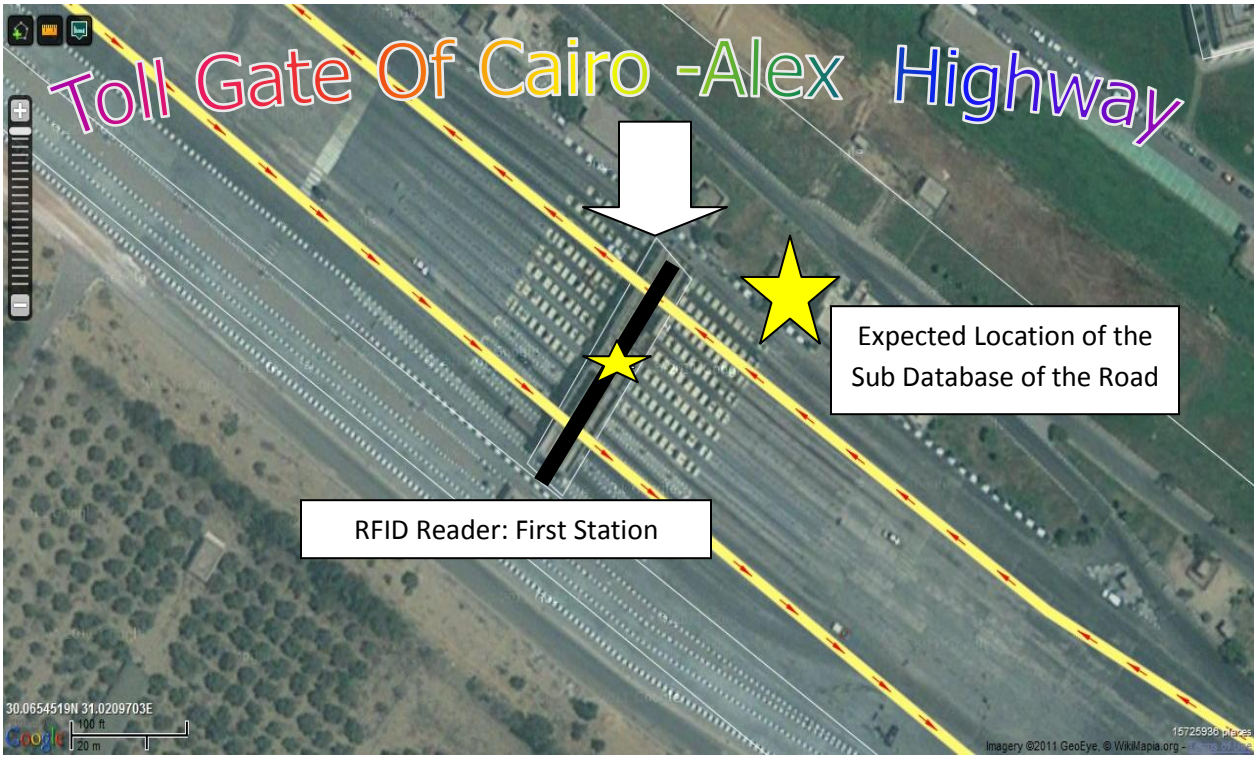


Figure 5. 1 : Real View of the toll gate of Cairo (Cairo - Alexandria) highway

We will make a sample of our system on the most important highway in Egypt which it is the Cairo – Alexandria Highway, this highway is 250 Km long, it connect between the most important cities in Egypt which is Cairo, & Alexandria. The highway also has some city gates entrance.
Also in the middle of the highway, it connects with the second most heavy traffic road in Egypt in the summer, Al Alamein Highway.

Our Scenario is to cover the full road with our system so according to the communication system & the RFID Reader Range so we can cover the full road with 5 – 8 RFID Reader Station (Every Station Contain 2 RFID Reader for

Full Duplex of the highway , and the 2 Reader connect with a Wireless Communication link like GSM/GPRS , WiMAX, ……..) ,
So our system can cover from 30 – 50 Km of the highway.
At the A certain Position (Like the Toll Gate) in the Highway , we will Put a sub database which at certain time will send it data to the Master Database in the General Administration of Traffic.

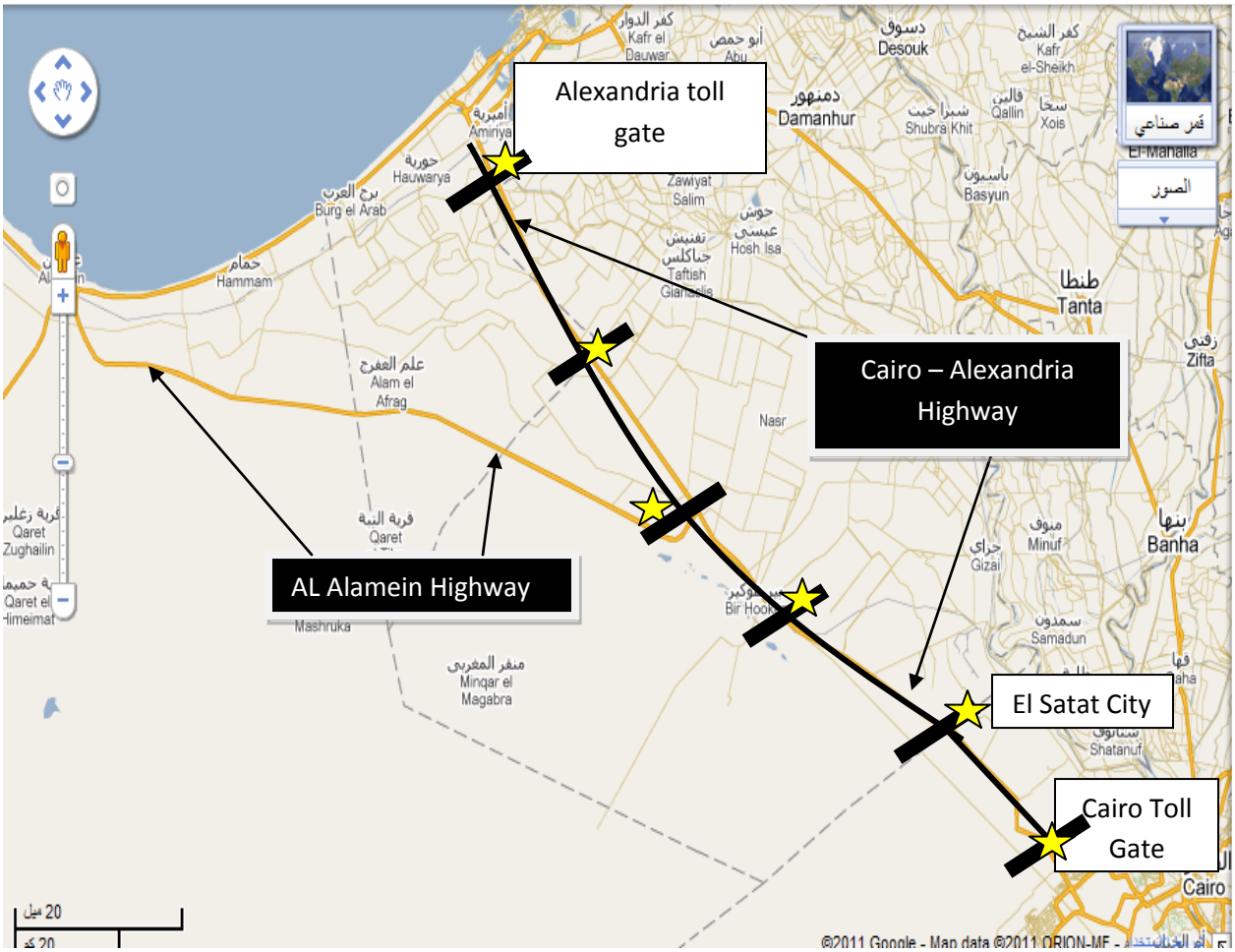


Figure 5. 2: (Cairo - Alexandria) highway with Expected location of RFID Station

5.2 Expected Scenario

A regular user will go to Alexandria through the Highway of Cairo–Alexandria The user will first face the toll gate of the Cairo , when he reach the Toll Gate , the gate will be sensitive to the car of the user , and open the gate to it , then the RFID reader attached to the gate will read the tag ID , if it is accepted , the system will collect the fees of using the highway Electronically then the gate is opened to the car to pass , if it is blocked , so the gate will trapped the car to know the reason of the blocking by the official police (Stolen Car , or , Unidentified ID), so after the Gates Station , the user will follow its way to alexandria , passing through the RFID Reader Station in the Highway , the system will calcutale the average speed of the user and alert him through SMS or by Email , if he takes a ticket for speed (if he was going with unaccepted speed or more than the official speed of the highway), if he was going with the Recommended Speed of the highway , so he will be safety reached to Alexandria Toll Gateat the Expected Time (2-3 hour).

5.3 System Framework Architecture

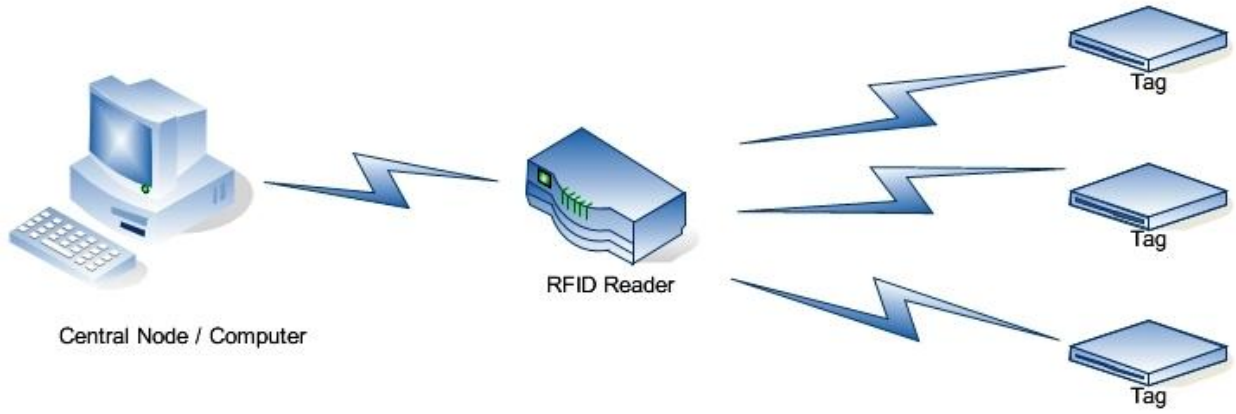


Figure 5. 3 : Typical RFID System

a. Tags.

Along with understanding the possible ways to achieve the desired performance of the RFID system, its basic operation is also important. The operation of a simple RFID system begins with a reader interrogating the tagged merchandise by sending and receiving radio frequency signals to and from the tag, or transponder, via their antennas.
The tags respond back to the reader with a unique identification code assigned to it, its EPC. The reader then transmits this data to the central node where an up-to-date picture of the inventory is created.

b. Readers.

Also referred to as an interrogator, the reader consists of an antenna, Transceiver and decoder. As a radio transmitter and receiver, a reader simultaneously communicates with the tag population (interrogates), while providing power to operate the integrated circuits in passive tags. The reader transmits an amplitude-modulated signal, which powers up the tags and sends the instructions. While the tags take turns responding with their identification code, the reader continues to transmit a non-modulated signal while it listens for tag responses. In the United States, readers must "hop" randomly from one frequency channel to another when operating in the ISM band, remaining for no longer than 0.4 seconds at any one frequency.

c. Central Node.

The data transmitted between tag and reader is not useful for commercial application unless the vast amounts of information are integrated within a larger system. Acting as a central node, a computer with specialized software can enable this incorporation of data. Middleware is the generic term given to this specialized software that takes the raw data from the reader and passes on the useful data. It can categorize the aggregated data, ultimately providing a representation of the physical inventory of the business.

d. The Network

The components described above interact to create a basic RFID system pictured in Figure 3, composed of tags, readers, and a central node. An implementation of this type of system at the storefront or distribution level would require an abundance of readers, dispersed throughout shelves and shelves of tagged items. These readers must communicate back to the central node so that the information can be used to provide supply chain visibility.

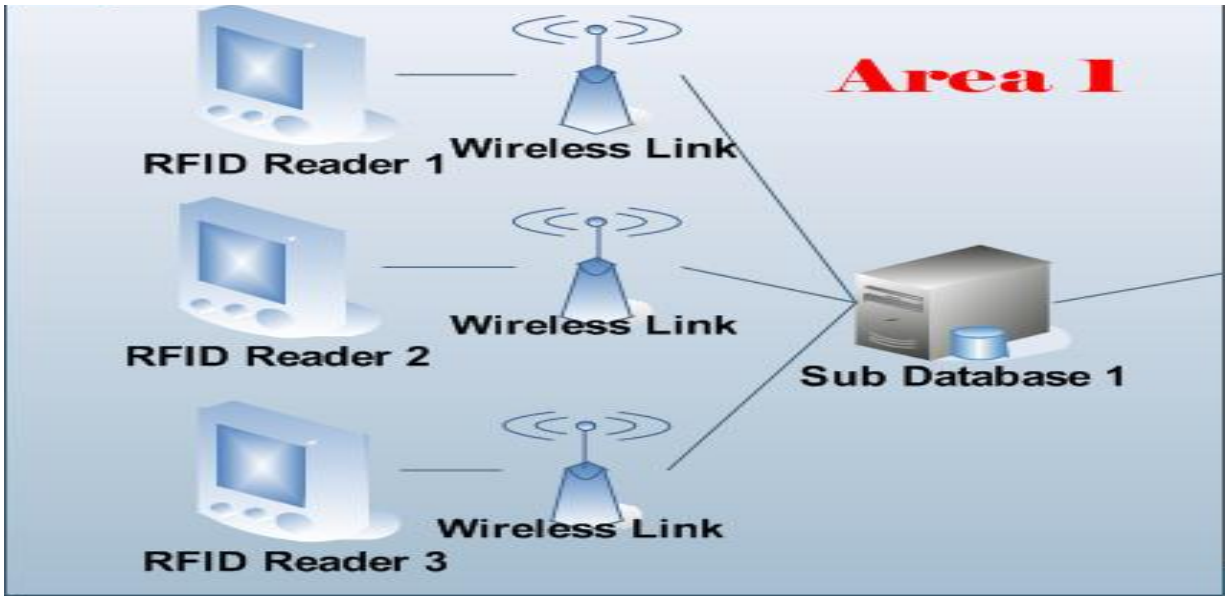


Figure 5. 4: Wireless-Enabled RFID System

Typically, systems transmit data collected by the RFID reader to the central node over awareness connection. The task of installing such a system involves expanding it to the level of scale necessary for a retailer at the storefront or distribution level. Depending on the size of scale, installing the necessary wired infrastructure may outweigh the few benefits of wired networking, such as reliability and low power consumption. Coupled with the high installation cost, the implementation of a wired network infrastructure may not be justifiable.

The next option would be to enable the reader and the central node to communicate wirelessly. This would alleviate the difficulty and cost of implementation.

With a wireless connection, the system becomes invaluable due to its flexibility and ease of installation. However, the issue of power must be considered as a ramification of eliminating the wired connection.

This creates the need for ultra-low-power readers; relying on battery power is a possible answer if power consumption is minimized. Even with such constraints, however, the ideal possible growth for an RFID system with wireless communication between the reader and Sub-Database is represented in Figure 4.

5.4 The Main Overview of the System

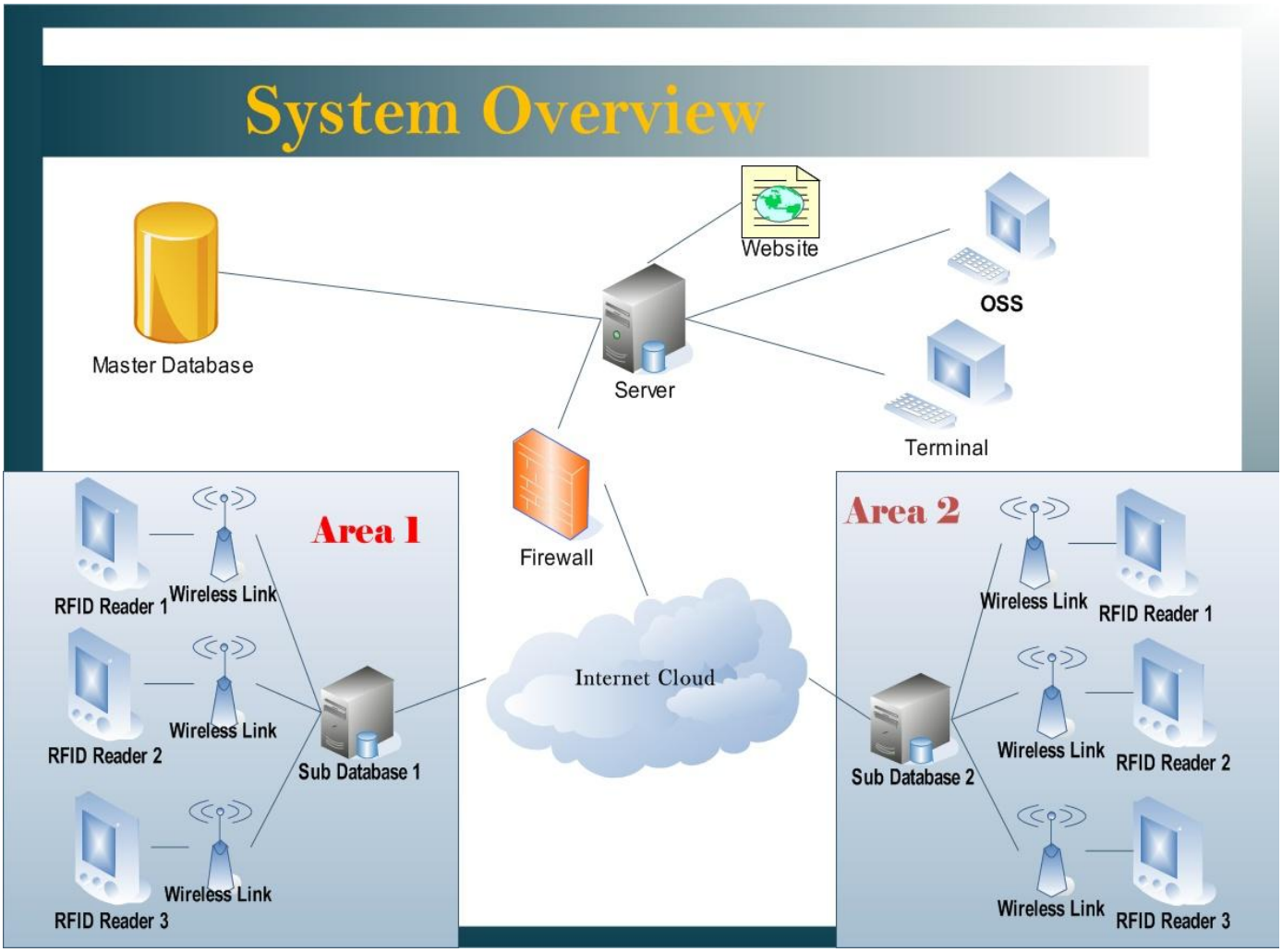


Figure 5. 5 : System Architecture

Our system will divide the overall Area of the Highway road in region. Every Region will contain several RFID Readers and Sub Database, Increasing the Number of the RFID Reader will improve the Efficiency of the system. The Recommended Range per Reader, 1 Reader per every 30-50 Km . The RFID Reader will be connected to the sub-database with wireless connection (GSM/GPRS , WiMax ,…….) and will send its data daily.

