بسم الله الرحمن الرحيم

Palestine Polytechnic University

College of Engineering &Technology

Electrical &Computer Engineering Department

Graduation Project

General Automated Fingerprint Identification System (GAFIS)

Project Team

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Hebron – Palestine

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Graduation Project Report

Submitted to the Department of Electrical and Computer Engineering in the College of Engineering and Technology

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College of Engineering &Technology

Electrical &Computer Engineering Department

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2008

جامعة بوليتكنك فلسطين

الخليل-فلسطين

كلية الهندسة و التكنولوجيا

دائرة الهندسة الكهربائية والحاسوب

اسم المشروع

General Automated Fingerprint Identification System (GAFIS)

أسماء الطلبة

تحرير أكرم جابر شيماء داوود الفلاح فداء محمد سباتين

بناءً على نظام كلية الهندسة والتكنولوجيا وإشراف ومتابعة المشرف المباشر على المشروع وموافقة أعضاء اللجنة الممتحنة تم تقديم هذا المشروع إلى دائرة الهندسة الكهربائية والحاسوب، وذلك للوفاء بمتطلبات درجة البكالوريوس في الهندسة تخصص هندسة أنظمة الحاسوب.

توقيع المشرف

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توقيع اللجنة الممتحنة

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توقيع رئيس الدائرة

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Abstract

The project team proposed to construct a general security system based on fingerprint identification which can be used in many companies, organizations and offices etc.

This system takes fingerprint of person by using fingerprint reader device which has the ability to take an image of the fingerprint then analyze this image and make search in the matching between fingerprint of the user and fingerprint which is stored in the database on the computer. Then the system must control the operation of the door opening to the users to enter or not to the company.

اقترح فريق المشروع بناء نظام أمني يعتمد على تعريف بصمة الأصبع ، حيث يمكن استخدامه في الكثير من الشركات والمؤسسات والمكاتب .

يعتمد هذا النظام على أخذ بصمة الشخص عن طريق استخدام جهاز قارئ البصمة والذي لديه القدرة على إعطاء صورة لبصمة أصبع الشخص ، وبعدها يتم تحليل هذه الصورة وإجراء عملية البحث عن تطابق بين هذه الصورة للبصمة مع إحدى صور البصمات المخزنة في نظام بيانات الشركة ليتم بعدها تحديد إمكانية الدخول للشركة أم لا عن طريق التحكم بعملية فتح الباب.

الإهداء

إلى الأمل الأول..... والهدف الأنبل..... والحلم الأجمل.....والدرب الأطول

فلسطين

إلى أجمل الزهور ..... إلى من إليها ترحل القلوب والعيون .... إلى زهرة المدائن

القدس

إلى معلمي الأول .....

إليك يا من في التضحية أفنيت عمرك ..... وفي الإيثار قدمت حلمي على حلمك

أبي

إلى صاحبة الوجه المشرق ..... واليد الحنون

أمي

إلى أحلى الذكريات .... وأمتع اللحظات

إخوتي

إلى كل من وهبني باقة من أحاسيسه ..... وساندني بوجدانه

أهلي وأصدقائي

تحرير جابر

شيماء الفلاح

فداء سباتين

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They said, *"Who did not thank people, will not thank God".*

We would thank our colleagues in the Electrical and Computer Department, and Mechanical Department for their support.

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CHAPTER ONE

Introduction

1.1 Overview

This Project is a general security system based on fingerprint identification which can be used in many companies, organizations and offices etc.

The system takes the fingerprint of a person by using fingerprint reader device then the system will search in the company database for a match. If there is a match between the current fingerprint with another one which stored in the company database; then the system must give complete information about the employee in the company, also gives his entering and leaving time. It also gives a welcome or goodbye voice message with his name, and finally opens the door for this person to enter or to leave the company. The system gives the ability to register new users by taking their fingerprints with all other needed information and store them in the company database .This operation is supervised by the administrator.

1.1.1 Importance of the Project:

- This system is simple and very secure as no two person have the same fingerprint

- This security system protects company from any strange person (can be used for controlling who can enter the company or the organization and who can't).

- Many offices use the manual system to record information about their employee which leads to inefficiency and wasting in time, move over the manual systems has many drawbacks. It's slow and unprofessional system and it is easily lost. So our security system helps you to organize employee's data, provide you with specific details about each employee during his work (his entering, leaving time, working hours, name, email, telephone number and ID etc).

- One of the main targets of all organizations is to manage the work in order to accomplish a sufficient work easily, so the idea of this project is to build software package that will save money and speed up this process.

- Simple to implement, it can be implemented in houses which allows only the family to open the main doors.

1.2 Project Objectives

- Designing and implementing a security system using fingerprint identification for companies, governments, organizations, banks etc.
- Giving full information about each employee in these places.
- Giving the administrator easy way to supervise the employees in his company.
- Ensured of employee time of work.
- Give the ability of registration for new users.

1.3 Literature Review

This section shows the previous studies whish is done in the same field of our system.

1.3.1 Previous Studies

- **Fingerprint Door Access Control System, can be used in Time Attendance System**

It senses your fingerprint to unlock your door. You also have the option of using a password and a good old fashioned key system, if you decide to enter your home through conventional means. [1]

- **Biometric Computer Logon Access Security Control System**

Provides flexible and granular account and resource management, allowing you to control how networks are accessed and by whom. [2]

1.4 Time Plane and Project Schedule

The project activities depend on each other, so the task durations and dependencies are as the following:

T1: Searching and preparing for the project: try to find the suitable project by searching the internet and the library then asking our advisor to initialize the project, and then evaluate the project tasks cost and levels.

T2: Understand the problem: understand the problem, find the requirements, the constraints and the location. This is done by meeting the user and prepares a certain questions to ask him for, in order to get the best project understanding.

T3: The project searching and analysis: search and analysis the project and allocate information and data about the project levels and sublevels, tasks and subtasks.

T4: The project requirements analysis: the project has many types of components that must be provided and explained in order to implement the final project and achieve the system requirements. The system has hardware and software requirements which must be achieved through the simulation and final presentation.

T5: Introduction to project and studying the Fingerprint Reader Device

T6: Studying the operation of opening the door using magnetic system that will use and other hardware required.

T7: Collecting Theoretical background about the system, by finding the hypothesis and study environment.

T8: Design concepts, modeling the system, design the block diagram and find the design options.

T9: Writing the software. Draw the flowcharts; write the algorithms and the code listing.

T10: Implementation and testing the system: the project will be tested and implemented to insure that the system and user requirements levels are achieved or not, to adjust the problems and errors in the system to maintain it, then try to test and execute it again until it works in the best way.

T11: Reanalyze and re-implement the system if any thing goes wrong.

T12: Final Project and presentation: as a conclusion the final project will be implemented completely without any problem.

T13: Documentation writing: the writing begins from the first step to the last one in parallel.

1.4.1 Timeline Chart

In order to determine what tasks will be conducted at a given point in time the timeline chart is drawn. This shows all the project tasks, the duration of each task and the concurrency between the tasks.

The following charts show the timeline for the first semester table 1-1, and the second semester table 1-2

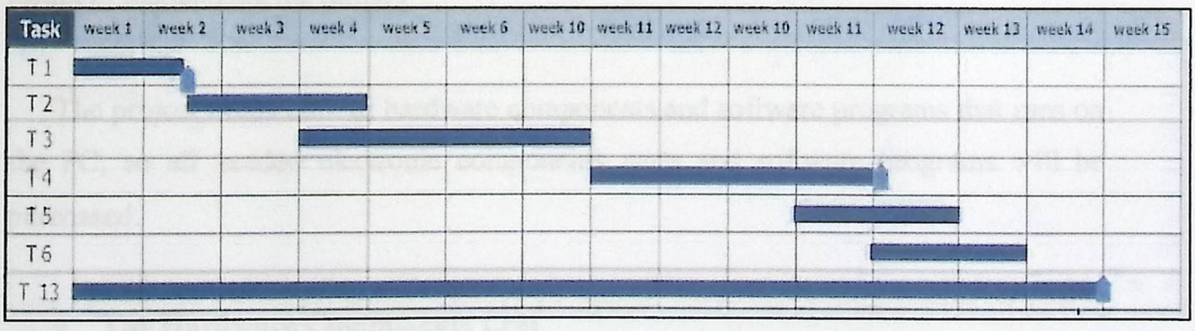

Figure 1-1: Project Activity Bar Chart (First Semester)

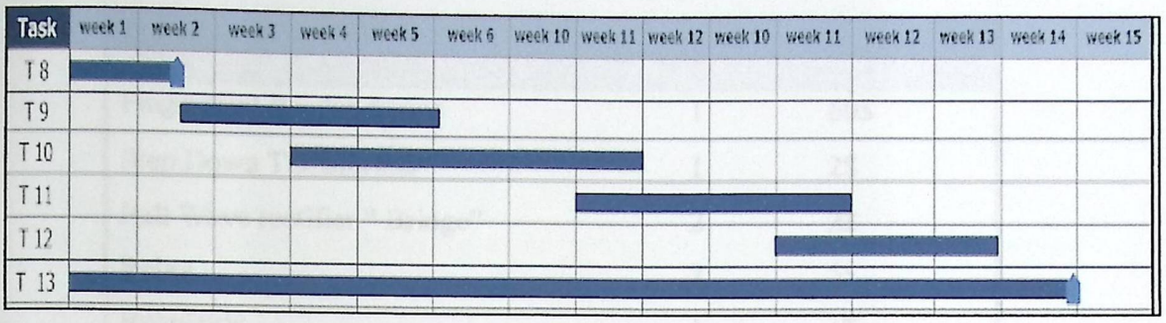

Figure 1-2: Project Activity Bar Chart (Second Semester)

It can be seen from both timeline charts there is some dependency between some tasks, such as the relation between the first two tasks (after looking at the suitable project and deciding what to do the problem understanding start). And also there is a concurrency between other (understand the problem and the project searching and analysis can be worked simultaneously) the second and the third task.

1.5 Estimated Cost and Budget Breakdown

The project components (hardware and software) will be purchased from the work group to implements the project.

The project needs both of hardware components and software programs that runs on the PC, so all needed electronic components parts and software programs will be purchased.

- **The Hardware Components Cost**

  There are many electrical Chips and equipments have to be provided Such as:

Component	Quantity	Price
Fingerprint Reader device	1	60$
Step Down Transformer	1	2$
Full Wave rectifier " Bridge"	2	2$
Relay	2	5$
Regulator	1	1$
DC motor	1	20$
Darlington pair	2	4$
Transformer 12 V,5A	1	20$
Capacitors and resistors	12	5$
Buzzer	1	1.5$
Amplifier	1	3.5$
LDR sensor	1	1$
Optocupler	1	2$
The Total Cost		**127$**

Table 1-1: Hardware Cost

Note: the electronic components price is varied depending on the component efficiency and the purchasing source and as the performance of the project increases the cost increase.

- **Software Programs Cost**

١. Windows XP version or more cost (20$).
٢. Microsoft PowerPoint, word, Smart draw, and publisher cost (50$).
٣. Oracle and VB.NET programs cost (50$)

- **Human Effort Cost**

The system group consists of three undergraduate engineering Students The estimated work cost all is 3000$ per semester.

The total cost contains the hardware equipments, software programs and human effort is approximately 3247 $.

1.6 Project Risk Management

The project risk management avoids the project from being suddenly threatened by occurred risk problem that might terminate the project, so by studying the project from its all sides the project come with some risks which can be avoided in particular case.

There are three categories of risks which are:

١. Project risks: the risks that affect the project schedule or resources which is:
   - Hardware which is essential for the project will not be delivered on schedule.

٢. Product risks: the risks that affect the quality or performance of the software and the hardware for the project which are:
   - Large number of requirements changed than anticipated
   - The database size is underestimated.

٣. Business risks: the risk that affect the system developing which are:
   - A competitive system has marketed with lower cost before the system complete.

- Cost risk that is the project may be terminated because of exceeding the available budget.

To avoid these risks and managing them; the following was done:

- Looking in the local market for the needed components before starting the project.
- Working on the project through the winter vocation to avoid the project delaying.
- Understand the project from all its different phases so no sudden changes occurred.
- Determine the project's cost before starting the implementation.
- Save the written works in more than one resources (Computer, flash memory, Internet Email , and CD ROM)

1.6.1 Error Resources

Getting the correct fingerprint for a user from the previously stored fingerprints is a not an easy operation using image processing algorithms. It can force many errors because of a plenty of error resources. The error resources are varying between resources we can control it or error resources are out of controlling.

In this section we will mention some of the error resources we forced through our work. We can divide these resources to Environment, human error resources.

Environment Error Resource

A fingerprint pattern which is recorded which is recorded on a rainy day is surly different than a fingerprint pattern that is recorded on a sunny day.

Human Error Resource

- The human could put his finger in a situation or position that we could not handle it or dealing with or it may give an incorrect result.
- Also the person ages is affect on the clarity of a fingerprint

1.7 Report contents

The final project report consists of seven chapters; we are interested in this semester with the first six chapters which we will talk about. The following is a brief description of the topics that are covered in each chapter.

