



PPU College of
Engineering and Technology

The Home of Competent Engineers and Researchers

Electrical Engineering Department

Communication Engineering Program

Bachelor Thesis

Graduation Project

Automobile Licenses Detecting System

Project Team

Abdallah M. Abu Munshar

Ahmad Salah Saa'd

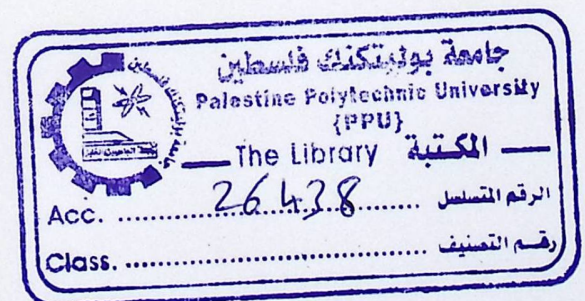
Mohammed B. Al-Najjar

Project Supervisor

Dr. Eng. Osama Ata

Hebron – Palestine

2012-2013



جامعة بوليتكنك فلسطين

الخليل - فلسطين

كلية الهندسة والتكنولوجيا

دائرة الهندسة الكهربائية

اسم المشروع:

Automobile License Detection System (ALDS)

أسماء الطلاب:

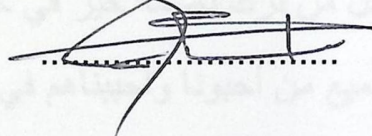
أحمد صلاح سعد

محمد بسام النجار

عبدالله محمد ابو منشار

بناءً على نظام كلية الهندسة والتكنولوجيا وإشراف ومتابعة المشرف المباشر على المشروع ومتابعة أعضاء اللجنة الممتحنة تم تقديم هذا المشروع إلى دائرة الهندسة الكهربائية وذلك استكمالاً لمتطلبات درجة البكالوريوس في تخصص هندسة الاتصالات والإلكترونيات

توقيع المشرف



توقيع اللجنة الممتحنة

توقيع رئيس الدائرة

إهداء:

إلى أمة الإسلام العظيمة

إلى كل الذين ضحوا بأرواحهم في سبيل نصره الحق

إلى كل من شاركوا في إزالة الظلم عن كاهل شعوبهم

إلى فلسطين أرضاً وشعباً وحجراً مقاوم

إلى أسرى الحرية القابعين في زنازين الظلم

إلى أمهاتنا وأبائنا

إلى إخوتنا وأخواتنا

إلى جميع أصدقائنا

إلى أساتذتنا ومعلمينا

إلى المشرف الدكتور أسامة عطا

الذي ما بخل علينا بثانيته من وقته وعلمه

وكل من ساهم في إنجاح هذا العمل

إلى كل من ترك بصمة خير في حياتنا

إلى جميع من أحبونا وأحببناهم في الله

نهدي هذا العمل

أعضاء المشروع

Acknowledgment

We would like to express our greatest gratitude to the people who have helped and supported us throughout the project.

We wish to thank our parents for their undivided support and interest who inspired us and encouraged us to go our own ways, without whom we would be unable to complete our project. At last but not the least I want to thank our friends who appreciated us for our work and motivated us and finally to God who made all the things possible. We are grateful to our teacher Dr. Osama Ata for his continuous support for the project, from initial advice and contacts in the early stages of conceptual inception and through ongoing advice and encouragement to this day. A special thank of our goes to our colleagues who helped us in completing the project and exchanged their interesting ideas, thoughts and made this project easy and accurate.

Abstract

There is tremendous inconvenience which is caused when a policeman stops a vehicle to check its license and the license of the driver, and see if the vehicle is legally registered and its license is not expired. This causes time wasting for drivers and passengers who are in the vehicle. We built a wireless system called Automobile License Detection System (ALDS) to alleviate the traffic congestion problem with a potential to directly impact the environment and noise pollutions. It will not fully remedy those pollutions but will help in reducing them, if the system is used effectively. Using the GPRS technology in the cellular network, a barcode of the two dimensional type can be fixed on the front windscreen inside the vehicle which holds all its data information. The barcode data is read by a barcode scanner utilized in a smartphone carried by a policeman, which transmits the data back to a computer server, held at the traffic department. The server that searches its database for the particular car, retransmits the carried information that includes registration, vehicle type, offences and legal ownership to other policemen, in the area; carrying security accessed smartphones for a possible necessary action. The system has also a potential to send a traffic offence ticket to the vehicle owner's address, as a further convenience adopted in advanced countries.

ALDS reduces undesired friction between drivers and policemen. It promotes societal development through better traffic discipline. This will indirectly help in improving human quality and protect human values from complex problems related to a civil society. Congestion could increase the probability of accidents and traffic chaos. ALDS overcomes these problems. ALDS applications may also be extended to general parks, hotels, companies, government departments, universities and large buildings. So the system has positive impact on many sectors in the society. The system, by nature, helps in reducing criminal aspects resulting from stolen, unregistered and unlicensed illegal cars. We verified a prototype of this system. It worked quite well to our satisfaction and we plan to develop it further for commercial promotion.

نظراً للإزعاج الذي يمكن أن يسببه إيقاف شرطي المرور لسائقي السيارة من أجل التأكد من أوراق السيارات والتأكد من ترخيصها وسريان هذه الأوراق، وما تؤدي إليه هذه العملية من تأخير للسائقين ومن يتواجدون معهم في نفس المركبة، نسعى لبناء نظام الكتروني لتجنب مثل هذه الأمور بطريقة تكنولوجية حديثة عن طريق توظيف تكنولوجيا GPRS، وتكنولوجيا Barcode، واستخدام قاعدة بيانات تقوم بتخزين المعلومات اللازمة عن كل مركبة يتم تسجيلها في النظام. حيث يتم قراءة شيفرة رقمية مثبتة على المركبة من خلال هاتف ذكي يتضمن تطبيق اندرويد يقوم بقراءة الشيفرة الرقمية ويتم إرسال هذا الرقم من خلال الاتصال المباشر مع الخادم المركزي إلى قاعدة البيانات الموجودة على الجهاز المركزي في دائرة السير. ثم يتم استخراج المعلومات المتوفرة حول هذا الرقم الخاص وإرسالها لرجل المرور الذي يكون متمركزاً على بُعد مسافة محددة من شرطي المرور الذي قرأ الشيفرة ليتم متابعة المركبة وقانونيتها.

النظام يساعد أيضاً على التقليل من ازدحام السير في المناطق التي يقوم فيها رجل المرور بعملية فحص الأوراق القانونية من خلال عدم الحاجة لاصطفاف المركبات على الطريق في انتظار دورها في تفقد الأوراق، كما أن نسبة التعامل المباشر بين رجل المرور وسائقي المركبات سينخفض بشكل ملحوظ وهو ما يؤدي لتفادي بعض الاشكاليات وبعض الأمور الغير القانونية في بعض الأحيان.

2.1	Overview	11
2.2	GSM/GPRS Technology	11
2.2.1	GSM in general	11
2.2.1.1	The basic overview of the GSM Network	11
2.2.1.2	GSM System Architecture	12
2.2.2	GPRS in general	13
2.2.2.1	Introduction to GPRS	13
2.2.2.2	GPRS Network Architecture	13
2.2.2.3	GPRS offered Services	15
2.2.2.4	Packet Switching Approach	15
2.2.3	GSM/GPRS Service in Our Project	17
2.3	Barcode Technology	17
2.3.1	Barcode	17
2.3.2	Barcode scanner	19
2.4	Mobile Phone and Android OS	20
2.4.1	Mobile Operating systems	20
2.4.1.1	Android operating system	21
2.4.1.2	Android architecture	22
2.4.1.3	Android features	23
2.4.2	Mobile phone in our project	22

Table of Contents

Subject	Page
Abstract	V
Table of Contents	VII
Table of Figures	X
Tables list	XII
1 Chapter One: Introduction	1
1.1 Overview	2
1.2 Introduction	2
1.3 Project Objectives	2
1.4 Project Motivations	3
1.5 Approach	3
1.6 Literature Review	4
1.7 Results and Problems	5
1.8 Project's Risk Managements	6
1.9 Project Schedule	6
1.10 Estimated Cost	8
1.11 Project Contents	8
2 Chapter Two: Theoretical Background	10
2.1 Overview	11
2.2 GSM/GPRS Technology	11
2.2.1 GSM in general	11
2.2.1.1 The basic overview of the GSM Network	11
2.2.1.2 GSM System Architecture	12
2.2.2 GPRS in general	13
2.2.2.1 Introduction to GPRS	13
2.2.2.2 GPRS Network Architecture	13
2.2.2.3 GPRS offered Services	15
2.2.2.4 Packet Switching Approach	15
2.2.3 GSM/GPRS Service in Our Project	17
2.3 Barcode Technology	17
2.3.1 Barcode	17
2.3.2 Barcode scanner	19
2.4 Mobile Phone and Android OS	20
2.4.1 Mobile Operating systems	20
2.4.1.1 Android operating system	21
2.4.1.2 Android architecture	22
2.4.1.3 Android features	23
2.4.2 Mobile phone in our project	22

2.5	Project software	24
2.5.1	Overview	24
2.5.2	Java programming language	25
2.5.3	Java architecture	25
2.5.4	Java features	26
2.5.5	Java Development environment	27
2.5.5.1	Eclipse IDE	27
2.5.5.2	NetBeans IDE	27
2.6	Database System	28
2.6.1	Introduction	28
2.6.2	Database Languages	28
2.6.2.1	Data-Manipulation Language (DML)	28
2.6.2.2	Data-Definition Language (DDL)	29
2.6.3	SQL Language	29
2.6.4	Microsoft Access Database	29
3 Chapter Three: System Design		31
3.1	Overview	32
3.2	System Design	32
3.3	Stages of the System	33
3.4	Barcode Plate	34
3.5	Barcode Reading Unit	35
3.5.1	Barcode Scanners	35
3.5.2	Mobile Barcode Reader	37
3.6	Reception mobile unit	40
3.7	Central office	41
3.8	System Software	42
3.8.1	Central Office Database	42
3.8.2	Central Office Server	44
3.8.3	Android Applications	45
4 Chapter Four: Description and Analysis of System Requirement		46
4.1	Overview	47
4.2	Description of the System	47
4.3	Description of System requirements	47
4.4	General Flowchart of the System	49
4.5	Use Cases of the System	50
4.6	Class Diagram	51
4.7	System Sequence Diagram	52
5 Chapter Five: System Testing		56
5.1	Overview	57
5.2	Sub-system Testing	57

5.3	Installing and Preparing System	57
5.3.1	Mobile Barcode Reading Application	58
5.3.2	Reception Mobile Application	64
5.3.3	Central Server Application	66
5.4	Test Scenarios	71
5.5	Testing Results	78
6	Chapter Six: Recommendations and Conclusion	79
6.1	Overview	80
6.2	Problems and Challenges	80
6.3	Conclusion and Achievement	80
6.4	Future Work Recommendation	81
	References	82

Table of Figures

Figure	Page
Figure 2.1: GSM Network	12
Figure 2.2: GSM Architecture	12
Figure 2.3: GSM network with GPRS capability	14
Figure 2.4: Functional View of GPRS	14
Figure 2.5: Packet switching topology	15
Figure 2.6: Circuit Switched vs. Packet Switched networking	16
Figure 2.7: Linear (1D) barcode sample	17
Figure 2.8: 2D "data matrix" barcode	18
Figure 2.9: Architecture of android OS	22
Figure 2.10: Java Main architecture	26
Figure 3.1: The system design	32
Figure 3.2: Block Diagram of the first stage	33
Figure 3.3: Block Diagram of the second stage	33
Figure 3.4: QR code	34
Figure 3.5: Barcode scanner	35
Figure 3.6: BRU with barcode scanner connection to server	36
Figure 3.7: Flowchart of barcode scanner operation	36
Figure 3.8: Flowchart of PC application	37
Figure 3.9: BRU with Mobile Barcode reader connection	38
Figure 3.10: Flowchart of Mobile Reader	39
Figure 3.11: Reception Mobile unit connection	40
Figure 3.12: Flowchart of Reception android application	41
Figure 3.13: Flowchart of server operation	45
Figure 4.1: General system flowchart	50
Figure 4.2: UML Use Cases of the system	51
Figure 4.3: UML class diagram of the system	52
Figure 4.4: Barcode Reading sequence diagram	53
Figure 4.5: Receiver mobile operation sequence diagram	54
Figure 4.6: Desktop user sequence diagram	55
Figure 5.1: Transformed application icon	58
Figure 5.2: Ask message to install application	59
Figure 5.3: Installation completed screen	59
Figure 5.4: Application icon mobile	60
Figure 5.5: Welcome screen	60
Figure 5.6: Login screen	61
Figure 5.7: Scanning screen	62
Figure 5.8: Detection screen	62
Figure 5.9: Barcode number display and send screen	63
Figure 5.10: "9008293" QR code plate	64
Figure 5.11: Feedback about the car from server	64

Figure 5.12: Welcome screen	65
Figure 5.13: Login screen	65
Figure 5.14: Display Data screen	65
Figure 5.15: Welcome screen in desktop application	67
Figure 5.16: Login screen	67
Figure 5.17: Welcome Message	68
Figure 5.18: Main window in desktop application	68
Figure 5.19: Add New Car form	69
Figure 5.20: Registered cars table	69
Figure 5.21: Add New Partner form	70
Figure 5.22: Partners Table	70
Figure 5.23: Blacklist Table	71
Figure 5.24: Barcode plate on the windscreen	72
Figure 5.25: Barcode plate at the front body	73
Figure 5.26: Barcode plate at the side body	73
Figure 5.27: No Problem Feedback about the car from server	75
Figure 5.28: Blacklist Table with filled data	75
Figure 5.29: Feedback for a barcode has a problem	76
Figure 5.30: Received data at cop ID "2"	77
Figure 5.30: Received data at cop ID "4"	77
Figure 5.29: Feedback for unregistered barcode	77

Tables list

Subject	Page
Table 1.1: Timing plan for the first semester	7
Table 1.2: Timing plan for the second semester	8
Table 1.3: Estimated Cost	8
Table 5.1: Speed vs. Distance Barcode detection	74

1

Chapter One

Introduction

1.1 Overview

1.2 Introduction

1.3 Project Objectives

1.4 Project Motivations

1.5 Literature Review

1.6 Approach

1.7 Results and Problems

1.8 Risk Management

1.9 Project Schedule and Time Plan

1.10 Estimated Cost

1.11 Project contents

1.1 Overview

In this chapter, we will introduce an introduction to the project, the objectives and motivations of the project, we also made some literature review with a mention of some projects that related to our system and show how we are different from there.

We also will show the methodology used to build and complete this system, the parts of the system will be mentioned. Also this chapter will show some of the risk management, some results and problems. The estimated cost will be modified, after that the content of the report will be shown.

1.2 Introduction

If we look at the world around us, we find that the technology has embraced the human being and took over most areas of his life, especially with the progress of science and innovation in new ways in which access to what meet the human needs and desires that cannot be broken.

The automobile's drivers, the traffic cops and traffic department, brought together by a reciprocal relationship, the traffic cop stops automobile's driver for some time for the purpose of verification of the car's license and its legality. These actions cause a kind of hassle with the drivers because of delay, which lost a lot of time waiting in a queue of vehicles to reach to the check point. Traffic man is also has a side of this relationship, that he is standing all the day in the sun or under the heavy rain to do the job and check the car and its registration papers.

Technology helps us to avoid these problems and inconveniences by building a system can connect these systems and make them in touch without the intervention of humans, and this is the idea underlying the project so that it is add a plate barcode contains a private number not afford another vehicle registered under the same traffic department and this barcode is read by barcode reader on the side of the road and sent number to the central computer in the Traffic Department, a database in this computer, will be used to restore information about all the registered automobiles, checks this information about the received number and send an alarm to the traffic cop located at a distance from the barcode reader waiting for information about any vehicle or breach of license validity expired registration.

1.3 Project Objectives

This project aims to achieve the following:

- 1) Implementing a new technologies used by the traffic cops to determine information about the vehicles.
- 2) Save drivers' time by reducing the touch between the traffic cops.
- 3) Controlling the operation of detecting and checking the license of any vehicle registered at the traffic department.
- 4) Reduce the vehicles congestion.
- 5) The possibility of development the system to make it able to send SMSs to the drivers to alarm them for any illegal behave recorded for the car.

1.4 Project Motivations

Due to the drivers' time wasted on the road when a police cops station a check point by waiting and checking the license papers one by one, which may cause some late for an important duty and may cause a cars traffic and collision at that area.

Building a system capable of control this operation is very important, and it will help to reduce this wasted time, reduce the road traffic and ease the operation of detecting the vehicle license automatically with no need to stop the car and check the information about it without any need for any touch with driver.

From the drivers' side; this system will make the ruler procedures on the road is more easy and causing no time delay. However, from the policemen side, they will be able to do their work more efficiently, and with more accuracy. Lastly, from our side as project designers, we see that our project will improve our nation and our future state, according to our vision that it's not only the economy and military make the power, also the civilian development, organized road traffic is a mark of nation sophistication.

1.5 Approach

The system is divided into three main parts, the central office, the barcode plate stationed on the vehicles, and the barcode reader - or smart phone - with java application.

The first part is the central office which PC with special software developed to control the information of the vehicles in the system. This software is designed using the Java programming language for the database using the Microsoft visual studio program with applying Java codes. Also, the central office will contain server developed using the same programming language to receive, execute, and sent the information.

On the other hand, a barcode will be added to the vehicles to label each car with identified number (ID) as barcode number won't be given for another vehicle and each is unique. Lastly, an instrument will be used to read these barcodes; they will be read using barcode reader or using smart phone with high resolution camera to scan for barcodes.

In the case of using barcode reader, it will be connected to PC via USB connection, an application will be installed to this PC will be used to send the barcode number to the database on the central office. On the other hand, when a smart phone will be used, this smart phone will be operated in the Android OS, and an android application will be developed to connect to the server of the central office, scan the barcode using the camera of the phone and then send the barcode number to the server.

For the server side, the barcode will be received to the database from the java application, the information related to the barcode will be executed and then it will be sent to the last part of the system which is another smart-phone with other android application to connect with the server and receive the information form it.

As an additional part to the system, the software built in the central PC will have the ability to send SMS to the vehicle's owner to remember them for any illegal action recorded and if the license is coming to be expired with date.

1.6 Literature Review and Related Work

Many technologies and approaches were introduced to achieve the Automobile License Detecting and was a subject of many project and study papers. Some of these papers were introduced in the following:

- ▶ RFID Technology of identifying the elements. This technology was used in libraries to ease the process of searching for a book in and to improve the security issues guarding from thieving books of documents. Also, it was used inside big manufactures to detect the types and numbers of existing products in the manufactures and to collect data about the products prepared to sell with more accuracy and faster.

- ▶ Barcode Detector Device which is manufactured by the Motorola Company. This device is used in the big manufactures with contain large number of vehicles inside it. It uses a special device added to each vehicle to be identified and this used to add data about the products it deals with. This data is read by PC application automatically and each vehicle has its own account in the database application.

► Market Drivers barcode scanners used in the supermarkets and malls to identify the products and count the total cost of the bought products for each customer.

► Kuo-Ming Hung and Ching-Tang Hsieh, A Real-time Mobile Vehicle License Plate Detection and Recognition-2009: a system used to detect the plate of vehicle utilizing video camera installed in the car and by capturing the photo of the car in front and to process instant vehicle license detection and recognition [1].

► Prasanna V. Palani, VLPD algorithm based on statistical characteristics in HIS color model, another system used the camera to detect the license plate using image processing of captured photo and using the HIS image conversion and color segmentation and the characteristics of the recognized picture [2].

1.7 Results and Problems

Project's Results:

- 1) A low cost system which can perform the major functions that is needed to detect the licenses of vehicles.
- 2) A system that is able to send the barcode number to the central PC and gathering the information for the vehicle. And the ability to send the data for the vehicle to the receiving unit with the traffic cop waiting far from the barcode scanner.
- 3) Alert the drivers for the illegal restrictions recorded for their vehicles and remembering them when the date of the license is going to be finished.
- 4) Reduce the traffic on the roads.
- 5) Reduce the number of illegal or unregistered vehicles in the cities.
- 6) Any vehicle been stolen will be marked for the traffic cops, so it will be added to the system the ease catching it.

Many problems were faced:

- 1) The availability of some components, like the barcode reader with the required features as the distance to scan from the barcode.
- 2) The barcode reader has only USB connection wire, but the microcontrollers only contain serial port; for that an application were developed to send the read barcode number.
- 3) Many languages must be learned to build the software parts in the system, like the java language and the android. Also the building of the C# server was new for us and took much time.

1.8 Project's Risk Managements

- 1) The vehicles have different heights and volumes, therefore; different heights for the barcode to be put on or policeman must carry the barcode reader to scan the barcodes on the vehicles.
- 2) The delay may happen during the information collecting and transmitting to/from the central PC.
- 3) As the distance between the barcode and the barcode scanner increase, the difficulties to read this barcode will increase and will become more complicated.

1.9 Project Schedule

- **Stag1: Select the idea**

Determine the idea of the project, the motivation, and the main objective we intend to achieve.

- **Stage2: Preparing for the project and collecting data**

In this stage, more and deeper determination of the tasks and steps we want to perform is done, and more information about the project is prepared.

- **Stage3: Project Analysis**

In this step, a study of the all possible design options to determine our own design.

- **Stage4: Determine the project requirement**

After determine our design scheme, we specify all the needed requirement for the user and the system, software and hardware. And try to bring them to be ready for the implementation stage.

- **Stage5: Studying the Principles**

This stage of the project is necessary to study the GSM, GPRS, database programming language and main server programming language, and the mobile programming language.

- **Stage6: Documentation Writing**
Documenting the project will begin from the first stage to the last stage.