The sub-database main function is to collect the data from the RFID Readers of the same region and send it to the master database (Main Database) in the General Admission For Traffic.

5.5 The System in the Highway View

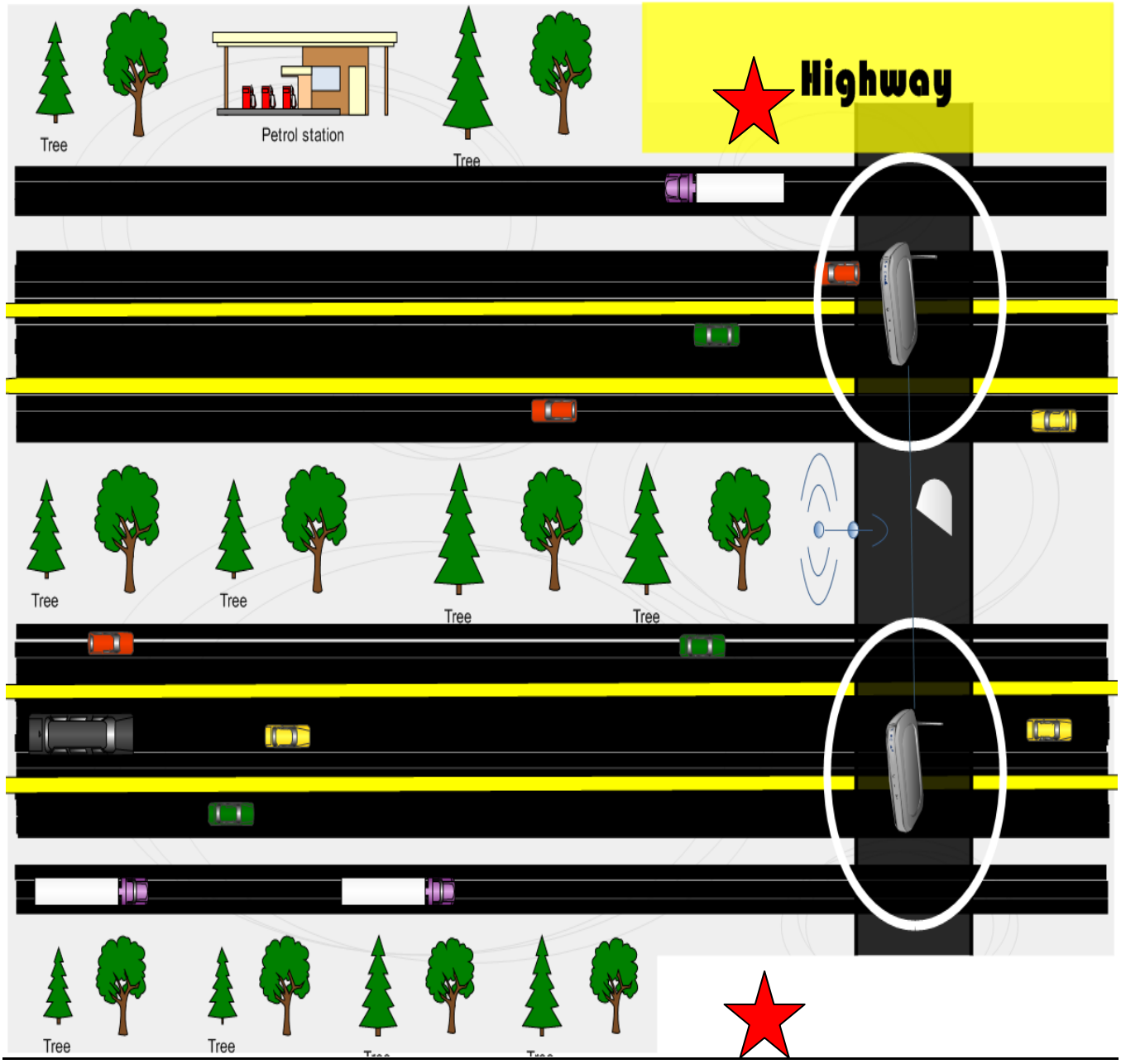


Figure 5. 6: Highway View

Our system approach will build a bridge or attach the RFID Reader with Fixed location beside the Highway, as showed in the Figure 6, in Every Station we will put a 2 RFID Reader for Full cover of the Highway as showed, and Every Station will be connected with the Database of the highway, with wireless connection link (in our system we will use GSM/GPRS connection which will be described later).

5.6 Toll Gate View in the Our system

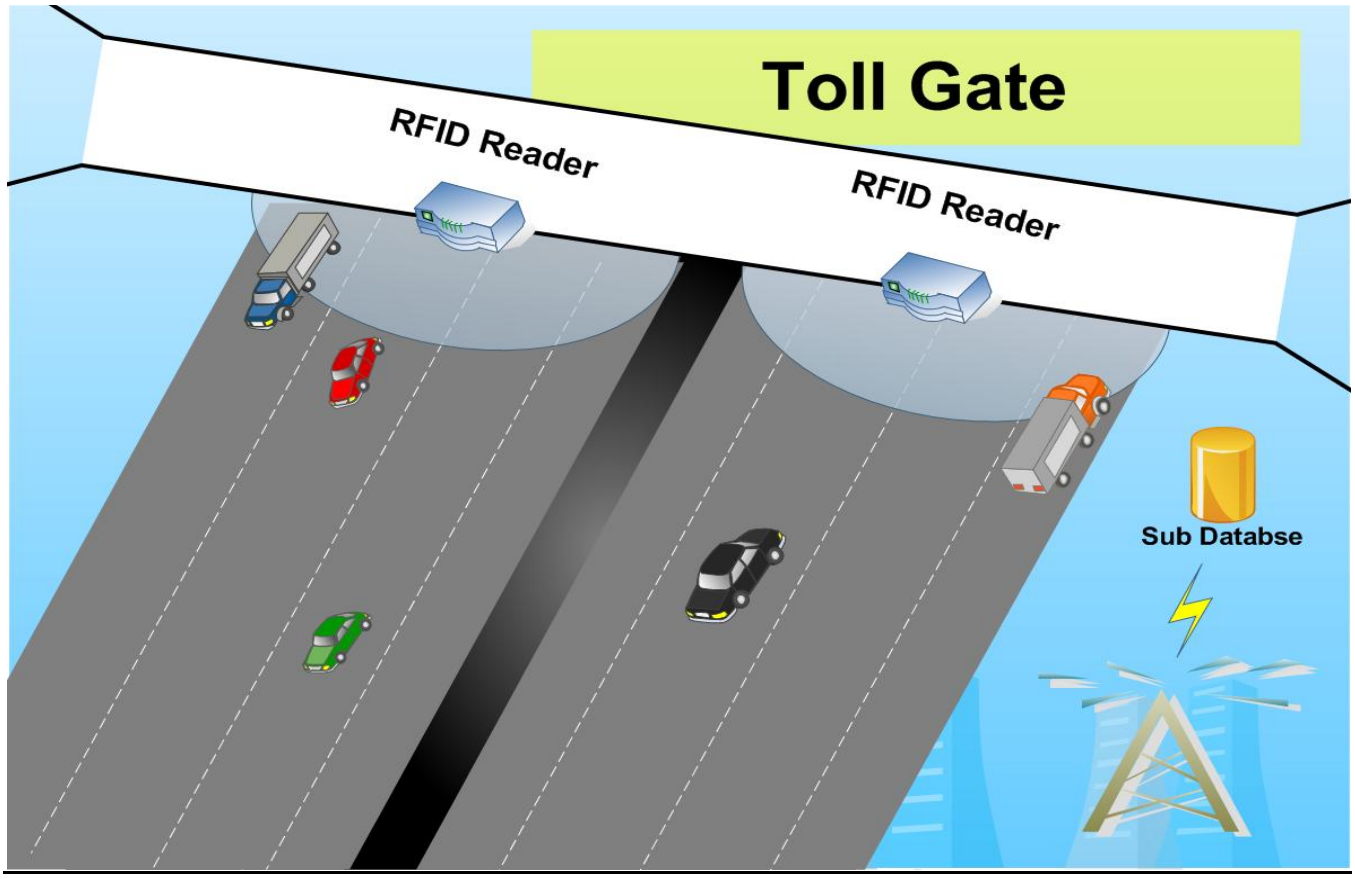


Figure 5. 7: Toll Gate

As showed in figure (7) , in the toll gate we will put the sub database location (the recommended position) .

The function of the RFID in the toll gates:

- Register the Car with its tag as (start point).
- Act as Toll gates as after registering the car it collect the fees of using the highway.
- Block the steal or unidentified cars.

The function of the Sub-Database

- Connect with All RFID reader in the highway with the same wireless connection used by the RFID Reader.
- It provides feedback of the highway traffic.
- It used to update Master Database (Main Database) with the data collected from the highway .

5.7 How the RFID Reader will work ?

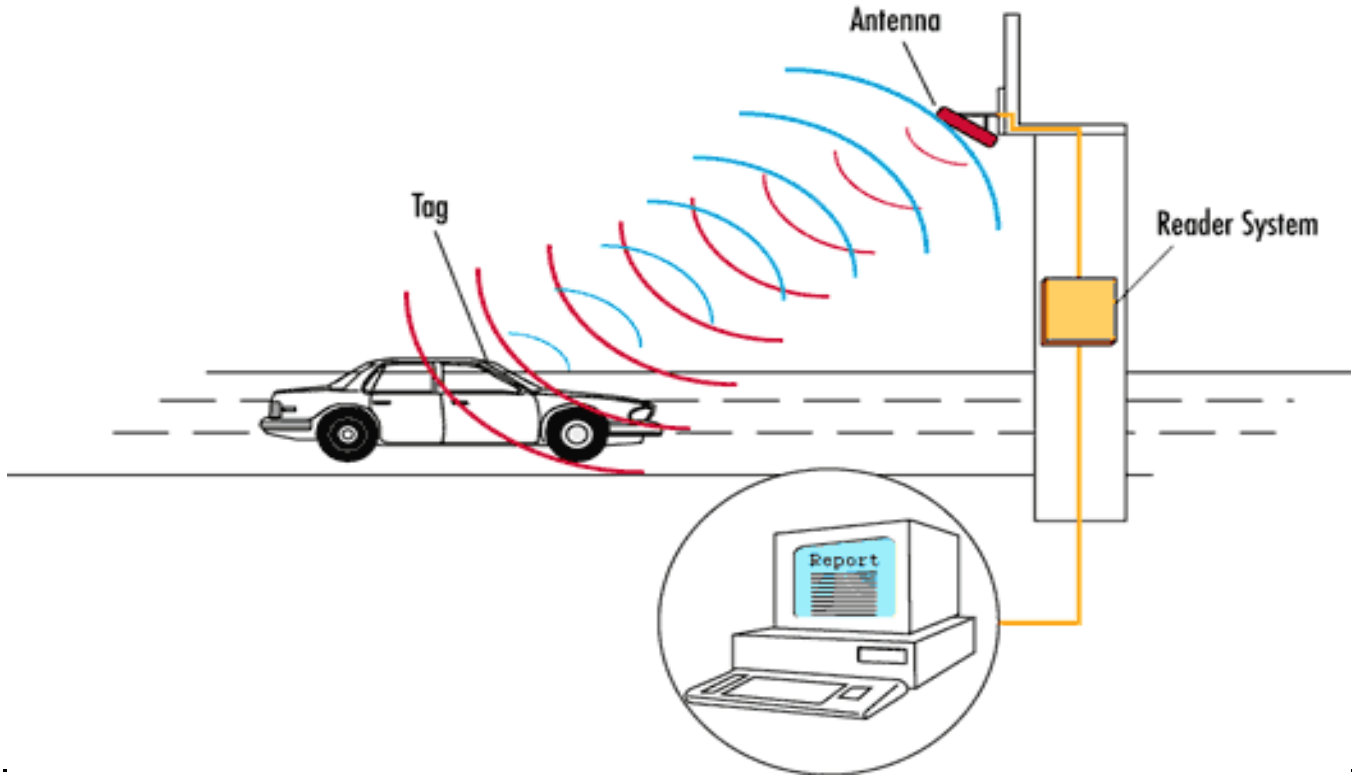


Figure 5. 8: Simple Figure on Our System

When a car with a tag go near the RFID Reader the reader send a signal and when the reader detect the tags it send its transmission code ,the Reader send through the wireless connection to the sub-database.

Transmission Code

The reader will send this code to identify the Region Area, the Reader identify location, the data sent.

Region Area	**Reader Sector Area**	*Direction*	*Data Sent*

5.8 Wireless Connection Link

a. Creating a Wireless Connection

After recognizing the value of enabling a wireless connection between the reader and the central node, an evaluation of the existing wireless standards was the next task. Other methods for making this connection wireless exist, but the benefits of using a standard instead of using a proprietary wireless communication protocol are obvious.

A standardized protocol functions universally. After deciding that a standard was the best choice, the available wireless standards were evaluated based on selected criteria. For the application of an RFID system, low power consumption and long range were imperative requirements. Support for a large network size was an additional advantage, as well as low cost.

b. Existing Wireless Standards

Four possible options for the wireless connectivity mentioned are presented in Table 1below. Table 1 illustrates the range of available wireless data communications standards from the very short range (Bluetooth) to the very long range (cellular GSM/GPRS/CDMA).

Each technology has applications it is best suited for. GSM, GPRS, CDMA, and 1xRTT are all standards for cellular telephone communications. Wi-Fi was developed to connect devices in local area networks (LANs). Bluetooth is a technology that was created for connecting devices in small personal area networks (PANs), such as a printer and a computer without the use of cables. ZigBee was developed for monitoring and control applications in short ranges.

As just mentioned, each technology has an appropriate purpose, or its application focus.

For each of these applications, the system resources specify approximately how much memory is necessary. The expandability of each technology is a feature characterized by its network size, the number of possible nodes within the network. Battery life, bandwidth and transmission range are self-explanatory and are important factors in choosing between technologies.

The Possible Wireless Connection for Our System:

- WiMAX (Worldwide Interoperability for Microwave Access)
- Microwave link
- The GPRS (General Packet Radio Service) Standard

a. WiMAX (Worldwide Interoperability for Microwave Access)

is a telecommunications protocol that provides fixed and mobile Internet access. The current WiMAX revision provides up to 40 Mbit/s with the IEEE 802.16m update expected to offer up to 1 Gbit/s fixed speeds. The name "WiMAX" was created by the WiMAX Forum, which was formed in June 2001 to promote conformity and interoperability of the standard. The forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL".

Terminology

WiMAX refers to interoperable implementations of the IEEE 802.16 wireless-networks standard (ratified by the WiMAX Forum), in similarity with Wi-Fi, which refers to interoperable implementations of the IEEE 802.11 Wireless LAN standard (ratified by the Wi-Fi Alliance). The WiMAX Forum certification allows vendors to sell their equipment as WiMAX (Fixed or Mobile) certified, thus ensuring a level of interoperability with other certified products, as long as they fit the same profile. The IEEE 802.16 standard forms the basis of 'WiMAX' and is sometimes referred to colloquially as "WiMAX", "Fixed WiMAX", "Mobile WiMAX", "802.16d" and "802.16e."

Clarification of the formal names are as follow:

- **802.16-2004** is also known as 802.16d, which refers to the working party that has developed that standard. It is sometimes referred to as "Fixed WiMAX," since it has no support for mobility.

- **802.16e-2005**, often abbreviated to 802.16e, is an amendment to 802.16-2004. It introduced support for mobility, among other things and is therefore also known as "Mobile WiMAX".

Mobile WiMAX is the WiMAX incarnation that has the most commercial interest to date and is being actively deployed in many countries. Mobile WiMAX is also the basis of future revisions of WiMAX.

Advantages of WiMAX :

WiMAX is sometimes referred to as "Wi-Fi on steroids" and can be used for a number of applications including broadband connections, cellular backhaul, hotspots, etc. It is similar to Wi-Fi but it can also permit usage at much greater distances. WiMax is more effective on a larger scale and it is more cost effective because the cost of moving traditional broadband services to the next is more expensive.

b. Microwave link

refers to the technology of transmitting information or power by the use of radio waves whose wavelengths are conveniently measured in small numbers of centimeters; these are called microwaves. This part of the radio spectrum ranges across frequencies of roughly 1.0 gigahertz (GHz) to 30 GHz. These correspond to wavelengths from 30 centimeters down to 1.0 cm. Microwaves are widely used for point-to-point communications because their small wavelength allows conveniently-sized antennas to direct them in narrow beams, which can be pointed directly at the receiving antenna. This allows nearby microwave equipment to use the same frequencies without interfering with each other, as lower frequency radio waves do. Another advantage is that the high frequency of microwaves gives the microwave band a very large information-carrying capacity; the microwave band has a bandwidth 30 times that of all the rest of the radio spectrum below it.

A Disadvantage is that microwaves are limited to line of sight propagation; they cannot pass around hills or mountains as lower frequency radio waves can. Microwave radio transmission is commonly used by communication systems on the surface of the Earth, in satellite communications, and in deep space radio communications. Other parts of the microwave radio band are used for radars, radio navigation systems, sensor systems, and radio astronomy.

The next higher part of the radio electromagnetic spectrum, where the frequencies are above 30 GHz and below 100 GHz, are called "millimeter

waves" because their wavelengths are conveniently measured in millimeters, and their wavelengths range from 10 mm down to 3.0 mm. Radio waves in this band are usually strongly attenuated by the Earthly atmosphere and particles contained in it, especially during wet weather. Also, in wide band of frequencies around 60 GHz, the radio waves are strongly attenuated by molecular oxygen in the atmosphere. The electronic technologies needed in the millimeter wave band are also much more difficult to utilize than those of the microwave band.

Properties of Microwave Transmission

- Suitable over line-of-sight transmission links without obstacles.

- Provides large useful bandwidth when compared to lower frequencies (HF, VHF, UHF).