Chapter One: Introduction

This chapter present general idea about the project and its importance, and also literature review, system requirements, project scheduling, estimated cost and risk analyses, also summarize the report contents.

Chapter Tow: Theoretical Background

This chapter talks in more details about the basic components used in the project, discuss the hypothesis, show the project integrity and theoretical background about the system components.

Chapter Three: Project Conceptual Design

This chapter describes in details the design concepts, introduces project objectives in details, shows the general block diagram of the system and explains how the system will work, discuss design options and justify those chosen for the project. Show how the system interacts with the surrounding environment.

Chapter Four: Detailed Technical Project Design

This chapter presents detailed description of the project phases, view the subsystem detailed design, show the schematic diagram and discuss the user system interface.

Chapter Five: Software System Design

This chapter handles the software related to the system, depicts flowcharts about system operation and the code listing.

Chapter Six: System Implementation and Testing

This chapter includes the implementation phase with the testing of these phase. General hardware and software component are tested and shown in this chapter.

Chapter Seven: Conclusions and Future Work

This chapter describes some significant points about the way of continuing do more and more in the field of the system concepts or tools. Also, it represents the conclusions extracted during designing and implementing it.

Chapter 2

THEORETICAL BACKGROUND

Overview

Theoretical Background Related to Main Idea of the Project

Hypothesis, Hardware, and Software Related to the System

Chapter Two

Theoretical Background

2.1 Overview

In this chapter we are going to introduce theoretical background of the system such as main component both hardware and software, also the theories related to the projects main idea , all of this will be described using different notations and models.

2.2 Theoretical Background Related to Main Idea of the Project

In this section we are going to give a theoretical background about the fingerprint and basic principles about it.

2.2.1 Fingerprint

A fingerprint is an impression of the friction ridges found on the inner surface of a finger or a thumb.
The science of fingerprinting constitutes the only unchangeable and infallible means of positive identification known to man.

The reasons why fingerprints are used for identification purposes are outlined next.

These premises are supported by scientific research in areas such as biology, embryology, anatomy and histology.

- Ridge patterns and the details in small areas of friction ridges are unique and never repeated.
- Friction ridges develop on the fetus in their definitive form before birth.
- Ridges are persistent throughout life except for permanent scarring.

Facts:

- Identical twins have the same DNA configuration but they do not have identical friction ridge configuration.
- Also, a clone is not a perfect copy, and fingerprints will be different.
- Some people have some skin diseases which prevent normal formation of fingerprints, and there are a case of one family which have no fingerprints (for genetic reason, probably).
- Some skin diseases such as psoriasis which cause problems for proper fingerprint recognition.
- Scars produce some unusual patterns that are easily recognizable.

2.2.2 Basic Principles of Fingerprints

In this section we are going to explain the basic principles of fingerprint; it's structure, types, how to be match two fingerprints, the classification of fingerprints.

2.2.2.1 A fingerprint is an individual characteristic

In the 90 years since fingerprinting was generally introduced, out of the millions of sets of prints that have been taken, no two individuals have been found to have the same fingerprints.

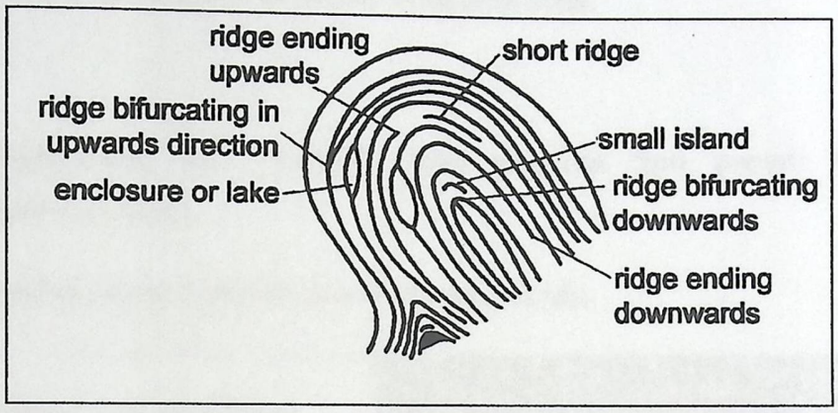

Figure 2-1: Fingerprint [3]

It is not the shape of the print that is individual, but rather the number, location and shape of specific ridge characteristics (also known as minutiae).

When comparing a print from a crime scene to a known print of a suspect the examiner is looking for minutiae in the same place on each print. This is complicated as it is rare to get a whole fingerprint at a crime scene so it is often only a section of a print that is being compared. It is also common for the print to be distorted as it is pressed or rolled onto a surface, so that two prints from the same finger of the same person don't look the same.

2.2.2.2 A fingerprint will remain unchanged during an individual's lifetime

The ridges on the grasping surfaces of hands and on the soles of feet are present at birth and remain unchanged for life except for size as growth occurs. They may be obscured by deep tissue damage that causes scarring, like burns for example. However these scars may also be useful as points of identification.

2.2.2.3 Fingerprints have general ridge patterns that permit them to be systematically classified

Fingerprint patterns are classified into three main kinds:

Arches; 5 % population

Loops; 60 - 65 %

Whorls; 30 - 35 %

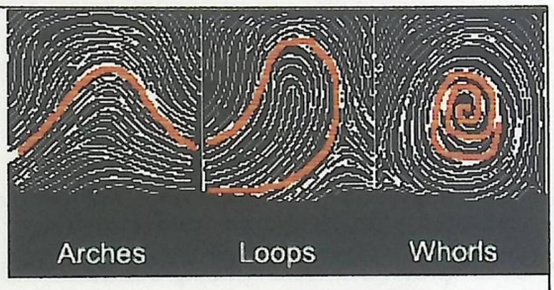

Figure 2-2: Fingerprint Types [4]

This classification was extended by Sir Edward Henry in "1897". This system of classification, with some variation, is still in use today.

Classifying the general pattern of fingerprints allows them to be stored in a filing system and subsequently retrieved for comparison.

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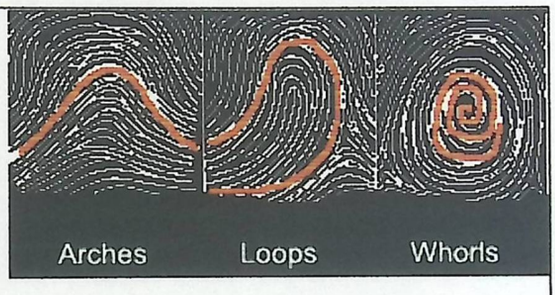

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Classifying the general pattern of fingerprints allows them to be stored in a filing system and subsequently retrieved for comparison.

2.2.2.4 Fingerprint Identification

Among all the biometric techniques, fingerprint-based identification is the oldest method which has been successfully used in numerous applications. Everyone is known to have unique, immutable fingerprints. A fingerprint is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as the minutiae points.

Minutiae points are local ridge characteristics that occur at either a ridge bifurcation or a ridge ending.

Fingerprint matching techniques can be placed into three categories:

- Minutiae-based
- Correlation-based.
- Ridge-based.

Minutiae-based techniques first find minutiae points and then map their relative placement on the finger.

However, there are some difficulties when using this approach. It is difficult to extract the minutiae points accurately when the fingerprint is of low quality. Also this method does not take into account the global pattern of ridges and furrows. The correlation-based method is able to overcome some of the difficulties of the minutiae-based approach. However, it has some of its own shortcomings. Correlation-based techniques require the precise location of a registration point and are affected by image translation and rotation. Ridge-based technique extracts the major straight lines that match the fingerprint ridges and uses these lines to estimate the rotation and translationparameters necessary to register the query and thetemplate fingerprint images.

Figure 2-3: Fingerprint Matching [5]

2.2.2.5 Fingerprint Classification

Large volumes of fingerprints are collected and stored everyday in a wide range of applications including access control, and driver license registration. An automatic recognition of people based on fingerprints requires that the input fingerprint be matched with a large number of fingerprints in a database (FBI database contains approximately 70 million fingerprints!). To reduce the search time and computational complexity, it is desirable to classify these fingerprints in an accurate and consistent manner so that the input fingerprint is required to be matched only with a subset of the fingerprints in the database.

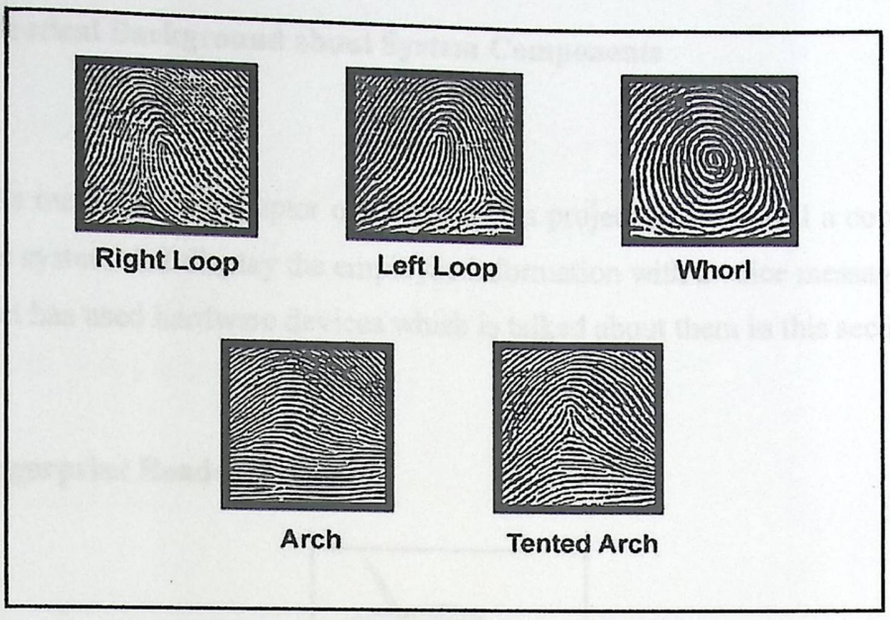


Figure2-4: Fingerprint Classification [6]

Fingerprint classification is a technique to assign a fingerprint into one of the several pre-specified types already established in the literature which can provide an indexing mechanism. Fingerprint classification can be viewed as a coarse level matching of the fingerprints. An input fingerprint is first matched at a coarse level to one of the pre-specified types and then, at a finer level, it is compared to the subset of the database containing that type of fingerprints only.

2.3 Hypothesis, Hardware and Software Related to the System

In this system we have a set of hypothesis we need to offer to determine how the system will be operating specifically.

The door will open and close automatically and the system will give a welcome and goodbye voice message. The system gives the entire employee's information, also the system provide the ability of registration for new users.

2.3.1 Theoretical Background about System Components

As mentioned in chapter one before, this project is in general a computerized stand alone system that display the employee information with a voice message.
This project has used hardware devices whish is talked about them in this section.

2.3.1.1 Fingerprint Reader Device

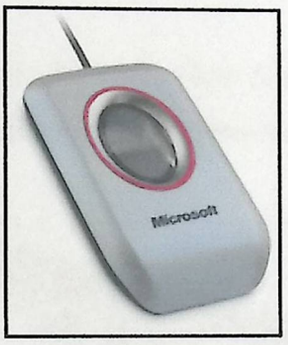


Figure 2-5: Fingerprint Reader Device

The Microsoft Fingerprint Reader is a device sold by Microsoft that augments normal passwords with the fingerprint of a user for convenience. Launched September 4, 2004, the device requires Windows XP or Windows Vista to run.

- Universal Serial Bus (USB) Compatible
- Easy-to-use software makes replacing passwords with your fingerprint a breeze.
- Use of a fingerprint reader in combination with a password offers a much higher level of authentication security for access to data or networks than can be achieved with a single form of authentication.
- This device reduces the complexity since a fingerprint cannot be forgotten, misplaced or shared.

Features and Benefits

- Secure fingerprint reader for accessing websites and other secure features.
- Smoothly integrates with Microsoft and other software.
- Eliminates sign-in hassles.
- Durable and reliable.
- Usable with either hand.

2.3.1.2 Electrical Lock

This electronic Lock opens the door when it receives a signal form the PC, it needs 12 VDC to work, and it is made from stainless steel.

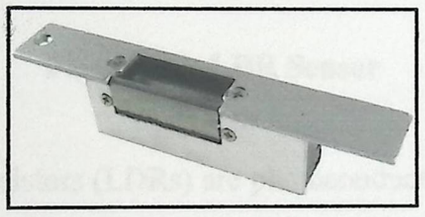


Figure 2-6: Electrical Lock

2.3.1.3 DC Motor

Figure 2-7: DC Motor

A DC motor is an electric motor that runs on direct current (DC) electricity. It uses electrical energy to produce mechanical energy. A DC motor is designed to run on DC electric power. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source; so they are not purely DC machines in a strict sense.

٢,٣,١,٤ Light Dependent Resistor "LDR" Sensor

Figure 2-8: LDR Sensor

Light Dependent Resistors (LDRs) are photoconductive cells which exhibit very high resistances typically in the MegaOhm range under low and "zero" light (i.e. totally dark) conditions, and conversely, a low resistance in very bright light. The high resistance is similar to the turning "off" of a switch while the low resistance, the turning "on" state. This makes the device very suitable for a wide variety of light sensing applications in solid-state electronics.