- **Stage7: make the hardware available**
In this stage, the needed hardware devices will be brought for the next steps, the barcode reader, mobiles and main server's PC will be brought for the next step.

- **Stage8: build up the software**
The programming of the project code is started and will be downloaded to the mobile and the central server. Make sure the needed to connect all the parts of the system together.

- **Stage9: testing the system**
In this stage barcode plates will be stationed on the vehicles, the barcode readers will be stationed on the roads or the mobiles will be ready to use by the policemen to scan barcode numbers, then feedback will be provided.

- **Stage10: Writing Documentation**
The documentation will continue from the first stage to the last one in parallel.

- **Stage11: Preparing for the final presentation**
The presentation will be prepared to show the project and its parts.

Table1.1: Timing plan for the first semester

Week \ Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
S1															
S2															
S3															
S4															
S5															
S6															

Table1.2: Timing plan for the second semester

Week \ Task	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
S7															
S8															
S9															
S10															
S11															

1.10 Estimated Cost

The following is a list of different costs needed to implement the system:

Table 1.3: Estimated cost

Equipment	Number	Price/ unit	Total price
Programming trainings	-	-	410 \$
Documentation and printing	-	-	40 \$
Transportation	-	-	40 \$
Smart Phone (Samsung Galaxy S1)	1	360 \$	360 \$
Smart Phone with 8MP Camera at least (Samsung Galaxy S2)	1	460 \$	460 \$
			1310 \$

1.11 Report Contents

The report is divided up to six chapters, these chapters explain the project, its contents and requirements and present an interview about it:

- **Chapter 1: Introduction**

Discuss the project from many sides, represents and overview about the project, the objectives and important for it, and the work plan and estimated cost. Also, the project risk management is shown in this chapter.

- **Chapter 2: Theoretical Background**

Talks about the theoretical background of the project, hardware and software and the technologies will be used in the project.

- **Chapter 3: System Design**

In this chapter we talk about the design concepts, the general block diagram, and the functional block diagram that mention all the implemented functions in the system.

- **Chapter 4: Description and Analysis of System Requirements**

In this chapter we will talk about the detailed software engineering design, and the system use case diagram will be described, also the sequence diagram will be mentioned.

- **Chapter 5: System Testing**

Measuring and testing the performance of the system is the final stage to complete the project. And this chapter gives a detailed description of the project testing performance.

Chapter 6: Recommendation and Conclusion

This chapter describes the real learning outcomes have been acquired during the work on the project, and recommendations and suggestions for future work and development.

2

Chapter 2

Theoretical Background

2.1 Overview

2.2 GSM/GPRS Technology

2.3 Barcode Technology

2.4 Mobile phone and Android OS

2.5 Java Programming Language

2.6 Project Software

2.6 Database System

2.1 Overview

It is interesting to deal with the general theoretical background about the project's requirement because many concepts will be used in the next chapters. In this chapter, the hardware and the software will be presented, as the GSM technology, GPRS service, barcode technology, Microsoft access database and servers building based on Java languages, java applications building, the android OS and application creating, and the smart phone will be mentioned.

2.2 GSM/GPRS Technology

2.2.1 GSM in general

GSM (Global System for mobile Communications) is the Europeans standard for the cellular communications developed by ETSI (European Telecommunications standards institute). Throughout Europe and the rest of the world, GSM has been widely adopted. The GSM system uses a TDMA radio access system employed in more than 135 countries, operating in 200 KHz channels with eight users per channel. The most important service in GSM is voice telephony. Voice is digitally encoded and carried by the GSM network as a digital stream in a circuit-switched mode. GSM offers data services already but they have been constrained by the use of circuit switched data channels over the air interface allowing a maximum bit rate of 14.4 Kbits/s.

For this reason, the GSM standard has continued its natural evolution to accommodate the requirement for higher bit rates. The HSCSD is one solution that addresses this requirement by allocating more time slots per subscriber and thus better rates. It remains however insufficient for data applications such as Web browsing. Moreover, HSCSD relies on circuit-switching techniques making it unattractive for subscribers who want to be charged based on the volume of the data traffic they actually use rather than on the duration of the connection. In turn, service providers need effective means to share the scarce radio resources between more subscribers. In a circuit switched mode, a channel is allocated to a single user for the duration of the connection. This exclusive access to radio resources is not necessary for data applications with the use of packet switched techniques. [3], [4]

2.2.1.1 The basic overview of the GSM Network

The GSM Network consists of three subsystems which provide the network functions; the first is the network switching subsystem, the base station subsystem, and the Mobile Station. The network switching subsystem is made up of two essential elements; Mobile Switching Center (MSC), and Gateway Mobile Switching Center (GMSC), the NSS is responsible for call control, service control, and subscriber mobility management functions. The base station subsystem performs radio-related

functions. It consists of base transceiver stations BTSs and base station controllers BSCs. However, the MS is the handset or the Mobile Equipment with the Subscriber Identification Module (SIM).

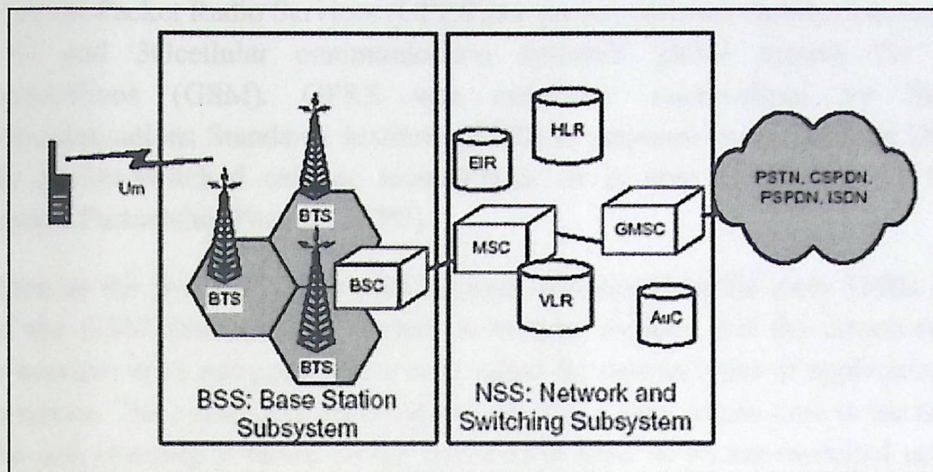


Figure 2.1: GSM Network. [5]

2.2.1.2 GSM System Architecture

A cell containing a Mobile station (MS) is formed by the radio coverage area of a Base Transceiver Station (BTS) several BTSs together are controlled by one Base Station Controller (BSC). The BTS and BSC form the Base Station subsystem (BSS). The combined traffic of the MSs in their respective cells is routed through the Mobile switching center (MSC).several databases are required for call control and network management: the Home Location Register (HLR), the Visitor Location Register (VLR), the Authentication Center (AUC), and the Equipment Identity Register (EIR). The GSM system architecture comprised with a set of essential components is illustrated in figure 2.2.

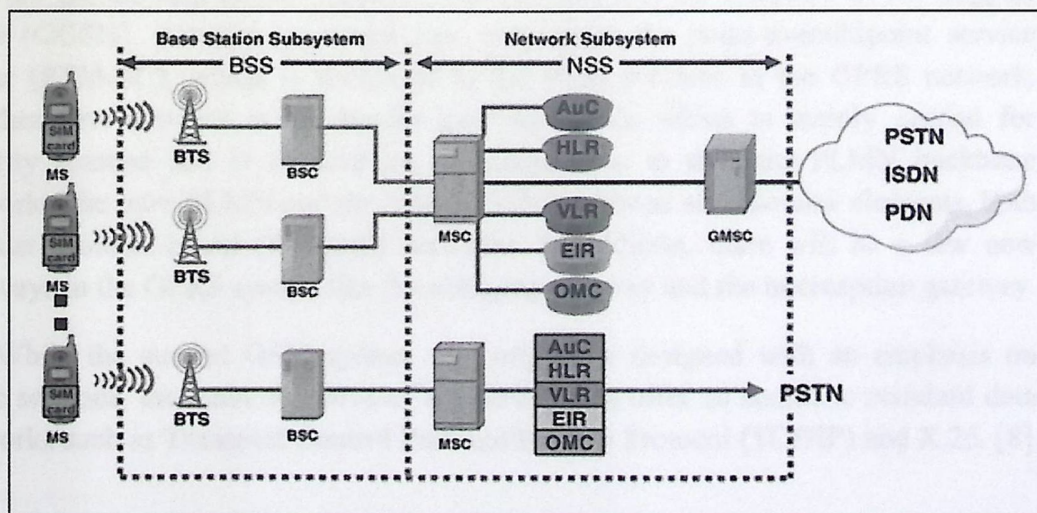


Figure 2.2: GSM Architecture [6]

2.2.2 GPRS in general

2.2.2.1 Introduction to GPRS

General Packet Radio Services (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM). 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).

Soon as the first GSM networks became operational in the early 1990s and the use of the GSM data services started, it became evident that the circuit-switched bearer services were not particularly well suited for certain types of applications with bursty nature. The circuit switched connections has a long access time to the network, and the call charging is based on the connection time. In packet-switched networks, the connection do not reserve resources permanently, but make use of the common pool, which is highly efficient, in particular, for applications with bursty nature. The GPRS system will have a very short access time to the network and the call charging could solely be based on an amount of transmitted data.

The GPRS system brings the packet-switched bearer services to the existing GSM systems. In the GPRS system, a user can access the public data networks directly using their standard protocol address (IP, X.25), which can be activated when the MS is attached to the GPRS network. The GPRS MS can use between one and eight channels over the air interface depending on the MS capabilities, and those channels are dynamically allocated to an MS when there are packets to be sent or received. [7]

2.2.2.2 GPRS Network Architecture

GPRS bring few new network elements to the GSM network. The most important ones are the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN). Another important new element is the point-to-multipoint service center (PTM-SC), which is dedicated to the PTM services in the GPRS network. Another new network is the border gateway (BW), which is mainly needed for security reasons and is situated on the connection to the inter-PLMN backbone network. The inter-PLMN and the intra-PLMN backbone are also new elements, both Internet protocol-based (IP-based) networks. In addition, there will be a few new gateways in the GPRS system like the charging gateway and the interception gateway.

While the current GSM system was originally designed with an emphasis on voice sessions, the main objective of the GPRS is to offer an access to standard data networks such as Transport Control Protocol/Internet Protocol (TCP/IP) and X.25. [8]

Figure 2.4: Fractional View of GPRS

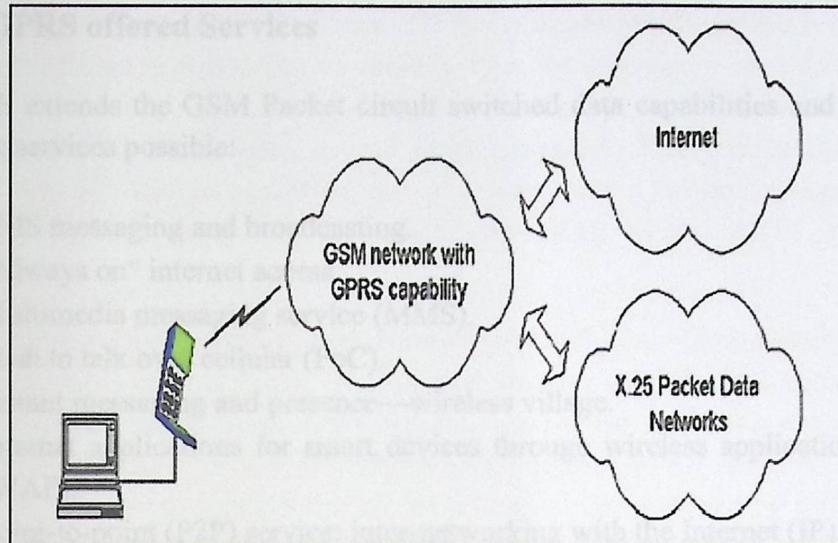


Figure 2.3: GSM network with GPRS capability. [9]

These other networks consider GPRS just as a normal sub-network. A GGSN in the GPRS network behaves as a router and hides the GPRS specified features from the external data network.

The mobile user can have either a static or dynamic data network address, and the data traffic will always use the gateway indicated by this address. However, the home network operator could force all the traffic to use a home GGNS, for example, for security reasons.

A static address is permanently allocated for one subscriber. As it will point to a gateway of the home network, the data packets will always be routed through the home network.

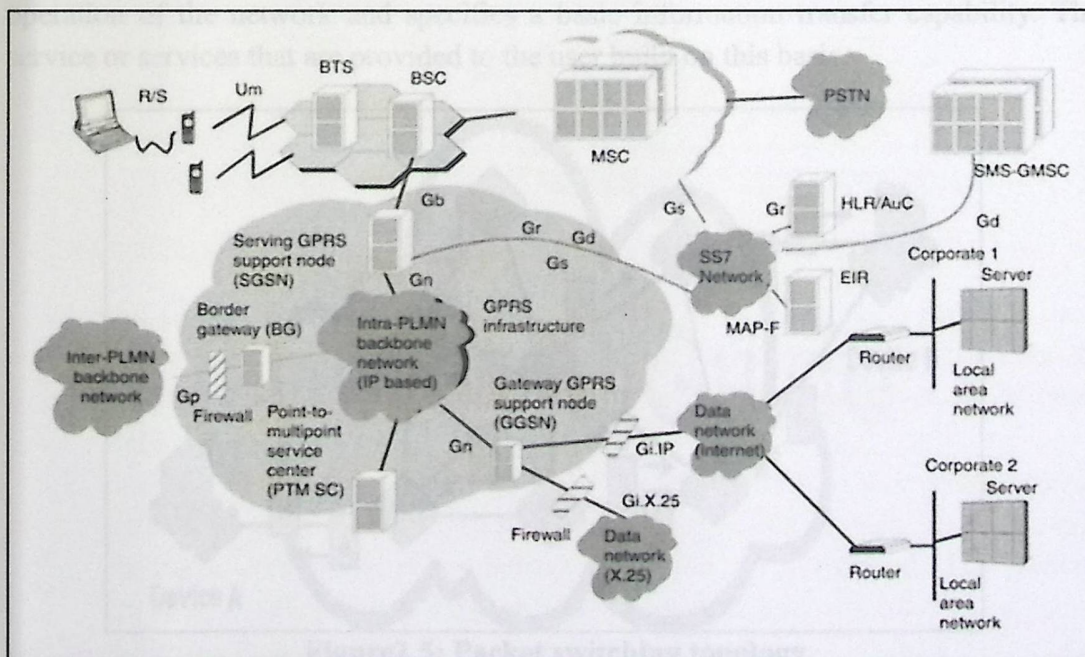


Figure 2.4: Functional View of GPRS

2.2.2.3 GPRS offered Services

GPRS extends the GSM Packet circuit switched data capabilities and makes the following services possible:

- SMS messaging and broadcasting.
- "Always on" internet access.
- Multimedia messaging service (MMS).
- Push to talk over cellular (PoC).
- Instant messaging and presence—wireless village.
- Internet applications for smart devices through wireless application protocol (WAP).
- Point-to-point (P2P) service: inter-networking with the Internet (IP).
- Point-to-Multipoint (P2M) service: point-to-multipoint multicast and point-to-multipoint group calls.

If SMS over GPRS is used, an SMS transmission speed of about 30 SMS messages per minute may be achieved. This is much faster than using the ordinary SMS over GSM, whose SMS transmission speed is about 6 to 10 SMS messages per minute. [9]

2.2.2.4 Packet Switching Approach

Several approaches can provide the essential network functions. These approaches are characterized by how information is organized for transmission, multiplexing, routing and switching in a network. Each approach defines the internal operation of the network and specifies a basic information transfer capability. The service or services that are provided to the user build on this basic.

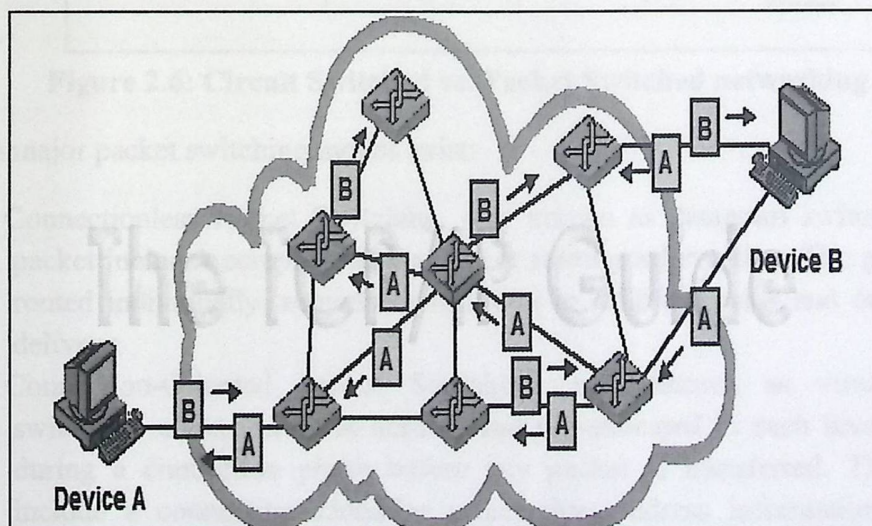


Figure2.5: Packet switching topology

Packet switching is a digital networking communications approach that groups all transmitted data – regardless of content, type, or structure – into suitably sized blocks, called Packets. Packet switching features delivery of variable bit-rate data streams (sequences of packets) over a shared network. When traversing network adapters, switches, routers and other network nodes packets are buffered and queued, resulting in variable delay and throughput depending on the traffic load in the network.

Packet switching contrasts with another principal networking paradigm, circuit switching, a method which sets up a limited number of dedicated connections of constant bit rate and constant delay between nodes for exclusive use during the communication session. In case of traffic fees (as opposed to flat rate), for example in cellular communication services, circuit switching is characterized by a fee per time unit of connection time, even when no data is transferred, while packet switching is characterized by a fee per unit of information. [10]

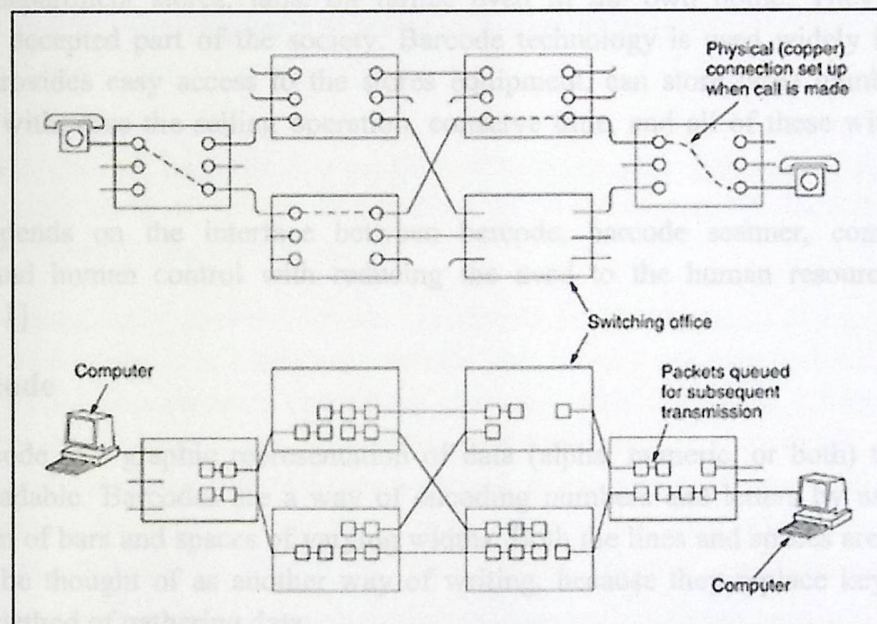


Figure 2.6: Circuit Switched vs. Packet Switched networking

Two major packet switching modes exist:

1. Connectionless Packet Switching, also known as datagram switching, each packet includes complete addressing or routing information. The packets are routed individually, sometimes resulting in different paths and out-of-order delivery.
2. Connection-Oriented Packet Switching, also known as virtual circuit switching: a connection is defined and pre-allocated in each involved node during a connection phase before any packet is transferred. The packets include a connection identifier rather than address information, and are delivered in order. [10]

2.2.3 GSM/GPRS Service in Our Project

The usage of the GSM/GPRS in our project represented by transferring the data from the barcode units on the road, which contain barcode reader connected to PC with software application to send the read barcode number, or smart-phone with application to scan barcodes and send the barcode number to the central server utilizing the GSM network. Also the server the server will receive the barcode and enter it to the database application and execute information about the barcode number and then utilizing the GSM/GPRS service it will be sent to the second cop waiting for message on his phone.

2.3 Barcode Technology

Barcodes have infiltrated every facet of life; can be found in grocery stores, hospitals, department stores, jails, on farms, even in the own home; They have become an accepted part of the society. Barcode technology is used widely in the world; it provides easy access to the stores equipment, can store large number of equipment with, ease the selling operation, conserve time, and all of these with the lowest cost.

It depends on the interface between barcode, barcode scanner, computer software, and human control with reducing the need to the human resources as possible. [11]

2.3.1 Barcode

A barcode is a graphic representation of data (alpha, numeric, or both) that is machine-readable. Barcodes are a way of encoding numbers and letters by using a combination of bars and spaces of varying widths. Both the lines and spaces are read. They may be thought of as another way of writing, because they replace key data entry as a method of gathering data.

Originally barcodes represented data by varying the widths and spacing of parallel lines, and may be referred to as linear or one-dimensional (1D). Later they evolved into rectangles, dots, hexagons and other geometric patterns in two dimensions (2D).



Figure 2.7: Linear (1D) barcode sample.

1D barcodes can be up to 7 digits in length. They appear just like regular barcodes found on retail items.