- Affected by the refractive index (temperature, pressure and humidity) of the atmosphere, rain (see rain fade), snow and hail, sand storms, clouds, mist and fog, strongly depending on the frequency.

Uses of microwave links

- In communications between satellites and base stations
- As backbone carriers for cellular systems
- In short range indoor communications

C. The GPRS (General Packet Radio Service) Standard

General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G communication systems global system for mobile communications (GSM). The service is available to users in over 200 countries. GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project(3GPP).

GPRS usage charging is based on volume of data, either as part of a bundle or on a pay-as-you-use basis. An example of a bundle is up to 5 GB per month for a fixed fee. Usage above the bundle cap is either charged for per megabyte or disallowed. The pay as you use charging is typically per megabyte of traffic. This contrasts with circuit switching data, which is typically billed per minute of connection time, regardless of whether or not the user transfers data during that period.

GPRS is a best effort service implies variable throughput and latency that depend on the number of other users sharing the service concurrently, as opposed to circuit switching, where a certain quality of service (QoS) is guaranteed during the connection. In 2G systems, GPRS provides data rates of 56-114 Kbit/second. 2G cellular technology combined with GPRS is sometimes described as *2.5G*, that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate-speed data transfer, by using unused time division multiple access (TDMA) channels in, for example, the GSM system. GPRS is integrated into GSM Release 97 and newer releases.

Protocols supported

GPRS supports the following protocols:

- Internet protocol (IP). In practice, built-in mobile browsers use IPv4 since IPv6 is not yet popular.

- Point-to-point protocol (PPP). In this mode PPP is often not supported by the mobile phone operator but if the mobile is used as a modem to the connected computer, PPP is used to tunnel IP to the phone. This allows an IP address to be assigned dynamically to the mobile equipment.

- X.25 connections. This is typically used for applications like wireless payment terminals, although it has been removed from the standard. X.25 can still be supported over PPP, or even over IP, but doing this requires either a network based router to perform encapsulation or intelligence built in to the end-device/terminal; e.g., user equipment (UE).

When TCP/IP is used, each reader can have one or more IP addresses allocated. GPRS will store and forward the IP packets to the reader even during handover. The TCP handles any packet loss (e.g. due to a radio noise induced pause).

5.9 Advantages of Choosing the GSM/GPRS

As we can see from Table 1, The GSM/GPRS is the best choice solution for a low complexity, low power, and high range application like the distributed reader network. From this decision making process, it was determined that the GSM/GPRS standard would be used to send the information to the Sub-Database from the readers.

And according to Table 2 , We can see also that GSM/GPRS is the best choice as it don't require an infrastructure as the WiMax ,because it already each mobile operator have a GSM/GPRS infrastructure so , it is cheaper than the WiMax ,

Table 5. 1: Comparison Between High Range Wireless Communication

Standard	Peak Downlink	Peak Uplink	Range	Typical Downlink throughput	COST
CDMA RTT 1x	0.3072	0.1536	~30 Km	0.125	Low
GSM GPRS Class 10	***0.0856***	***0.0428***	***~25 Km***	***0.014***	***Low***
GSM EDGE type 2	***0.4736***	***0.4736***	***~25 Km***	***0.034***	***Low***
WiMax: 802.16e	70.000	70.000	~7 Km	>10	Very High
Wi-Fi: 802.11n	200.00	200.00	~50 meters	40	Low

- **Downlink** is the throughput from the base station to the user handset or computer.
- **Uplink** is the throughput from the user handset or computer to the base station.
- **Range** is the maximum range possible to receive data at 25% of the typical rate.

Table 5. 2 : Comparison between Short Range Wireless Communication

Market Name	ZigBee™	---	Wi-Fi™	Bluetooth™
Standard	802.15.4	GSM/GPRS CDMA/1xRTT	802.11b	802.15.1
Application Focus	Monitoring & Control	Wide Area Voice & Data	Web, Email, Video	Cable Replacement
System Resources	4KB - 32KB	16MB+	1MB+	250KB+
Battery Life (days)	100 - 1,000+	1-7	.5 - 5	1 - 7
Network Size	Unlimited (2^{64})	1	32	7
Bandwidth KHz	20 - 250	64 - 128+	11,000+	720
Transmission Range (meters)	1 - 100+	1,000+	1 - 100	1 - 10+
Success Metrics	Reliability, Power, Cost	Reach, Quality	Speed, Flexibility	Cost, Convenience

Table 5. 3: The Possible Wireless Connection For our System

	GPRS	WiMaX	Microwave Link
Data Rate	56- 114 Kbit/second	The current WiMAX revision provides up to 40 Mbit/s with the IEEE 802.16m update expected to offer up to 1 Gbit/s	1.5 – 2 Mbps (QPSK) 14 – 34 Mbps (16 QAM)
Cost	low	Very high	High
Type of Connection	Can connect with any device in any way	Can connect with any device in any way	Point to Point Connection
Power Required	Low Power required per module	-	High Power
Disadvantage	May be after long time and high traffic , the data rate may be the problem	Required Infrastructure which cost a lot. Required a license to used.	microwaves are limited to line of sight propagation; they cannot pass around hills or mountains as lower frequency radio waves can

5.10 Coverage Area

In telecommunications, the coverage of a radio station is the geographic area where the station can communicate. Broadcasters and telecommunications companies frequently produce coverage maps to indicate to users the station's intended service area. Coverage depends on several factors, such as mountains and buildings, technology and radio frequency. Some frequencies provide better regional coverage, while other frequencies penetrate better through obstacles, such as buildings in cities.

Given cellular network technologies are also optimized for particular needs, such as in the 3G Third Generation networks, a CDMA2000 1x EV-DO network is more suited for large regional coverage in less developed markets such as the USA, while W-CDMA is more suited for dealing with heavy congestion in markets such as those in Western Europe where mobile phone density is more than 50% greater per capita, and more than 300% greater per square mile than in North America.

The ability of a mobile phone to connect to a base station depends on the strength of the signal. That may be boosted by higher power transmissions, better antennae and taller antenna masts. Signals will also need to be boosted to pass through buildings, which is a particular problem designing network for large metropolitan areas with modern skyscrapers. Signals also do not travel deep underground, so specialized transmission solutions are used to deliver mobile phone coverage into areas such as underground parking garages and subway trains.

A coverage notice is a device that beeps (or vibrates) when in a zone that lacks coverage (white spot). This is fundamental for critical services (security, emergency and so on). When the user goes to a covered area, the notice ceases beeping.

As standard, each coverage map can show two classes of coverage. This will normally depict regions of strong and variable coverage. The signal level used to distinguish between strong and variable service should be as follows:
Strong: >= -92dBm Variable: >= -100dBm

To ensure that coverage can be compared like-for-like, it is requested that submissions do not deviate from these signal levels. Depending on the submission data format, operators may wish to submit two layers, one for each classification. Both classes can be included in to a single layer if there is sufficient attribute information to differentiate them. A variable coverage layer may also include areas of the strong layer.

It is preferable to include coverage over international borders and the sea in your data. If you "clip" your data to internal borders/coastlines, it is likely that this will not match the borders/coastlines that we use, and apparent gaps in coverage may result. Coverage maps on gsmworld.com and the Info Centre separate different technologies. For example, if an operator has a GSM 900/1800 and a 3G network, they will be implemented on separate maps.

5.10.1 Coverage maps

Coverage maps are designed to indicate the service areas of radio communication transmitting stations. Typically these may be produced for radio or television stations, for mobile telephone networks and for satellite networks. Such maps are alternatively known as propagation maps. For satellite networks, a coverage map is often known as a footprint.

5.10.2 Definition of coverage

Typically a coverage map will indicate the area within which the user can expect to obtain good reception of the service in question using standard equipment under normal operating conditions. Additionally, the map may also separately denote supplementary service areas where good reception may be obtained but other stations may be stronger, or where reception may variable but the service may still be usable.

Technical details

The field strength that the marked service boundary on a coverage map represents will be defined by whoever produces the map, but typical examples are as follows:

VHF (FM) / Band II

For VHF (FM) / Band II, the BBC defines the service area boundary as corresponding to average field strength of 54 dB (relative to 1 μV/m) at a height of 10 m above ground level.

MF / Medium wave

For MF / Medium wave, the BBC defines the daytime service area boundary as minimum field strength of 2 mV/m. At night, the service area of medium wave services can be drastically reduced by co-channel interference from distant stations.

5.10.3 Limitations

Often coverage maps show general coverage for large regions and therefore any boundary indicated should not be interpreted as a rigid limit. The quality of reception can be very different at places only short distances apart, and this phenomenon is more apparent as the transmission frequency increases. Inevitably small pockets of poor reception may exist within the main service area that cannot be shown on the map due to scale issues. Conversely, the use of sensitive equipment, high gain antennas, or simply being located on high ground can yield good signal strengths well outside the indicated area. The significance of local geographical conditions cannot be over emphasized and this was underlined by an experiment which revealed the signal reception conditions around a typical house. The site did not have the critical "line-of-sight propagation" to the transmitter. Average signal levels, taken at the same height, varied by up to 6dB, and for individual frequencies by up to 14dB. In RF reception terms these figures are huge differences.

Although carriers and broadcasters attempt to design their networks to eliminate dead zones, no network is perfect, so coverage breaks within the general coverage areas are still possible.

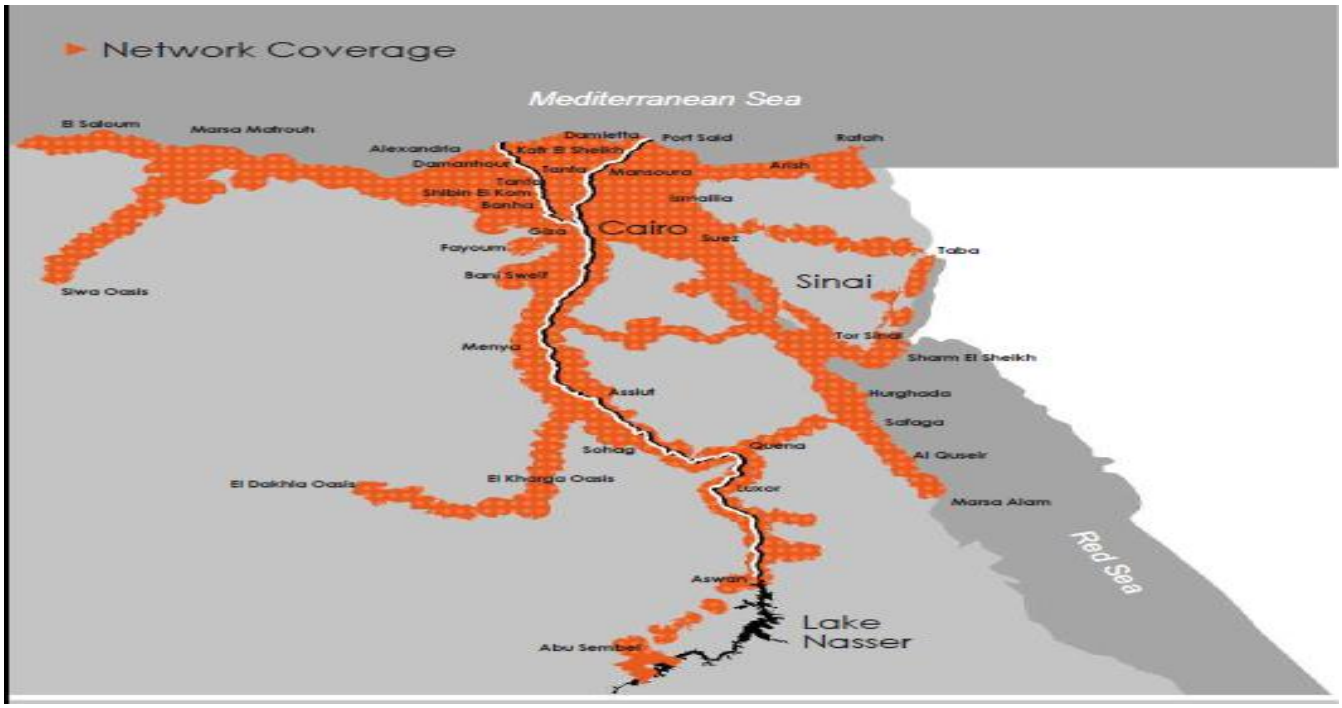


Figure 5. 9: Mobile GSM Coverage Area (Mobile Operator)

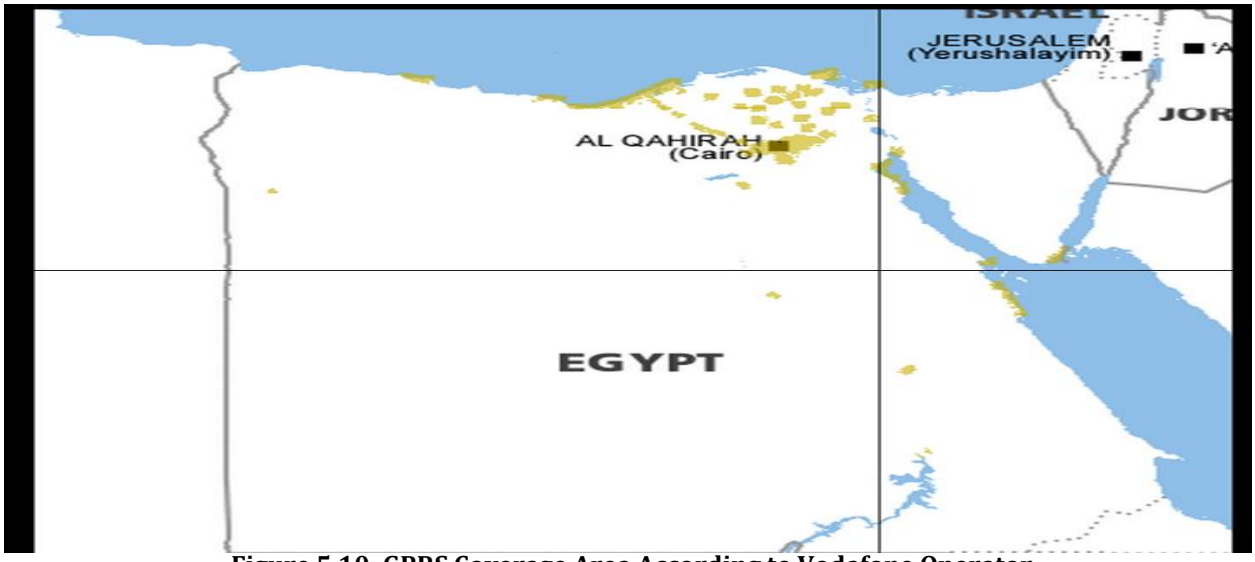


Figure 5.10: GPRS Coverage Area According to Vodafone Operator

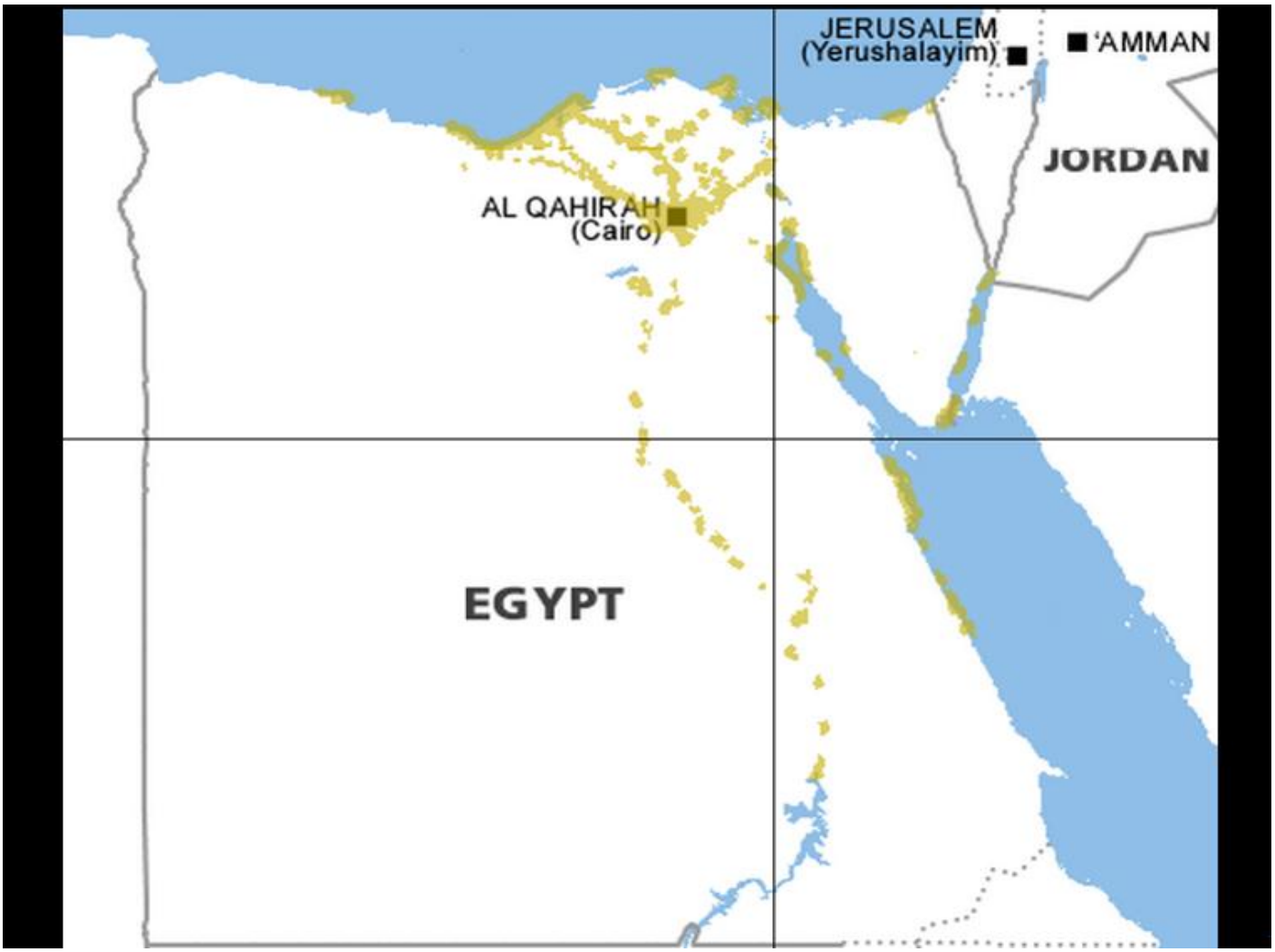


Figure 5.11: GPRS Coverage Area According to Mobinil Operator

Figures below showed the present of the infrastructure of the GSM/GPRS required to our system according to one of the Mobile Service Operator (Mobinil). With this Map, we can detect that our system can be applied on almost most of the road of the Egypt, in the blend area in maps, we can organize with the Mobile Service Operators to make an Infrastructure of Possible Wireless connection like making infrastructure of WiMaX , which could be like updating Step to our system.