٢,٣,١,٥ The TDA2030 Operational Amplifier

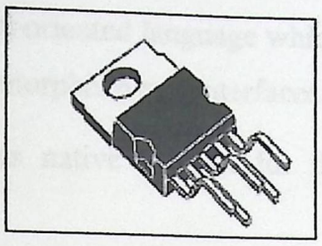


Figure 2-9: TDA2030 Amplifier

The TDA2030 is a monolithic integrated circuit in pent watt package, intended for use as a low frequency class AB amplifier. Typically it provides 14W output power. TheTDA2030 provides high output current and has very low harmonic and cross-over distortion.

Further the device incorporates an original (and patented) short circuit protection system comprising an arrangement for automatically limiting the dissipated power so as to keep the working point of the output transistors within their safe operating area.

٢,٣,٢ Software Requirements

In this section we are going to talk about the needed software for our project whish is used to implement our system.

2.3.2.1 Visual basic .NET 2005 (VB.NET)

VB.NET is a simple, modern, object oriented language derived from C and Java. It aims to combine the high productivity of C++.VB.NET includes a Common Execution engine and a rich class library.

Features of VB.NET

١. VB.NET is object oriented language which supports Data Encapsulation, inheritance, polymorphism and interfaces.

٢. VB.NET includes native support for the COM and windows based applications.

٣. Users no longer have to explicitly implement the unknown and other COM interfaces, those features are built in.

٤. Components from C# and other managed code languages can be used in VB.NET.

٥. VB.NET is a modern, object oriented language that enables programmers too quickly and easily build solutions for the Microsoft.NET platform.

Note: we used VB.NET in programming this project because it is easy to be connected with database and needed software like SDK and fingerprint driver.

2.3.2.2 Microsoft Access

Microsoft Access is a powerful program to create and manage your databases. It has many built-in features to assist you in constructing and viewing your information. Access is much more involved and is a more genuine database application than other programs such as Microsoft Works. The access database is simple, portable allow executing query strings through the .Net providers and can use in this project. We use it as software related to recording fingerprint pattern and all person's information.

Chapter 3

SYSTEM CONCEPTUAL DESIGN

Overview

Detailed System Objectives

Design Options

System Modeling

System Block Diagram

CHAPTER THREE

System Conceptual Design

3.1 Overview

This chapter will focus on the system objectives, design options, system block diagram, system implementation and modeling.

3.2 Detailed System Objectives

The main objectives of the project are to produce a security system for general usage from many organizations, companies, or houses etc, there are some other minor objectives related to the main objective such as:

- A security system using fingerprint identification for companies, governments, organizations and banks etc. this system allows only a specific people to enter the company according to their fingerprints, any unknown person can't enter the company since this system control the operation of the door opening by making it open and close automatically according to an order come from the PC.
- Give full information about each employee in the company so this System helps the administrator to organize employee's data, provide him with specific details about each employee during his work e.g. (his entering and leaving time etc),ensured of employee time of work in a way without wasting time and effort. All these information stored in database system on the PC. And it can be accessed easily by using specific programming language with Microsoft access.
- Give the ability of registration for new users. when new employee come to work

in the company; this system allow them to register by taking their fingerprints form the device and the all needed information (user's name , user's image, user's id , phone number and email) about them . This information is registered on graphical user interface form then storing all information in the system database.

3.3 Design Options

Securely system can be designed using many different approaches such as:

a. Why choose Fingerprint Recognition over other biometrics?

- The finger image is about 1/3 X 1/2 inch in area while others have large images size for example the face is 5 X 8 inches in area; so less data to process and analysis.
- By using the fingerprint reader we control the lighting strength and the size of the image, so fingerprint images are clear for processing.
- Voice readers are not reliable in noisy environments like public places or across phone lines with variable acoustic properties while fingerprint works well in public places.
- This approach is both more efficient and less costly.

b. This system must be taking the fingerprint of the person

To perform this goal; we can use many techniques such that:

١. Taking an image of the fingerprint by using scanner.
٢. Taking the fingerprint image from fingerprint reader device.

This project chooses the second option which is using fingerprint reader device and the reason of choosing it refers to:

- This device give an image of the fingerprint that more clear rather than an image from the scanner. That means the comparison operation will be more accurate and give better results.
- Since this project represents a security system that using in the company or organization to control that is enter and who is not. So taking the fingerprint by using fingerprint reader device is more easy way for the people rather than using the scanner. Only; any employee can press on the device and then can be enter.
- It's also smoothly integrates with Microsoft and other software.
- Durable and reliable.

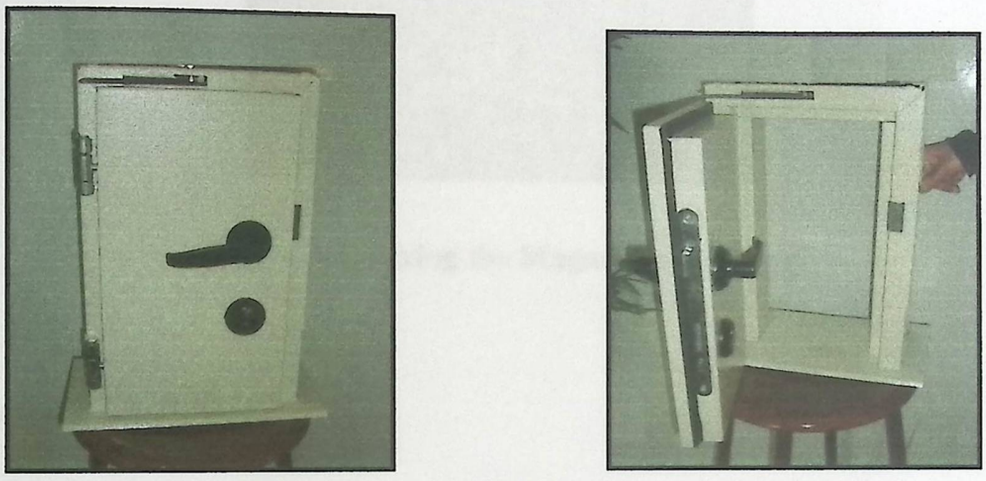
c. The system must be control the door opening operation by an order come from the PC through interfacing unit between PC and the door.

There are many techniques can be used to make this such that:

- Using electrical motor that is fixed on the door and gear, when the PC gives an order to open the door. This motor and through interfacing unit causes the door open for the employee to enter or to leave.
- Using magnetic system, by fixing an electrical magnet on the wall behind the door; and piece of iron that fixes on the top of the door, when the order come from the PC, the lock of the door must open automatically, then an electrical current is passing the magnetic file, this is delivering a magnetic field which is give a magnetic force causing the door to move.
- Using the electro-pneumatic action which represents a control system for pipe organs, whereby air pressure, controlled by an electric current and operated by the keys of an organ console, opens and closes valves within wind chests.

In this project we chose the second option at the first which is using magnetic technique to open the door of the company, but after the implementation and testing we faced a lot of difficulties which made us to change this mechanism and using electrical DC motor that is fixed on the door with gear.

Figure 3-1 shows the model of the door that we did the testing upon it.



A B

Figure 3-1: Model of the Door (A- Closed B- Opened)

In general the main door of the companies is made of iron for security purposes because of that it is difficult to make the magnetic field to attract a specific area of the door so the torque needed to move the door will be increased.

Another difficulty is the position of the magnet and how to fix it or to make it able to move. Since the magnet filed has a flux lines with static direction and the door in each moment change its position; the magnet mustn't be fixed but it must has a path for its movement in order to face the door in every moment and attract it .

Figure 3-2 shows the way of fixing the magnet on the door slide and other on the

door edge.

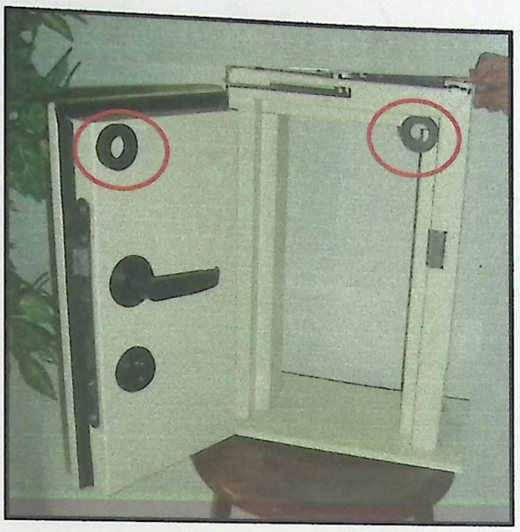


Figure 3-2: Fixing the Magnet on the Door

3.4 System Modeling

In order to understand the system clearly graphical representation is made. There are many modeling graphs, in the system modeling, we will talk about the use-case and the sequence diagram; these will be shown in the following figures.

3.4.1 Use-Case

We have two use-case diagrams; the first for registration shown in figure 3-3 and other for general employee usage shown in figure 3-4.

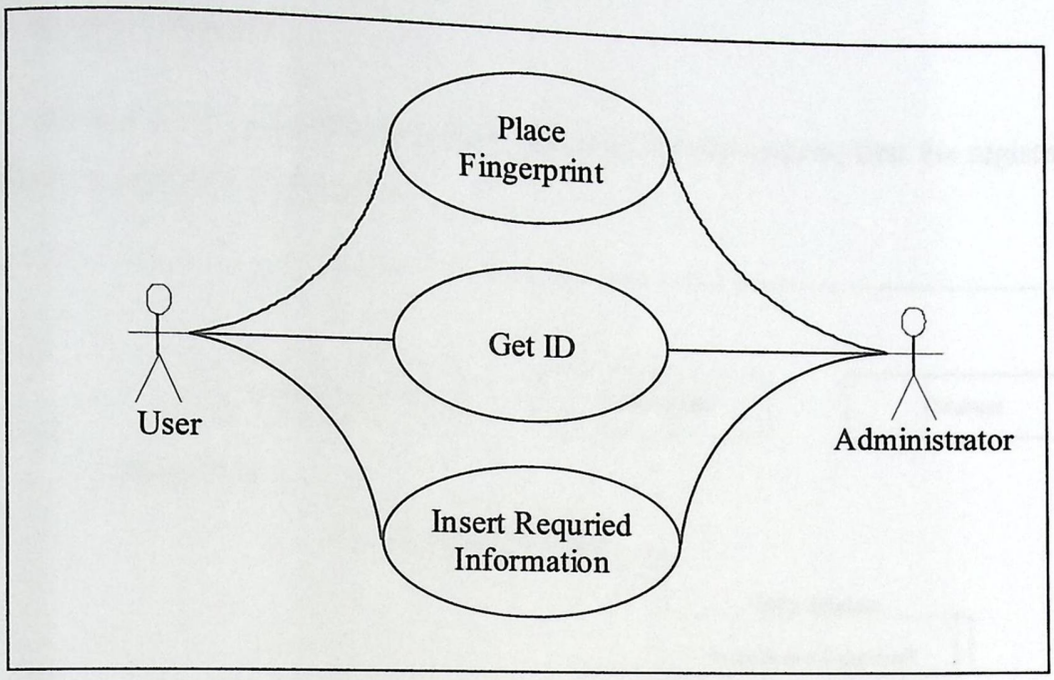


Figure 3-3: Registration Use-Case

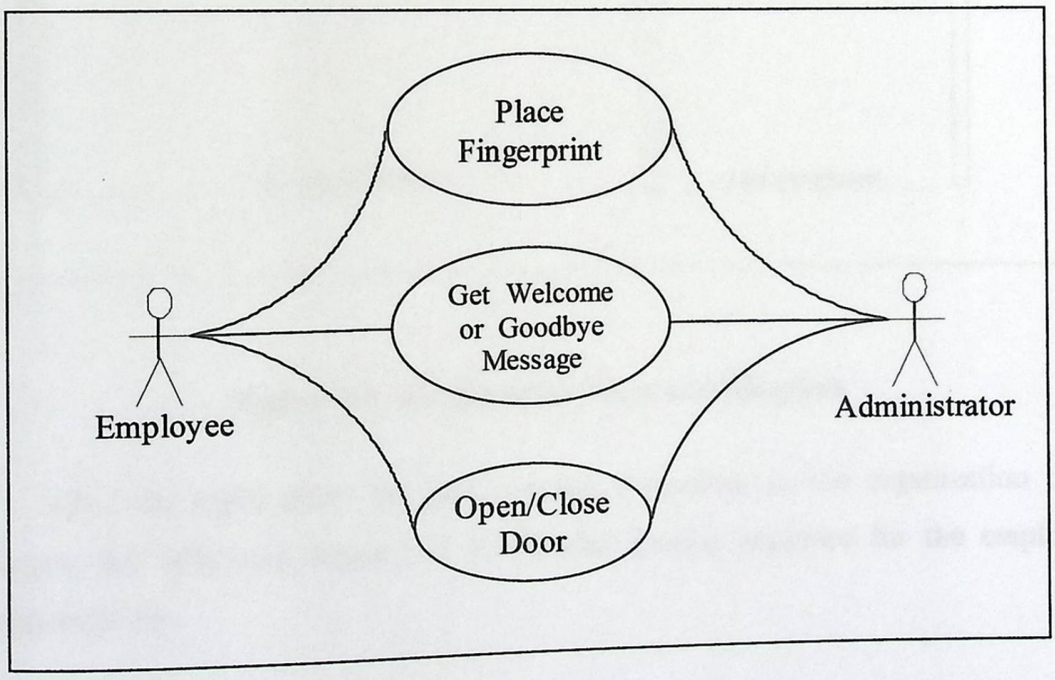


Figure 3-4: General Use-Case

3.4.2 Sequence Diagram

Here, we will show the sequence diagrams for our system; first the registration sequence as appear in figure 3-5.