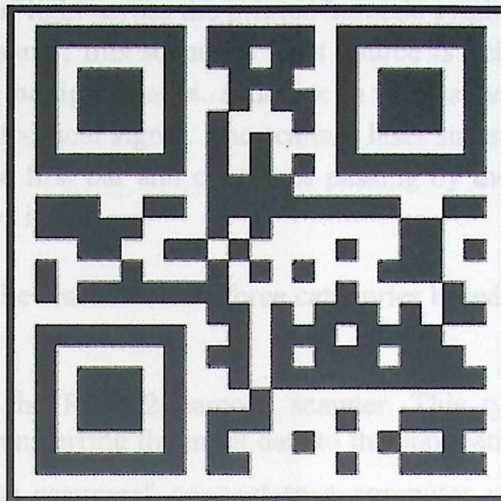


Figure 2.8: 2D "data matrix" barcode

2D "data matrix" barcodes are capable of holding more information as they contain multiple rows of unique data and up to 16 characters. 2D barcodes are provided by PDF417, Data Matrix, etc.

A barcode typically does not contain descriptive data, as the name of equipment and other related data; it is a reference number that a computer uses to look up an associated record that contains descriptive data and other important information. When the barcode scanner scans the number, it is transmitted to a computer, which finds the record associated with that item number in the database. The matching items record contains a description of the item, name, number, and other information. The computer instantly does a search for this scanned number and submits this information.

Symbology is considered a language in barcode technology, when a barcode is scanned; it is the symbology that enables the information to be read accurately. When a barcode is printed, it is the symbology that enables the printer to understand the information that needs to be turned in to a label. [12]

- Barcode plate in our project:

In our project we used the QR-code (2-D barcodes). Each vehicle has its unique QR-code; this barcode has a unique number not provided for other vehicle. The barcode plate presents the number of the vehicle and installed to the vehicle. The QR-code is read by the barcode scanner to extract the number it represents and send it to the main server of the system.

2.3.2 Barcode scanner

Barcode scanner is a device used to extract information optically from a barcode by sweeping a small spot of light across the printed barcode symbol. A thin red line is emitted from the laser scanner; this scanner's light source is being absorbed by the dark bars and reflected by the light spaces. A device in the scanner takes the reflected light and converts it into electrical signal. The scanner laser starts to read the barcode at a white space before the first bar and continues passing by the last bar, ending in the white space that follows it.

Barcode scanners can be classified into three categories based on their connection to the computer.

1. The older type is the RS-232 barcode scanner. This type requires special programming for transferring the input data to the application program.
2. "Keyboard interface scanners" connect to a computer using a PS/2 or AT keyboard-compatible adaptor cable. The barcode's data is sent to the computer as if it had been typed on the keyboard.
3. The keyboard interface scanner, USB scanners are easy to install and do not need custom code for transferring input data to the application program.

The barcode scanners have many types of scanning methodologies based on the type of code they read and the internal building of it:

1. A pen-type reader consists of a light source and a photodiode that are placed next to each other in the tip of a pen or wand. To read a barcode, the person holding the pen must move the tip of it across the bars at a relatively uniform speed.
2. Laser scanners work the same way as pen type readers except that they use a laser beam as the light source and typically employ either a reciprocating mirror or a rotating prism to scan the laser beam back and forth across the barcode. As with the pen type reader, a photodiode is used to measure the intensity of the light reflected back from the barcode.
3. CCD (charge-couple device) readers use an array of hundreds of tiny light sensors lined up in a row in the head of the reader. Each sensor measures the intensity of the light immediately in front of it. Each individual light sensor in the CCD reader is extremely small and because there are hundreds of sensors lined up in a row, a voltage pattern identical to the pattern in a bar code is generated in the reader by sequentially measuring the voltages across each sensor in the row.

4. Camera-based readers are two dimensional imaging scanners are the fourth and newest type of bar code reader. They use a camera and image processing techniques to decode the bar code.
5. Omni-directional barcode scanners use series of straight or curved scanning lines of varying directions in the form of a starburst, a lissajous pattern, or other multi-angle arrangement are projected at the symbol and one or more of them will be able to cross all of the symbol's bars and spaces, no matter what the orientation. [13]

2.4 Mobile Phone and Android OS

Mobile phone is one of the most sophisticated and modern techniques that spread dramatically in our societies, it transformed from a simple use to make calls, to be used nowadays in many complex and useful applications.

Back to the history of mobile phones, we found that the first mobile telephone call was made from a car in St. Louis, Missouri, USA on June 17, 1946, using the Bell System's Mobile Telephone Service.

Many updates and developments are quickly continued on mobile phones, and still updates until now, Mobile phones become nowadays a very smart, efficient, and small device that puts the whole world in your hands, and support large number of modern techniques included within this small device.

2.4.1 Mobile Operating systems (mobile software platform):

Like Microsoft's Windows, Apple's Macintosh, and Linux, and many others desktop operating systems, the evolution that has occurred on the mobile phone also enable us to control a mobile devices , applications and services, with their special operating systems, as the case with computer operating systems.

The most common mobile operating systems are:

- Android from Google Inc. (open source, Apache).
- BlackBerry OS from RIM (closed source, proprietary).
- Symbian OS from the Symbian Foundation (open public license).
- Windows Phone from Microsoft (closed source, proprietary).

These operating systems and many other ones represent the operating systems for our mobile phones, and by using the appropriate programming language for each operating system, we enable to programming these phones, so we can build different applications and services we want from these mobiles. [14]

In our system Android is the operating system that we want to use in order to support our project objective requirements.

2.4.1.1 Android operating system:

What is android?

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language.

In recent years Open Handset Alliance led by Google has deployed a neat, versatile, powerful, and elegant platform which was android. This platform spread widely and its market quickly growing, because it is supported by large set of hardware, software, and network carriers.

“Android is an open source platform and it is released under open source license. The Android operating system software stack consists of Java applications running on a Java based object oriented application framework on top of Java core libraries running on a Dalvik virtual machine featuring JIT compilation. Libraries written in C include the surface manager, Open Core media framework, SQLite relational database management system, OpenGL ES 2.0 3D graphics API, Web-Kit layout engine, SGL graphics engine, SSL. [15]

Why android?

The Android operation system provides many advantages that attracts you to use it, some of these advantages as the following:

- **Market share:**

The Android Market puts your app right into your users' hands easily! Users don't have to go searching the Internet to find an app to install. They just simply go to the Android Market that is preinstalled on their device, and they have access to all your apps.

- **Time to market:**

With all the application programming interfaces (APIs) that Android comes packed with, it's easy to develop full-featured applications in a relatively short time frame. After you have signed up with the Android Market, just upload your apps and publish them.

- **Open platform:**

The Android operating system is open platform, meaning that it's not tied to one hardware manufacturer and/or one provider. As you can imagine, the openness of Android is allowing it to gain market share quickly. All hardware manufacturers and providers can make and sell Android devices.

- **Cross Compatibility:**

Android can run on many devices with different screen sizes and resolutions. Besides being cross-compatible, android comes with the tools that help you develop cross-compatible applications.

- **Mash up Compatibility:**

A mashup combines two or more services to create an application. You can create a mashup by using the camera and Android's location services, for example, to take a picture with the exact location displayed on the image! It's easy to make a ton of apps by combining services or libraries in new and exciting ways. [15]

2.4.1.2 Android architecture

The architecture of Android operating system is described as following diagram with briefly explanation:

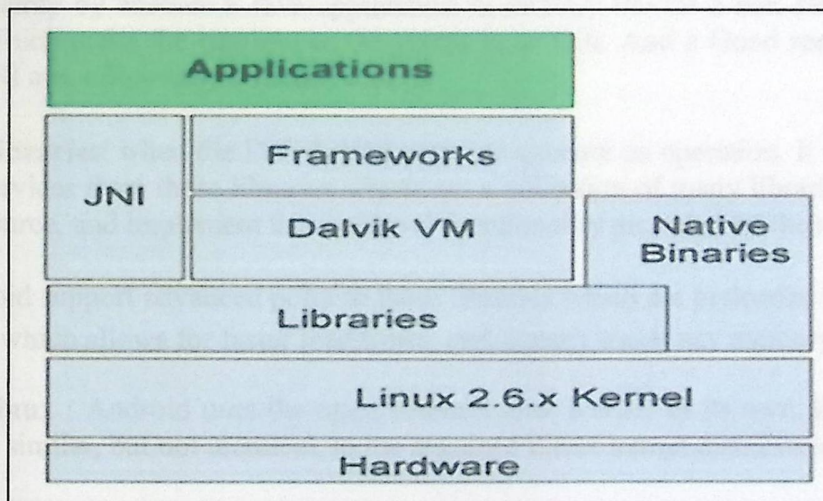


Figure 2.9: Architecture of Android OS

- Application java is the programming language for most of applications written with android, using Android SDK.

These applications when deployed are being a single file in a format (.apk). This is a modified Java Archive (JAR) file. This file contains the Java classes in a custom format (.dex) which make up the application, as well as an application manifest.

- Application Frameworks are also written in Java, and are based on the low level core libraries -which provide the basic subset of Java – java.io.*, java.util.*, etc.

And there is many level of manage and control the application, such as activity, window, package, telephony, and many other managers, that control the application you build.

- Dalvik VM Dalvik virtual machine which has been adapted to the specifics of mobile systems with limited CPU capabilities, low RAM and disk space, and limited battery life.

Dalvik is a register-based virtual machine, and it is neither fully J2SE nor J2ME compatible. Instead it works with its own version of Java Byte Code, pre-processing its input by using a utility called “dx” which produce “.dex” files from the corresponding Java “.class” files.

- **Native Binaries** this is a standard Linux binaries of ELF formatted, they can be created with the Android Native Development Kit after being coded in C or C++ usually, and then compiled directly to the target processor (usually, ARM).
- **JNI (Java Native Interface)** which used to achieve native-level functionality, mainly by enables a Java application to directly invoke a non-Java function. Which make the runtime environment is so rich. And a Good reasons to use JNI are, efficiency, and obfuscation.
- **Libraries:** when the Dalvik VM wants to execute an operation. It will call for services from these libraries which are a collection of many libraries, all open source, and implement the low level functionality provided by the runtime.

Android support advanced point to these libraries which are preloaded into memory, which allows for faster load times, and doesn't waste any memory.

- **Linux :** Android uses the open source Linux Kernel as its own, the kernel is similar, but not identical, to the standard Linux kernel distribution. [15]

2.4.1.3 Android features:

There are many features supported by android operating system, and here we mention some of them which give a helpful point for our system objectives:

- **Application framework** enabling reuse and replacement of components.
- **Dalvik virtual machine** optimized for mobile devices.
- **Integrated browser** based on the open source Web-Kit engine.

- **Optimized graphics** powered by a custom 2D graphics library; 3D graphics based on the OpenGL ES 1.0 specification. (hardware acceleration optional)
- **SQLite** for structured data storage.
- **Media support** for common audio, video, and still image formats (MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, and GIF).
- **GSM Telephony** (hardware dependent).
- **Bluetooth, EDGE, 3G, and Wi-Fi** (hardware dependent).
- **Camera, GPS, compass, and accelerometer** (hardware dependent).
- **Rich development environment** including a device emulator, tools for debugging, memory and performance profiling, and a plugin for the Eclipse IDE. [15]

2.4.2 Mobile phone in our project:

We will use the mobile phone, as optional device in our project; it will be used as a recover of missing the barcode scanner or getting one with small read distance range. It will be used to scan barcode numbers and sent it to the central office server.

Another mobile phone will be used in our project as the final part, which contains an android application that connects the smart-phone to the central server to receive the message including the information related to the barcode.

2.5 Project software

2.5.1 Overview

Now a day's computers are able to perform different tasks in different fields, but it can't do that by itself! It needs detailed procedures for each task. That what we call a computer program. There is a lot of programming languages that is used to build out a computer program, choosing any language depends on the tasks of the program.

The advancement of programming tools and consumer-electronic devices like, cell phones and PDAs created problems and new requirements. Also the integration of software components from various languages proved difficult, and installation problems were common because new versions of shared components were incompatible with old software.

Developers also discovered they needed Web-based applications that could be accessed and used via the internet. And also the need for software that was accessible to anyone and available via almost any type of device.

2.5.2 Java programming language:

Java is a language in which developers express source code (program text). Java's syntax (rules for combining symbols into language features) is partly patterned after the C and C++ languages to shorten the learning curve for C/C++ developers.

Java is a platform for executing programs. In contrast to platforms that consist of physical processors (such as an Intel processor) and operating systems (such as Linux), the Java platform consists of a virtual machine and associated execution environment.

In our project, the smart-phone applications and the server are programmed using java programming language, where it is an important language that is created by James Gosling from Sun Microsystems in 1991, and nowadays owned by Oracle, it's one of a very popular, powerful, general-purpose, concurrent, class-based, and object-oriented language.

It uses to support many important applications and one of these is Android applications, which relies heavily on java fundamentals.

The Android SDK includes many standard Java libraries such as data structure libraries, math libraries, graphics libraries, and many other ones as you want.

2.5.3 Java architecture:

We will mention the main architecture for java programming language, where Java programming language consists mainly of four components; Java compiler, Java virtual machine, java run time environment, and the Java class libraries. And the relation between these three components can be described in brief during program execution as follow:

- You write your source code with the programming instructions.
- When you run your code it will be compiled using the language compiler that translates it from the source to Java class files.
- Run the class files on a Java virtual machine, where JVM is written specifically for a specific operating system.
- Java class libraries: that enables you to access system resources; by calling methods in the classes that implement the Java Application Programming Interface. As your program runs, it fulfills your program's Java API calls by invoking methods in class files that implement the Java API.
- Java runtime environment (JRE) that consists of the JVM and the Java class libraries. [16]

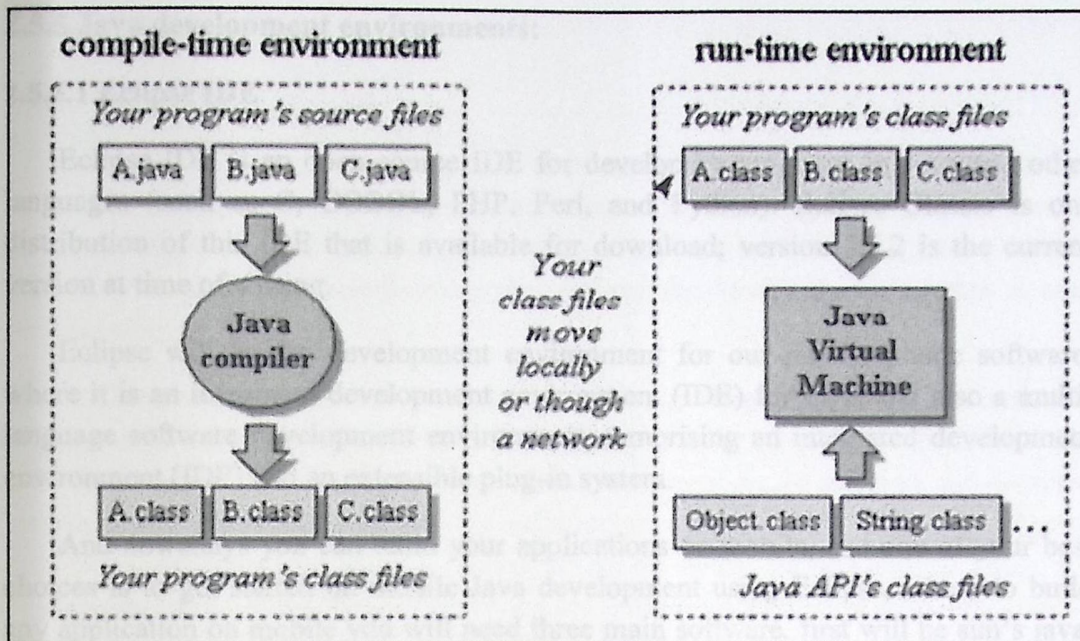


Figure 2.10: Java Main Architecture

2.5.4 Java features:

- **Platform Independence:** Java compilers produce byte-code instructions for the Java Virtual Machine (JVM), and use the JVM as abstraction and do not access the operating system directly. So same compiled byte code can run unmodified on several platforms.
- **Objects Oriented:** everything in a Java program is an object and everything is descended from a root object class. Except the primitive data types.
- **Strongly-typed programming language:** Java is strongly-typed, where the types of the used variables must be pre-defined and conversion to other objects is relatively strict.
- **Familiar C++-like Syntax:** there is similarity between Java syntax and that of the popular C++ programming language. Which enabling the rapid adoption of Java.
- **Garbage Collection:** this feature makes your programming easier to write and less prone to memory errors, make memory use efficient and reduce the losses and unused space. Where Java does not require programmers to explicitly free dynamically allocated memory. [17]

2.5.5 Java development environments:

2.5.5.1 Eclipse IDE

Eclipse IDE is an open source IDE for developing programs in Java and other languages (such as C, COBOL, PHP, Perl, and Python). Eclipse Classic is one distribution of this IDE that is available for download; version 3.5.2 is the current version at time of writing.

Eclipse will be the development environment for our mobile phone software, where it is an integrated development environment (IDE) for Java, and also a multi-language software development environment comprising an integrated development environment (IDE) and an extensible plug-in system.

And nowadays you can build your applications on mobile, and one of your best choices is to get started on mobile Java development using Eclipse, where to build any application on mobile you will need three main software, first will be sun's java, then Eclipse, and Eclipse ME plug-in and the Sun Java Wireless Toolkit also needed.[18]

2.5.5.2 NetBeans IDE

The NetBeans Platform [19] is a generic framework for Swing applications. It provides the "plumbing" that, before, every developer had to write themselves—saving state, connecting actions to menu items, toolbar items and keyboard shortcuts; window management, and so on.

The NetBeans Platform provides all of these out of the box. One does not need to manually code these or other basic features. The platform does not add a lot of overhead to the application - but it can save a huge amount of time and work.

The NetBeans Platform provides reliable and flexible application architecture. The application does not have to look anything like an IDE. It can save years of development time. The NetBeans Platform provides a time-tested architecture for free; an architecture that encourages sustainable development practices. Because the NetBeans Platform architecture is modular, it's easy to create applications that are robust and extensible.

The NetBeans IDE 7.2.1 was used in our system to create the server using the Java programming language. It provides the ability to run many server applications at the same time. In our project, three servers were running together; the data receiving and analyzing application, the password checking application and the data sending application.

2.6 Database System

2.6.1 Introduction

A database-management system (DBMS) is a collection of interrelated data and a set of programs to access those data. The collection of data, usually referred to as the database, contains information relevant to an enterprise. The primary goal of a DBMS is to provide a way to store and retrieve database information that is both convenient and efficient.

Database systems are designed to manage large bodies of information. Management of data involves both defining structures for storage of information and providing mechanisms for the manipulation of information. In addition, the database system must ensure the safety of the information stored, despite system crashes or attempts at unauthorized access. If data are to be shared among several users, the system must avoid possible anomalous results. Because information is so important in most organizations, computer scientists have developed a large body of concept and techniques for managing data.

Database applications are widely used all over the world; it is used in banking, for customer information, accounts, loans, and banking transactions. Also database is used at the airlines for reservations and schedule information. In universities for student information, course registrations, and grade. The telecommunications depends on database over many sides; for keeping records of calls made, generating monthly bills, maintaining balanced on prepaid calling cards, and storing information about the communication network. The credit card transactions, finance, sales, manufacturing, and human resources are other applications depend on database systems [20].

2.6.2 Database Languages

A database system provides a data definition language to specify the database schema and a data manipulation language to express data base queries and updates. In practice, the data definition and data manipulation languages are not two separate languages; instead they simply form parts of single database languages, such as the widely used SQL language [20].

2.6.2.1 Data-Manipulation Language (DML)

DML is a language that enables users to access or manipulate data as organized by the appropriate data mode. The two basic types are Procedural DMLs and Declarative DMLs. The first requires a user to specify what data are needed and how

to get those data, while the Declarative requires a user to specify what data are needed without specifying how to get those data.

2.6.2.2 Data-Definition Language (DDL)

DDL is a set of definitions expressed by a special language used to specify additional properties of the data. A specified storage and access methods used by the database system by a set of statements in a special type of DDL called a data storage and definition language. These statements define the implementation details of the database scheme. The data values stored in the database must satisfy certain consistency constraints.

2.6.3 SQL Language

Structured Query Language (SQL) is the most influential commercially marketed relational query language. It has several parts as Data-definition language DDL which provides commands for defining relation schemas, deleting relations, and modifying relation schemas. However, the second part is the data-manipulation language DML which includes a query language and commands to insert tuples into, delete tuples from, and modify tuples in the database.

SQL includes a variety of language constructs for queries on the database. These include the select, from, and where clauses, and support for natural join operation. SQL also provides mechanisms to rename both attributes and relations, and to order query results by sorting on specified attributes.

2.6.4 Microsoft Access Database

Microsoft Access, also known as Microsoft Office Access, is a database management system from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software-development tools. It is a member of the Microsoft Office suite of applications, included in the Professional and higher editions or sold separately. On May 12, 2010, the current version of Microsoft Access 2010 was released by Microsoft in Office 2010; Microsoft Office Access 2007 was the prior version.

Microsoft Access stores data in its own format based on the Access Jet Database Engine. It can also import or link directly to data stored in other applications and databases.

Software developers and data architects can use Microsoft Access to develop application software, and "power users" can use it to build software applications. Like other Office applications, Access is supported by Visual Basic for Applications, an object-oriented programming language that can reference a variety of objects including DAO (Data Access Objects), ActiveX Data Objects, and many other

ActiveX components. Visual objects used in forms and reports expose their methods and properties in the VBA programming environment, and VBA code modules may declare and call Windows operating-system functions.

- **MS Access Features**

Users can create tables, queries, forms and reports, and connect them together with macros. Advanced users can use VBA to write rich solutions with advanced data manipulation and user control. Access also has report creation features that can work with any data source that Access can "access".