5.11. Conclusion

The goal of this project is to "design, implement, and test a prototype RFID reader network using the GSM/GPRS data communications standard."

Table 5. 4: GSM/GPRS Data Communication Standard

Advantages	Disadvantages
• Low Cost • Low Complexity • Easily to implement anyway • Easily connected to device in its coverage area	• Required active mobile operator services • Low data rate can be affected on high traffic rate • High effect with the quantity of service

In working towards this goal, several requirements have shaped this project and its corresponding design process. As a proof of concept project, the focus was mainly on demonstrating the ability of the technology, and less on the specific operating requirements of the system. None the less, some general requirements include:

❖To establish a robust network using a standards-based wireless technology, preferably GSM/GPRS, this will be composed of autonomous, battery-powered wireless nodes, each with the capability of an RFID reader.

❖To prove the ability to reliably transmit data from end devices to router and from RFID Reader to central node (Sub-Database) at a minimum of several (20 - 30) Km for reasonable range in a typical implementation (according to the standard we selected).

❖To deliver a working prototype system, including the hardware, software and Documentation necessary to allow further development.

Chapter 6 :

Plan and Budget

Preview

We introduce in this chapter the project's plan and budget And the real system Implementation's plan and budget.

Plan and Budget

6.1 Our project Implementation's plan and Budget

A. Our project implementation's plan

Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Late Start	Late Finish	Total Float	
A	Read and Search information	1	1	18OCT10	24OCT10	22NOV10	28NOV10	5	
B	Identify Project Objectives and	2	2	25OCT10	07NOV10	29NOV10	12DEC10	5	
C	Search Company to buy RFID	4	4	08NOV10	05DEC10	13DEC10	09JAN11	5	
D	Interface RFID and reading	1	1	06DEC10	12DEC10	10JAN11	16JAN11	5	
E	Design , Building Database and	2	2	13DEC10	26DEC10	17JAN11	30JAN11	5	
G	Make video showing why	2	2	13DEC10	26DEC10	04APR11	17APR11	16	
H	Design a Brochure advertising	1	1	13DEC10	19DEC10	11APR11	17APR11	17	
F	Building C# program for 3MAN	5	5	27DEC10	30JAN11	31JAN11	06MAR11	5	
I	Build Website, connect with db,	5	5	27DEC10	30JAN11	18APR11	22MAY11	16	
M	Simulating the 3MAN system on	2	2	27DEC10	09JAN11	04JUL11	17JUL11	27	
J	Buy Circuits components	4	4	31JAN11	27FEB11	07MAR11	03APR11	5	
K	Design and Building model for	4	4	28FEB11	27MAR11	04APR11	01MAY11	5	
L	Design RFID modules terminal &	3	3	28MAR11	17APR11	02MAY11	22MAY11	5	
N	Write a complete report of the	5	5	18APR11	22MAY11	23MAY11	26JUN11	5	
O	Designing, Organizing &	3	3	23MAY11	12JUN11	27JUN11	17JUL11	5	

Figure 6. 1: Table of activity of our project

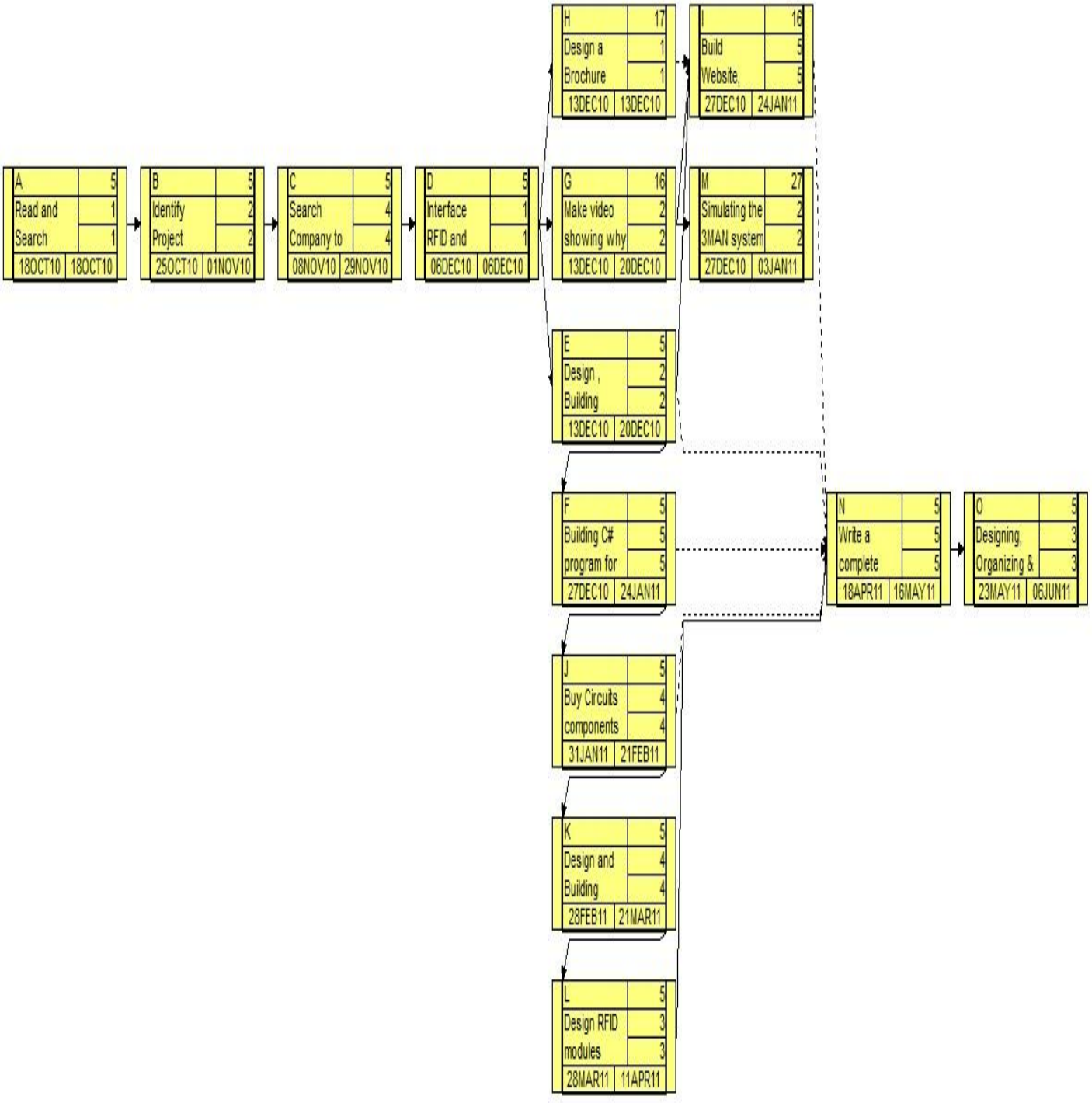


Figure 6. 2: Project Network activities implemented on primavera software

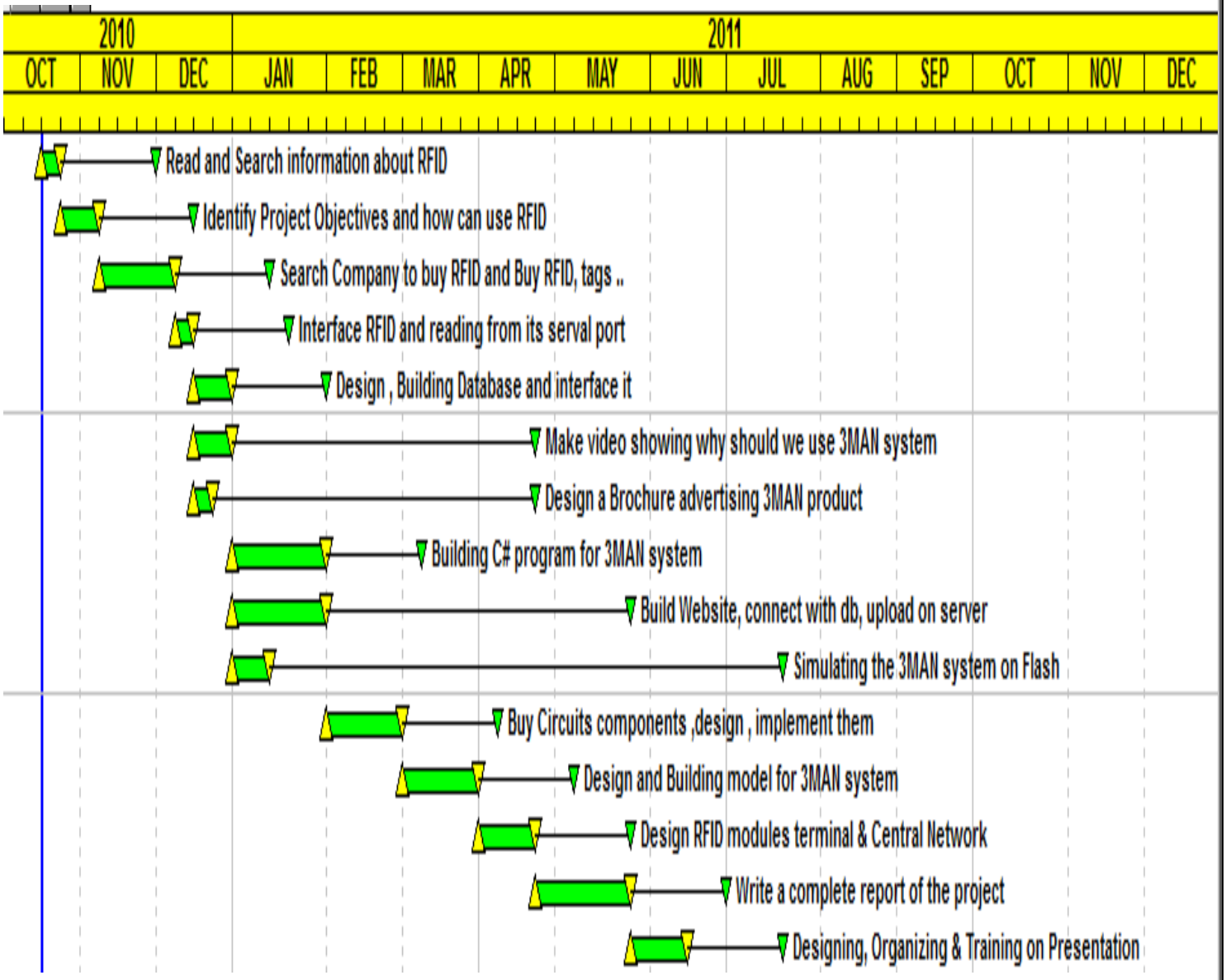


Figure 6. 3 : Gantt Chart of the project

Primavera Scheduling and Leveling Calculations -- Scheduling Report Page: 1

This Primavera software is registered to MORRISON KNUDSEN.
Start of schedule for project 3MAN.
Serial number...19555921

User name MARYSE .

Open end listing -- Scheduling Report Page: 2

Activity A has no predecessors
Activity M has no successors
Activity O has no successors

Scheduling Statistics for Project 3MAN:
Schedule calculation mode - Retained logic
Schedule calculation mode - Contiguous activities
Float calculation mode - Use finish dates
SS relationships - Use early start of predecessor

Schedule run on Sun Jul 24 14:29:21 2011
Run Number 4.

Number of activities	15
Number of activities in longest path	11
Started activities	0
Completed activities	0
Number of relationships	20
Percent complete	0.0
Data date	18OCT10
Start date	18OCT10
Imposed finish date	17JUL11
Latest calculated early finish	12JUN11

Figure 6. 5 : The project implementation on primavera software

B. Our Project's Budget :

Table 6. 1 : Project's Budget

RFID Reader	760.5
Customs	90
Reader's Shipping	263.25
Money Transfer fees	117
Electronic tools	500
Electronic Components & Chips	500
Model	600
Transferring the model	200
Printing Project's Book (10 copies)	1000
Remote Controlled Car	230
Stepper Motors	120
Total	4380.75

6.2 Real System Implementation's Plan and Budget

A. Real System Implementation's Plan

Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start		Early Finish	Late Start	Late Finish	Total Float
A	Searching for,bidding RFID	2	2	26DEC11		08JAN12	26DEC11	08JAN12	0
B	Buying the Equipment &	4	4	09JAN12		05FEB12	09JAN12	05FEB12	0
C	Searching for & bidding	2	2	26DEC11		08JAN12	16JAN12	29JAN12	3
D	Buying Servers & shipping	2	2	09JAN12		22JAN12	30JAN12	12FEB12	3
E	Implementing the readers with	1	1	06FEB12		12FEB12	06FEB12	12FEB12	0
F	Make System Software and	8	8	13FEB12		08APR12	13FEB12	08APR12	0
G	Configuring the network	2	2	09APR12		22APR12	09APR12	22APR12	0
H	Configuring the Servers	1	1	23APR12		29APR12	23APR12	29APR12	0
I	Testing the system	4	4	30APR12		27MAY12	30APR12	27MAY12	0

Figure 6. 6 : Real System Implementation's activities

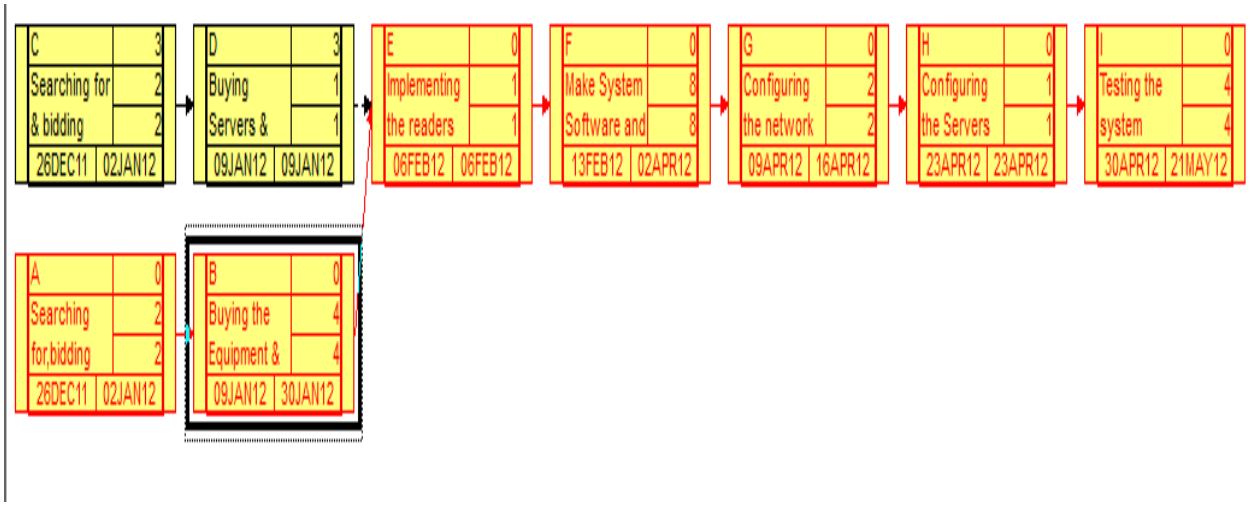


Figure 6. 7: Real System implementation's Network

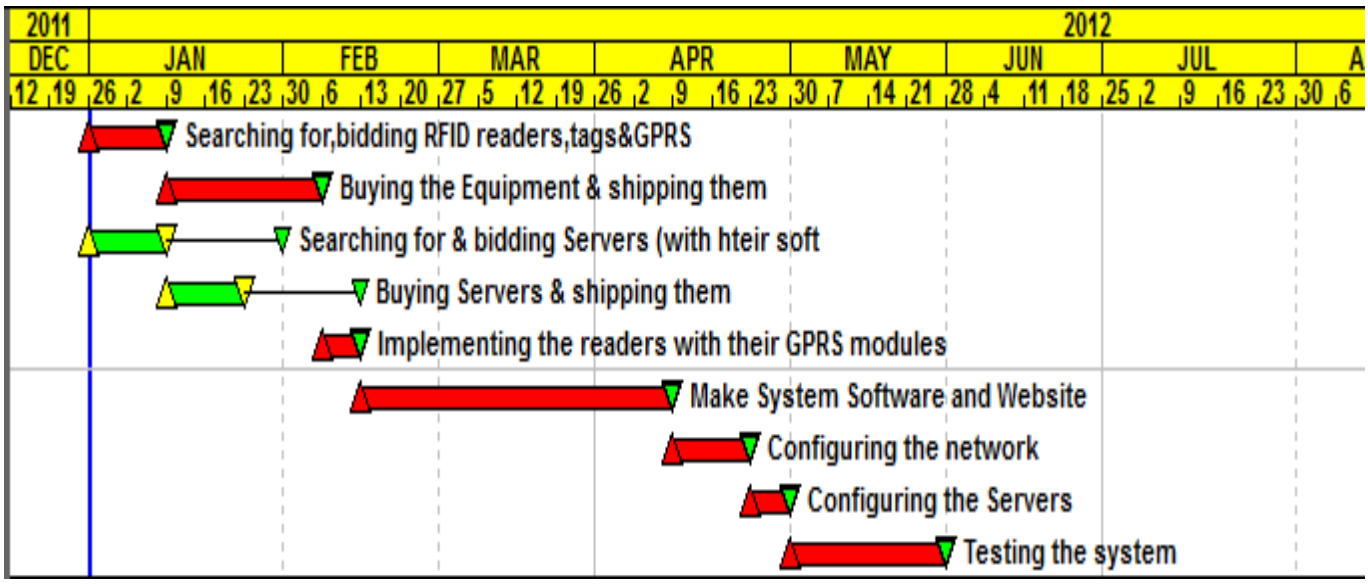


Figure 6. 8 : Gantt Chart of Real System Implementation

Primavera Scheduling and Leveling Calculations -- Scheduling Report Page: 1

This Primavera software is registered to MORRISON KNUDSEN.
Start of schedule for project MAAN.
Serial number...19555921

User name MARYSE .

Open end listing -- Scheduling Report Page: 2

Activity A has no predecessors
Activity C has no predecessors
Activity I has no successors

Scheduling Statistics for Project MAAN:
Schedule calculation mode - Retained logic
Schedule calculation mode - Contiguous activities
Float calculation mode - Use finish dates
SS relationships - Use early start of predecessor

Schedule run on Sun Jul 24 14:21:42 2011
Run Number 1.

Number of activities	9
Number of activities in longest path	7
Started activities	0
Completed activities	0
Number of relationships	8
Percent complete	0.0
Data date	26DEC11
Start date	26DEC11
Imposed finish date	
Latest calculated early finish	27MAY12

Figure 6. 9 : Real System Implementation on primavera software.