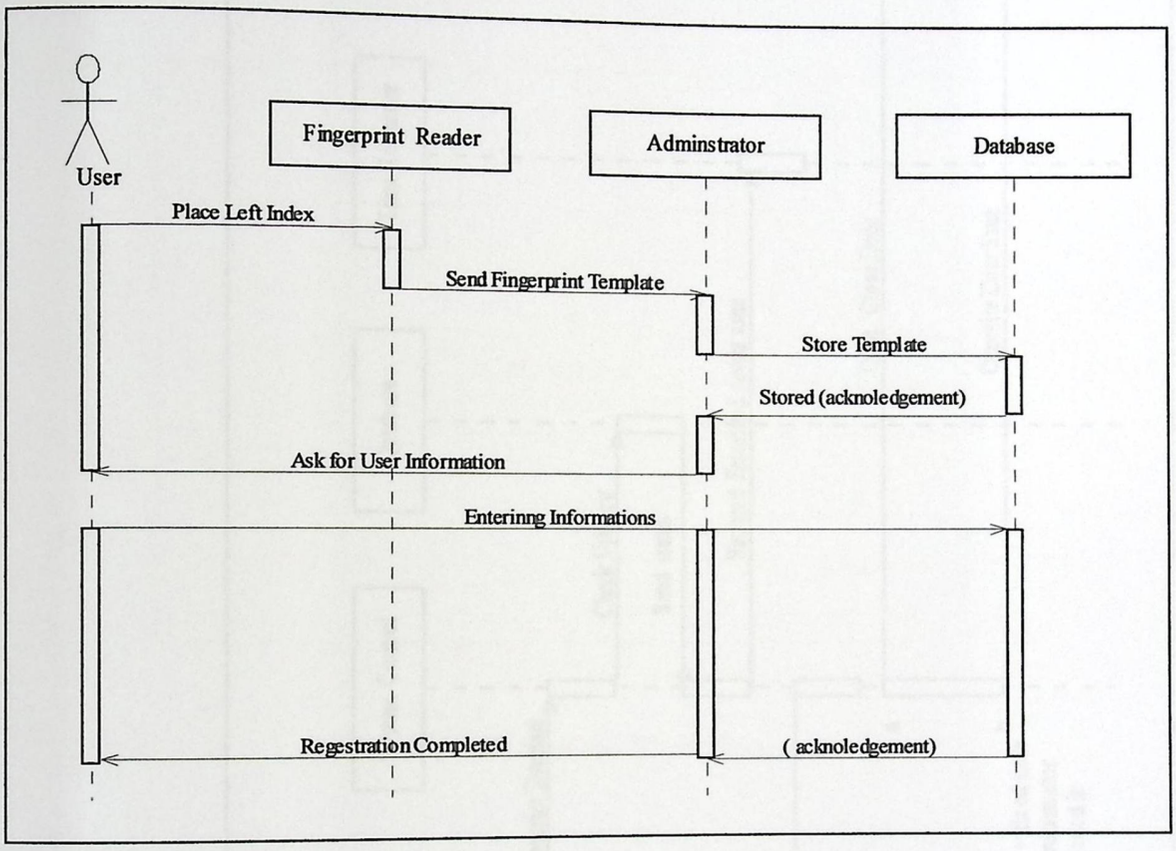
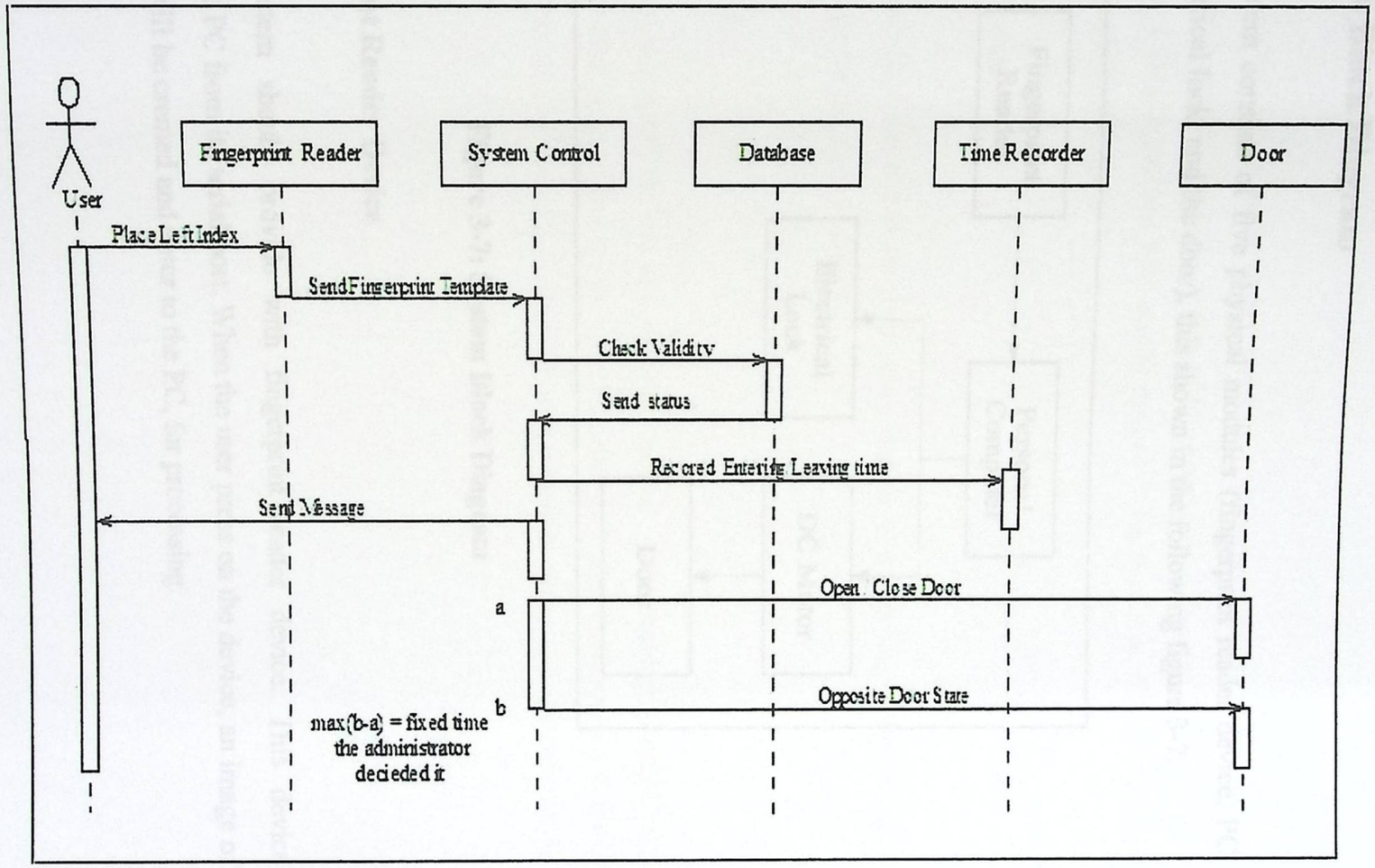


Figure 3-5: Registration Sequence Diagram

After the registration the user become a member in the organization or an employee, the following figure 3-6 shows the general sequence for the employees through each day.


User
Fingerprint Reader
System Control
Database
Time Recorder
Door
Place Left Index
Send Fingerprint Template
Check Validity
Send status
Record Entering Leaving time
Send Message
a
Open . Close Door
b
Opposite Door State
max(b-a) = fixed time
the administrator
decieded it

3.5 System Block Diagram

This system consists of five physical modules (fingerprint reader device, PC, DC motor, Electrical lock, and the door), this shown in the following figure 3-7.

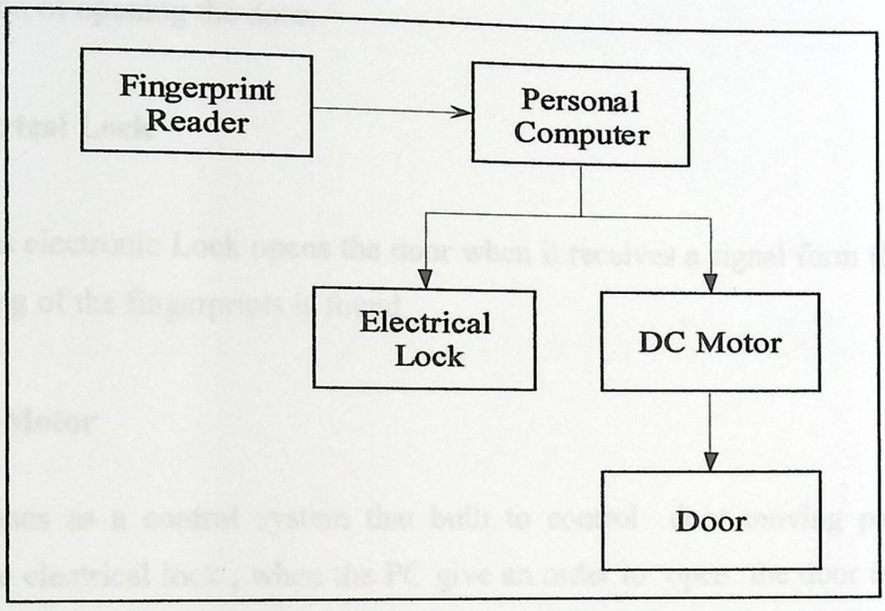


Figure 3-7: System Block Diagram

3.5.1 Fingerprint Reader Device

This system should provide with fingerprint reader device. This device connected to the PC from its serial port. When the user press on the device, an image of the fingerprint will be created and enter to the PC, for processing.

3.5.2 Personal Computer

The PC connected from its serial port to the fingerprint reader device which gives when the user presses on it, an image of his fingerprint. Then taking this image and making comparison operation with stored images in the database. It's also control the operation of opening the door.

3.5.3 Electrical Lock

This electronic Lock opens the door when it receives a signal form the PC after the matching of the fingerprints is found.

3.5.4 DC Motor

It uses as a control system that built to control door moving parallel with opening the electrical lock , when the PC give an order to open the door in a form of digital signal ,this signal activate the DC motor which cause the door to move automatically .

Chapter 4

DETAILED TECHNICAL SYSTEM DESIGN

Overview

Detailed Description of the Program Phases

Subsystem Detailed Design

Over all System Design

CHAPTER FOUR

Detailed Technical System Design

4.1 Overview

In this chapter we are going to describe the whole design for the system and describe the project components in detail.

4.2 Detailed Description of the Program Phases

The system goes through three main phases: the input, the processing and the output. These phases are explained as the following:

4.2.1 The Input Phase

This system has one input comes from the fingerprint reader device which is connected to the PC through serial port. After the person press his finger on this device; the device gives an image of his fingerprint and then storing it in the PC for processing see figure 4-1.

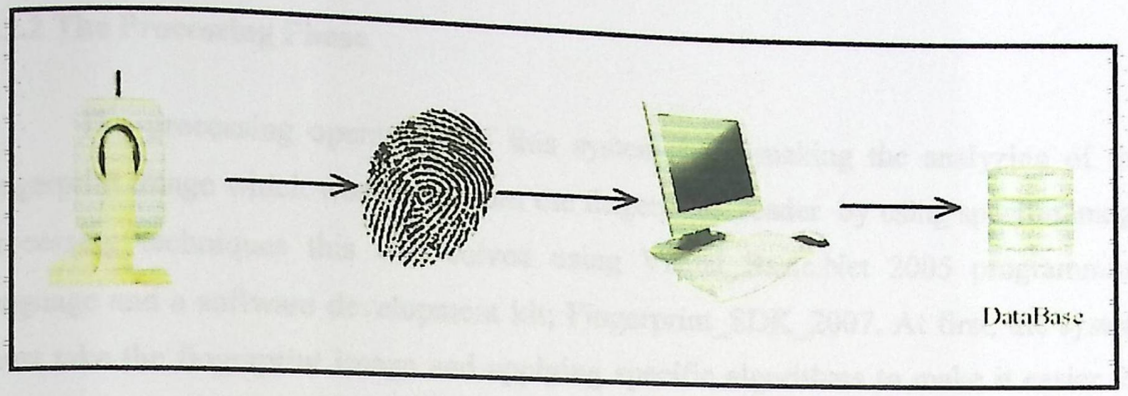


Figure 4-1: Input Phase

For the first time the system allow specific users for registration, they register by taking their fingerprints directly from the device and storing them in the system database with all other needed information about them ,the registration done by using graphical user interface like the following figure 4-2 .