The original concept of Access was for end users to be able to "access" data from any source. Other features include: the import and export of data to many formats including Excel, Outlook, ASCII, dBase, Paradox, FoxPro, SQL Server, Oracle, etc. It also has the ability to link to data in its existing location and use it for viewing, querying, editing, and reporting. This allows the existing data to change while ensuring that Access uses the latest data. It can perform heterogeneous joins between data sets stored across different platforms. Access is often used by people downloading data from enterprise level databases for manipulation, analysis, and reporting locally.

There is also the Jet Database format (MDB or ACCDB in Access 2007) which can contain the application and data in one file. This makes it very convenient to distribute the entire application to another user, who can run it in disconnected environments.

One of the benefits of Access from a programmer's perspective is its relative compatibility with SQL queries can be viewed graphically or edited as SQL statements, and SQL statements can be used directly in Macros and VBA Modules to manipulate Access tables. Users can mix and use both VBA and "Macros" for programming forms and logic and offers object-oriented possibilities. VBA can also be included in queries. [21]

3

Chapter Three

System Design

3.1 Overview

3.2 System Design

3.3 Stages of the System

3.4 Barcode Plate

3.5 Barcode Scanner/Reader

3.6 Reception Mobile Unit

3.7 Central Office

3.8 Software Design

3.1 Overview

This chapter will show the design of the system and discuss all parts of the project. Also, it will introduce an overall explanation for every unit used in the system.

Additionally, features and detailed schematic diagrams for each component will be shown.

3.2 System Design

The following figure 3.1 shows the general design of the system:

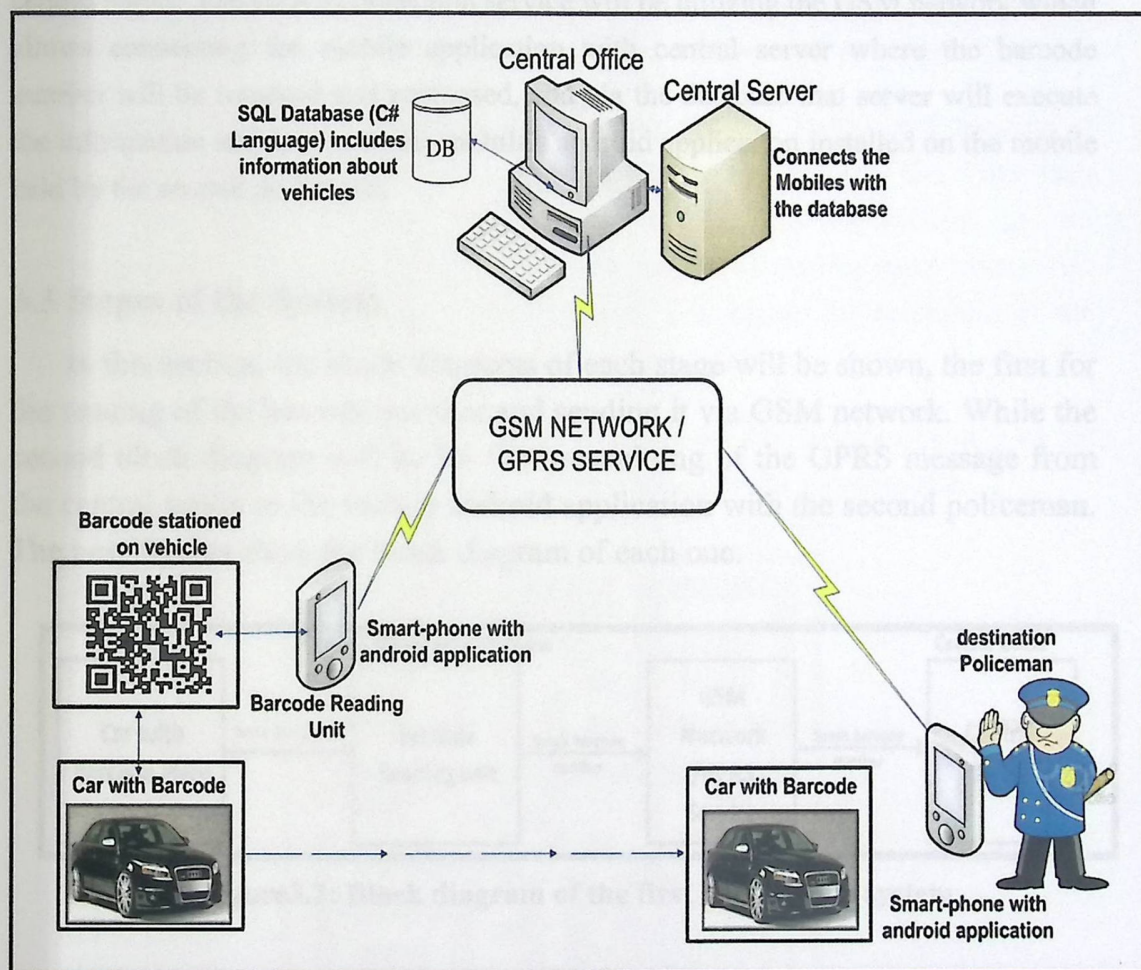


Figure3.1: The System Design.

The figure above shows the general design of the system, and its parts and how they are integrated with each other via the GSM network which is the backbone of the system. Also, the figure shows all the components of each part in the system.

The system is divided into four subsystems:

1. Barcode plate.
2. Barcode reading unit.
3. The central office.
4. Reception unit (Android Mobile handled with the policeman).

The system is based on reading a barcode installed on the vehicle with a unique number for each vehicle, this barcode will be read using smart phone, that has acceptable quality camera (8-Mega Pixel or higher), and using android application and GPRS connection, the barcode number with the cop login ID will be sent to the central server. The GPRS connection service will be utilizing the GSM network which allows connecting the mobile application with central server where the barcode number will be received and processed, and via the database that server will execute the information and send it to the mobile's android application installed on the mobile held by the second policeman.

3.3 Stages of the System

In this section, the block diagrams of each stage will be shown, the first for the reading of the barcode number and sending it via GSM network. While the second block diagram will be for the transmitting of the GPRS message from the central server to the mobile android application with the second policeman. The next figures show the block diagram of each one.

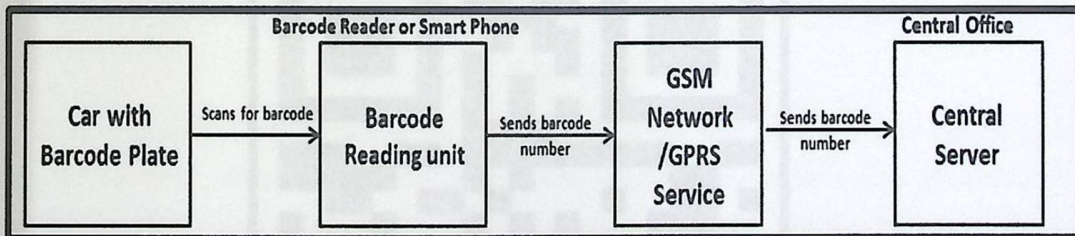


Figure3.2: Block diagram of the first Stage of the system.

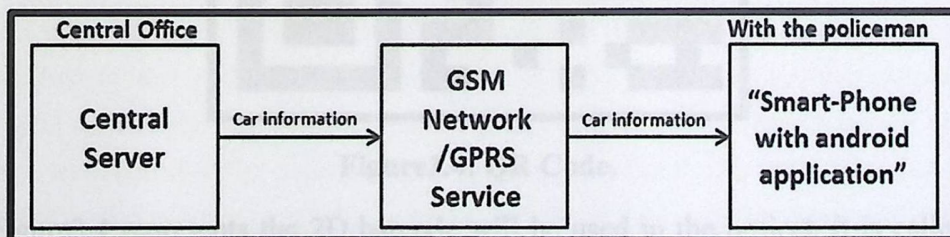


Figure3.3: Block diagram of the second Stage of the system.

The main components of the system are the Barcode Plate, Barcode Reading Unit, GSM Network, Central Office (includes the database and central server), and the mobile's android application with the second policeman. All the components will be explained in this Chapter in more details.

3.4 Barcode Plate:

This is the first component of the system. It is a plate containing barcode number installed on the vehicles windscreen; each vehicle has its unique barcode number that is not offered for any other vehicle. A barcode is a graphic representation of data (alpha, numeric, or both) that is machine-readable, and it's a way of encoding numbers and letters by using a combination of bars and spaces of varying widths.

Originally barcodes represented data by varying the widths and spacing of parallel lines, and may be referred to as linear or one-dimensional (1D). Later they evolved into rectangles, dots, hexagons and other geometric patterns in two dimensions (2D). The QR code is a 2D barcode that can be read by smart phone with QR code applications using the phone's camera. The higher the resolution of the camera is better to read the barcodes and from larger distances.

In this system, QR codes will be used to represent the barcode numbers of the vehicles, to present possibility to use mobile in reading it with given number.

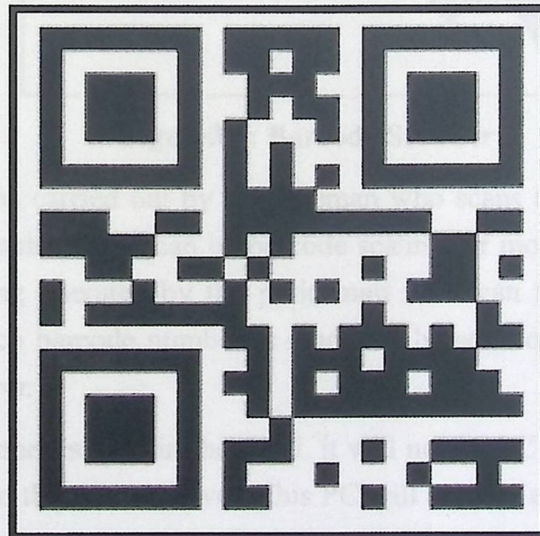


Figure3.4: QR Code.

Figure3.4 represents the 2D barcode will be used in the project, it is called QR code and can be read by the QR code application.

3.5 Barcode Reading Unit

The second and main part of the system is the barcode reading unit (BRU). This unit will be responsible of reading the barcode plates and sending them to the central server in the central office.

BRU will contain special device to read barcodes which is installed in the vehicles. BRU may have different devices to read the barcodes, it could be a special device used to read barcodes, which is called barcode reader (barcode scanner). Also, the mobiles could be used as a barcode reading unit with special application installed on it.

3.5.1 Barcode Scanners

The next figure shows the barcode scanner:

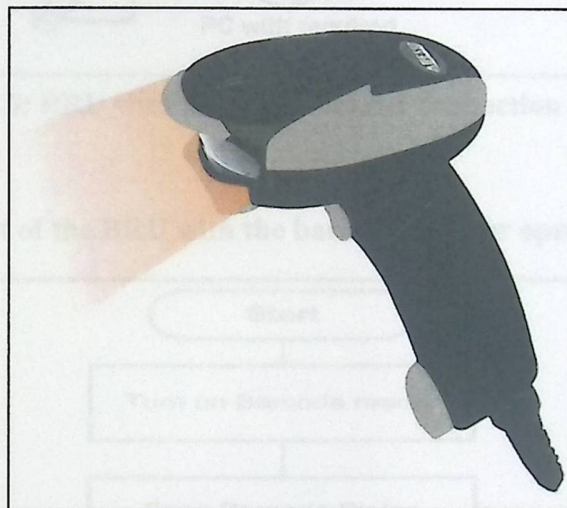


Figure3.5: Barcode Scanner

This unit must be carried out by a policeman who scans the barcode plates and reads the barcode numbers; this can be barcode scanner or mobile using the camera. The BRU, after being operated by the policeman will scan for the barcode plates continuously and each barcode number is read will be sent to the GSM network to reach the central server.

If a barcode scanner is used in the BRU, it will need a PC to extract the barcode number and send it to the central server. This PC will contain an installed application developed to take the barcode number for a text file, where the read barcode number appears, and send it to the central office. On the other hand, if a mobile is used in the BRU, the connection between the mobile and the server will be direct utilizing the GSM network.

The next figure3.6 represents the barcode reading unit if the barcode scanner is used, it shows how is the barcode scanner connected to a PC using USB interfacing cable, and the PC is connected to the server using the GSM Network by the edge card.

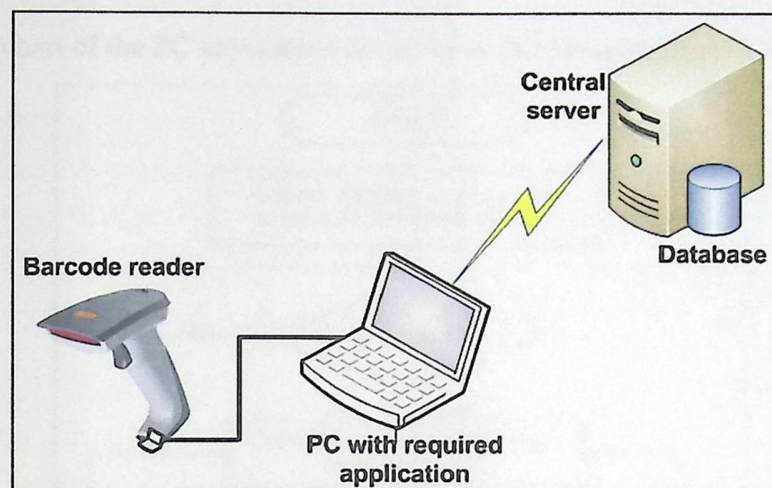


Figure3.6: BRU with Barcode Scanner connection to server.

❖ Flowchart of the BRU with the barcode scanner operation:

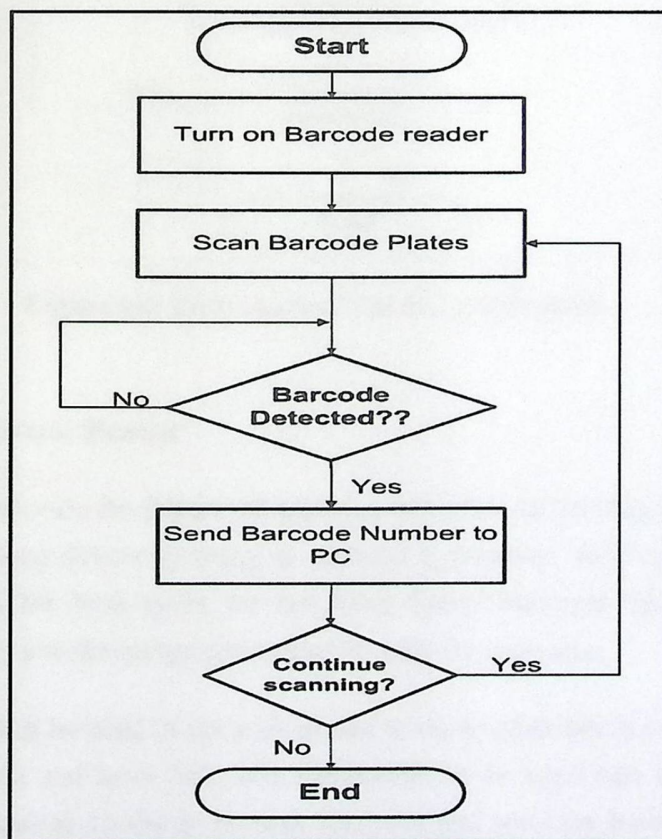


Figure3.7: Flowchart of barcode scanner operation.

As figure3.6 shows, the barcode scanner requires a PC interfacing to extract the scanned barcode number. This PC requires special software application to take the barcode number and send it to the central server. And the connection between the PC and server will be utilizing the cellular network using edge card to access the network.

The flowchart of the PC application is shown as following in figure3.8:

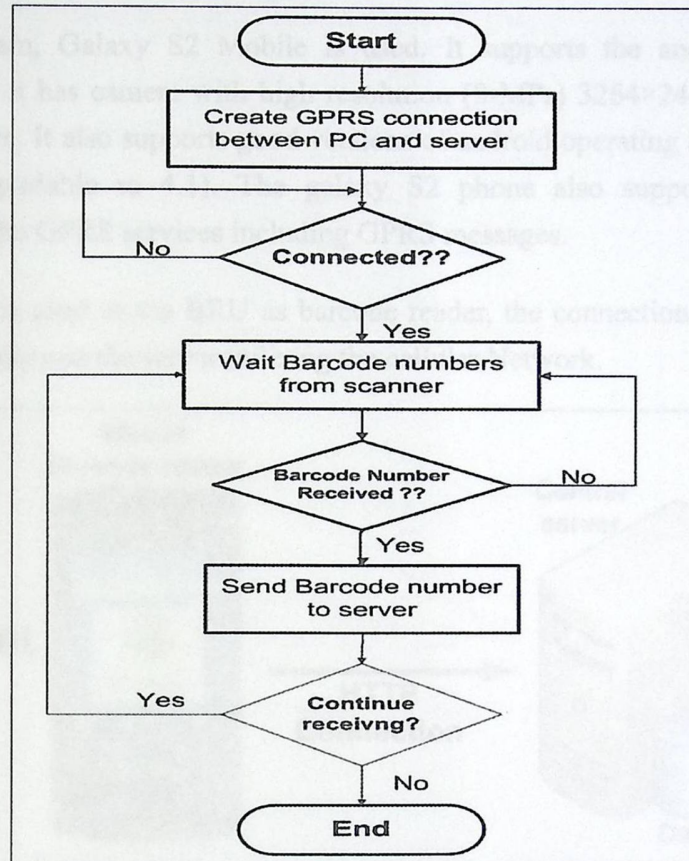


Figure3.8: Flowchart of the PC application.

3.5.2 Mobile Barcode Reader

Mobiles can provide the feature of scanning barcodes and sending it to the central server using the same device by using an android application built by java language. Mobiles can scan for both types for barcodes; linear barcodes and 2-dimentional barcodes. And they use the image processing to scan for barcodes.

The mobiles will be used in our system due to the availability in our market and it is easier to be used and have only one component to be used that is the mobile to perform all the required functions to scan barcodes and send the barcode numbers to the central server.

The used mobile must contain a camera with high definition and its resolution must not be less than 8 Mega pixels. This will improve higher performance of reading barcodes and increase the speed of reading them. Mobiles with android operating system will be used, because android is an open source software and easy to be used. It also provides large number of free applications in its web market. Also, android OS provides the possibility of updating the interfaces designs.

In our system, Galaxy S2 Mobile is used. It supports the android OS and applications and it has camera with high resolution (8-MPs) 3264×2448 pixels with LED flash feature. It also supports good versions of android operating system (v2.3.4 and v4.0.4, upgradable to 4.1). The galaxy S2 phone also supports the GSM technology and the GPRS services including GPRS messages.

If a mobile is used in the BRU as barcode reader, the connection will be direct between the mobile and the server utilizing the cellular Network.

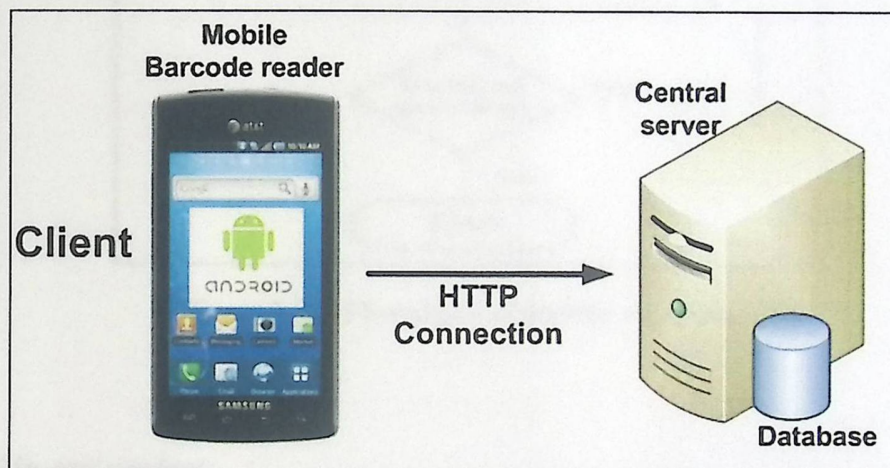


Figure3.9: BRU with Mobile Barcode Reader connection to server.

- ❖ The following flowchart shows the process of the android application in mobile readers:

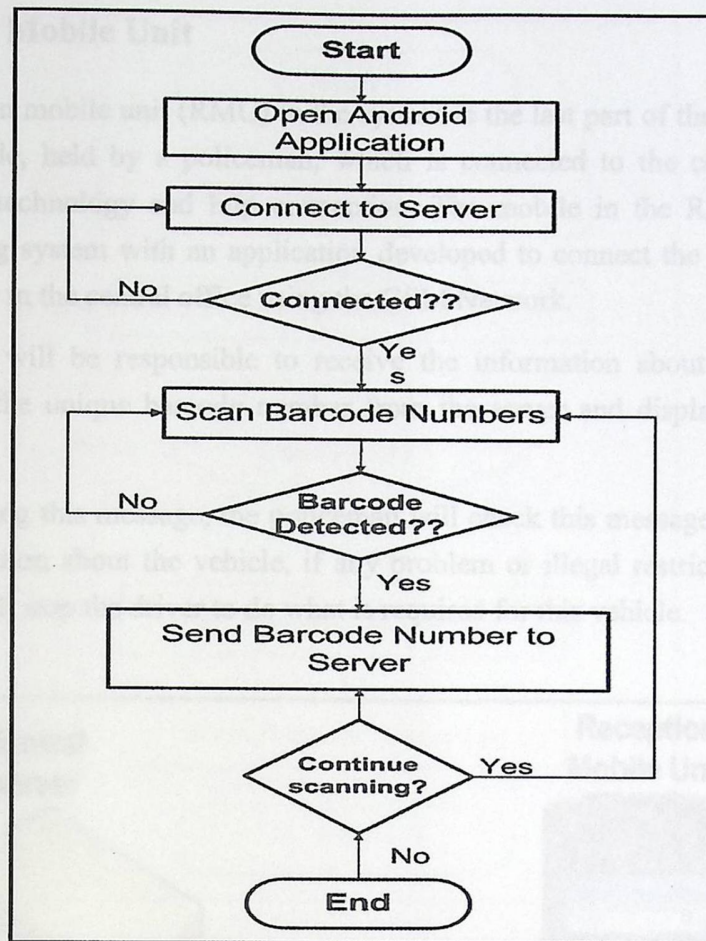


Figure3.10: Flowchart of mobile readers.