B. Real System Implentation Budget

Table 6. 2 : Real Implementation budget , according to the numbers in table 6.3

RFID Readers	**175500**
GPRS modules	1800
Database Servers + SW	100000
Implementation	50000
Tags	14625000
Total	14952300

Table 6. 3 :Numbers of readers and servers to cover Cairo - Alexandria highway only

No. Of readers	**12**
No. Of DB servers	2
No. Of cars	5000000

Chapter 7 :

Conclusion and Future Ideas

Preview

We introduce in this chapter the Conclusion and The future ideas that we will apply in the future.

Conclusion and Future Ideas

The objective of this project was to assess that our RFID system is multifunctional, and much more efficient than the current traditional systems. In particular, the research focused on three main traffic applications:

- Speed control
- Reduce traffic jamming
- Easily track suspected or stolen cars

7.1 Summary of Activities:

As part of this project, the research team conducted the following activities in an effort to assess the feasibility of using RFID technology to better manage some traffic problems, specially overspeeding on highways:

- Interfacing the RFID reader and reading from its serial port in C#.
- Building the database and interfacing it with C#.
- Analyzing the Signal sent by the reader & formatting the input.
- Speed calculations and speed ticket update to database in C#.
- Interfacing a mobile device using USB port to send SMS to the speeding car owner using C#.
- Sending an E-mail to the speeding car owner using C#.
- Building a Website driven Database for the system by using (ASP.NET, HTML, XHTML, CSS and C#).
- Connect Website with Database.
- Implementing the highway gate stepper motors and interfacing them with parallel port and controlling the motor from C#.
- Implementing infrared sensor on the gates and interfacing it with serial port to be read on C#.
- Design all the circuits using (Proteus).
- Designing the RFID modules, terminal & central network.

- Design the Network of real system by using Packet Tracer.
- Planning Our Graduation Project implementation on Primavera Software.
- Planning the system real implementation on Primavera Software.
- Budget of Our Graduation Project.
- Budget of a Real System implementation.
- Designing the GUI of the C#.
- Design Flow Chart of the Project.
- Design UML of the Program C#.
- Making a simulation video showing why we should use the solution of the RFID.
- Simulating the system on flash.
- Building a model for 3MAN smart highway system.
- Programming and implementing microcontrollers (PIC16F877A & PIC16F84A) for controlling an LCD screen and road lighting.

7.2 Summary of findings:

As a result of the various activities conducted through this project, the research team developed the following findings:

- RFID technology (Radio Frequency IDentification), its basic components and applications of RFID.
- Hardware interfacing.
- Working on complicated problems on C#, ASP.NET, SQL Server & Proteus.
- Building website driven database.

7.3 Recommendations:

Based on the findings generated from the activities of this project, the team offers the following conclusions and recommendations regarding the use of RFID technology for speed control, traffic management and stolen car recovery & tracking.

7.4 Future Ideas:

- Traffic tracking algorithm to control traffic and reduce traffic jam
- Live car tracking algorithm
- Electronic parking payments
- Truck weight limit control system at the toll gates
- Implement a design for DSRC, which will make the following applications possible to implement:
    - Emergency warning system for vehicles
    - Cooperative Adaptive Cruise Control
    - Cooperative Forward Collision Warning
    - Intersection collision avoidance
    - Approaching emergency vehicle warning (Blue Waves)
    - Vehicle safety inspection
    - Transit or emergency vehicle signal priority
    - Commercial vehicle clearance and safety inspections
    - In-vehicle signing
    - Rollover warning
    - Probe data collection
    - Highway-rail intersection warning

Appendix A:

World Health Organization report: about road safety in Egypt

EGYPT

World Health Organization

ROAD SAFETY IN TEN COUNTRIES

Population (2008): **81 527 000**
Income group: **Middle**
Gross national income per capita (2008): **$2015**
Road traffic death rate (estimate): **41.6/100 000 population**
Number of registered vehicles (2008): **4 300 000**

Egypt is one of ten countries included in the *Road safety in 10 countries (RS10)* project funded through a grant from the Bloomberg Philanthropies. It is implemented by national partners with technical support provided by a consortium of road safety partners. The partners in Egypt are WHO (in the lead), the Global Road Safety Partnership (GRSP), the International Injury Research Center from Johns Hopkins University (JHU) and the Association for Safe International Road Travel (ASIRT).

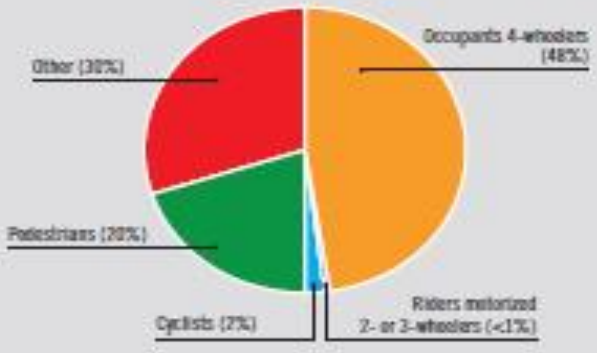
Every year about 12 000 Egyptians lose their lives as a result of a road traffic crash. Many thousands are non-fatally injury - some with resultant long-term disability.

Almost half of those killed in motor vehicle crashes are occupants (passengers and drivers) of four-wheeled vehicles although pedestrians make up an additional one-fifth.

Traffic flows in Egypt are chaotic with trucks, pedestrians, two-wheelers, buses and motor vehicles all sharing the same space. In addition, there is poor infrastructure, particularly for vulnerable road users.

Although there are laws on speed, blood alcohol concentration for the general population, seat-belt wearing and helmet wearing, they are poorly enforced. Sustained and highly visible policing, coupled with public education and infrastructural improvements are the key challenges which need to be addressed in order to reduce the road traffic injury and death toll in Egypt's roads.

DEATHS BY ROAD USER CATEGORY



EGYPT

The overall goal of RS10 in Egypt is to support the Egyptian government to implement good practices to reduce deaths and injuries due to road traffic collisions. The focus of the project will be on speeding, particularly on the "ring road" around Cairo and seat-belt wearing in both Cairo and Alexandria. In addition to the road safety prevention work, national and international partners will also work in the area of data system development.

The key objectives in Egypt will be to:

- Develop model programmes which address speed management and seat-belt use that can be replicated in other sites in Egypt;
- Improve the quality of road traffic injury data through the implementation of a road traffic "accident" database as well as through injury surveillance in hospitals, community-based surveys and improved death certification;
- Raise public awareness through an appropriate social marketing campaign;
- Strengthen the road safety capacity of multisectoral professionals through appropriate training programmes;
- Stimulate the involvement of nongovernmental road safety organizations; and
- Monitor and evaluate the impact of the interventions.

Activities to be implemented during the first phase (2010–2011) of the project include:

- Reviewing and revising road safety legislation;
- Enhancing enforcement of road safety regulations;
- Advocating and raising public awareness about the high burden of traffic injuries and the potential for improving road safety;
- Training key personnel on road safety planning, risk factor assessment and enforcement of road safety legislation;
- Strengthening nongovernmental organizations to conduct advocacy and awareness raising;
- Providing equipment to assist in addressing risk factors;
- Improving road traffic injury and fatality data systems; and
- Conducting studies to monitor and evaluate impact of interventions.

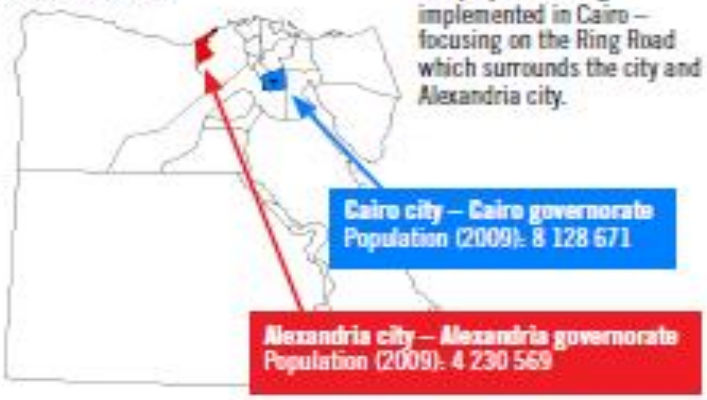
Seat-belt laws

Applies to all occupants	**No, drivers only**
Seat-belt wearing rate (drivers only)	**70%**
Child restraint law	**No**

Speeding laws

Set nationally	**Yes**
Maximum limit (urban roads)	**60km/h**
Maximum limit (rural roads)	**60km/h**

Project implementation sites:
The project is being implemented in Cairo – focusing on the Ring Road which surrounds the city and Alexandria city.



International Consortium partners:

WHO Responsible for overall coordination of the consortium partners; providing financial and technical support to elements relating to social marketing, enforcement operations, legislative review, revision and the procurement of enforcement equipment and data system setup.

GRSP Responsible for capacity development.

ASIRT Responsible for engaging the nongovernmental organizations in Egypt and working with the media to promote road safety.

JHU Responsible for ongoing monitoring and impact/outcome evaluation of the programme.

All consortium partners will provide technical support to the Government of Egypt throughout the implementation of the programme.

National partners:
Ministry of Health
Traffic Police
General Authority for Roads, Bridges and Land Transport (GARBLT)
Egyptian Red Crescent
Egyptian Society for Road Safety
Union for Road Traffic Injuries
Central Agency for Public Mobilization and Statistics (CAPMAS)

Contacts:
WHO country office:
Magdy Bakr
Email: bakrm@egy.emro.who.int

WHO regional office:
Jaffar Hussain
Email: hussainj@emro.who.int

WHO headquarters:
Maleckidzadeck Khayesi
Email: khayesim@who.int

Source:
http://data.un.org/CountryProfile.aspx?crname=Egypt
2005, National Information Center for Health & Population
Global status report on road safety, WHO, 2009
http://www.who.int/violence_injury_prevention/road_traffic/countrywise/egy/index.html

Appendix B

RFID datasheet

EM MICROELECTRONIC - MARIN SA

SWATCH GROUP ELECTRONIC SYSTEMS

EM4100

Read Only Contactless Identification Device

Description

The EM4100 (previously named H4100) is a CMOS integrated circuit for use in electronic Read Only RF Transponders. The circuit is powered by an external coil placed in an electromagnetic field, and gets its master clock from the same field via one of the coil terminals. By turning on and off the modulation current, the chip will send back the 64 bits of information contained in a factor y pre-programmed memory array.

The programming of the chip is performed by laser fusing of polysilicon links in order to store a unique code on each chip.

The EM4100 has several metal options which are used to define the code type and data rate. Data rates of 64, 32 and 16 periods of carrier frequency per data bit are available. Data can be coded as Manchester, Biphase or PSK.

Due to low power consumption of the logic core, no supply buffer capacitor is required. Only an external coil is needed to obtain the chip function. A parallel resonance capacitor of 74 pF is also integrated.

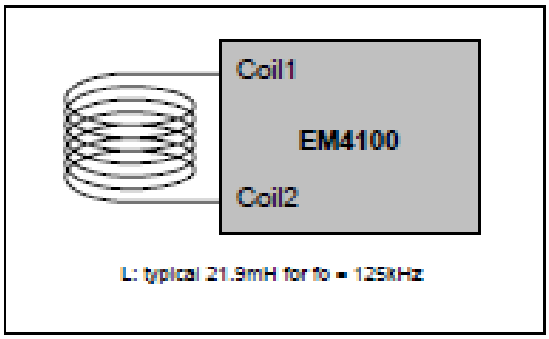
Features

- 64 bit memory array laser programmable
- Several options of data rate and coding available
- On chip resonance capacitor
- On chip supply buffer capacitor
- On chip voltage limiter
- Full wave rectifier on chip
- Large modulation depth due to a low impedance modulation device
- Operating frequency 100 - 150 kHz
- Very small chip size convenient for implantation
- Very low power consumption

Applications

- Logistics automation
- Anticounterfeiting
- Access control
- Industrial transponder

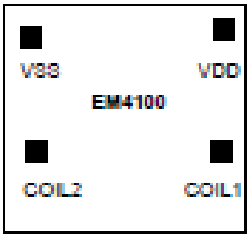
Typical Operating Configuration



L: typical 21.9mH for fo = 125kHz

Fig. 1

Pin Assignment



COIL1	Coil terminal / Clock input
COIL2	Coil terminal

Fig. 2

Absolute Maximum Ratings

Parameter	Symbol	Conditions
Maximum DC Current forced on COIL1 & COIL2	I_{COIL}	±30mA
Power Supply	V_{DD}	-0.3 to 7.5V
Storage Temp. Die form	T_{store}	-55 to +200°C
Storage Temp. PCB form	T_{store}	-55 to +125°C
Electrostatic discharge maximum to MIL-STD-883C method 3015	V_{ESD}	1000V

Stresses above these listed maximum ratings may cause permanent damage to the device.
Exposure beyond specified operating conditions max affect device reliability or cause malfunction.

Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temp.	T_{op}	-40		+85	°C
Maximum Coil Current	I_{COIL}			10	mA
AC Voltage on Coil	V_{coil}	3	14*)		Vpp
Supply Frequency	f_{coil}	100		150	kHz

*) The AC Voltage on Coil is limited by the on chip voltage limitation circuitry. This is according to the parameter I_{coil} in the absolute maximum ratings.

Handling Procedures

This device has built-in protection against high static voltages or electric fields; however due to the unique properties of this device, anti-static precautions should be taken as for any other CMOS component.

System Principle

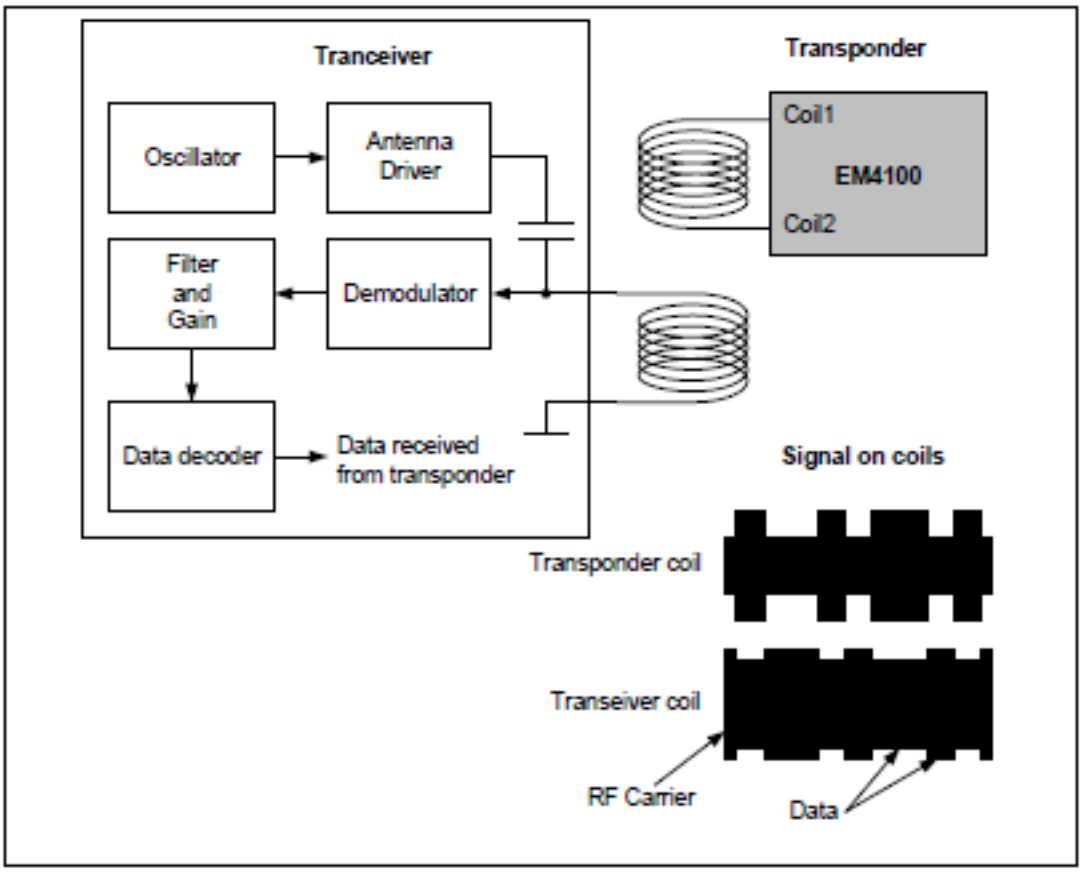


Fig. 3

Electrical Characteristics

V_{DD} = 1.5V, V_{SS} = 0V, f_{C1} = 134kHz square wave, T_a = 25°C
V_{C1} = 1.0V with positive peak at V_{DD} and negative peak at V_{DD} -1V unless otherwise specified

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{DD}		1.5		1)	V
Rectified Supply Voltage	V_{DDREC}	V_{COIL1} - V_{COIL2} = 2.8 VDC Modulator switch = "ON"	1.5			V
Coil1 - Coil2 Capacitance	C_{res}	V_{coil}=100mVRMS f=10kHz		74 2)		pF
Power Supply Capacitor	C_{BUF}			120		pF
Biphase & Manchester Versions						
Supply Current	I_{DD}			0.63	1.5	µA
C2 pad Modulator ON voltage drop	V_{ONC2}	V_{DD}=1.5V I_{VDDC2}=100µA with ref. to V_{DD} V_{DD}=5.0V I_{VDDC2}=1mA with ref. to V_{DD}	0.9 2.1	1.1 2.3	1.3 2.8	V V
C1 pad Modulator ON voltage drop	V_{ONC1}	V_{DD}=5.0V I_{VDDC1}=1mA with ref. to V_{DD}	2.1	2.3	2.8	V
PSK Version						
Supply Current PSK	I_{DDPSK}			0.92	2	µA
C2 pad Modulator ON voltage drop	$V_{ONC2PSK}$	V_{DD}=1.5V I_{VDDC2}=100µA with ref. to V_{DD}	0.3	0.6	0.9	V

Note 1) The maximum voltage is defined by forcing 10mA on COIL1 - COIL2
Note 2) The tolerance of the resonant capacitor is ± 15% over the whole production.
Optional reduced tolerance on request
On a wafer basis, the tolerance is ± 2%

Timing Characteristics

V_{DD} = 1.5V, V_{SS} = 0V, f_{coil} = 134kHz square wave, T_a = 25°C
V_{C1} = 1.0V with positive peak at V_{DD} and negative peak at V_{DD} -1V unless otherwise specified
Timings are derived from the field frequency and are specified as a number of RF periods.