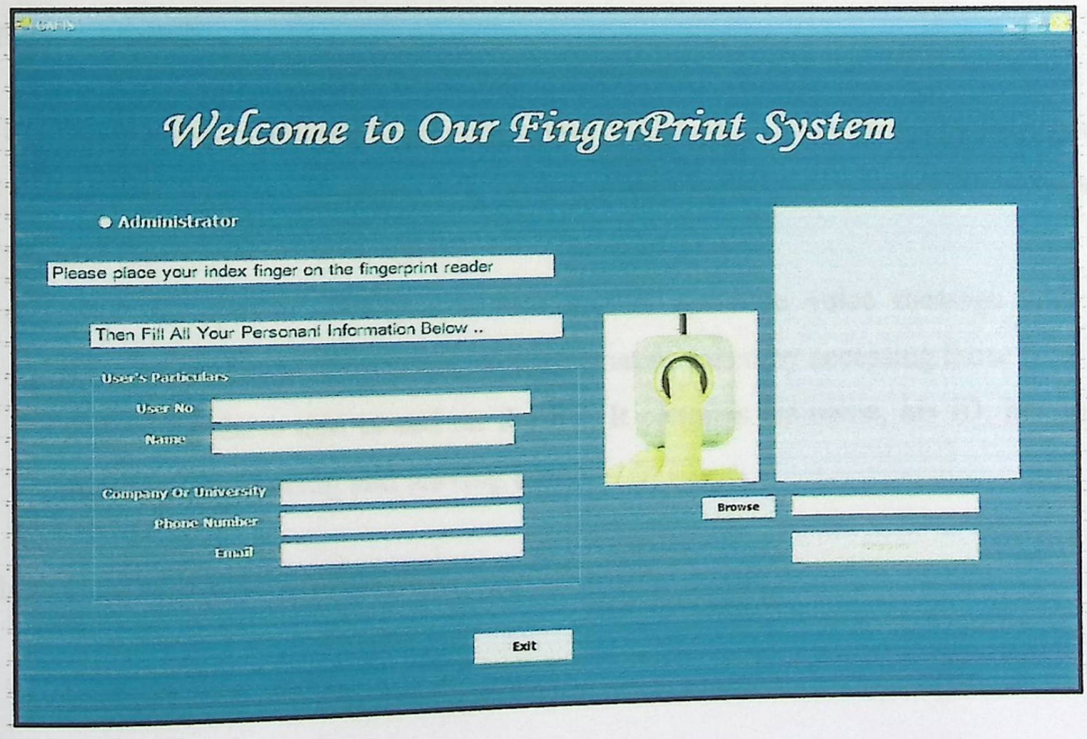


Figure 4-2: Registration Interface

4.2.2 The Processing Phase

The processing operations of this system is in making the analyzing of the fingerprint image which was taken from the fingerprint reader by using specific image processing techniques this will solved using Visual Basic.Net 2005 programming language and a software development kit; Fingerprint_SDK_2007. At first, the system must take the fingerprint image and applying specific algorithms to make it easier for processing, and then it makes comparison between this image and the other images which stored in the system database to check if there is a matching between them and then determine what action the system must do.

4.2.3 The Output Phase

The output of this system must achieve the following:

If there is a match

- Open the door automatically according to an order comes from the PC through the parallel port see figure 4-3, so let the person to enter or leave the company, and then close the door again.
- Also the system will give a welcome or goodbye voice message and full information about the person, this information taken by accessing those from the system database that stored on the PC. It contains his name, his ID, his phone number, his entering and leaving time.

If there is no match the system will:

- Keep the door close.
- Give a voice error message to tell the person that he is not allowed to enter.

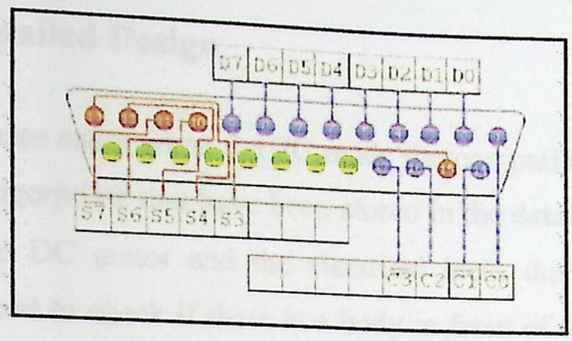


Figure 4-3: 25-way Female D-Type Connector

Parallel port

All contemporary PCs, shipped with a single parallel printer port, seem to have the base address at 378 Hex.

The PC parallel port adapter is specifically designed to attach printers with a parallel port interface, but it can be used as a general input/output port for any device or application that matches its input/output capabilities. It has 12 TTL-buffer output points, which are latched and can be written and read under program control using the processor in or out instruction. The adapter also has five steady-state input points that may be read using the processor's in instruction.

The PC's Parallel printer port had a total of 12 digital outputs and 5 digital inputs accessed via 3 consecutive 8-bit ports in the processor's I/O space.

- 8 output pins accessed via the Data port
- 5 input pins (one inverted) accessed via Status port
- 4 output pins (three inverted) accessed via the Control port

The remaining 8 pins are grounded

4.3 Subsystem Detailed Design

The output phase starts when the PC made the comparison between the current fingerprint and the fingerprints that have been stored in the database and then it sends a signal to activate the DC motor and the electrical lock; this control signal is sent through the LDR circuit to check if there is a body in front of the door before opening or closing it, see figure 4-4.

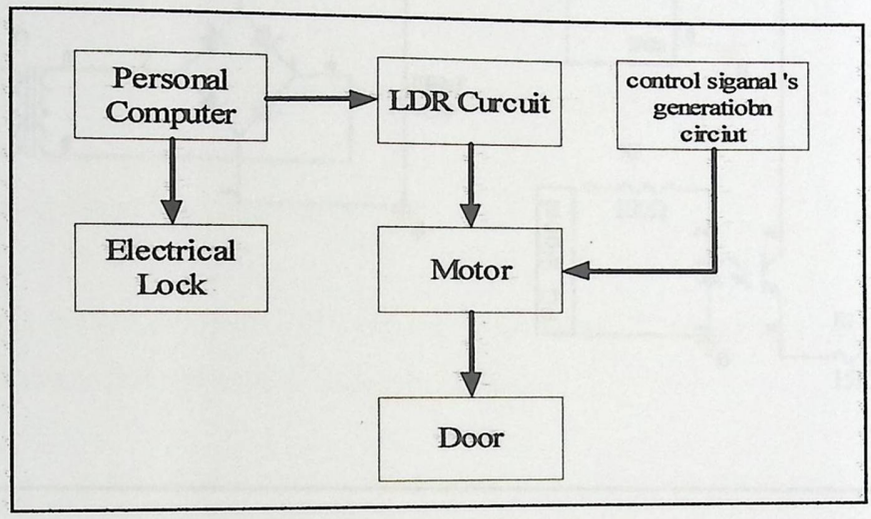


Figure 4-4: General Block Diagram

4.3.1 Control Signal's Generation Circuit

When the system find a match between the fingerprint of the person who want to enter and the others in the database it sends a control signal through the parallel port to the optcoupler as shown in figure 4-5.

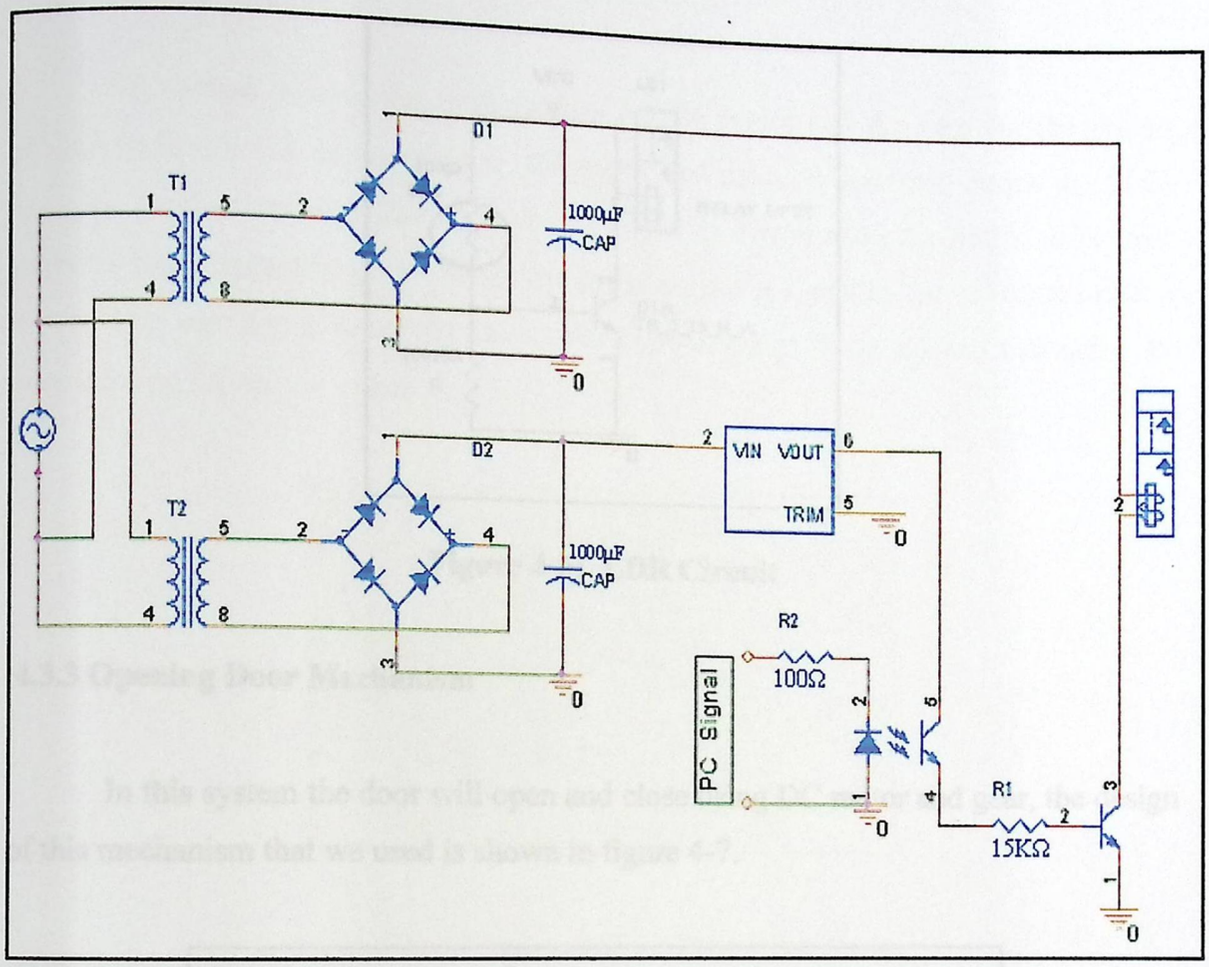


Figure 4-5: Control Signal's Generation Circuit

4.3.2 LDR Circuit

The previous circuit is connected with the LDR circuit shown in figure 4-6 through a transformer which is connected to the DC motor, if there is no person in front of the door then the circuit is closed and the motor will move the door to open or close depending on the person state. If there was a person in front of the door, the system will give an alarm to make the person attends.

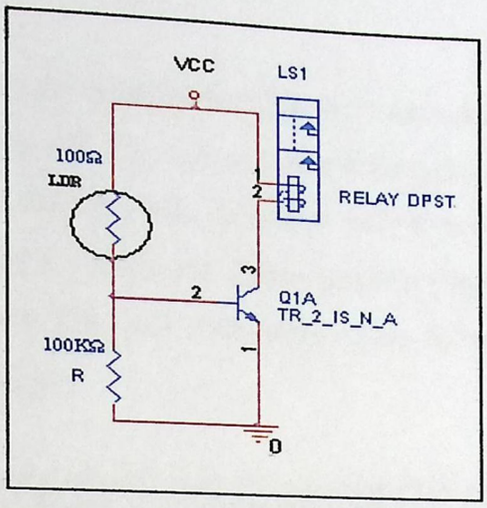


Figure 4-6: LDR Circuit

4.3.3 Opening Door Mechanism

In this system the door will open and close using DC motor and gear, the design of this mechanism that we used is shown in figure 4-7.