❖ **BRU in our project:**

As described in Figure3.6, BRU requires PC interfacing with the barcode reader, EDGE card to connect the PC to the server and special software application to transmit the barcode number. However we used Mobile Barcode Reader as shown in figure3.7. The advantage is that it enables direct connection to the central server with no need of other devices or applications.

There is some limitation trials by the team show that a distance of 3 meters is possible to read a barcode on a stationed car (area of barcode plate ~15cm×15cm). With a slowly moving car, the distance shrinks due to ~1.5-2 meters for clear reading. With a barcode scanner, however, the maximum reading obtained was less than 30 cm.

Because of these limitation trials provided by the barcode scanner, the mobile barcode reader will be used.

3.6 Reception Mobile Unit

The reception mobile unit (RMU) in the system is the last part of the system; the RMU is a mobile, held by a policeman, which is connected to the central server utilizing GPRS technology and http connection. The mobile in the RMU has the android operating system with an application developed to connect the mobile with the central server in the central office using the GSM Network.

The mobile will be responsible to receive the information about the vehicle associated with the unique barcode number from the server and displays it on the screen.

After receiving this message, the policeman will check this message and see the included information about the vehicle, if any problem or illegal restrictions found; the policeman will stop the driver to do what is required for this vehicle.

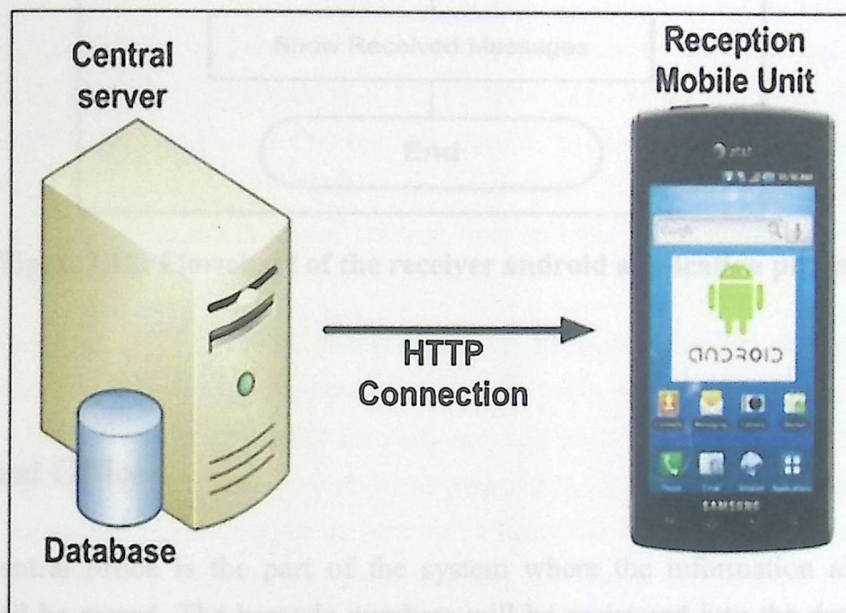


Figure3.11: Reception Mobile Unit connected to the server.

The following figure shows the flowchart of the Reception Mobile Unit:

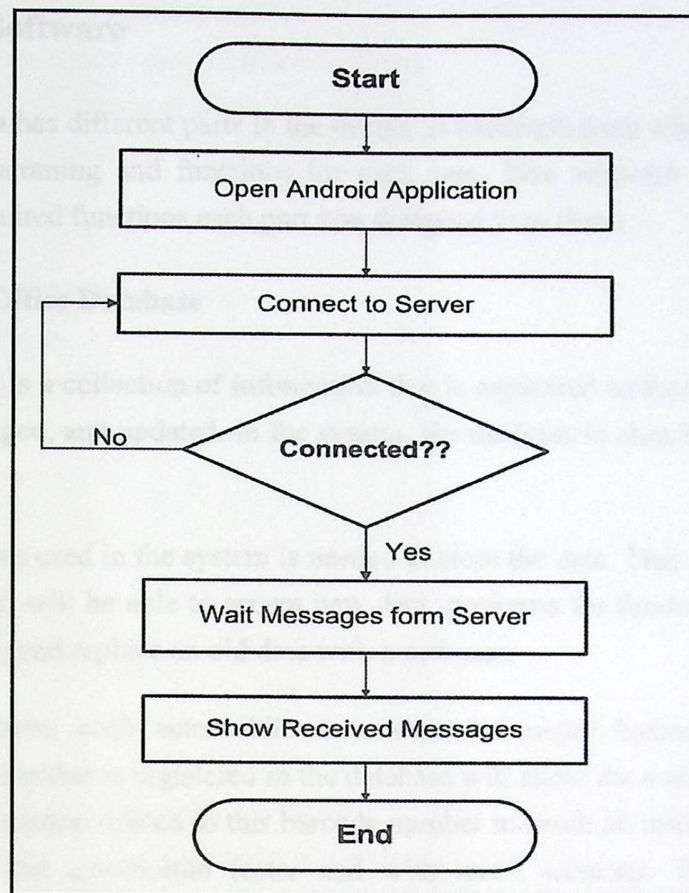


Figure3.12: Flowchart of the receiver android application process.

3.7 Central Office

The central office is the part of the system where the information about the vehicles will be stored. The barcode numbers will be registered into the database in the central office by an authorized person from the traffic department and he will add all the required information about the vehicle to the associated barcode number.

Also, the central office will contain the central server which is responsible of receiving the barcode numbers from the barcode reading units and sending the information associated to the barcode number to the reception mobile unit.

The central office has a PC with special software developed to create the database with its functions and the central server.

3.8 System Software

The system has different parts in the design as hardware parts which need special software programming and functions for each part. This software will be able to identify the required functions each part was designed to perform.

3.8.1 Central Office Database

A database is a collection of information that is organized so that it can easily be accessed, managed, and updated. In the system, the database is classified as a type of full-text.

The database used in the system is needed to store the data. This data is stored as in archive and it will be able to accept new data, performs the functions of updating an existing data, and replace an old data with a new one.

In our system, each automobile must own its unique barcode number (ID Number). This number is registered in the database will allow the authored persons to access the information related to this barcode number to reach all information and the features about the automobile faster and with more accuracy. The database is connected via server to the barcode reading unit and the other mobile held by the policeman.

The database will contain all the information about the car and owner contact related to the barcode, it also will contain partners table to define the policemen to each other, this table contains an ID for each cop and each partners IDs are related to each other, and it also contains the encrypted passwords for each cop. Partners table is used to define where the data must be sent by defining the ID of the cops in the table. Additionally, this table will contain field to check the status of the cops if they are online or not.

- ❖ The table that will be related to the barcode number will contain the following fields:
 - For the car information:
 - Barcode number.
 - Car plate number.
 - Car type.
 - Car name.
 - Car color.
 - Manufacturing year (year model).

- Offenses status if exist or not.
 - Last date to pay if offenses existing.
 - Last winter test date.
 - License duration valid until.
- Owner Contact information:
 - Name.
 - ID card number.
 - Driving license number.
 - Phone.
 - Mobile.
 - E-mail.
 - Home city.
 - Current address.
 - The other table in the database will be the couples of cops' information. This table will include the following information:
 - Cop's ID.
 - Partner ID.
 - Cop login password.
 - Cop's status.
 - ❖ The database will perform the following functions for the desktop user:
 - Add new car to the database.
 - Edit car information.
 - Remove car from database.
 - Add new cop partners to the database.
 - Edit Partners information.

The database was created using the Microsoft Access 2010 program. It is easy program to be used and provides the ability of creating desktop application to control the table and information registered into the tables. Also, large number of tables can be created within the same database application in MS Access.

The database application is connected directly to the Netbeans server using database connection to make it reachable by the server.

3.8.2 Central Office Server

One of the important parts of the system is the central server; it is a PC with special software programs. It is responsible of receiving the barcode number and accesses it to the database software and process the information related to the received barcode number, executes it and sends the needed rows of data to the second policeman's mobile.

The server can be built using different software programming languages, like C# or java languages, or using the visual basic depending on the complexity of the database and the importance of it. Each of these languages has its own features. In our system the server will be programmed with java programming language using the NetBeans IDE 7.2.1, by creating a complete java program that receives the barcode numbers, then processes them, analyzes the information, and determine the ID of the transmitter cop to determine the Destination cop.

The Java programming language is used in our project due to its simplicity and it contains all the required functions in our project. In addition, java is object oriented language clean, usable and designed to be easy to use and learn. The java supports multi-threaded programming for writing program that perform concurrent computations.

To build the server we used the NetBeans IDE 7.2.1 due to its simplicity of use, and it introduces the ability of running many server applications at the same time with different functions for each. Also it is direct environment used to link the clients to the server and other applications.

The operation the server will be responsible about:

1. Open the connection with the mobile of the first cop. And check the status of the other cop if connection was created or not.
2. Once the couple of cops are connected to the server, the server performs the operations of receiving and transmitting the messages.
3. When a barcode number is received on the server, it will insert the number to the database to be processed and analyzed, executed, and prepare the IP of the second cop to be the destination of the information message.
4. While the second cop still connected, the server will send the message with required data to alarm the cop to do what is required.

The following figure shows the flowchart of the server function in general:

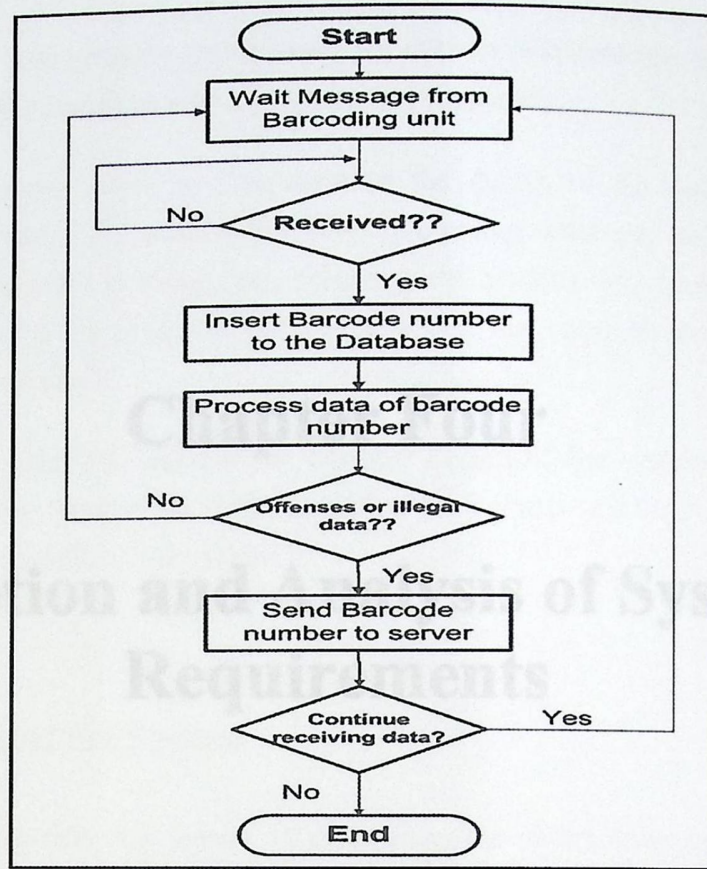


Figure3.13: Flowchart of server operation.

3.8.3 Android Applications

Two android applications will be developed in the system. The first one will be used in the barcode reading unit; it will be installed to the smart-phone (galaxy S2). It will be responsible for reading the barcodes and then sending the barcode numbers to the central server.

The second android application will be used as the last part of the system. It will be responsible for receiving the information from the central server and displaying them on the smart-phone's screen providing this information for the policeman.

These android applications will be built using the java programming language utilizing the eclipse environment which allows the programmer to develop android applications for the new devices that use the android operating system.

4

Chapter Four

Description and Analysis of System Requirements

4.1 Overview

4.2 Description of the System

4.3 Description of the Functional Requirements

4.4 General Flowchart of the System

4.5 Use Cases of the System

4.6 Class Diagram

4.7 System Sequence Diagram

4

Chapter Four

Description and Analysis of System Requirements

4.1 Overview

4.2 Description of the System

4.3 Description of the Functional Requirements

4.4 General Flowchart of the System

4.5 Use Cases of the System

4.6 Class Diagram

4.7 System Sequence Diagram

4.1 Overview

This chapter will describe and analyze the system requirements. It will focus on the detailed design of each part of the system independently.

The software part takes in consideration the design of the central office PC program step by step. It includes the way of creating database, receiving data to database, processing the existing data, selecting and sending data from the database. Also, it also includes the design of the central server that connects the database with the android applications.

This chapter also will discuss the detailed design of the system including the android applications connection with the server. Flowcharts will be shown to discuss the process of each stage of the system.

4.2 Description of the System

The system provides the service of identifying the automobiles registered in the traffic department using the barcode plate. It depends on an installed barcode plate on the automobile with a unique number for each. And android application installed on mobile with android operating system and special application to read this barcode. The system presents the ability to automate the process of checking the license of the automobile with no need for stopping cars.

4.3 Description of System Requirements

4.3.1 Description of the functional requirements for the policeman mobile application:

1. Connecting to the central server.

The android application must connect to the central server to determine the point where the data will be sent. This connection will be GPRS connection utilizing the cellular network and will be responsible of transmitting data.

4.1 Overview

This chapter will describe and analyze the system requirements. It will focus on the detailed design of each part of the system independently.

The software part takes in consideration the design of the central office PC program step by step. It includes the way of creating database, receiving data to database, processing the existing data, selecting and sending data from the database. Also, it also includes the design of the central server that connects the database with the android applications.

This chapter also will discuss the detailed design of the system including the android applications connection with the server. Flowcharts will be shown to discuss the process of each stage of the system.

4.2 Description of the System

The system provides the service of identifying the automobiles registered in the traffic department using the barcode plate. It depends on an installed barcode plate on the automobile with a unique number for each. And android application installed on mobile with android operating system and special application to read this barcode. The system presents the ability to automate the process of checking the license of the automobile with no need for stopping cars.

4.3 Description of System Requirements

4.3.1 Description of the functional requirements for the policeman mobile application:

1. Connecting to the central server.

The android application must connect to the central server to determine the point where the data will be sent. This connection will be GPRS connection utilizing the cellular network and will be responsible of transmitting data.

2. Reading the barcode plate installed on the automobile.

Reading the barcode plate will be using the camera of the mobile held by the policeman. It requires a high-definition camera on the mobile to raise the efficiency of scanning the barcodes. The android application is responsible for translating the barcode to number to prepare it for sending.

3. Transmitting the data (cop ID and Barcode number) to the central server.

The android application after reading the barcode is responsible for sending the barcode number with the cop ID to the central server using the GPRS connection.

4. Add violation on the owner of the automobile for any breach of the traffic laws.

The android application will provide the ability of adding violation on the owner of the automobile if the policeman noticed any breach of the traffic law happened by the driver of the automobile. This operation will be using special code and activity added to the application.

4.3.2 Description of the functional requirements for the desktop database application in the central office:

1. Add new car to the database.

The database application installed on the PC in the central office is responsible for adding the car with the associated information for it. This information will be added by a person who is operating the system and

2. Add the couples of cops to the database.

The user of the database in the database is responsible for adding the information to the couples of cops table. This requires a special window form to add each policeman with his ID and add the couple cop that is receiving the information associated to the barcode number the policeman read and send to server.

3. Edit information exist in the database.

Editing the information in the database could be done by the PC user manually or by the policeman on the road who sends the information to an account for the automobile and the user in the central office is responsible for verifying these information.

4. Monitor the tables in the database.

The database is responsible of receiving the data and inserting it to the process and then selecting the required fields existing in the database to be sent to the receiving mobile application.

4.3.3 Description of the functional requirements for receiving mobile application:

1. Connecting to the server and appearing online.

The application is built with the java programming language as android application. It is responsible for connecting to the server in the central office by the continuous listening for any data from server.

2. Receiving data from the server.

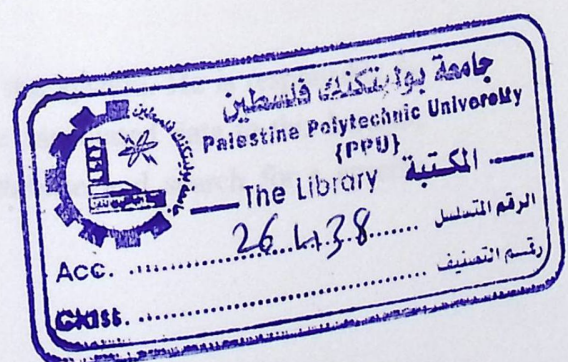
With the listening property in the android application, the application is receiving the data from the server.

3. Showing the received data as messages.

After receiving the data from the server; the application is responsible for displaying this data on the screen of the mobile to show the policeman holding the mobile the properties of the car and information associated to it.

4.4 General Flowchart of the System

Figure 4.1 shows the general flowchart of the system including all the stages. This shows the general processes done by all parts in the system; the barcode reading unit, the central office software and the receiving mobile unit:



4. Monitor the tables in the database.

The database is responsible of receiving the data and inserting it to the process and then selecting the required fields existing in the database to be sent to the receiving mobile application.

4.3.3 Description of the functional requirements for receiving mobile application:

1. Connecting to the server and appearing online.

The application is built with the java programming language as android application. It is responsible for connecting to the server in the central office by the continuous listening for any data from server.

2. Receiving data from the server.

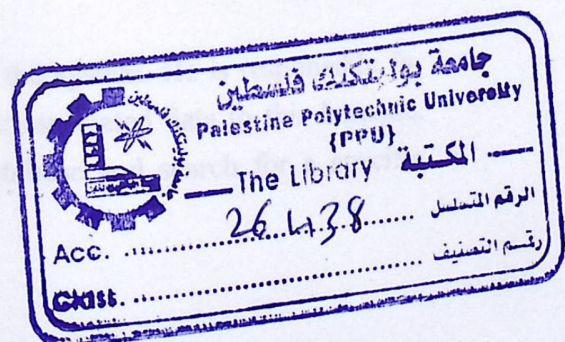
With the listening property in the android application, the application is receiving the data from the server.

3. Showing the received data as messages.

After receiving the data from the server; the application is responsible for displaying this data on the screen of the mobile to show the policeman holding the mobile the properties of the car and information associated to it.

4.4 General Flowchart of the System

Figure 4.1 shows the general flowchart of the system including all the stages. This shows the general processes done by all parts in the system; the barcode reading unit, the central office software and the receiving mobile unit:



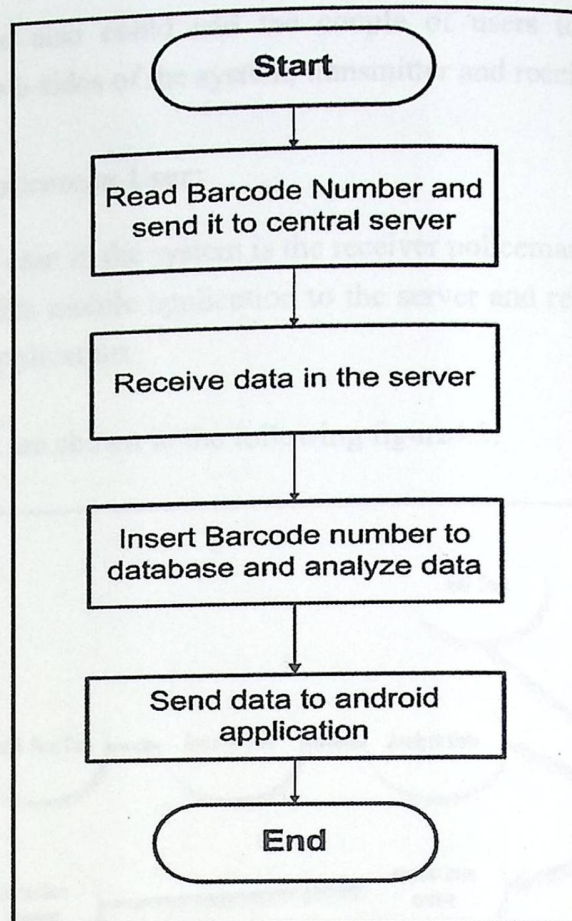


Figure4.1: General system flowchart.

4.5 Use Cases of System

The system includes three operations, these are as follow:

- **Reader Policeman User:**

The policeman who is holding the mobile barcode reader could be able to connect his mobile application to the server to open the session for transmitting the data to the server. In addition, he is responsible for reading the barcode number and sending it with his ID to the server.