Parameter	Symbol	Test Conditions	Value	Units
Read Bit Period	T_{rdb}	depending on option	64, 32, 16	RF periods

Timing Waveforms

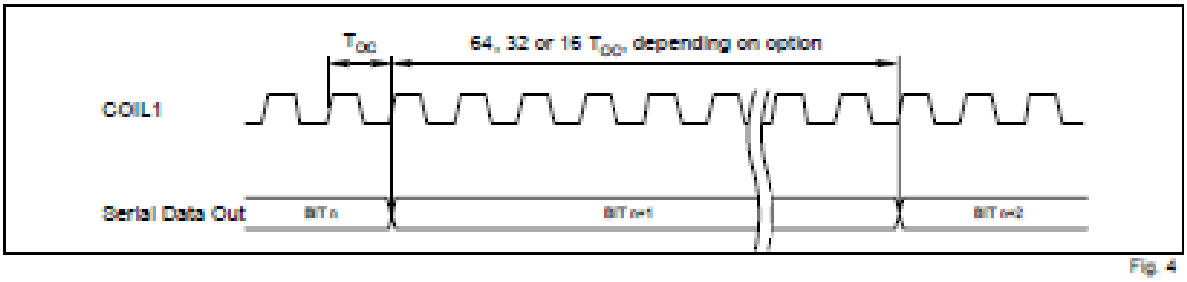


Fig. 4

Block Diagram

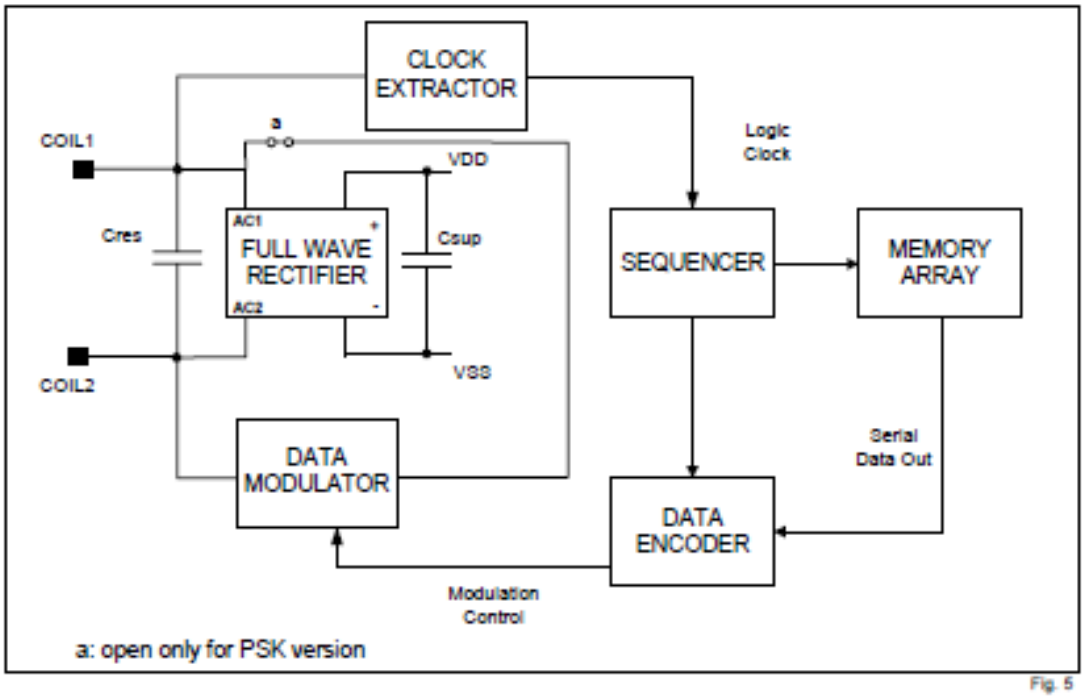


Fig. 5

Functional Description

General

The EM4100 is supplied by means of an electromagnetic field induced on the attached coil. The AC voltage is rectified in order to provide a DC internal supply voltage. When the last bit is sent, the chip will continue with the first bit until the power goes off.

Full Wave Rectifier

The AC input induced in the external coil by an incident magnetic field is rectified by a Graetz bridge. The bridge will limit the internal DC voltage to avoid malfunction in strong fields.

Clock Extractor

One of the coil terminals (COIL1) is used to generate the master clock for the logic function. The output of the clock extractor drives a sequencer.

Sequencer

The sequencer provides all necessary signals to address the memory array and to encode the serial data out.
Three mask programmed encoding versions of logic are available. These three encoding types are Manchester, biphase and PSK. The bit rate for the first and the second type can be 64 or 32 periods of the field frequency. For the PSK version, the bit rate is 16.
The sequencer receives its clock from the COIL1 clock extractor and generates every internal signal controlling the memory and the data encoder logic.

Data Modulator

The data modulator is controlled by the signal Modulation Control in order to induce a high current in the coil. In the PSK version, only COIL2 transistor drives this high current. In the other versions, both coil1 and coil2 transistors drive it to Vdd. This will affect the magnetic field according to the data stored in the memory array.

Reconance Capacitor

This capacitor can be trimmed in factory by 0.5pf steps to achieve the absolute value of 74pf typically. This option, which is on request, allows a smaller capacitor tolerance on the whole of the production.

Memory Array for Manchester & Bi-Phase encoding ICs
The EM4100 contains 64 bits divided in five groups of information. 9 bits are used for the header, 10 row parity bits (P0-P9), 4 column parity bits (PC0-PC3), 40 data bits (D00-D93), and 1 stop bit set to logic 0.

1	1	1	1	1	1	1	1	1	9 header bits
8 version bits or customer ID				D00	D01	D02	D03	P0	
				D10	D11	D12	D13	P1	
32 data bits				D20	D21	D22	D23	P2	
				D30	D31	D32	D33	P3	
				D40	D41	D42	D43	P4	
				D50	D51	D52	D53	P5	
				D60	D61	D62	D63	P6	
				D70	D71	D72	D73	P7	
				D80	D81	D82	D83	P8	
				D90	D91	D92	D93	P9	10 line parity bits
				PC0	PC1	PC2	PC3	S0	

4 column parity bits

The header is composed of the 9 first bits which are all mask programmed to "1". Due to the data and parity organisation, this sequence cannot be reproduced in the data string. The header is followed by 10 groups of 4 data bits allowing 100 billion combinations and 1 even row parity bit. Then, the last group consists of 4 event column parity bits without row parity bit. S0 is a stop bit which is written to "0"
Bits D00 to D03 and bits D10 to D13 are customer specific identification.
These 64 bits are outputted serially in order to control the modulator. When the 64 bits data string is outputted, the output sequence is repeated continuously until power goes off.

Memory Array for PSK encoding ICs
The PSK coded IC's are programmed with odd parity for P0 and P1 and always with a logic zero.
The parity bits from P2 to P9 are even.
The column parity PC0 to PC3 are calculated including the version bits and are even parity bits.

Code Description

Manchester
There is always a transition from ON to OFF or from OFF to ON in the middle of bit period. At the transition from logic bit "1" to logic bit "0" or logic bit "0" to logic bit "1" the phase change. Value high of data stream presented below modulator switch OFF, low represents switch ON (see Fig. 6).

Biphase Code
At the beginning of each bit, a transition will occur. A logic bit "1" will keep its state for the whole bit duration and a logic bit "0" will show a transition in the middle of the bit duration (see Fig. 7).

PSK Code
Modulation switch goes ON and OFF alternately every period of carrier frequency. When a phase shift occurs, a logical "0" is read from the memory. If no shift phase occurs after a data rate cycle, a logical "1" is read (see Fig. 8).

Manchester Code

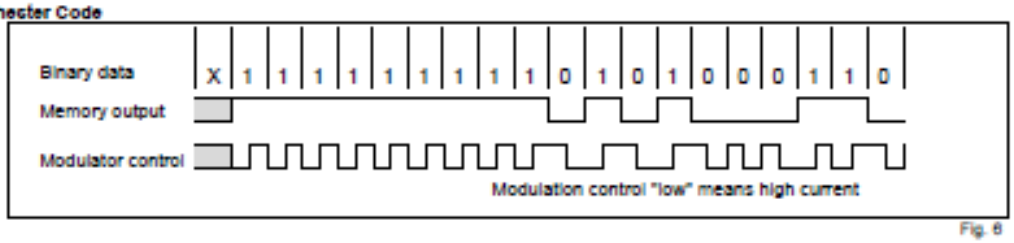


Fig. 6

Biphase Code

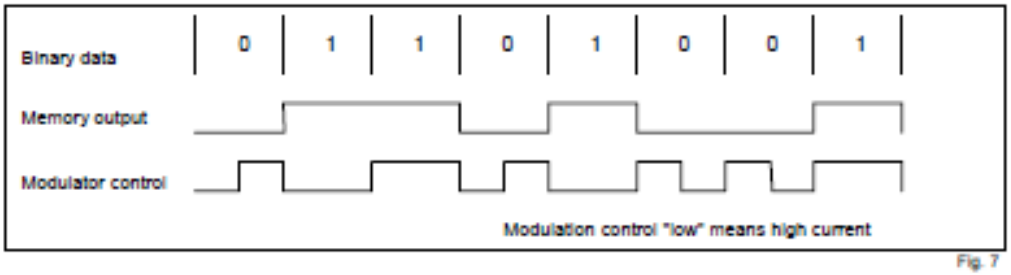


Fig. 7

PSK Code

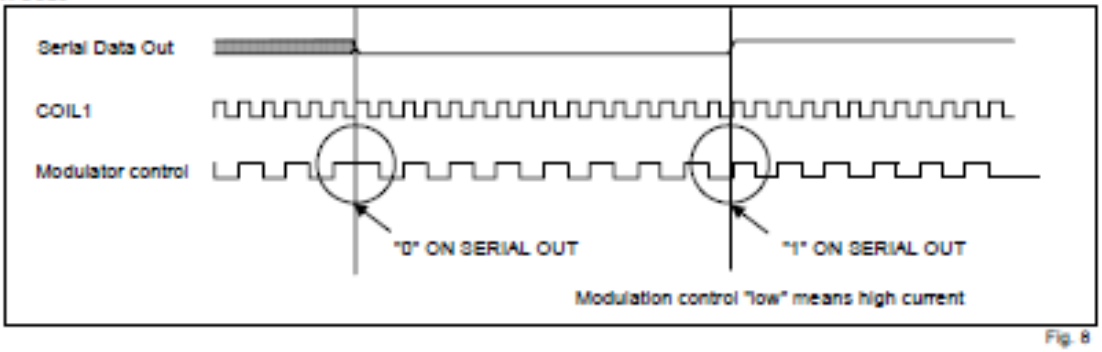


Fig. 8

Typical Performance Characteristics

Typical Capacitor Variation versus Temperature

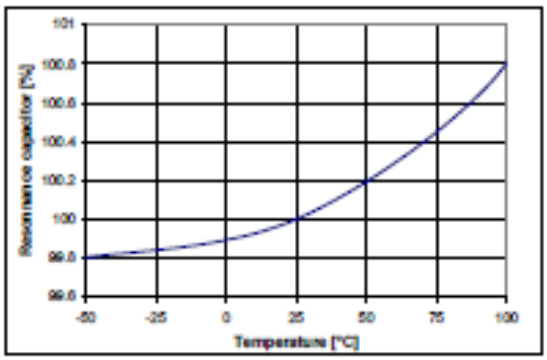


Fig. 9

Dynamic Consumption Versus temperature with Vdd-Vss=1.6V

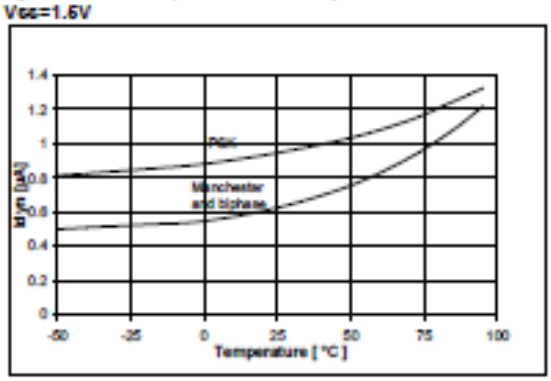


Fig. 10

L versus Resonance Frequency versus for a typical coil capacitance of 74 pf

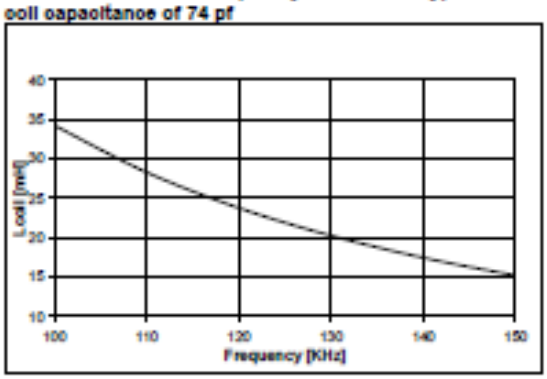


Fig. 11

Rectified Voltage versus temperature for Vcoil2-Vcoil1=2.8V

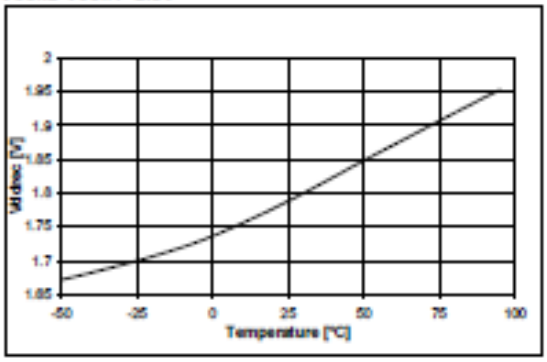


Fig. 12

CHIP Dimensions

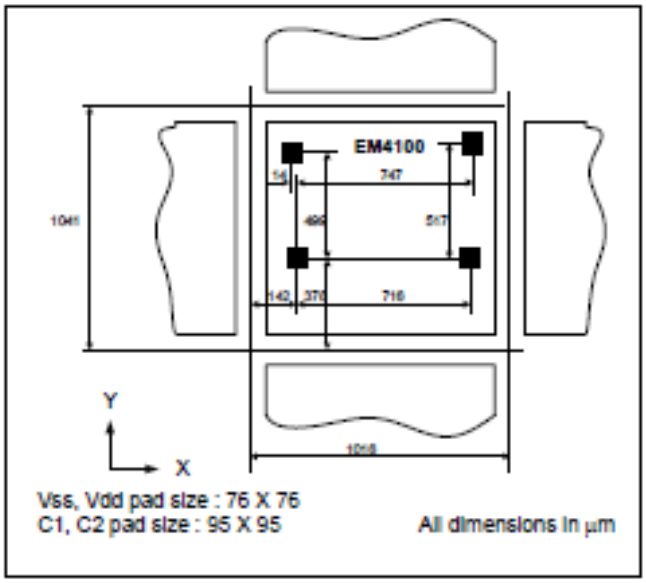
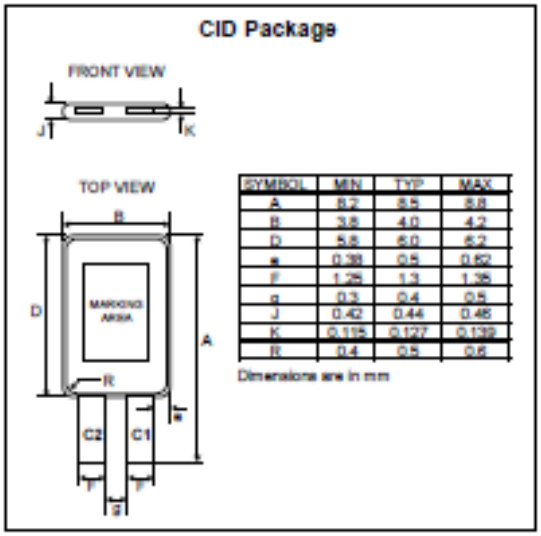


Fig. 13

CID Package

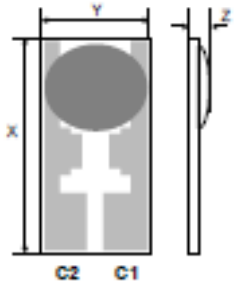


SYMBOL	MIN	TYP	MAX
A	8.2	8.5	8.8
B	3.8	4.0	4.2
D	5.8	6.0	6.2
e	0.38	0.5	0.62
F	1.25	1.3	1.35
g	0.3	0.4	0.5
J	0.42	0.44	0.46
K	0.115	0.127	0.139
R	0.4	0.5	0.6

Dimensions are in mm

Fig. 14

PCB Package



SYMBOL	MIN	TYP	MAX
X		8.0	
Y		4.0	
Z			1.0

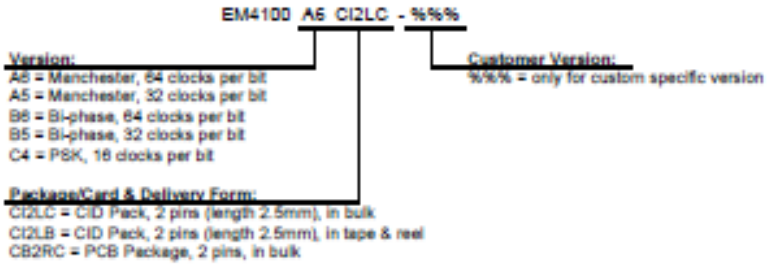
Dimensions are in mm

Fig. 15

Ordering Information

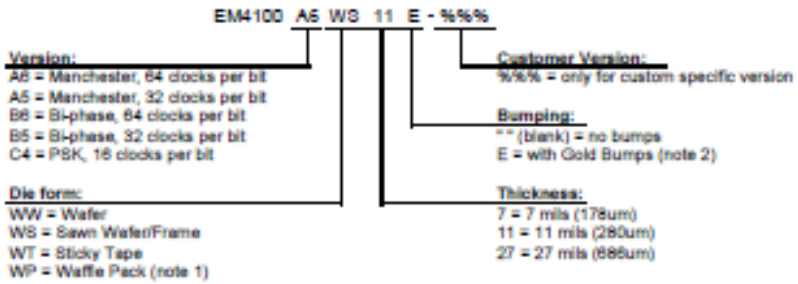
Packaged Devices

This chart shows general offering; for detailed Part Number to order, please see the table "Standard Versions" below.



Die Form

This chart shows general offering; for detailed Part Number to order, please see the table "Standard Versions" below.



Remarks:

- For ordering please use table of "Standard Version" table below.
- For specifications of Delivery Form, including gold bumps, tape and bulk, as well as possible other delivery form or packages, please contact EM Microelectronic-Marin S.A.
- **Note 1:** This is a non-standard package. Please contact EM Microelectronic-Marin S.A for availability.
- **Note 2 :** Direct connection using this version is subject to license. Please contact info@emmicroelectronic.com

Standard Versions:

The versions below are considered standards and should be readily available. For other versions or other delivery form, please contact EM Microelectronic-Marin S.A. Sales Office. Please make sure to give complete part number when ordering, without spaces.