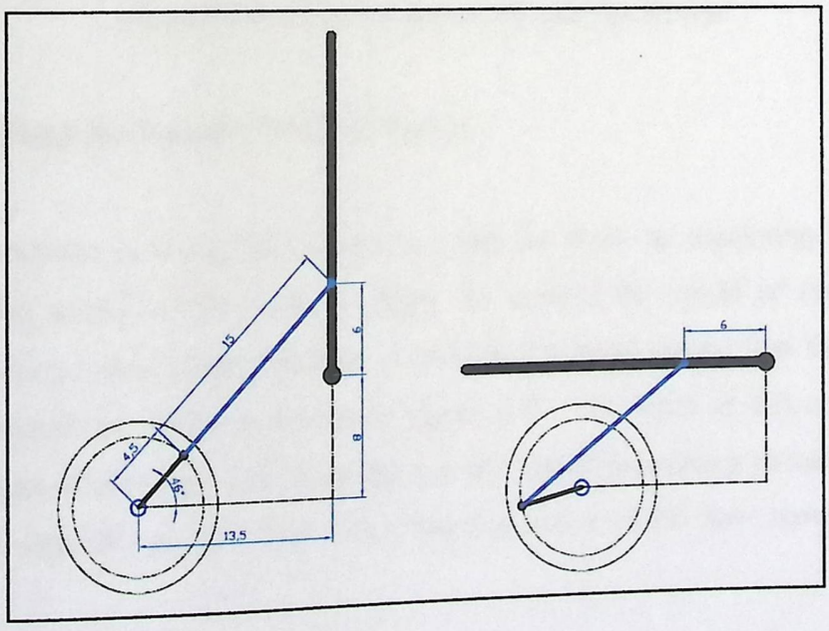


Figure 4-7: Motor and Gear Design

The actual design and implantation for the motor and the gear for the system appears in figure 4-8. as we can see , the motor and the gear are fixed on the top of the door in mechanical way that depends on using two iron arms connected with disk whish is fixed under the gear . When the system sends a signal to the motor; the disk is moved in a circular motion and causes the arms move in linear motion that make the door moving (open and close).

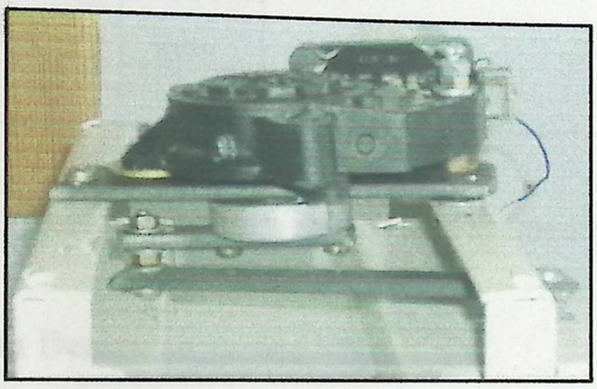


Figure 4-8: Mechanism of Fixing the Motor

4.3.4 Controlling the Speed of the DC Motor

This system is using DC motor to open the door by supplying it with 12 V signals, so the speed of the motor is high. To control the speed of the door at the opening and close operations; there is an electrical control circuit that based on using 18W Hi-Fi amplifier; whish is shown in figure 4-9. The input of this circuit is taken from the output of the relay 12V from the control signal generation circuit. The output is connected with DC motor. The result that the speed of the door moving is slowed down.

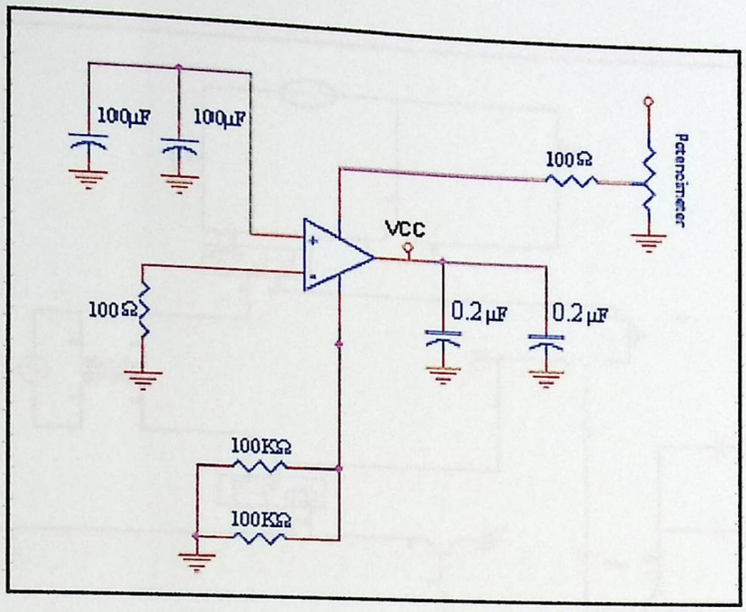


Figure 4-9: Motor's Speed Control Circuit

4.4 Overall System Design

The overall interface circuit between the PC and the door is described in the following circuit diagram. See Figure 4-10.

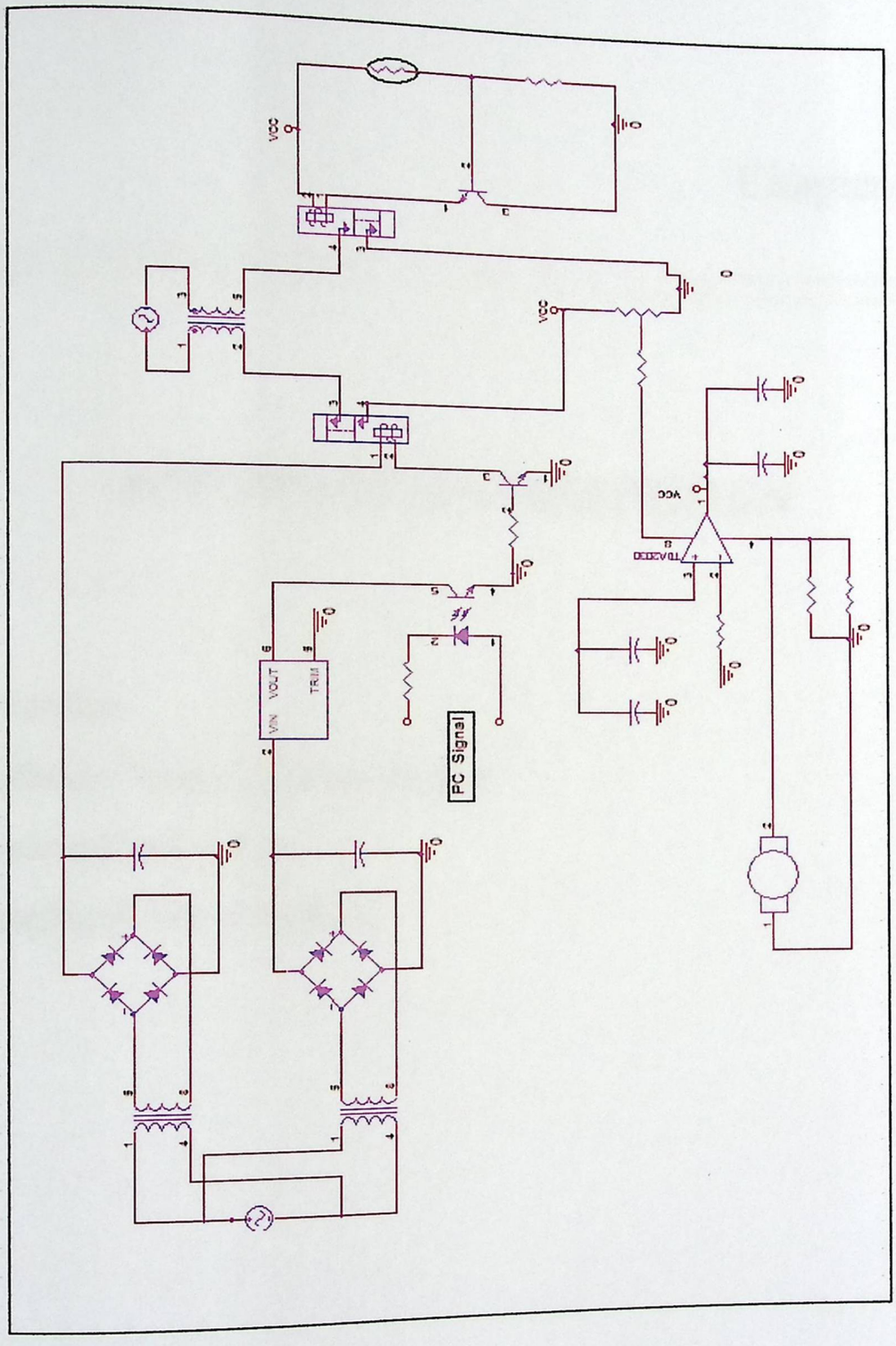


Figure 4-10: Circuit Diagram for Overall System

Chapter 5

SOFTWARE SYSTEM DESIGN

Overview

Software Needed for the Project

System Flow Chart

Graphical User Interface

CHAPTER FIVE

Software System Design

5.1 Overview

In this chapter we will describe the software that used in this project, the interface, and the flow chart for the system.

5.2 Software Needed for the Project

The project needs some computer programs and data structures in order to make the modeling, implementation, programming, and testing for the project.

The needed software for the project is:

- Visual Basic.Net 2005 (VB.NET).
- MS Access.
- Software Development Kit (SDK).

5.2.1 Fingerprint Software Development kit

A fingerprint SDK is a software toolkit that allows the integration of biometric fingerprint recognition into various applications. They will typically utilize either DLL or ActiveX (COM) to interface with the integrated application. By referencing these

DLL or COM objects, developers are able to utilize the fingerprint functionality from within a desired application.

Fingerprint SDKs provide a basic framework of functions to talk to a fingerprint scanner, capture an image, extract the unique minutiae data from the image, and compare two sets of extracted minutiae data. All of the more complex features and functionality are built upon this framework.

5.2.1.1 SDK Functions

- initialize() -- Initializes the fingerprint SDK application programming interface API (when starting)
- cleanup() -- Release resources initialized by API (when finished)
- openDevice() -- Open a fingerprint scanner device
- closeDevice() -- Close fingerprint scanner device
- captureImage() -- Captures a fingerprint image from device
- getMinutiae() -- Extracts minutiae points from captured fingerprint image .
- matchMinutiae() -- Compares two minutiae records .

5.2.1.2 SDK Operational Model

- A template is created for each target element t in set T. The successful creation of a template is considered a successful enrollment; otherwise it is considered an enrollment failure.
- Each image q in set Q is compared to each successfully generated template (i.e., all query elements are pair wise compared against all target elements). For each comparison, the score representing the similarity between the images is recorded. The score is assumed to be a floating-point number that represents the similarity between the images. Higher scores indicate similar biometric signatures, lower scores dissimilar ones. A null similarity score (typically zero)

would be used given a system error, such as failure to enroll the target or query signature.

Gp/i

٥,٢,١,٣ SDK Algorithm

SDK Algorithm has many proprietary algorithmic solutions, which enhance the system performance and reliability as:

- It includes fingerprint image quality determination which can be used during enrollment to ensure that only the best quality fingerprint template will be stored into database.
- It uses the adaptive image filtring algorithm that allows to eliminate noise, ridge ruptures and stuck ridges, and extract minutiae reliably even from poor quality fingerprints, with a processing time of about 0.2 - 0.4 seconds (all times are given for a Pentium 4, 3 GHz processor).
- It's functions can be used in 1:1 matching (verification), as well as 1:N mode (identification).
- It is a fast template matching algorithm that is tolerant to fingerprint translation, rotation and deformation. It allows it to match up to 40,000 fingerprints per second and identify fingerprints even if they are rotated, translated, reformatted and have only 5 - 7 similar minutiae (usually fingerprints of the same finger have 20 - 40 similar minutiae).
- It can use database entries which were pre-sorted using certain global features. Fingerprint matching is performed first with the database entries having global features most similar to those of the test fingerprint. If matching within this group yields no positive result, then the next record with most similar global

features is selected, and so on, until the matching is successful or the end of the database is reached. In most cases there is a fairly good chance that the correct match will be found at the beginning of the search. As a result, the number of comparisons required to achieve fingerprint identification decreases drastically, and correspondingly, the matching speed increases.

- It has the fingerprint enrollment with features generalization mode. This mode generates the collection of the generalized fingerprint features from a set of fingerprints of the same finger. Each fingerprint image is processed and features are extracted. Then the features collection set is analyzed and combined into a single generalized features collection, which is written to the database. This way, the enrolled features are more reliable and the fingerprint recognition quality considerably increases.

5.2.3 Text-To-Speech System (TTS)

Simulate human process of reading aloud given texts. TTS is mainly used as aids for blind or speaking-impaired and in automatic information services (e.g. reading weather forecasts, news, or mailbox contents over the telephone line).

First we must analyze text to be read aloud in terms of underlying linguistic structure and then generate speech starting from results of analysis.

TTS is Text to Speech software with natural sounding voices. This easy to use software can convert any written text such as MS Word, Webpage, PDF files, and Emails into spoken words. TTS can also convert any written text into audio files

The goal of Text-to-Speech (TTS) synthesis is to convert arbitrary input text to intelligible and natural sounding speech so as to transmit information from a machine to a person.

Therefore, TTS goes beyond simple cut-and-paste systems used, for example, in some telecom applications to read back a phone number. Such systems string together words spoken in isolation and the artifacts of such a scheme are often perceptible.

The methodology used in TTS is to exploit acoustic representations of speech for synthesis, together with linguistic analyses of text to extract correct pronunciations and prosody in context.

Synthesis systems are commonly evaluated in terms of three characteristics: accuracy of rendering the input text, intelligibility of the resulting voice message, and perceived naturalness of the resulting speech.

This system works on windows operating system that has the ability to play back printed text as spoken words and using this feature to give the user a voice messaging at entering and leaving.

5.3 System Flow Charts

These flowcharts show the functions of the programs and algorithms written to make the system work properly.