- **Desktop user:**

A user of the desktop application is a part of the system. He is responsible for adding barcode number to the database and the associated data to this barcode. Also, he could edit this information in the database and search for a specific

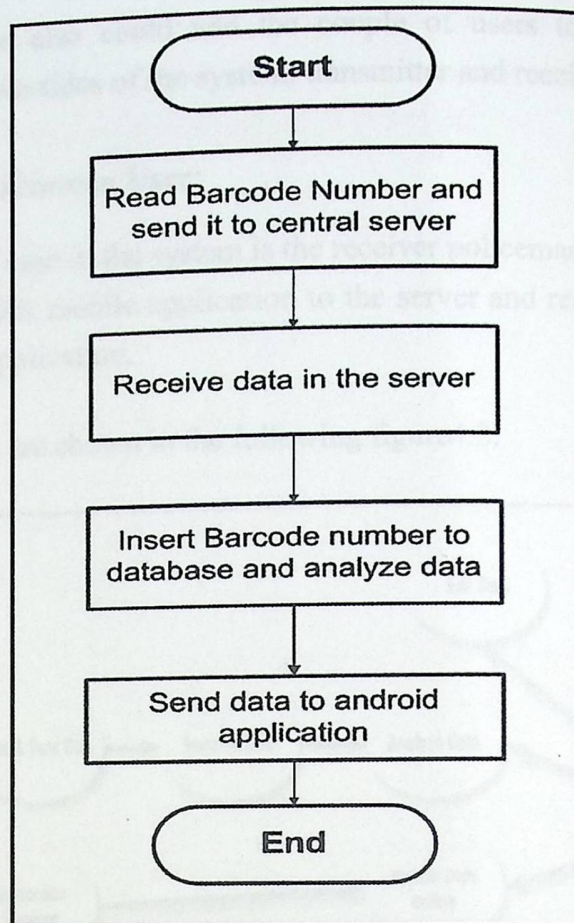


Figure4.1: General system flowchart.

4.5 Use Cases of System

The system includes three operations, these are as follow:

- **Reader Policeman User:**

The policeman who is holding the mobile barcode reader could be able to connect his mobile application to the server to open the session for transmitting the data to the server. In addition, he is responsible for reading the barcode number and sending it with his ID to the server.

- **Desktop user:**

A user of the desktop application is a part of the system. He is responsible for adding barcode number to the database and the associated data to this barcode. Also, he could edit this information in the database and search for a specific

the receiver mobile. In the system; the server dials with a database installed on the PC, this database contains the information about the cars and about the couple of cops. And Figure (4.3) shows the Class Diagram of the system:

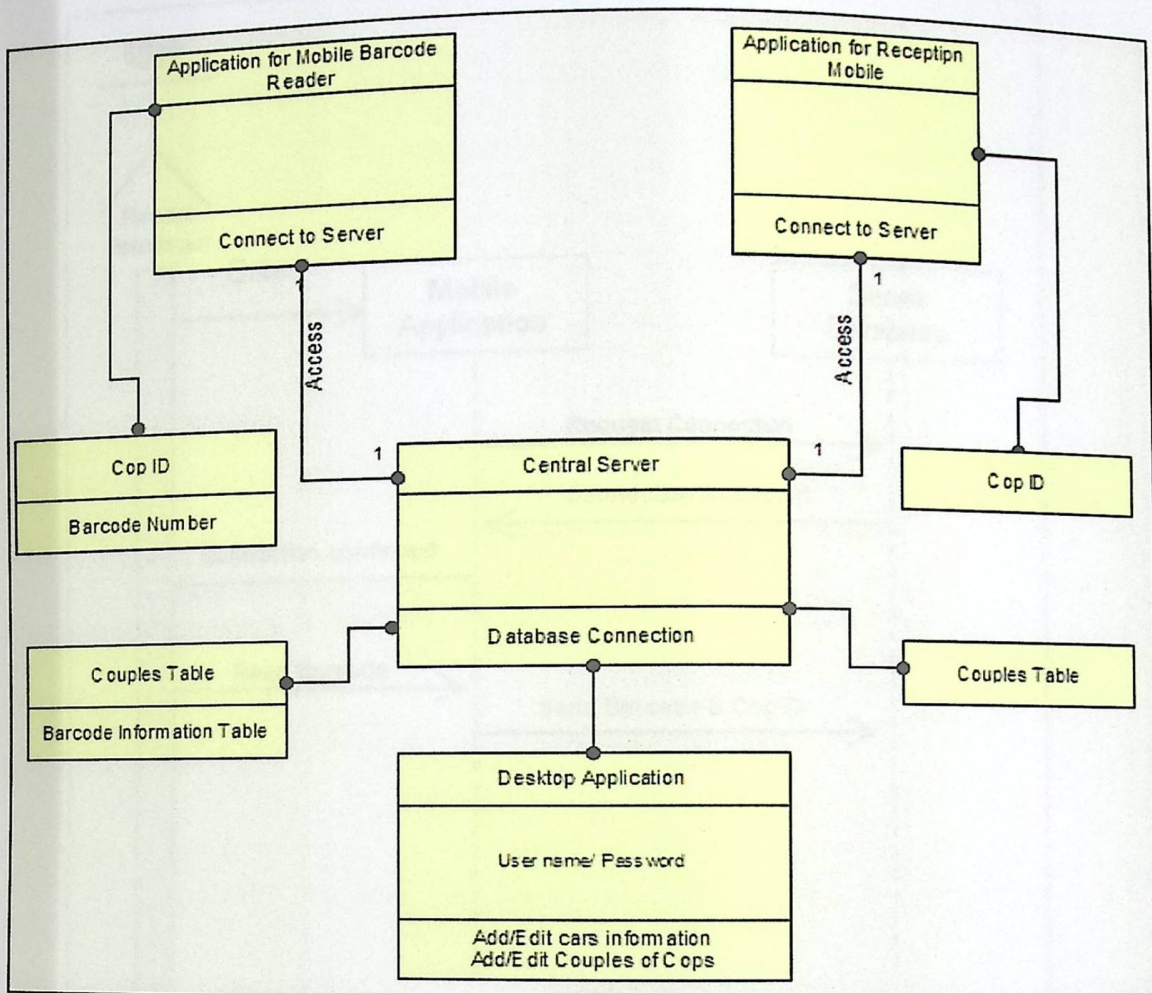


Figure4.3: UML Class Diagram of the system.

4.7 System sequence diagram

For each of the use cases a sequence diagram will be created in this section, in order to show which objects are needed to perform this case, how they will interact with each other, and the time sequence of the process steps:

4.7.1 Sequence diagram of the operation of reading barcodes in the application:

Figure4.4 shows the sequence diagram of the first use case in the system which is the case of reading the barcode number by the mobile application on the mobile held

by the first policeman. As shown in the figure; this case starts when policeman enter to the mobile application and then a request for connection is sent to the server. After the request is accepted, the application will be ready to read barcodes and send data to the main server.

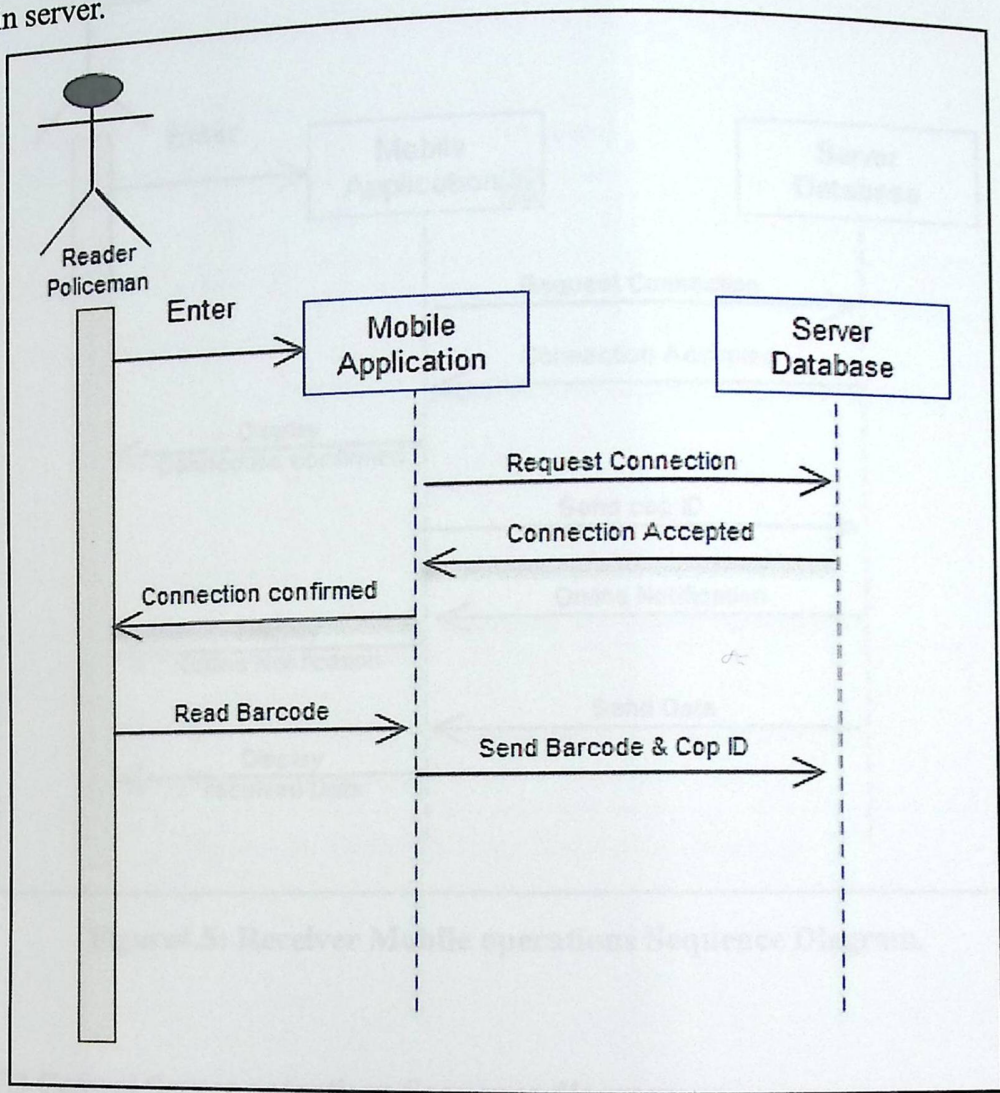


Figure4.4: Barcode Reading sequence diagram.

4.7.2 Sequence Diagram of the operations performed by the receiver mobile application:

The second use case is the operations performed by the receiver mobile application. As shown if Figure4.5; the session starts when the policeman enters to the application on his mobile device. Then, the application asks for a connection with the main server to start the listening for data for the server.

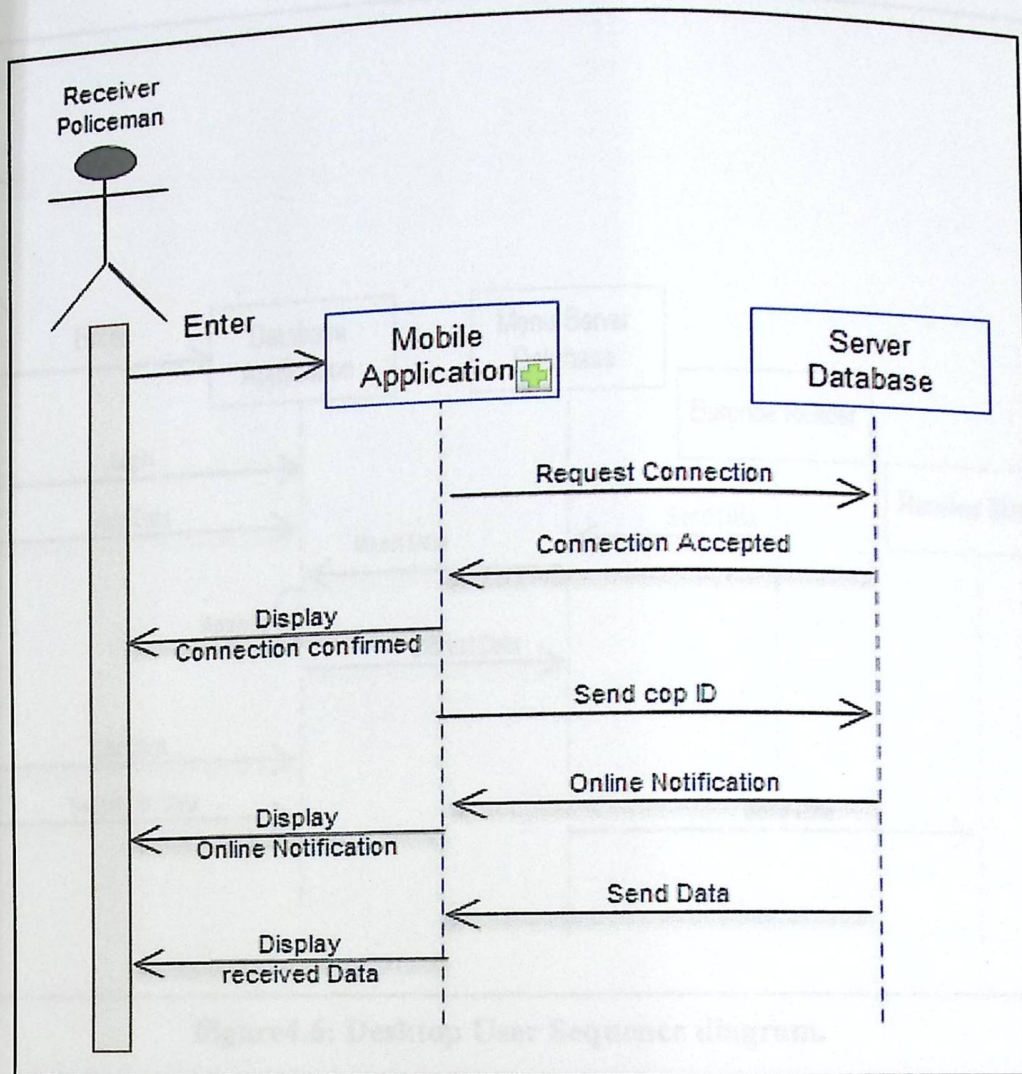


Figure4.5: Receiver Mobile operations Sequence Diagram.

4.7.3 Central Server operations Sequence diagram:

The Sequence diagram of the main server operations is shown in Figure4.6. The figure shows the operations done by the desktop user which starts when the user enter to the database application. Then the application asks for login information for authentication issues with no allowing for unauthorized user to access the database. Then the user adds the data and saves it in the database. The server which is connected to the database receives data from barcode reading unit and inserts this data to the database where it is analyzed and associated data is extracted and prepared to be sent. The server takes this data and sends it to the receiver mobile application.

5

Chapter Five

System Testing

5.1 Overview

5.2 Sub-System Testing

5.3 Installing and Preparing the System

5.4 Test Scenarios

5.5 Testing Results

5.1 Overview

This chapter describes the whole testing stage of the system. The test of each part of the system will be mentioned with clearly showing all the probable scenarios. It is also represents each part test of the system, its errors and challenges. However, in this chapter the system accuracy is figured out.

5.2 Sub-System Testing

The main aim of this testing part is to test the main operations in the system. The system is divided into six operations. The six operations are:

1. Detecting the automobile barcode plate we installed on it.
2. Posting the data (cop ID and Barcode number) from the mobile reading unit to the central server.
3. Receiving the data into the main server and analyzing the associated data.
4. Determining the required the cop ID (partner of reader) where the forwarding will be.
5. Extracting the required fields of data and prepare it to be sent.
6. Posting data to the Reception Mobile Unit (RMU) and displaying the data on the screen of the mobile.

All the operations mentioned before are tested and met the expectations.

5.3 Installing and preparing the System

At this stage all parts of the system must be ready for testing at the three sides; the barcode mobile reading application, the mobile reception unit application, and the desktop application at the server.

All the steps of installing and preparing are mentioned at this section.

Two mobile android applications has been built using the Eclipse Environment and installed to the mobiles. To install the application on the mobile, the mobile must be connected to the computer device using Bluetooth connection or via USB cable connection to send the android application to. Both of the applications are of the version v2.1 of the android version to guarantee it work on most of the mobile that has android operating system.

5.3.1 Mobile Barcode Reading Application

The first application we built is the application that will read the barcode number and send it to the main server. This application as mention is built using the eclipse environment.

After building of the application, it is installed on the Galaxy S2 mobile, and the file (ALDSReader.apk) is the required file to be installed on the mobile. This file exists at the workspace of the eclipse.

After sending the ALDSReader.apk file to the mobile, it will appear in the files screen as in Figure5.1:

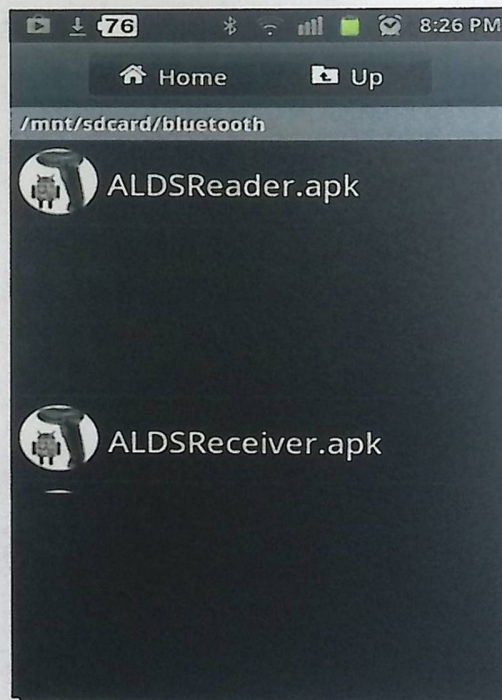


Figure5.1: transformed applications icons.

Click on the icon appears and the mobile will display the preparing of install screen as in Figure5.2:

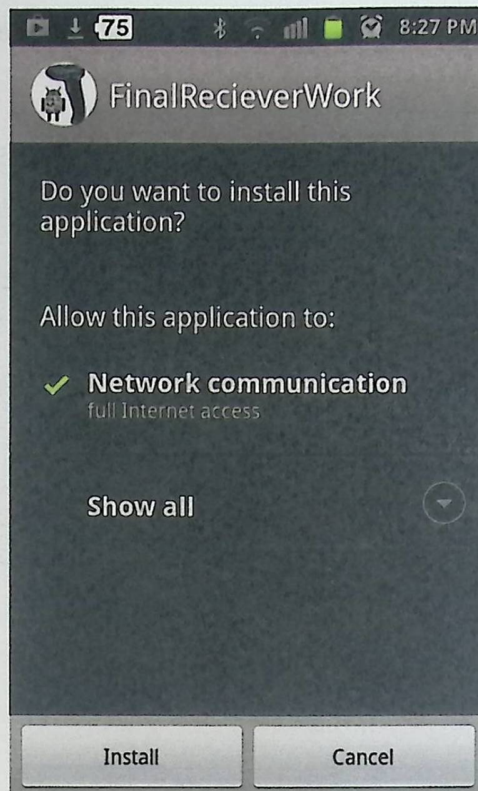


Figure5.2: Ask message to install application.

After the installation is complete, the following message is shown on the screen as in Figure5.3:

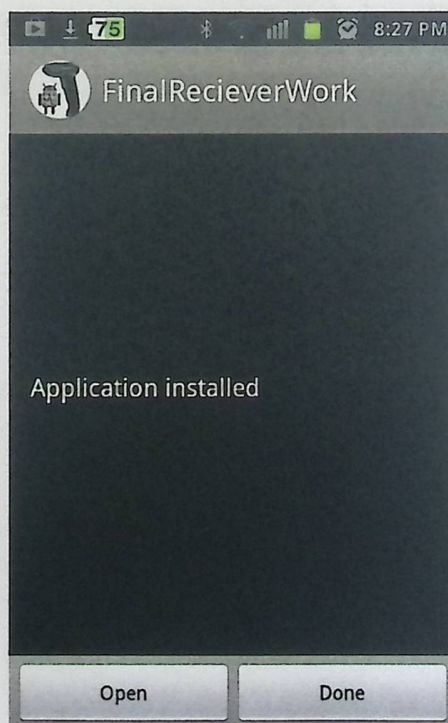


Figure5.3: Installation done screen.

After installation complete, the icons of the applications will be on the mobile as shown in Figure5.4:



Figure5.4: Application icons on the mobile.

Now the installation of the applications is completed and it is ready to be used by the policeman and to read barcodes. After opening the application, the welcome screen is shown as in Figure5.5:

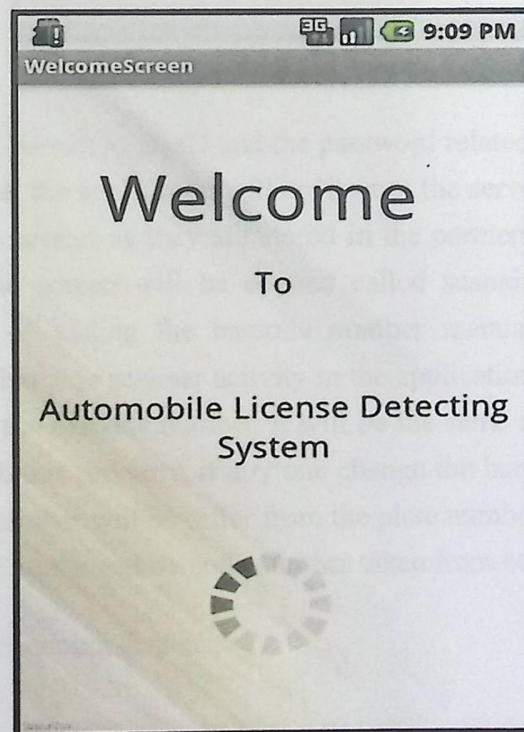


Figure5.5: Welcome screen.

After the welcome screen, new screen is opened which is the login screen that allow each cop to login to his application with his ID to determine the partner cop ID where the associated data will be sent.

Figure5.6 shows the Login screen:

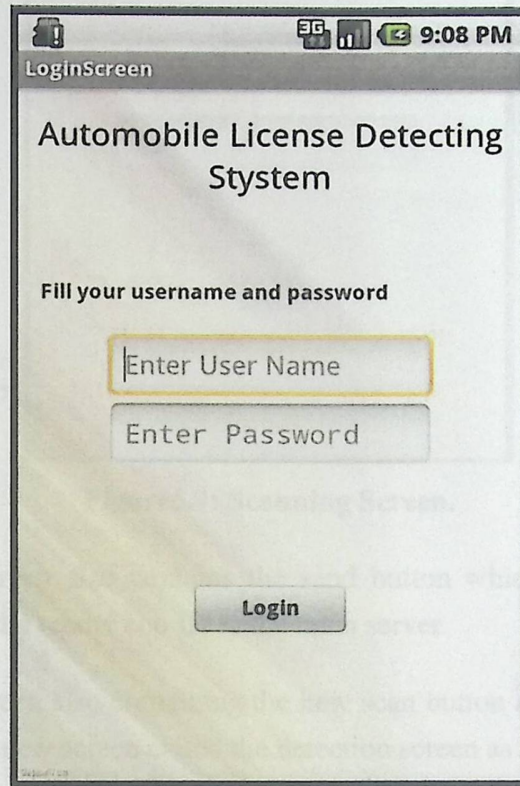


Figure5.6: Login screen.