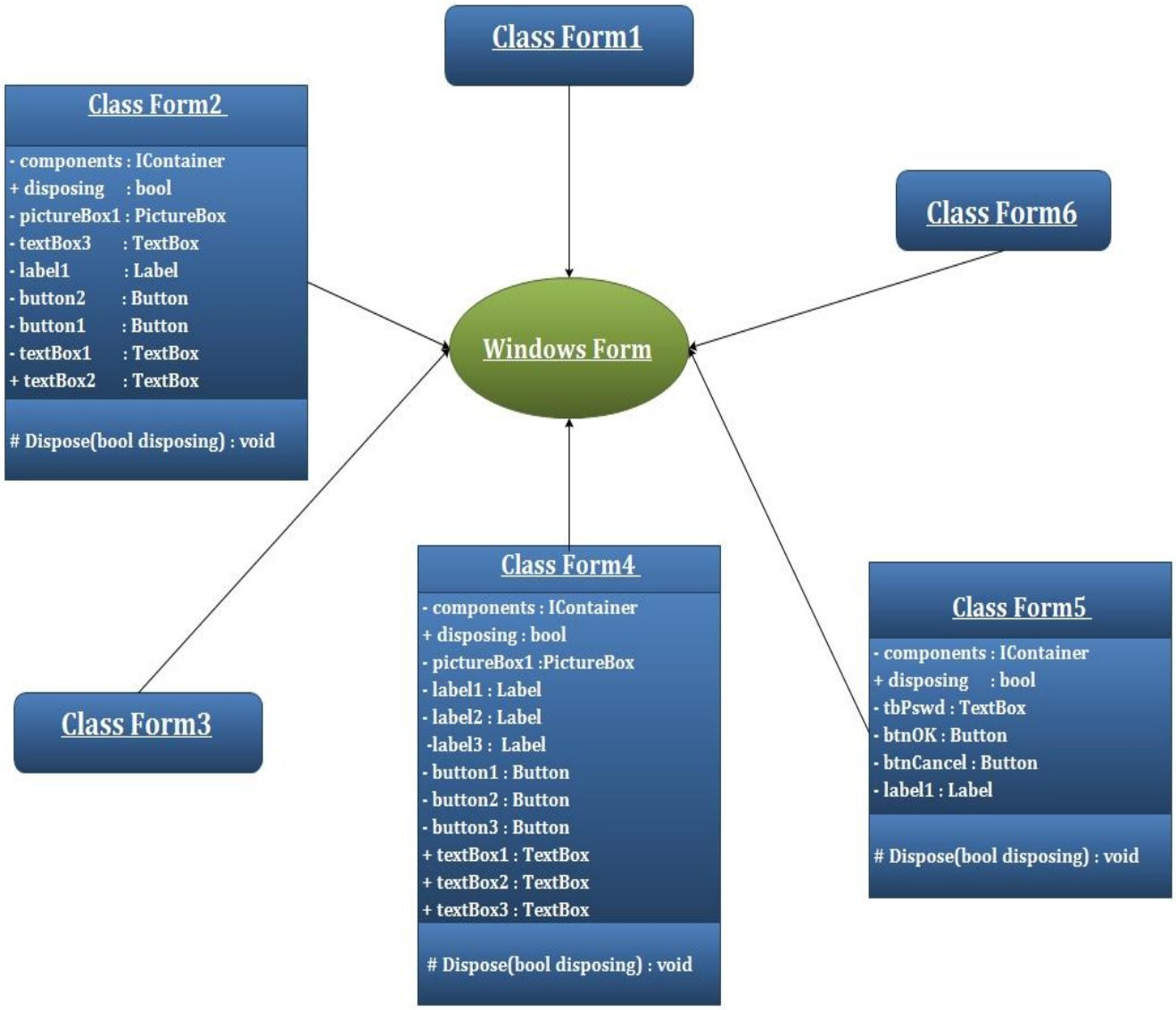
Part Number	Bit coding	Cycle/ bit	Package/Card/Die Form	Delivery Form / Bumping
EM4100A5CB2RC	Manchester	32	PCB Package, 2 pins	bulk
EM4100A5CI2LC	Manchester	32	CID package, 2 pins (length 2.5mm)	bulk
EM4100A6CB2RC	Manchester	64	PCB Package, 2 pins	bulk
EM4100A6CI2LB	Manchester	64	CID package, 2 pins (length 2.5mm)	tape
EM4100A6CI2LC	Manchester	64	CID package, 2 pins (length 2.5mm)	bulk
EM4100A6WP7	Manchester	64	Die in waffle pack, 7 mils	no bumps
EM4100A6WS7	Manchester	64	Sawn wafer, 7 mils	no bumps
EM4100A6WT7	Manchester	64	Die on sticky tape, 7 mils	no bumps
EM4100A6WW7	Manchester	64	Unsawn wafer, 7 mils	no bumps
EM4100B5CB2RC	Bi-phase	32	PCB Package, 2 pins	bulk
EM4100B5CI2LC	Bi-phase	32	CID package, 2 pins (length 2.5mm)	bulk
EM4100B6CB2RC	Bi-phase	64	PCB Package, 2 pins	bulk
EM4100B6CI2LC	Bi-phase	64	CID package, 2 pins (length 2.5mm)	bulk
EM4100C4WS11	PSK	16	Sawn wafer, 11 mils thickness	no bumps
EM4100XXYYY-%%%	custom		custom	custom

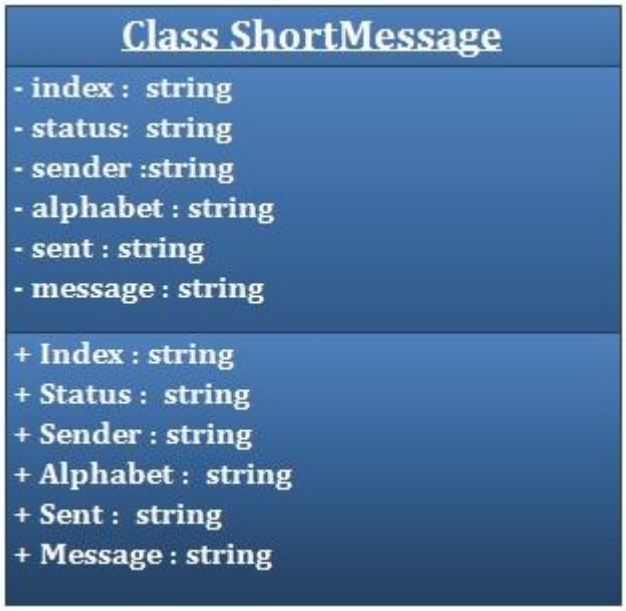
Product Support

Check our Web Site under Products/RF Identification section.
Questions can be sent to info@emmicroelectronic.com

Appendix C

Software UML


Class Form1
Class Form2
- components : IContainer
+ disposing : bool
- pictureBox1 : PictureBox
- textBox3 : TextBox
- label1 : Label
- button2 : Button
- button1 : Button
- textBox1 : TextBox
+ textBox2 : TextBox
# Dispose(bool disposing) : void
Class Form6
Windows Form
Class Form3
Class Form4
- components : IContainer
+ disposing : bool
- pictureBox1 :PictureBox
- label1 : Label
- label2 : Label
-label3 : Label
- button1 : Button
- button2 : Button
- button3 : Button
+ textBox1 : TextBox
+ textBox2 : TextBox
+ textBox3 : TextBox
# Dispose(bool disposing) : void
Class Form5
- components : IContainer
+ disposing : bool
- tbPswd : TextBox
- btnOK : Button
- btnCancel : Button
- label1 : Label
Dispose(bool disposing) : void


Class ShortMessage
- index : string
- status: string
- sender :string
- alphabet : string
- sent : string
- message : string
+ Index : string
+ Status : string
+ Sender : string
+ Alphabet : string
+ Sent : string
+ Message : string

Class clsSMS

+ port : SerialPort
+ p_strPortName : string
+ p_uBaudRate : int
+ p_uDataBits : int
+ p_uReadTimeout : int
+ p_uWriteTimeout: int
+ input : string
+ buffer : string
+ t : string
+ CountTotalMessages : int
+ recievedData : string
+ command : String
+ uReceivedDataLength : int
+ strSplit : string[]
+ strMessageStorageArea1 : string
+ strMessageExist1 : string
+ recievedError : string
+ receiveNow : AutoResetEvent
+ messages : ShortMessageCollection
+ r : Regex
+ m : Match
+ msg : ShortMessage
+ readNow : AutoResetEvent
+ isSend : bool
+ recievedData : string
+ command : String
+ isDeleted : bool
+ command : string
+ responseTimeout : int
+ errorMessage : string
+ sender : object
+ e : SerialDataReceivedEventArgs
+ timeout : int
+ p_strCommand : string
+ PhoneNo : string
+ Message : string

+ OpenPort(string p_strPortName, int p_uBaudRate, int p_uDataBits, int p_uReadTimeout, int p_uWriteTimeout) : SerialPort
+ ClosePort(SerialPort port) : void
+ ExecCommand(SerialPort port,string command, int responseTimeout, string errorMessage) : string
+port_DataReceived(object sender, SerialDataReceivedEventArgs e) : void
+ ReadResponse(SerialPort port,int timeout) : string
+ CountSMSmessages(SerialPort port) : int
+ ReadSMS(SerialPort port, string p_strCommand) : ShortMessageCollection
+ ShortMessageCollection ParseMessages(string input)
+ sendMsg(SerialPort port, string PhoneNo, string Message) : bool
+ DeleteMsg(SerialPort port , string p_strCommand) : bool
+ DataReceived(object sender, SerialDataReceivedEventArgs e) : void


Class Form6
- components : IContainer
+ disposing : bool
- button1 : Button
- textBox1 : TextBox
- label1 : Label
- button2 : Button
- textBox2 : TextBox
- label2 : Label
- button3 : Button
- richTextBox1 : RichTextBox
- label3 : Label
- label4 : Label
- label5 : Label
- label6 : Label
- label7 : Label
- label8 : Label
- textBox3: TextBox
- label9 : Label
- button4: Button
- button5: Button
- pictureBox1:PictureBox
- label10 : Label
- label11 : Label
Dispose(bool disposing) : void

Class : Form1

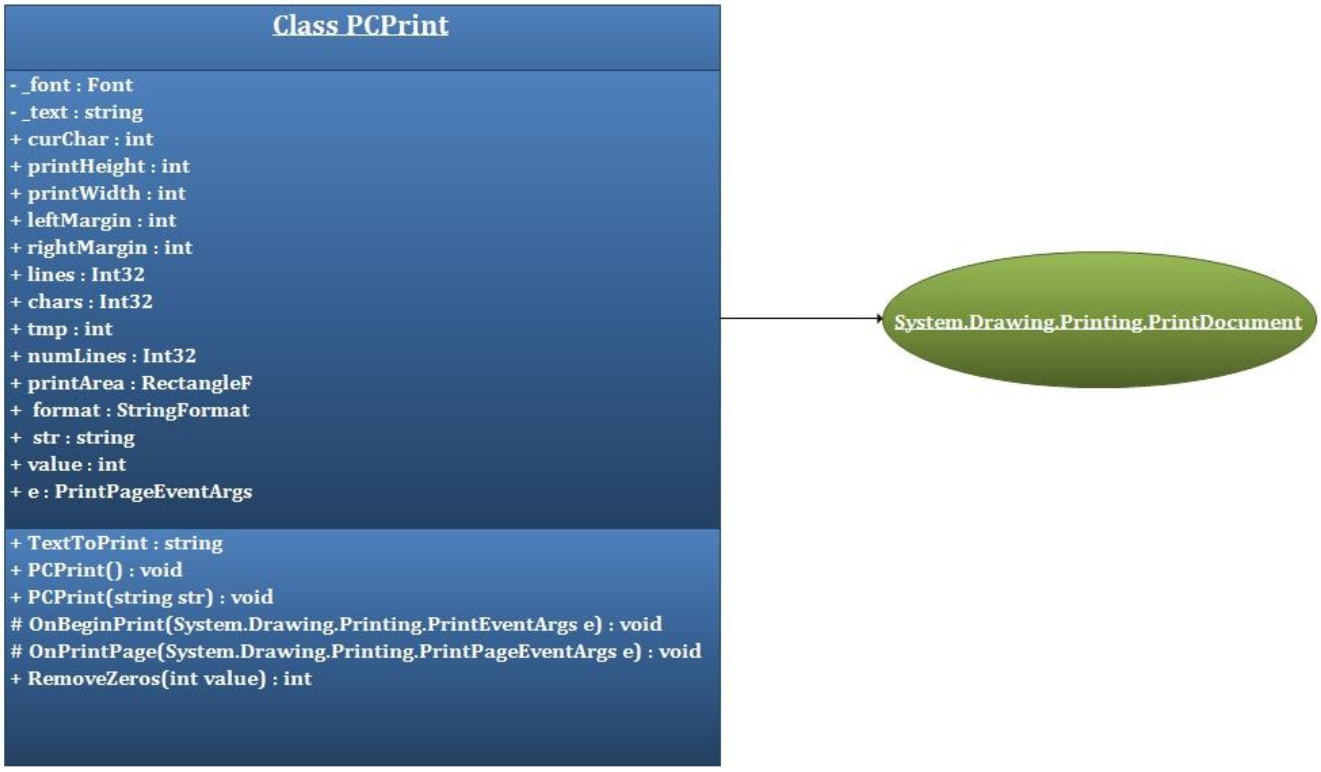
- groupBox1 : GroupBox
- label1 : Label
- Logging : GroupBox
- label2 : Label
- label5 : Label
- textBox2 : TextBox
-ComboBaudrate:ComboBox
-ComboDatabits:ComboBox
- btnOpen : Button
- ComboPort : ComboBox
- checkLog : CheckBox
- checkTerminal:CheckBox
- mainMenu1: MainMenu
- checkPortChange: CheckBox
- buttonWait : Button
- axSPortAx1: AxSPortAx
- read : Button
- components:IContainer
- button1 : Button
- ListLog : ListBox
- button2 : Button
- button3 : Button
- button4 : Button
- statusBar1 : StatusBar
- button5 : Button
- pictureBox1:PictureBox
+ config : String
+ port : ParallelPort
+ buffSize : int
+ Buff : byte[]
+ flag : int
+ i : int
+ myReader: SqlCeDataReader
+ cm : SqlCeConnection
+ db : SqlCeDataAdapter
+ tag : String
+ flag1 : int
+ myComman:SqlCeCommand
+ myCommand:SqlCeCommand
+ t1 : DateTime
+ t2 : DateTime
+ type : String
+ updateSql: String
+ sc : SpeedCalc
+ speed : int[]
+ iN : int
+ x1 : string
+ x2 : string
+ sms : String
+ frm : Form2
+ frm : Form3
+ rval : int
+ frm : Form4
+ frm : Form6
+ frm : AboutBox1
+ x : Boolean
+ sp : SerialPort
+ objclsSMS:clsSMS
+ port : SerialPort
+ mobPort : String
+ numb : String
+ cboPortName:String
+ cboBaudRate :int
+ cboDataBits :int
+ txtReadTimeOut:int
+ txtWriteTimeOut:int
+ strMsg : string
+ toEmail : string
+ sender : object

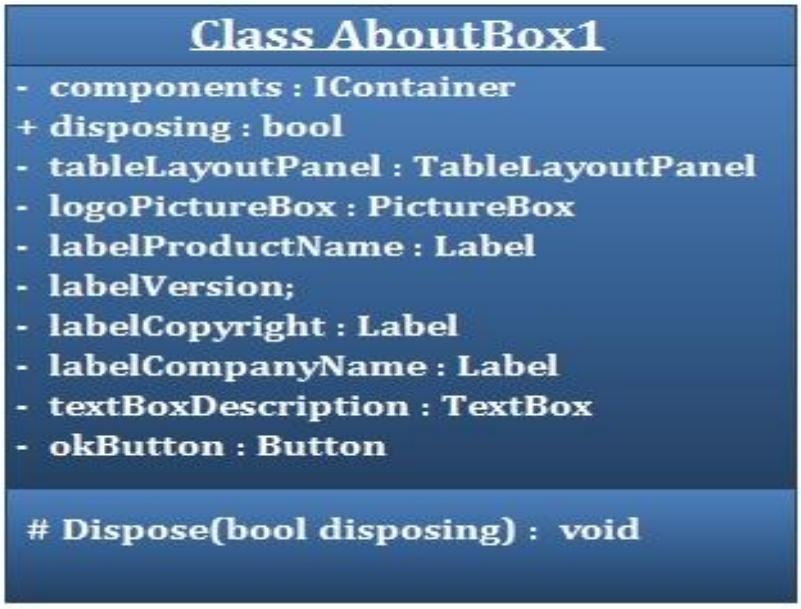
+ Form1()
# Dispose(bool disposing): Void
+ Main() : Void
- groupBox1_Enter(object sender, System.EventArgs e):Void
- Form1_Load(object sender, System.EventArgs e) : void
- Log(String message) : void
- button1_Click(object sender, System.EventArgs e):void
- textBox2_KeyPress(object sender, System.Windows.Forms.KeyPressEventArgs e):void
-ComboBaudrate_SelectedIndexChanged(object sender, System.EventArgs e):void
-ComboDatabits_SelectedIndexChanged(object sender, System.EventArgs e):void
-isReady() : void
-axSPortAx1_OnRxChar(object sender, AxSPortLib._ISPortAxEvents_OnRxCharEvent e):void
-axSPortAx1_OnBreak(object sender, System.EventArgs e):void
-axSPortAx1_OnCommError(object sender, AxSPortLib._ISPortAxEvents_OnCommErrorEvent e):void
-axSPortAx1_OnCTS(object sender, AxSPortLib._ISPortAxEvents_OnCTSEvent e) : void
-axSPortAx1_OnDCD(object sender, AxSPortLib._ISPortAxEvents_OnDCDEvent e):void
-axSPortAx1_OnDSR(object sender, AxSPortLib._ISPortAxEvents_OnDSREvent e):void
-axSPortAx1_OnRxFlag(object sender, System.EventArgs e):void
-axSPortAx1_OnTxEmpty(object sender, System.EventArgs e) : void
-axSPortAx1_OnRing(object sender, AxSPortLib._ISPortAxEvents_OnRingEvent e):void
- axSPortAx1_OnPortAdded(object sender, AxSPortLib._ISPortAxEvents_OnPortAddedEvent e):void
-axSPortAx1_OnPortRemoved(object sender, AxSPortLib._ISPortAxEvents_OnPortRemovedEvent e):void
-axSPortAx1_OnLatencyExpiry(object sender, EventArgs e):void
- buttonWait_Click(object sender, EventArgs e):void
-checkPortChange_CheckedChanged(object sender, EventArgs e):void
-axSPortAx1_OnChangePortsList(object sender, EventArgs e):void
-read_Click_1(object sender, EventArgs e):void
-button1_Click_1(object sender, EventArgs e):void
-textBox2_TextChanged(object sender, EventArgs e):void
-textBox2_MultilineChanged(object sender, EventArgs e):void
-button2_Click(object sender, EventArgs e):void
-Form1_KeyPress(object sender, KeyPressEventArgs e):void
-button3_Click(object sender, EventArgs e):void
-button4_Click(object sender, EventArgs e):void
-IRWait():void
-sendSMS(String mobPort, String numb, String sms):void
-button5_Click(object sender, EventArgs e):void
-connectMobile(String cboPortName):void
+SendMail(string strMsg, string toEmail):bool
-statusBar1_PanelClick(object sender, StatusBarPanelClickEventArgs e):void