Registration Flowchart

The user can register with this system under the administrator control by

entering his fingerprint using the fingerprint reader device and his image by using a digital camera. And filling the personal information in the textboxes on the graphical user interface, these steps are explained in the following flow chart.

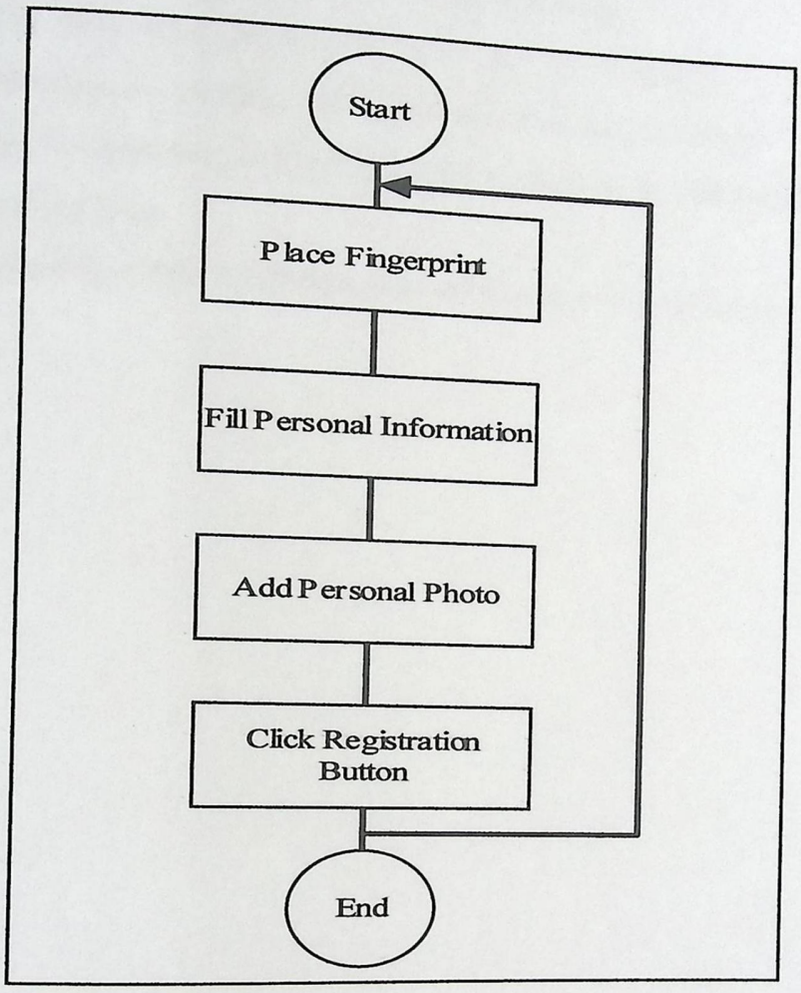


Figure 5-1: Flow Chart for Registration

General Program Flow Chart

This flowchart describes how the basic program works. Generally it should start with taking the fingerprint image from the fingerprint reader device and then searching for a match.

If there is matching then the system must do the following:

- Open the door for employee to enter or leave the company.
- Give welcome or goodbye voice message containing his name.
- Update the database by modifying information about each employee's entering and leaving time.

If there is no matching then the system must give a voice error message.

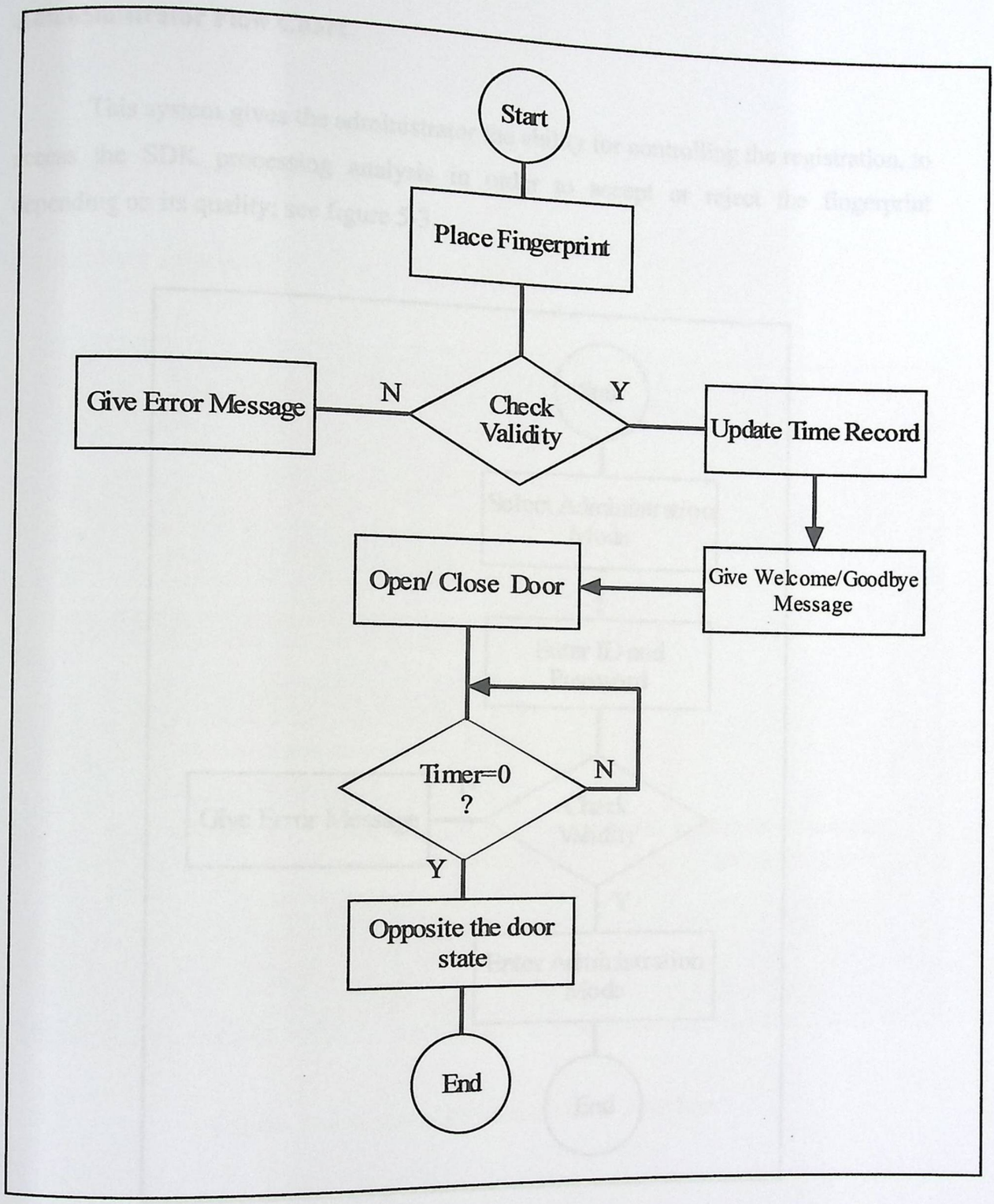


Figure 5-2: General System Flow Chart

Adm65inistrator Flow Chart

This system gives the administrator the ability for controlling the registration, to access the SDK processing analysis in order to accept or reject the fingerprint depending on its quality; see figure 5-3.

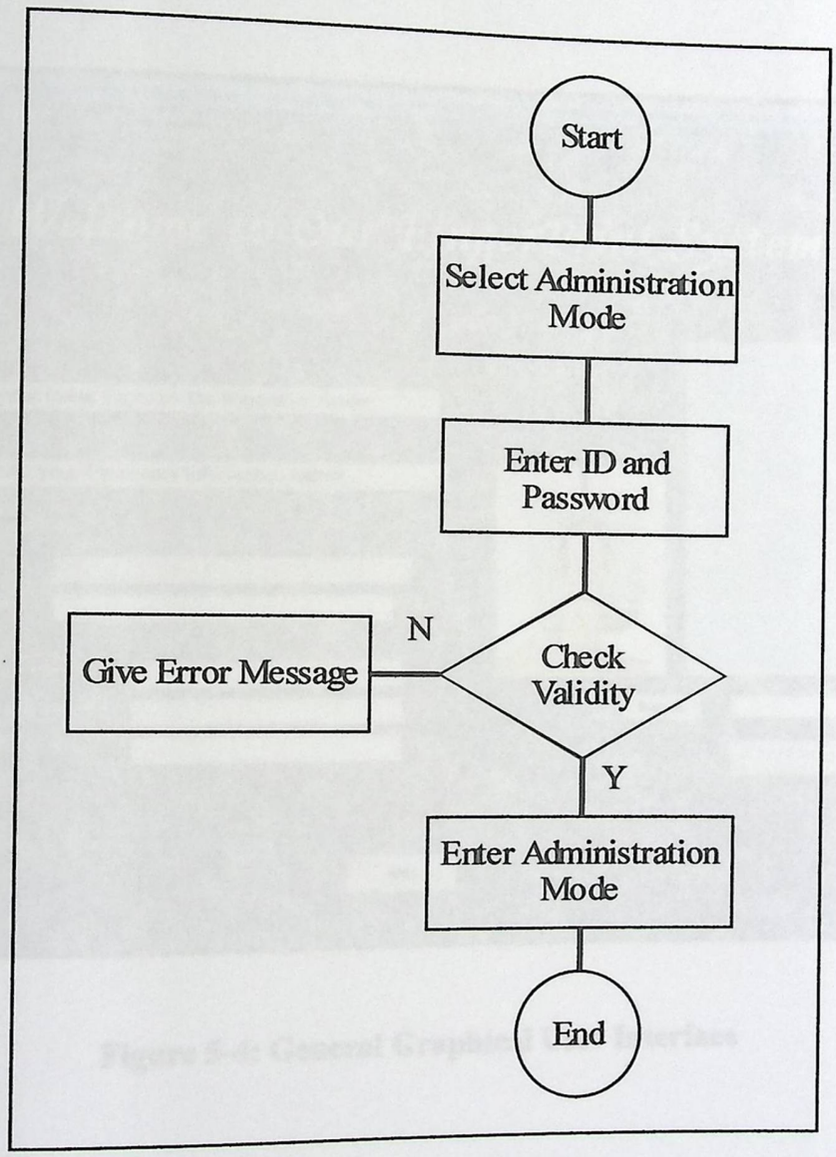


Figure 5-3: Administration Flow Chart

5.4 Graphical User Interface

This system has two main user interfaces, the first for the ordinary employee and the other for the administrator.

General User Interface

Figure 5-4: General Graphical User Interface

Administrator Interface

At the first the system asks for the ID and the password for security purpose, see figure 5-5.

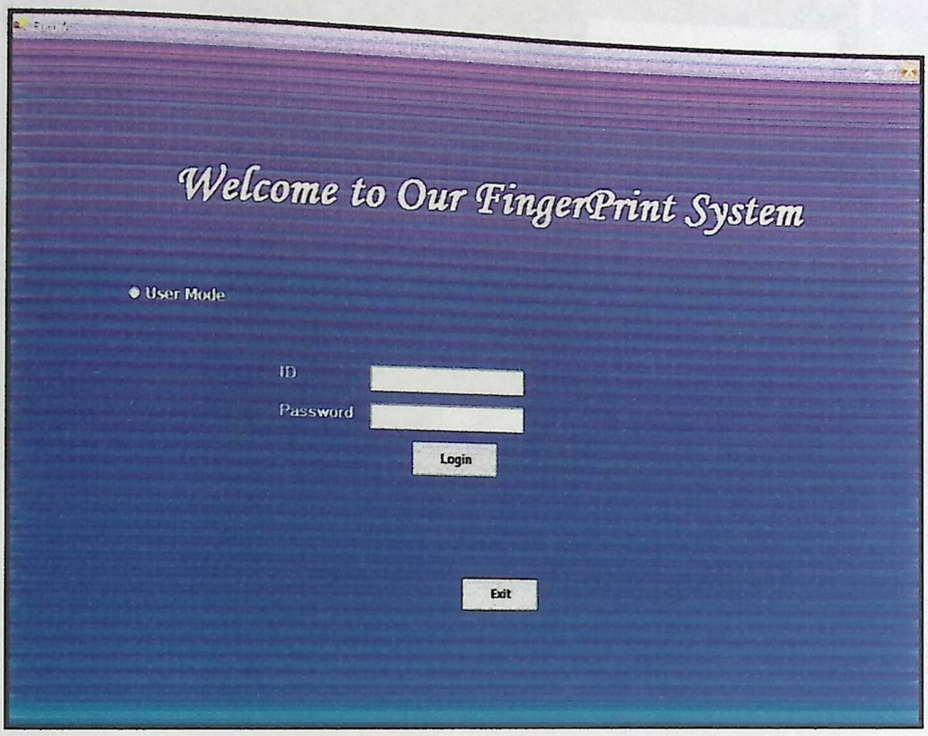


Figure 5-5: Administrator Authentication

After the administrator authentication the system let him/her to access the system database through the following interface see figure 5-6