After writing the correct login ID and the password related to it correctly, and the login button is pushed, the application will connect to the server to search if the login ID and password are correct as they are stored in the partners table in the database. Then, a new window screen will be opened called scanning screen; this screen contains the ability of adding the barcode number manually or by scanning it automatically by the barcode scanner activity in the application. To add the feature of the manual inserting the barcode number, it will be the same number as the numbers on the car plate. With this property, if any one change the barcode plate stationed on his car, the scanned number will be differ from the plate number and it will be marked as unregistered car or duplicated barcode number taken from other car.

Figure5.7 shows the Scanning screen:

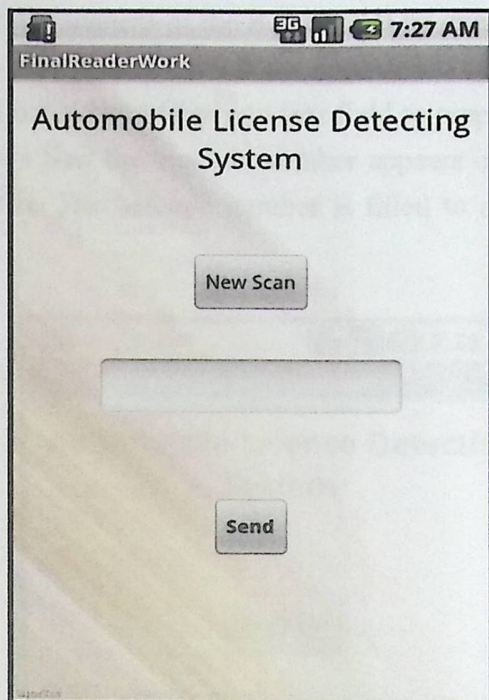


Figure5.7: Scanning Screen.

The scanning screen also contains the send button which is used to send the barcode number and the reader cop ID to the main server.

The scanning screen also containing the new scan button and if it is selected, the application will open new screen called the detection screen as shown in figure5.8.

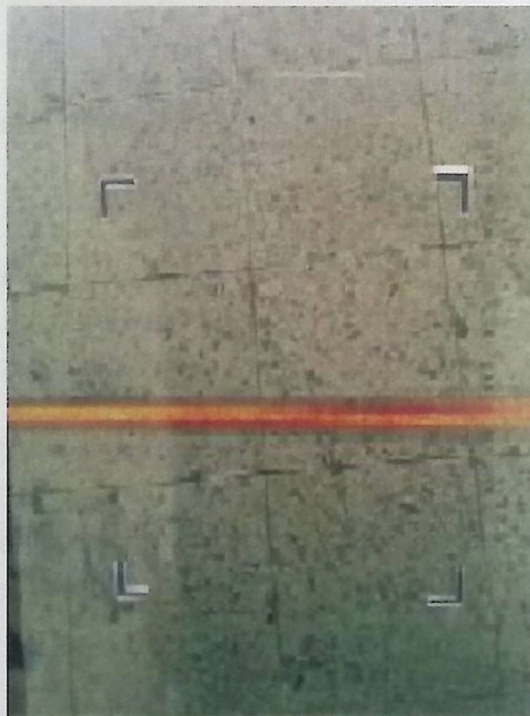


Figure5.8: Detection screen.

When it is opened, the camera of the mobile will be opened to start scanning for barcodes. And when a barcode is detected, the application will return to the scanning screen and fill the read barcode number into text field to prepare it to be sent with the cop ID. Figure5.9 shows how the barcode number appears on the text field after the barcode plate is detected. The barcode number is filled to a Text field showing the number:

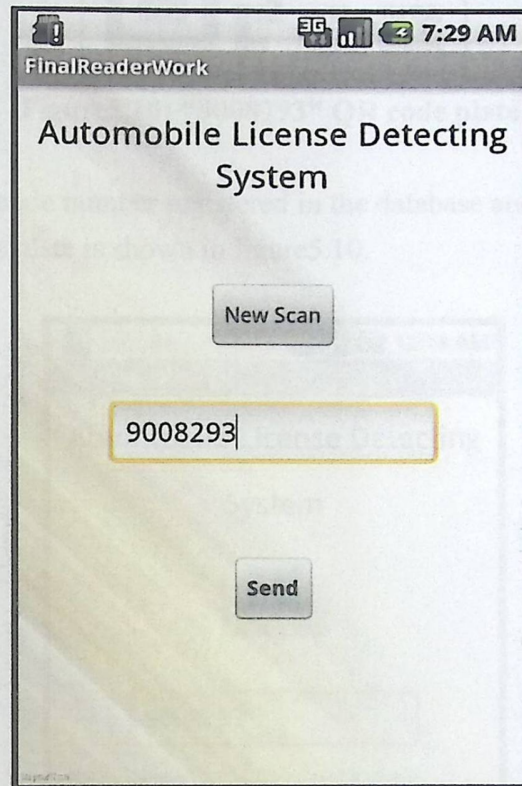


Figure5.9: Barcode number display and send screen.

The send button sends the data form mobile to server. This data contains the cop ID and the detected barcode number. The cop ID is determined when the cop logs into his account by his cop ID and password.

When the send button is pressed, the data will be sent to the server and feedback from the server is returned to show the status of the car for the reader cop. Figure5.11 shows the feedback for the car with the barcode number "9008293" shown in figure5.10. The car has no problems so that the feedback was "No Problem Found" as shown in figure5.11:

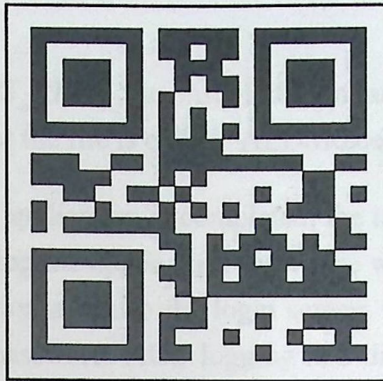


Figure5.10: "9008293" QR code plate.

"9008293" is a barcode number registered in the database and printed as QR code plate to be scanned; this plate is shown in figure5.10.

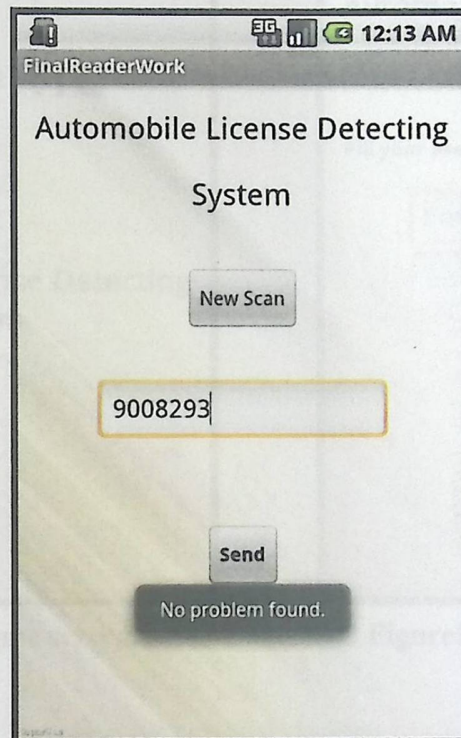


Figure5.11: Feedback about the car from server.

5.3.2 Reception Mobile Application

The second application in the system is the android application installed on the reception mobile held by a cop. This application is responsible of receiving the associated data from the server and displaying this data on the screen to show in to the cop.

This application (ALDS_RMU) is installed similarly as the first android application (ALDS_BMR) but the file is called "ALDSReceiver.apk".

After the installation the application is completed, the icon appears on the mobile screen as in figure 5.4. Opening the application shows the welcome screen same as in barcode mobile read application and also the login screen. Here, the cop login to the system with his cop ID and password. After logging into the cop account, the mobile is connected to the main server to notify that it is online and ready to receive data from the server. Figure5.12 and Figure5.13 show the welcome and login screens.

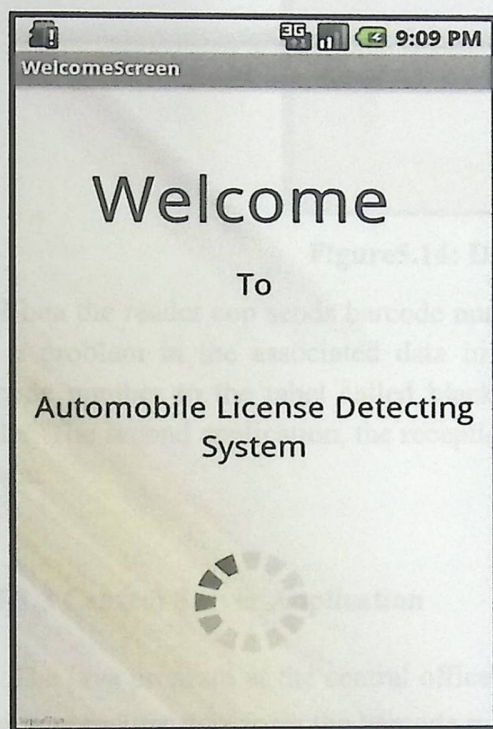


Figure5.12: Welcome screen.

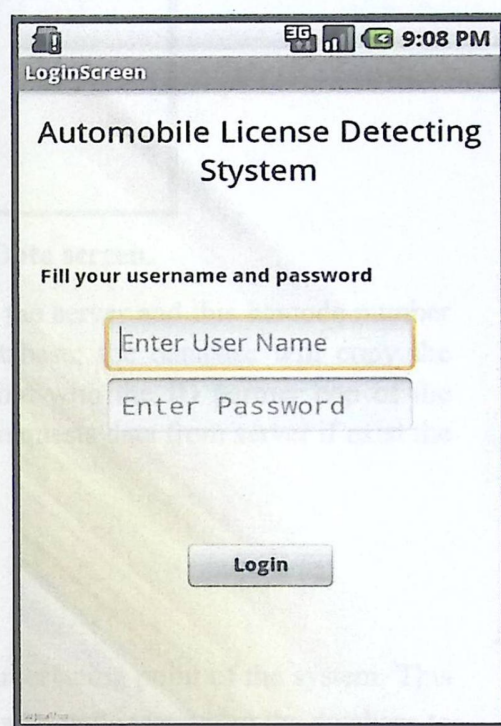


Figure5.12: Login screen.

After the cop login to the system, the application goes to the receiving data screen where the application displays the received data. Figure5.14 shows the Display screen.

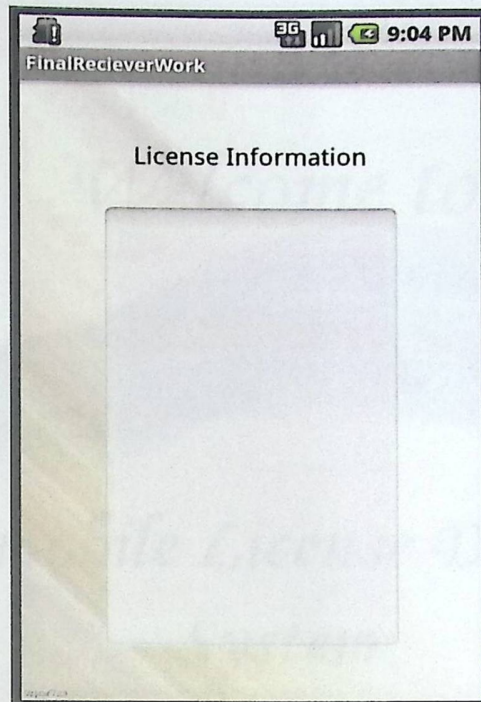


Figure5.14: Display Data screen.

When the reader cop sends barcode number to the server and this barcode number has a problem in the associated data in the database; the database will copy the barcode number to the tabel called black list table with the ID partner cop of the reader. The second application, the reception unit requests data from server if exist the be sent.

5.3.3 Central Server Application

The java program at the central office is the interfacing point of the system. This program receives data form the barcode mobile reader and inserts it to the database to analyze it. Then, it sends the associated data to the reception mobile application to display this data.

The java program is built with the NetBeans program with the java programming language. It contains two application works as one and together, the database, where the data is stored, and the server, which receives and sends data in the system.

To start the java application, we must go to the NetBeans program and run the apache tomcat server and the java application.

After running the application, welcome screen will be shown as in Figure5.15:

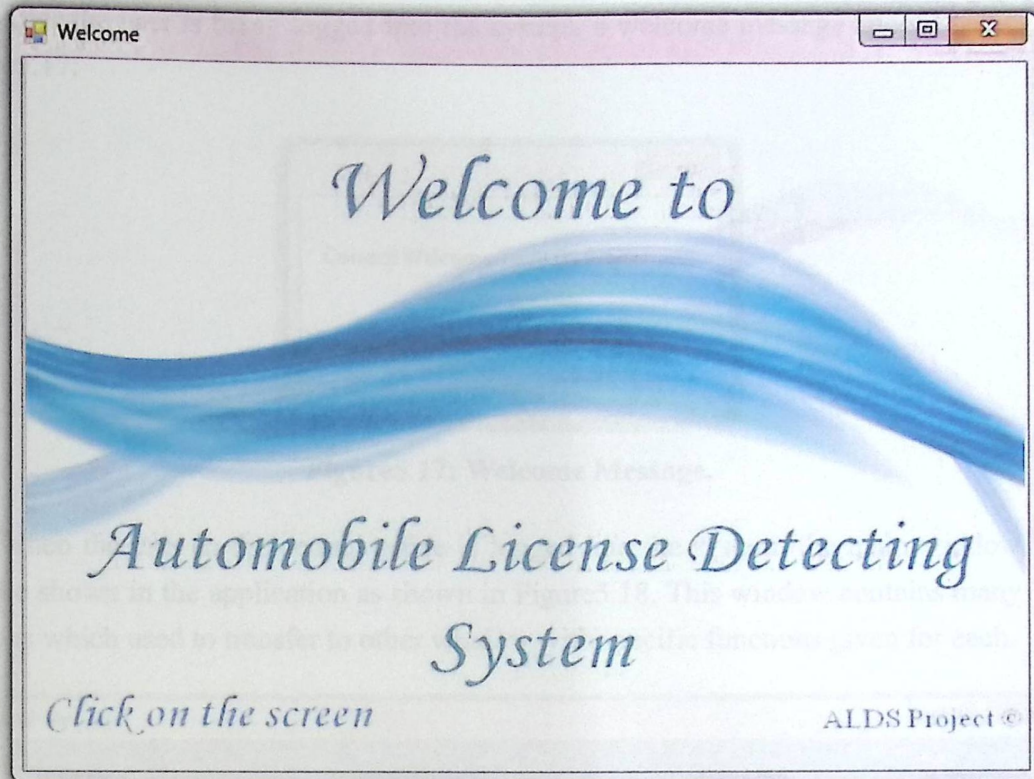


Figure5.15: Welcome Screen in the Java application.

By clicking on the welcome screen, the application will go to the Login Screen. The Login Screen asks the user to insert his login information (Username and Password) to get the access to the system. Figure 5.16 shows the Login Screen:

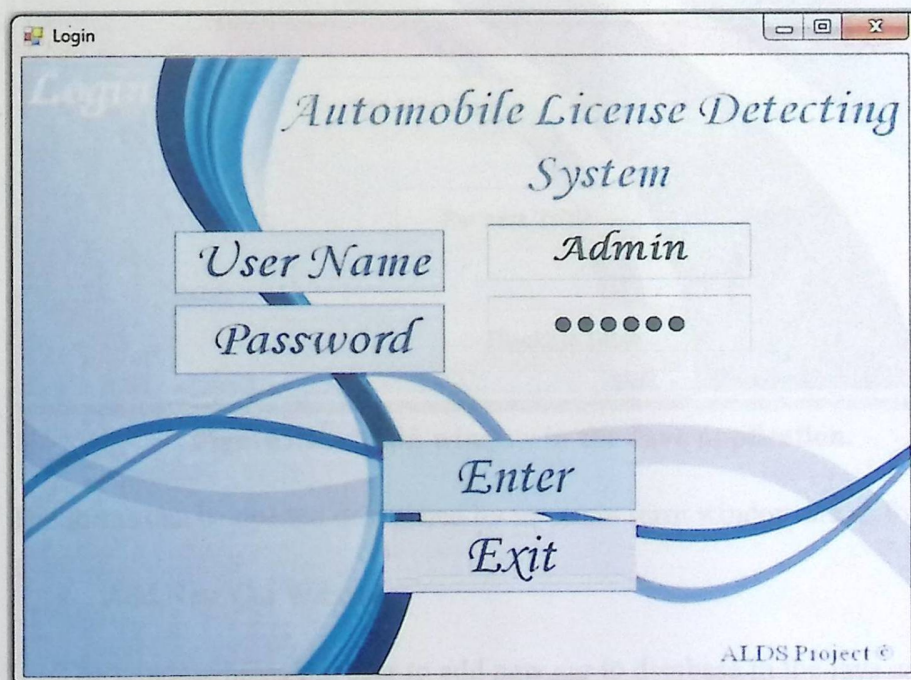


Figure5.16: Login Screen.

After the user is being logged into the system, a welcome message appears as in figure5.17:

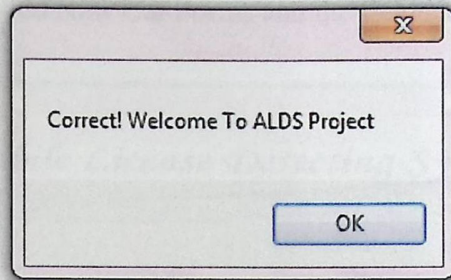


Figure5.17: Welcome Message.

When the user in the central office is logged into the system, the main window will be shown in the application as shown in Figure5.18. This window contains many buttons which used to transfer to other window with specific functions given for each.

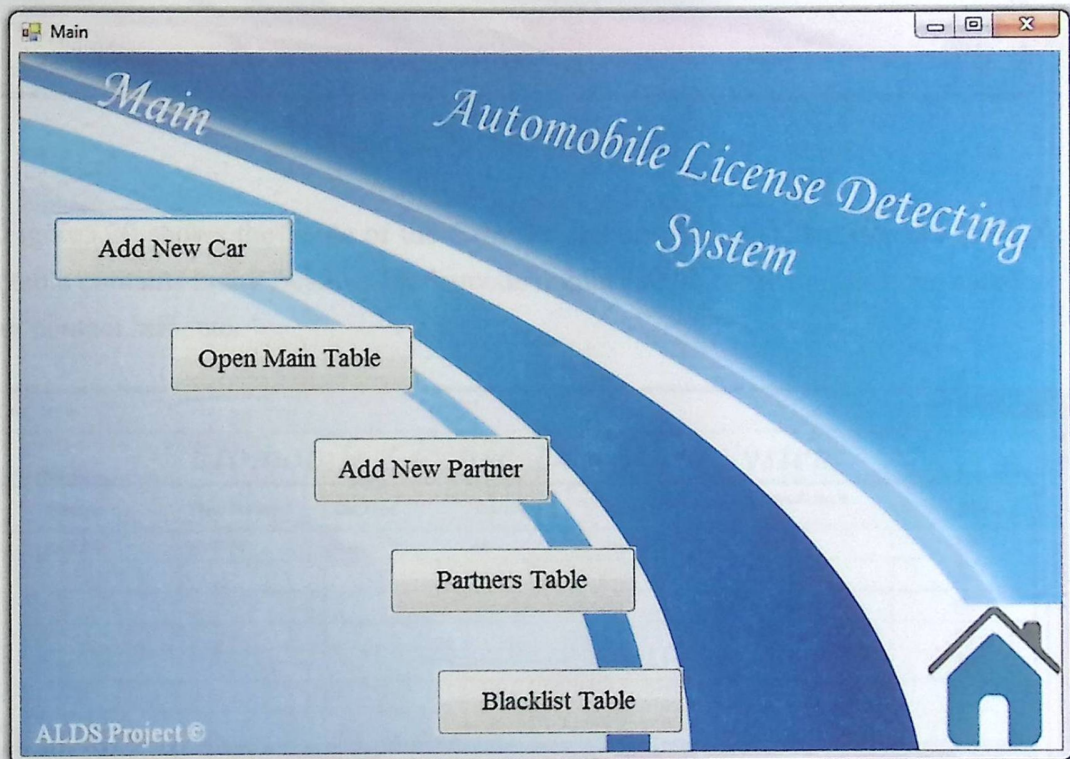


Figure5.18: Main window in the Java application.

The forms can be opened or reached by the main form window are as follow:

- Add New Car Window:

The window helps the user to add new car to database in the java application. This window contains many text fields to add all the required data stored in

the tables of the created database. Also, from this window you can search for a specific car and edit information for existing car.

Figure5.19 shows the Add New Car Forms and the fields it contains:

Add Car

Automobile License Detecting System

Barcode:

Plate Number:

Car Type:

Car Name:

Color:

Manufacture Year:

Offense State:

Last Date To Pay:

Last Winter Test:

License Valid:

Owner Name:

Owner ID card Number:

Driving License Number:

Phone:

Mobile:

Email:

Address:


ALDS Project © 

Figure5.19: Add New Car Form.

Figure5.20 shows the Table of the Cars and the information filled into the table. This table contains many fields as the barcode number field, car plate, car type, name, owner contact info, etc.