Class Form3

+ srr : object
+ sender : object
+ cm : SqlCeConnection
+ db : SqlCeDataAdapter
+ l : Random
+ x : int

+ Form3() : void
+ textBox1_TextChanged(object srr) : void
- comboBox1_SelectedIndexChanged_1(object sender, EventArgs e): void
- button1_Click_1(object sender, EventArgs e) : void
- richTextBox1_TextChanged_1(object sender, EventArgs e) : void
- pictureBox1_Click(object sender, EventArgs e) : void
- textBox2_TextChanged_1(object sender, EventArgs e) : void
- button2_Click(object sender, EventArgs e) : void
- textBox1_KeyPress(object sender, KeyPressEventArgs e) :void
- pictureBox1_Click_1(object sender, EventArgs e) : void


Class PCPrint
- _font : Font
- _text : string
+ curChar : int
+ printHeight : int
+ printWidth : int
+ leftMargin : int
+ rightMargin : int
+ lines : Int32
+ chars : Int32
+ tmp : int
+ numLines : Int32
+ printArea : RectangleF
+ format : StringFormat
+ str : string
+ value : int
+ e : PrintPageEventArgs
+ TextToPrint : string
+ PCPrint() : void
+ PCPrint(string str) : void
# OnBeginPrint(System.Drawing.Printing.PrintEventArgs e) : void
# OnPrintPage(System.Drawing.Printing.PrintPageEventArgs e) : void
+ RemoveZeros(int value) : int
System.Drawing.Printing.PrintDocument


Class AboutBox1
- components : IContainer
+ disposing : bool
- tableLayoutPanel : TableLayoutPanel
- logoPictureBox : PictureBox
- labelProductName : Label
- labelVersion;
- labelCopyright : Label
- labelCompanyName : Label
- textBoxDescription : TextBox
- okButton : Button
Dispose(bool disposing) : void


Class SpeedCal
+ t1 : DateTime
+ t2 : DateTime
+ type : String
+ t3 : TimeSpan
+ dist : int
+ legalSpeed : int
+ speed : int
+ overdrive : int
+ x:int[]
+ SpeedCal(DateTime t1, DateTime t2, String type) : int[]

Class NTPort

+ GetLPTPortAddress(short nPortNo) : short
+ ERROR_NONE : int
+ ERROR_DRIVER : int
+ERROR_SCM_CANT_CONNECT :int
+ nPortStart : short
+ nPortStop : short
+ nPortAddress : short
+ nData : short
+ sUserName : String
+ dwKey : int
+sError : StringBuilder
+ bOption : bool

+GetLastState([MarshalAs(UnmanagedType.LPStr)] StringBuilder sError): int
+ EnablePorts(short nPortStart, short nPortStop) : void
+DisablePorts(short nPortStart, short nPortStop) : void
+IsWinNT() : bool
+IsWin64() : bool
+Inport(short nPortAddress) : byte
+Inp(short nPortAddress): byte
+Inpw(short nPortAddress):short
+InportW(short nPortAddress): short
+Inpd(short nPortAddress):short
+InportD(short nPortAddress):int
+Outp(short nPortAddress, short nData):void
+Outport(short nPortAddress, short nData):void
+Outpw(short nPortAddress, short nData):void
+OutportW(short nPortAddress, short nData): void
+Outpd(short nPortAddress, int nData) : void
+OutportD(short nPortAddress, int nData) : void
+LicenseInfo([MarshalAs(UnmanagedType.LPStr)]String sUserName, int dwKey) : void
+GetNTPortVersion() : short
+SetFastMode(bool bOption) : void
+GetFastMode() : bool
+NTPort() : void

Appendix D

Software's Imported Classes

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Text;
using System.IO.Ports;
using System.Threading;
using System.Text.RegularExpressions;

namespace Example
{
   public class clsSMS
   {

      #region Open and Close Ports
      //Open Port
      public SerialPort OpenPort(string p_strPortName, int p_uBaudRate, int p_uDataBits, int
p_uReadTimeout, int p_uWriteTimeout)
      {
         receiveNow = new AutoResetEvent(false);
         SerialPort port = new SerialPort();

         try
         {
            port.PortName = p_strPortName;              //COM1
            port.BaudRate = p_uBaudRate;               //9600
            port.DataBits = p_uDataBits;              //8
            port.StopBits = StopBits.One;              //1
            port.Parity = Parity.None;                //None
            port.ReadTimeout = p_uReadTimeout;          //300
            port.WriteTimeout = p_uWriteTimeout;        //300
            port.Encoding = Encoding.GetEncoding("iso-8859-1");
            port.DataReceived += new SerialDataReceivedEventHandler(port_DataReceived);
            port.Open();
            port.DtrEnable = true;
            port.RtsEnable = true;
         }
         catch (Exception ex)
         {
            throw ex;
         }
         return port;
      }

      //Close Port
      public void ClosePort(SerialPort port)
      {
         try
         {
            port.Close();
            port.DataReceived -= new SerialDataReceivedEventHandler(port_DataReceived);
            port = null;
```

```
        }
        catch (Exception ex)
        {
          throw ex;
        }
      }

      #endregion

      //Execute AT Command
      public string ExecCommand(SerialPort port,string command, int responseTimeout, string
errorMessage)
      {
        try
        {

          port.DiscardOutBuffer();
          port.DiscardInBuffer();
          receiveNow.Reset();
          port.Write(command + "\r");

          string input = ReadResponse(port, responseTimeout);
          if ((input.Length == 0) || ((!input.EndsWith("\r\n> ")) && (!input.EndsWith("\r\nOK\r\n"))))
            throw new ApplicationException("No success message was received.");
          return input;
        }
        catch (Exception ex)
        {
          throw ex;
        }
      }

      //Receive data from port
      public void port_DataReceived(object sender, SerialDataReceivedEventArgs e)
      {
        try
        {
          if (e.EventType == SerialData.Chars)
          {
            receiveNow.Set();
          }
        }
        catch (Exception ex)
        {
          throw ex;
        }
      }
      public string ReadResponse(SerialPort port,int timeout)
      {
        string buffer = string.Empty;
        try
        {
          do
          {
            if (receiveNow.WaitOne(timeout, false))
```

```
            {
               string t = port.ReadExisting();
               buffer += t;
            }
            else
            {
               if (buffer.Length > 0)
                  throw new ApplicationException("Response received is incomplete.");
               else
                  throw new ApplicationException("No data received from phone.");
            }
         }
         while (!buffer.EndsWith("\r\nOK\r\n") && !buffer.EndsWith("\r\n> ") &&
!buffer.EndsWith("\r\nERROR\r\n"));
      }
      catch (Exception ex)
      {
         throw ex;
      }
      return buffer;
   }

   #region Count SMS
   public int CountSMSmessages(SerialPort port)
   {
      int CountTotalMessages = 0;
      try
      {

         #region Execute Command

         string recievedData = ExecCommand(port, "AT", 300, "No phone connected at ");
         recievedData = ExecCommand(port, "AT+CMGF=1", 300, "Failed to set message format.");
         String command = "AT+CPMS?";
         recievedData = ExecCommand(port, command, 1000, "Failed to count SMS message");
         int uReceivedDataLength = recievedData.Length;

         #endregion

         #region If command is executed successfully
         if ((recievedData.Length >= 45) && (recievedData.StartsWith("AT+CPMS?")))
         {

            #region Parsing SMS
            string[] strSplit = recievedData.Split(',');
            string strMessageStorageArea1 = strSplit[0];    //SM
            string strMessageExist1 = strSplit[1];          //Msgs exist in SM
            #endregion

            #region Count Total Number of SMS In SIM
            CountTotalMessages = Convert.ToInt32(strMessageExist1);
            #endregion

         }
         #endregion
```

```
        #region If command is not executed successfully
        else if (recievedData.Contains("ERROR"))
        {

            #region Error in Counting total number of SMS
            string recievedError = recievedData;
            recievedError = recievedError.Trim();
            recievedData = "Following error occured while counting the message" + recievedError;
            #endregion

        }
        #endregion

        return CountTotalMessages;

    }
    catch (Exception ex)
    {
        throw ex;
    }

}
#endregion

#region Read SMS

public AutoResetEvent receiveNow;

public ShortMessageCollection ReadSMS(SerialPort port, string p_strCommand)
{

    // Set up the phone and read the messages
    ShortMessageCollection messages = null;
    try
    {

        #region Execute Command
        // Check connection
        ExecCommand(port,"AT", 300, "No phone connected");
        // Use message format "Text mode"
        ExecCommand(port,"AT+CMGF=1", 300, "Failed to set message format.");
        // Use character set "PCCP437"
        ExecCommand(port,"AT+CSCS=\"PCCP437\"", 300, "Failed to set character set.");
        // Select SIM storage
        ExecCommand(port,"AT+CPMS=\"SM\"", 300, "Failed to select message storage.");
        // Read the messages
        string input = ExecCommand(port, p_strCommand, 5000, "Failed to read the messages.");
        #endregion

        #region Parse messages
        messages = ParseMessages(input);
        #endregion

    }
```

```
    catch (Exception ex)
    {
        throw ex;
    }

    if (messages != null)
        return messages;
    else
        return null;

}
public ShortMessageCollection ParseMessages(string input)
{
    ShortMessageCollection messages = new ShortMessageCollection();
    try
    {
        Regex r = new Regex(@"\+CMGL: (\d+),""(.+)"",""(.+)"",(.*),""(.+)""\r\n(.+)\r\n");
        Match m = r.Match(input);
        while (m.Success)
        {
            ShortMessage msg = new ShortMessage();
            //msg.Index = int.Parse(m.Groups[1].Value);
            msg.Index = m.Groups[1].Value;
            msg.Status = m.Groups[2].Value;
            msg.Sender = m.Groups[3].Value;
            msg.Alphabet = m.Groups[4].Value;
            msg.Sent = m.Groups[5].Value;
            msg.Message = m.Groups[6].Value;
            messages.Add(msg);

            m = m.NextMatch();
        }

    }
    catch (Exception ex)
    {
        throw ex;
    }
    return messages;
}

#endregion

#region Send SMS

static AutoResetEvent readNow = new AutoResetEvent(false);

public bool sendMsg(SerialPort port, string PhoneNo, string Message)
{
    bool isSend = false;

    try
    {

        string recievedData = ExecCommand(port,"AT", 300, "No phone connected");
```

```
        recievedData = ExecCommand(port,"AT+CMGF=1", 300, "Failed to set message format.");
        String command = "AT+CMGS=\"" + PhoneNo + "\"";
        recievedData = ExecCommand(port,command, 300, "Failed to accept phoneNo");
        command = Message + char.ConvertFromUtf32(26) + "\r";
        recievedData = ExecCommand(port,command, 3000, "Failed to send message"); //3 seconds
        if (recievedData.EndsWith("\r\nOK\r\n"))
        {
          isSend = true;
        }
        else if (recievedData.Contains("ERROR"))
        {
          isSend = false;
        }
        return isSend;
      }
      catch (Exception ex)
      {
        throw ex;
      }

    }
    static void DataReceived(object sender, SerialDataReceivedEventArgs e)
    {
      try
      {
        if (e.EventType == SerialData.Chars)
          readNow.Set();
      }
      catch (Exception ex)
      {
        throw ex;
      }
    }

    #endregion

    #region Delete SMS
    public bool DeleteMsg(SerialPort port , string p_strCommand)
    {
      bool isDeleted = false;
      try
      {

        #region Execute Command
        string recievedData = ExecCommand(port,"AT", 300, "No phone connected");
        recievedData = ExecCommand(port,"AT+CMGF=1", 300, "Failed to set message format.");
        String command = p_strCommand;
        recievedData = ExecCommand(port,command, 300, "Failed to delete message");
        #endregion

        if (recievedData.EndsWith("\r\nOK\r\n"))
        {
          isDeleted = true;
        }
        if (recievedData.Contains("ERROR"))
```

```
            {
                isDeleted = false;
            }
            return isDeleted;
        }
        catch (Exception ex)
        {
            throw ex;
        }

    }
    #endregion

  }
}
```

Appendix E

Metal Tags

KU INFORMATION & TELECOMMUNICATION TECHNOLOGY CENTER
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UHF KU-RFID Tag

Technology Opportunity

▶ Overview

The University of Kansas (KU) Information and Telecommunication Technology Center (ITTC) has developed a passive UHF RFID tag that overcomes the difficulties encountered by current tags when placed near metal or liquid. Current passive tags do not work when placed directly on metal or on a container holding liquid. The UHF KU-RFID tag, or KU-Tag, has been specifically designed to address this issue and, at the same time, maintain a size and thickness similar to those of current popular tags. Additionally, the KU-Tag can be manufactured using standard tag manufacturing techniques, allowing it to be produced at a price competitive with passive tags currently on the market that do not work when placed on metal or liquid materials. The KU-Tag embodies five enabling technologies that are patent pending.

Table 1: Performance comparison of the passive KU-Tag and current passive and active RFID tags.

	KU-Tag	Comparable Tags	
		Passive	Active
Cost	✓	✓	
Performance on metal	✓		✓
Performance on containers with liquid	✓		✓
Size	✓	✓	
Thickness	✓	✓	
Manufacturability	✓	✓	

▶ Advantages of the KU-Tag

The KU-Tag tag performs 20%–100% better than the leading tags currently in use when tested at the KU RFID Alliance Laboratory (**www.rfidallianceIab.org**). (See Table 1, above right.)

Read Distance:

Read distance (distance from which a standard reader can read RFID tags) for the KU-Tag—suspended in free air, on metal, or on a container containing liquid—is better than for comparable tags under the same conditions. Table 2 (on reverse) illustrates the KU-Tag's performance in free air, separated from a metal surface by 7 mm, and mounted on a metal surface, compared with the performance of current passive RFID tags. The design of the KU-Tag allows its performance to be independent of mounting surfaces (including containers of liquid).

Thickness:

The technology within the KU-Tag has allowed us to build the thinnest tag that works near metal and liquid—1.6 mm thick (about the thickness of a quarter).

Size:

The current KU-Tag prototypes have been designed with profiles as large as 4 by 6 inches, and as small as 2 by 4.5 inches. The most recent prototype, with profile 4 by 5.5 inches, has been conservatively measured to give consistent reads at 20 feet when placed on any surface.

Cost:

Low cost is achievable, as the KU-Tag is:

- Designed for easy manufacturing, of readily available materials, by standard processes.
- Completely planar, constructed by layering-up two-dimensional materials (see Fig. 1, on reverse).

Standards Compliance:

The design of the KU-Tag is not constrained to a particular chip or standard—which, as related to chip performance, makes the KU-Tag comparable to all other tags currently on the market.

Active-Tag Replacement:

Performance of the UHF KU-RFID tag, combined with its ability to be manufactured on a scale and at a cost comparable to current passive tags, makes it well suited for applications that currently require expensive active-tag solutions. Active tags used to overcome the metal/liquid tagging problem cost from $20.00 to more than $150.00 per tag. In comparison, cost of manufacture of the passive KU-Tag, which works near metal and liquid, is estimated to be between $0.50 and $1.50.

▶ Barriers Overcome by the KU-RFID Tag

Current passive tags do not work well:

- When placed near water (bottled water, dampened cardboard, etc.).
- When placed on or near metal (steel cans, electrical appliances, etc.).

Previous "solutions" have drawbacks:

- Positioning the tag 5–8 mm from the metal or water presents problems because of size and space.
- Active tags (that do work near water and metal) are expensive replacements for passive tags.

Radio Frequency Identification (RFID) Background

RFID technology is:

- The current successor to bar coding.
- Achieving capabilities and efficiencies far beyond those of bar codes.
- Projected to increase 25-fold in the next four years, reaching $33 billion (based on findings by market research company In-Stat, in *Information Week* magazine article posted January 18, 2006).

The RFID tag is:

- The basic building block of an RFID system.
- In its simplest and most economical form, composed of an antenna and a small silicon-based integrated circuit (or IC chip) that contains a radio receiver, a radio modulator for sending a response back to the reader, control logic, memory, and a power system.
- "Passive" if the power system is completely powered by the incoming RF signal.
- "Active" if the tag's power system has a battery.

Passive tags:

- Have been widely adopted for use in supply-chain tracking.
- Cost between $0.05 and $20.00.

Active tags:

- Are generally used in situations where passive tags do not work well (i.e., near metal or liquid) or where sensor data is integrated into the tag (e.g., a tag that would monitor the temperature of a container during transport).
- Can cost from $2.00 to more than $150.00.

Further Facts About the UHF KU-RFID Tag

Table 2: Read distance for the KU-Tag in comparison with passive and active RFID tags currently in use.

	Avery AD-620	Avery	Symbol	Avery	KU-Tag
Read Distance (ft)					
Free Space	14.5	17	21	22	21
7mm cardboard separation	11.5	12.5	7.5	11	21
On Metal	0	0	2.5	8	21

Fig. 1: Sample construction of the KU-Tag.

Readily available, low-cost construction materials and standard manufacturing processes for the KU-Tag:

- Substrate material 60 mils thick, provides a semi-rigid, high-performance, highly impact-resistant, low water-absorption mounting surface for the microstrip antenna.
- Metal foil is laminated to bottom of substrate. (Aluminum foil seems to be most cost-effective.)
- Pressure-sensitive adhesive laminates bottom of foil to liner.
- RFID tag inlay (tag antenna and IC chip on polyester film) is laminated on top of substrate.
- Standard conversion process laminates paper or plastic label (for product identification) atop inlay.

Summary

- The KU-Tag technologies (five patents pending) outperform the technology of RFID tags currently in use.
- The KU-Tag (operating in the UHF spectrum) is readable at distances of more than 20 feet and overcomes the difficulties experienced with currently available tags when placed near metal or liquid materials.
- The KU-Tag may be manufactured using readily available commodities and standard processes, keeping its size and thickness small and its costs low—to approximately $0.05 to $1.50 per tag.

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