Cars_Table

Automobile License Detecting System

Barcode	Plate Number	Car Type	Car Name	Color	Manufacture Year	Offense Status
9008293	9008293	Audi	A4	MoonBlue	2010	<input type="checkbox"/>
						<input type="checkbox"/>
						<input type="checkbox"/>
						<input type="checkbox"/>
						<input type="checkbox"/>
						<input type="checkbox"/>
						<input type="checkbox"/>


ALDS Project © 

Figure5.20: Registered Cars Table.

Other window form can be reached from the main form is the form "Add New Partners". This form is used to add the cops who are reading the barcode number and cop who will receive the associated data to that barcode number.

Each pair of cops is stored in the database and when the reader cop sends his ID, server determines who is the receiver cop form this data table. The table as shown in Figure5.21 and Figure5.22 contains the barcode reader cop ID, receiver cop ID and the password of each cop.

Figure5.21 shows the form "Add Partners" which is used to add the information to the couples table:

Figure5.21: Add New Partner form.

Figure5.22 shows the table of the partners. This table contains the necessary fields of data required to determine the two points of connection with the server; where the server will send the data depending on the received data "cop ID".

Cop ID	Partner ID	Password
1	2	XXXXXXXXXX
2	1	XXXXXXXXXX
3	4	XXXXXXXXXX
4	3	XXXXXXXXXX
5	6	XXXXXXXXXX
6	5	XXXXXXXXXX

Figure5.22: Partners Table.

During the process of the system, the last table will be used, which is the Blacklist Table, this table will be used to determine which scanned barcode number has a problem in the associated number, and this barcode number will be stored to the table with the receiver ID "Partner ID". This table will be used when the reader will detect barcode number has a problem, then the barcode number will be stored and also the partner ID will be stored with it. Figure 5.23 shows the blacklist table:

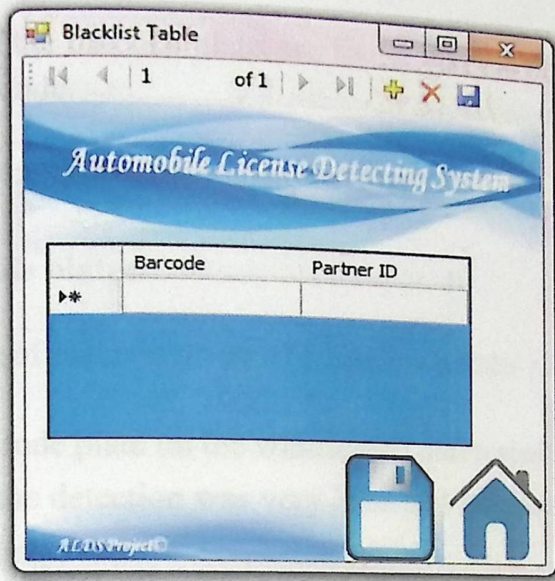


Figure 5.23: Blacklist Table.

5.4 Test Scenarios

In this section of the chapter, the scenario of starting the system with all its parts will be mentioned, including all the necessary steps which include:

- Download the mobile applications into both of the mobiles, the barcode reader and the receiver mobile.
- Install barcode plates to cars with different places in the car, we put one on the windscreen and other on the driver door. However, we put other on the frontal side of the car beside the car plate.
- Run the java applications "database and server" with the added data with multiple choices of data.
- Take the mobiles and run their applications and start scanning barcode plates with the different places of plate, different cases of cars movement and status of associated data to barcodes.

During the process of the system, the last table will be used, which is the Blacklist Table, this table will be used to determine which scanned barcode number has a problem in the associated number, and this barcode number will be stored to the table with the receiver ID "Partner ID". This table will be used when the reader will detect barcode number has a problem, then the barcode number will be stored and also the partner ID will be stored with it. Figure5.23 shows the blacklist table:

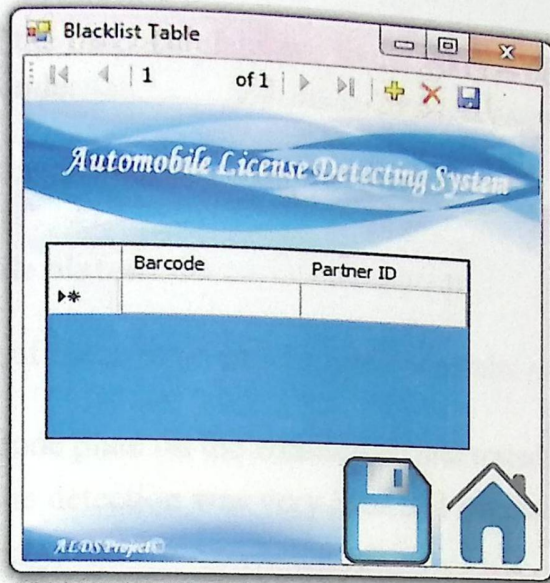


Figure5.23: Blacklist Table.

5.4 Test Scenarios

In this section of the chapter, the scenario of starting the system with all its parts will be mentioned, including all the necessary steps which include:

- Download the mobile applications into both of the mobiles, the barcode reader and the receiver mobile.
- Install barcode plates to cars with different places in the car, we put one on the windscreen and other on the driver door. However, we put other on the frontal side of the car beside the car plate.
- Run the java applications "database and server" with the added data with multiple choices of data.
- Take the mobiles and run their applications and start scanning barcode plates with the different places of plate, different cases of cars movement and status of associated data to barcodes.

• Testing scenarios:

At this section, we tested the parts of our project one by one with different cases. We tested the barcode plate installed at different places on the vehicle, and then we tested multiple sizes of barcode plates. Also, we tested different speeds of the vehicle and tried to detect barcodes at these speeds. And as we mentioned before, we tested different statuses of the data associated for barcodes.

But for the size of the barcode plate, we found that the best size is 10cm × 10cm for the barcode as QR code.

Next, we are showing the different scenarios of tests:

1. Place of barcode plates:

We tested many places of barcode on the car, and the results as follow:

- a. We put the barcode plate on the windscreen and tested the detection status, but we found that the detection was very hard and the mobile reading was at very close distance only.

Figure5.24 shows the barcode plate at the windscreen.



Figure5.24: Barcode plate on the windscreen.

- b. The barcode plate was put at the front body of the car as in figure5.24. At this position of plate, the detection of the barcode was more efficient than the windscreen but the cop have to stop very close to the car and this may cause danger for him.

Figure 5.25 show the barcode plate at the front body of the vehicle.

- **Testing scenarios:**

At this section, we tested the parts of our project one by one with different cases. We tested the barcode plate installed at different places on the vehicle, and then we tested multiple sizes of barcode plates. Also, we tested different speeds of the vehicle and tried to detect barcodes at these speeds. And as we mentioned before, we tested different statuses of the data associated for barcodes.

But for the size of the barcode plate, we found that the best size is 10cm × 10cm for the barcode as QR code.

Next, we are showing the different scenarios of tests:

1. **Place of barcode plates:**

We tested many places of barcode on the car, and the results as follow:

- a. We put the barcode plate on the windscreen and tested the detection status, but we found that the detection was very hard and the mobile reading was at very close distance only.

Figure5.24 shows the barcode plate at the windscreen.



Figure5.24: Barcode plate on the windscreen.

- b. The barcode plate was put at the front body of the car as in figure5.24. At this position of plate, the detection of the barcode was more efficient than the windscreen but the cop have to stop very close to the car and this may cause danger for him.

Figure 5.25 show the barcode plate at the front body of the vehicle.



Figure5.25: Barcode plate at the front body.

- c. The barcode plate was put on the side body of the car above the wheel. This case was found as the best one and it is used in the project. This case provides the ability of reading barcodes form different distances and with no danger may happen for the reader cop.

Figure5.26 shows the barcode plate on the side body of the car:



Figure5.26: Barcode plate on the side body of the car.

2. Speed vs. distances test.

We tested the system at different speeds of the vehicle and from different distances. Table5.1 shows the testing results:

Table5.1: Speed vs. Distance barcode detection.

Speed	Distance	Status
30 km/h or higher	5 m	The barcode was not detectable
30 km/h or higher	2 m	The barcode was not detectable
15 km/h	5 m	The barcode was not detectable
15 km/h	2 m	Detectable but hardly
10 km/h	5 m	Detectable but hardly
10 km/h	2 m	More efficient than 5 meter but hardly detectable
Stopped car	5 m	Good detection
Stopped car	2 m	Very good and fast detection

From table5.1 we can notice that the detection of the barcode becomes harder when the vehicle is moving faster and if the vehicle speed is more than 30 km/h then the barcode become undetectable.

3. Testing multi-cases for the information associated to barcodes:

At this part of testing, we tested the process of the system and how it deals with different status of information, has problems or has not. We tried many barcode numbers some without problems in the associated data, others with problems and lastly barcodes not registered in the database.

a. We started with barcode with no problems

At the beginning we watched the blacklist table after the detection of the barcode "9008293" which has no problems in the associated data and noticed that the barcode number did not fill into the table. As the barcode has no problems, the server will return feedback to the reader mobile to mention the cop this car has no problems as shown in figure5.27.

Figure5.27 shows the feedback for the car with the barcode number "9008293". The car has no problems so that the feedback was "No Problem Found" as shown in figure5.27.

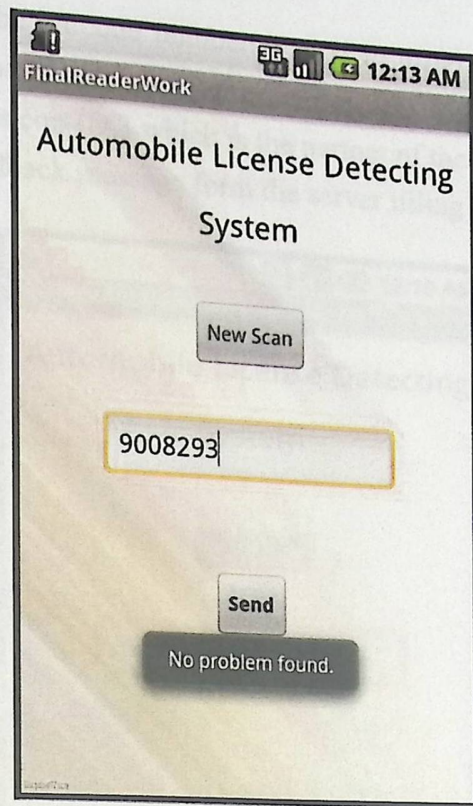


Figure5.27: Feedback about the car from server.

b. Problems in data associated to barcode number

At this part, we tried many barcode numbers with problems in the associated data. When the reader mobiles detected the barcodes, these barcode numbers was stored in the Blacklist Table. We tested three barcode numbers with problems using two mobile applications of our system, the first has the cop ID "1" and the second has the cod ID "3" and the data was stored in blacklist table as shown in figure5.28:

Barcode	Partner ID
9258792	2
7856590	4
3659874	2

Figure5.28: Blacklist Table with filled data.

We can notice that the barcode numbers stored to different partners ID, this is because two reading mobiles used, one with the cop ID "1" which is the partner of cop ID "2" and the other is cop ID 3 which is the partner of the cop with the ID "4". Figure5.29 shows the feedback message form the server tilling this car has a problem:

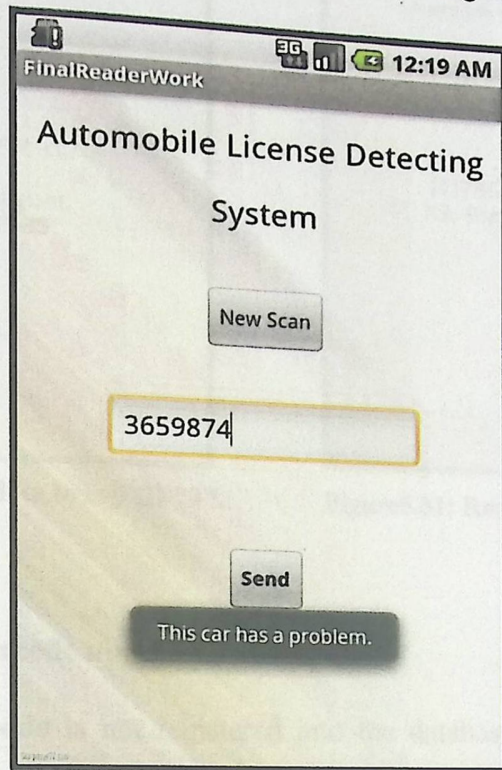


Figure5.29: Feedback for a barcode has a problem.

The problem may be in the last winter test date, License valid data and/or offense not paid on time.

Two other barcode numbers detected with problem they are "9258792" and "7856590" in addition to the "3659874" barcode number.

At the receiver side, we tested the system with two mobiles with different login cop ID. We used the cop IDs 2 and 4 to access the applications.

As shown in the blacklist table in figure5.28, partner with ID "2" has two barcode number and partner with the ID "4" has one barcode number. So that the received data was as shown in figures5.30 and figure5.31:

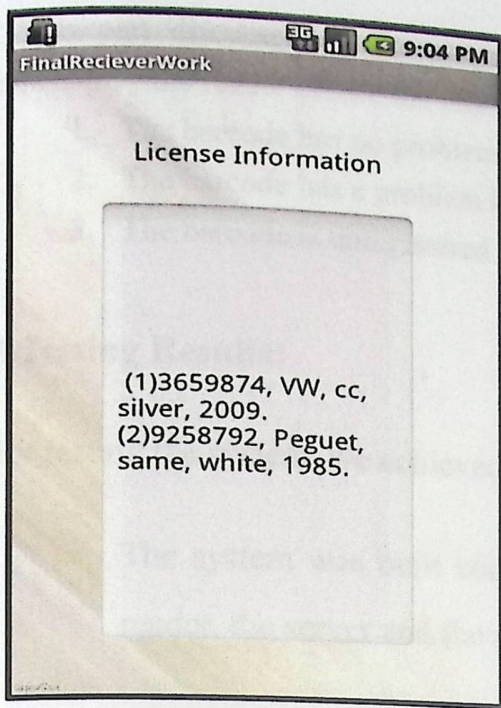


Figure5.30: Received data to cop ID "2".

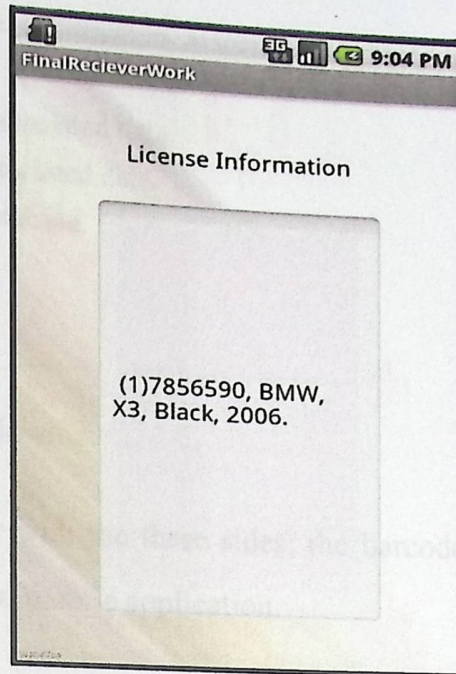


Figure5.31: Received data to cop ID "4".

c. Unregistered barcode number

Weather, if the barcode is not registered into the database, the system will be return a feedback to the reader cop to show this barcode is illegal or unregistered as shown in figure 5.32:

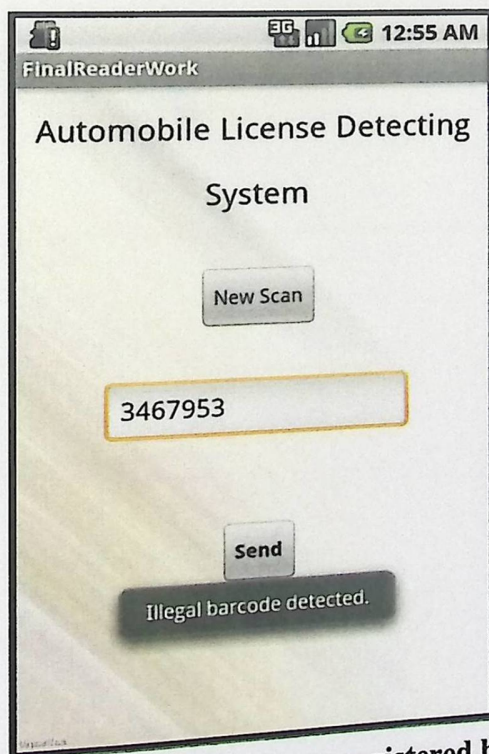


Figure5.32: Feedback for an unregistered barcode.

This part discussed all the cases for the information associated to barcode numbers may the reader detect, the cases are:

1. The barcode has no problem in the associated data.
2. The barcode has a problem in the associated data.
3. The barcode is unregistered in the database.

5.5 Testing Results:

After testing the system, we achieved the following:

- The system was built completely with the three sides; the barcode reader, the server and the reception mobile application.
- The best place of the barcode plate is to the side of the car, form the insider side of the window.
- The barcode plate is readable from suitable distance with slow speed of the car.

6

Chapter Six

Recommendations and Conclusion

6.1 Overview

6.2 Problems and challenges

6.3 Conclusion and achievement

6.4 Future work recommendation

6.1 Overview

In this chapter, the problems and challenges that we faced are described. The project real learning outcomes have been acquired during the work on the project and what we achieved. Recommendations and suggestions for future work and development are included.

6.2 Problems and Challenges

Many problems, challenges, and issues have been raised during the work on the project. Many experiments, suggestions, ideas and researches have been carried out to deal with the different situations. Some of these problems are:

1. The availability of the quality of some of the requirements of the Project, such as a long distance barcode scanner (3-5 m).
2. The main device of the project, the barcode scanner, was not available with the required features; so we changed it for the smart mobile handset with special application.
3. The mobile application has special android application programming using the java programming language, so that required learning new programming language to complete the project.
4. The use of mobile for long time consumes large amount of power, so we have battery restrictions.
5. As the reading distance of barcodes increases, the detection of the barcode number becomes harder and requires very slow movement of the cars.

6.3 Conclusion and Achievement

Almost all the goals of our system have been achieved. In this section the main achievements of the system are discussed and the ways of achieving it.

- We built two mobile android applications, the first for reading barcode plates and send it to the main server. However, the second for receiving the data from server and displaying it on the screen for the policeman holding the mobile.
- We built desktop software dealing with data and received barcode number and

posting the information associated to the barcode to the appropriate the second mobile application.

- We detected the unlicensed automobiles on the road and displayed their information on the mobile application.

6.4 Future work Recommendation

In this project, there are some ideas that could be done or added to improve its performance, or add some capabilities, some techniques that are efficient and meet user needs. Some of these ideas are mentioned below:

- System can be improved by modifying the mobile application at the receiving end to provide the policeman to send the violation to the drivers by SMS and simultaneously add the car information to the database.
- System could be improved using mobiles with high resolution cameras (larger than 8 M pixel) or with long range high speed laser barcode scanner.
- The system can improved to utilize the WiMax network instead of GPRS networks, which is less costly with more reliability and improved performance.
- The RFID technology is more suitable method to apply the system using unique coded frequency associated to car.

References:

- [1] Kuo-Ming Hung and Ching-Tang Hsieh, "A Real-time Mobile Vehicle License Plate Detection and Recognition", Tamkang Journal of Science and Engineering, Vol. 13, No. 4, pp. 433-442 (2010).
-
- [2] K. Deb, H. Lim, Suk-Ju Kang and Kang-Hyun Jo, "An Efficient Method of Vehicle License Plate Detection Based on HSI Color Model and Histogram", JOURNAL OF COMPUTERS, VOL. 4, NO. 8, pp. 771-777, AUGUST 2009.
-
- [3] T. Halonen, J. Romero, and J. Melero, "GSM, GPRS, and EDGE Performance Evolution towards 3G/UMTS", 2nd edition, 2003.
-
- [4] F. Hamdi, "GSM/GPRS Evaluation and optimization", M. T. MASMOUDI, M. MISSAOUI, 2006.
-
- [5] B. Ghribi and L. Logrippo, "Understanding GPRS: The GSM Packet Radio Service", scientific paper "abstract", 2007.
-
- [6] Man Young Rhee, "Mobile Communication Systems and Security", 2009.
-
- [7] F. Hamdi, " GSM/GPRS Evaluation and optimization", M. T. MASMOUDI, M. MISSAOUI, 2006.
-
- [8] J. Cai and D. J Goodman, "General Radio Packet Service in GSM", Topics in personal communications, IEEE Communications Magazine, Rutgers University.
-
- [9] Usha Communications Technology, "GPRS – General Packet Radio Service", white paper/GPRS, June 2000.
-
- [10] T. Halonen, J. Romero and J. Melero, "GSM, GPRS, and EDGE Performance", second edition, 2005.
-
- [11] Mckesson, "Implementing Guide of the use of Barcode Technology in Healthcare", 2003.
-

-
- [12] R. F. Lewis, "The Impact of Information Technology on Patient Safety", 2002.
-
- [13] I. R. N. Goudar, "Barcode Technology and its Application to Library Services", 2004.
-
- [14] A. Balaz and J. Kromp, "Mobile Developers Guide", tenth edition, February, 2012.
-
- [15] Android Developers, "What is Android – The Android Developer Guide", April 2009.
-
- [16] B. Eckel, President, MindView, Inc., "Thinking in Java", fourth edition, 2006.
-
- [17] S. Alaa, "Introduction to Java", Document paper, December 2010.
-
- [18] Oracle developers, "Introduction to Java Platform, Enterprise Edition 6", an Oracle white paper, April 2010.
-
- [19] H. Böck, "The Definitive Guide to NetBeans Platform", guide book, 2009.
-
- [20] A. Silberschatz, H. F. Korth and S. Sudarshan "Database System Concepts", sixth edition, 2009.
-
- [21] A. Abbasi, "Microsoft Access 2007: Step by Step", guide book, 2006.
-