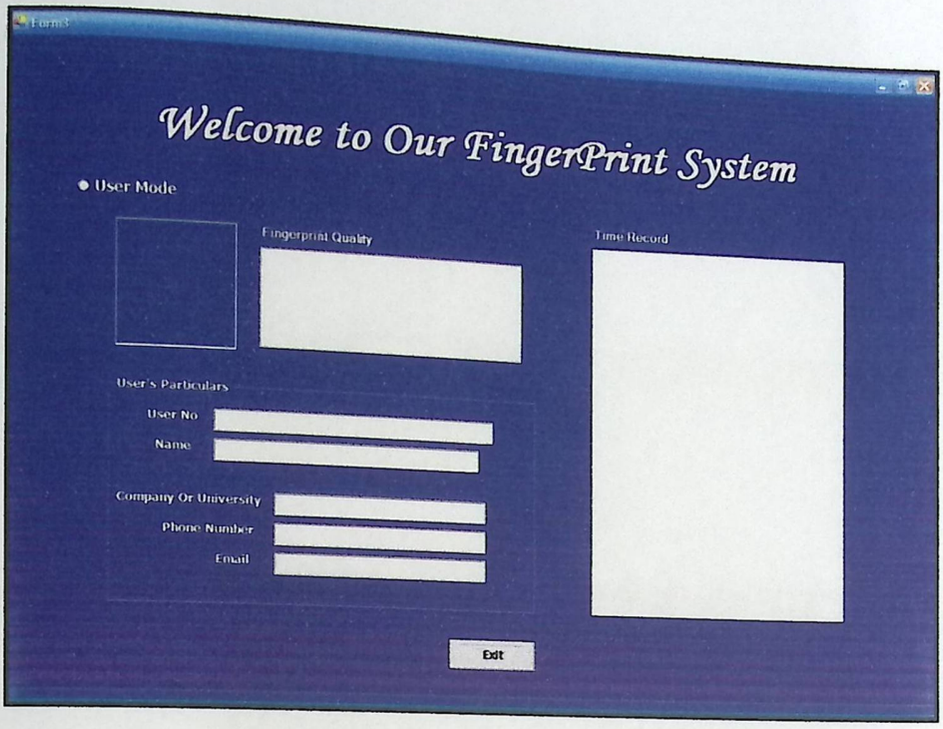


Figure 5-6: Administration Graphical Interface

Chapter 6

IMPLEMINTATION AND TESTENG

Overview

Implementation

Testing the System

Chapter Six

Implementation and Testing

6.1 Overview

This chapter shows the interface that appears for the users, the project's implementation and the testing for the whole system. System testing is an important and crucial step in implementing a system.

This system has more than one issue to be tested. Some testing parts reflect software or hardware, Here is the testing issues. They are not ordered in any manner; rather they represent some way of system integrity and operation.

٦,٢ Implementation

After the code was written, we have tested it and get the following results:

New user interface

Any new user comes to the company or organization have the ability for registration under the administrator control, so if the new user comes and try to register without the administrator presence or a new person try to enter the company without registration the system will deny this operation and give a voice message to alarm him, in each interface there is an exit button that used to stop the program. See figure 6-1.

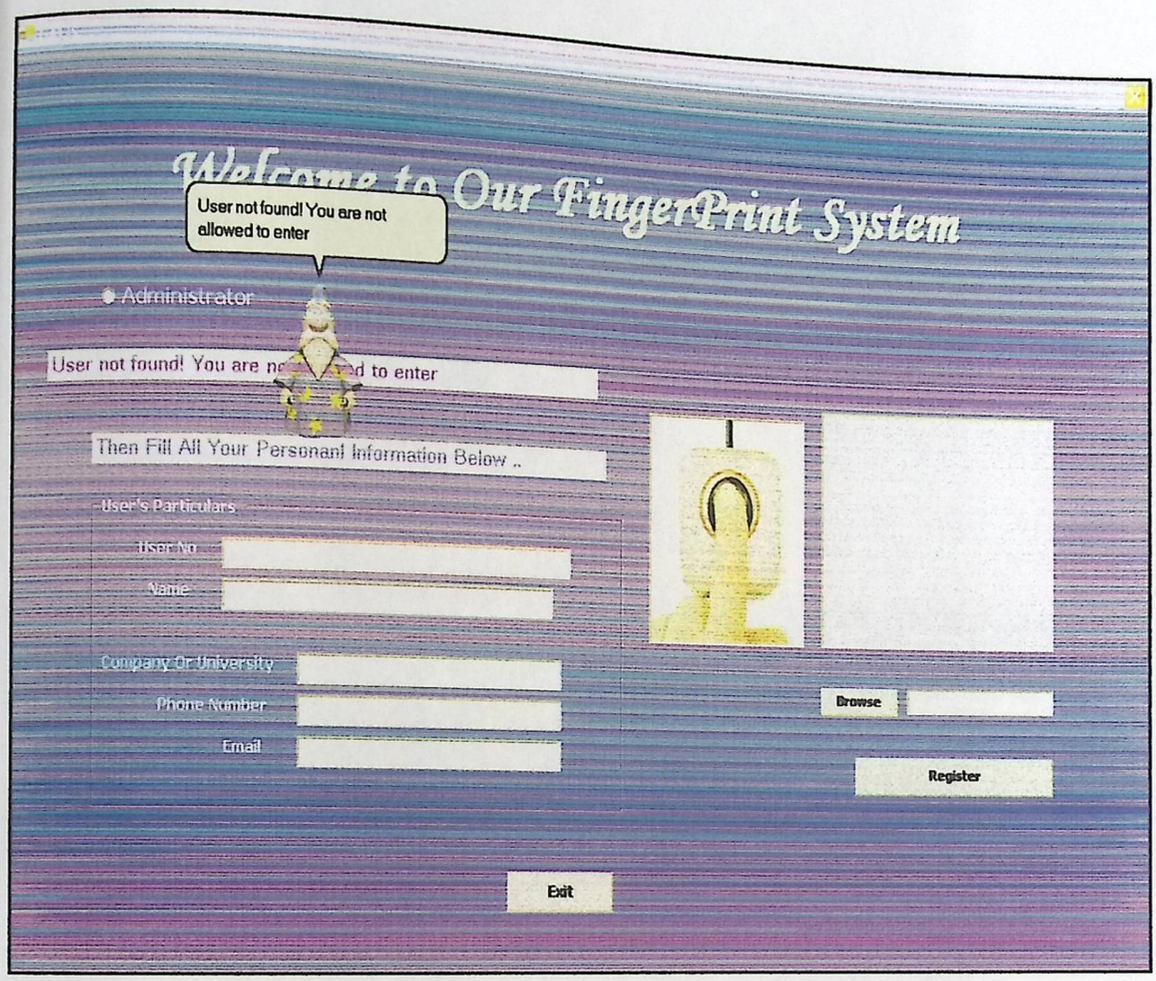


Figure 6-1: Voice Message Appears When a New User Tries to Enter Without Registration

Registration Interface

The registration operation has some steps that the user must follow: first place his/her left index fingerprint on the fingerprint reader to accept it depending on its quality, see figure 6-2.

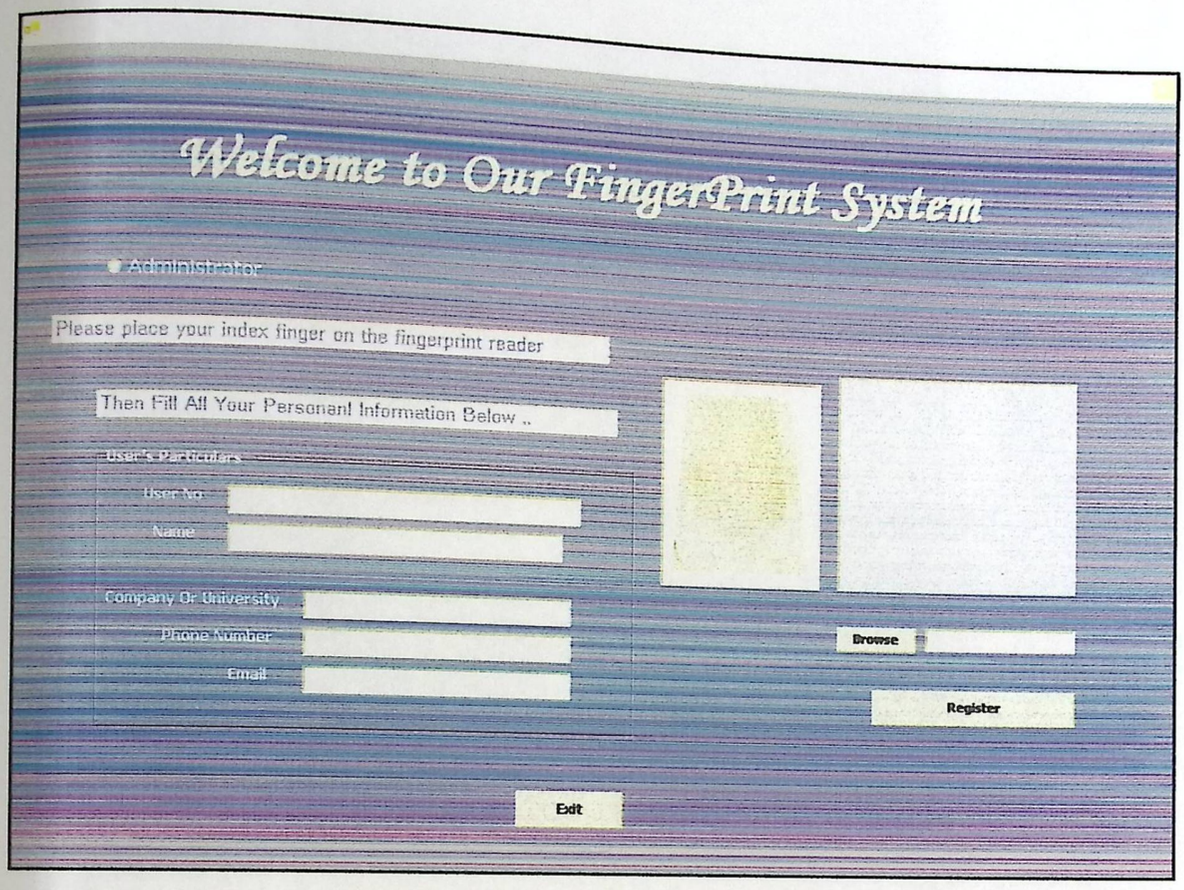


Figure 6-2: Registration First Step (Place Left Index)

Then the user must fill his personal information to store it in the system database, see figure6-3, this system has a validation for the fields that the user used to type his/her information, for example if the user type a text instead of numbers in the phone number field the system give a voice message to show this error, see figure 6-4.

Figure 6-3: Registration Second Step (Fill Personal Information)

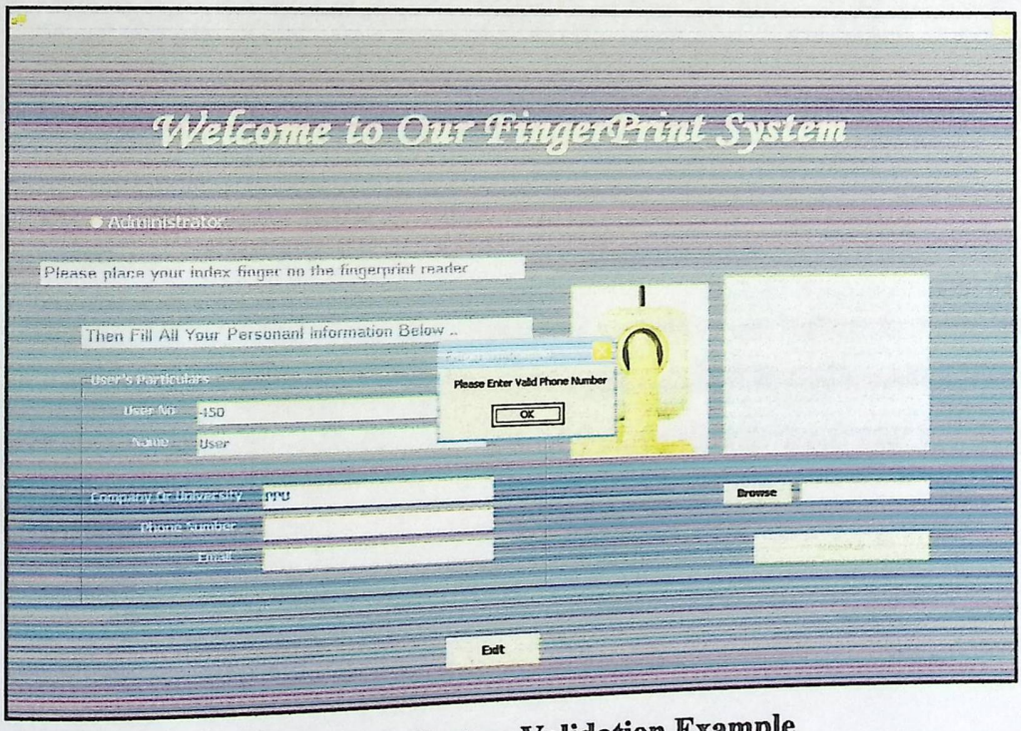


Figure 6-4: System Validation Example

After that the user adds his personal photo from a specific folder, see figure 6-5.

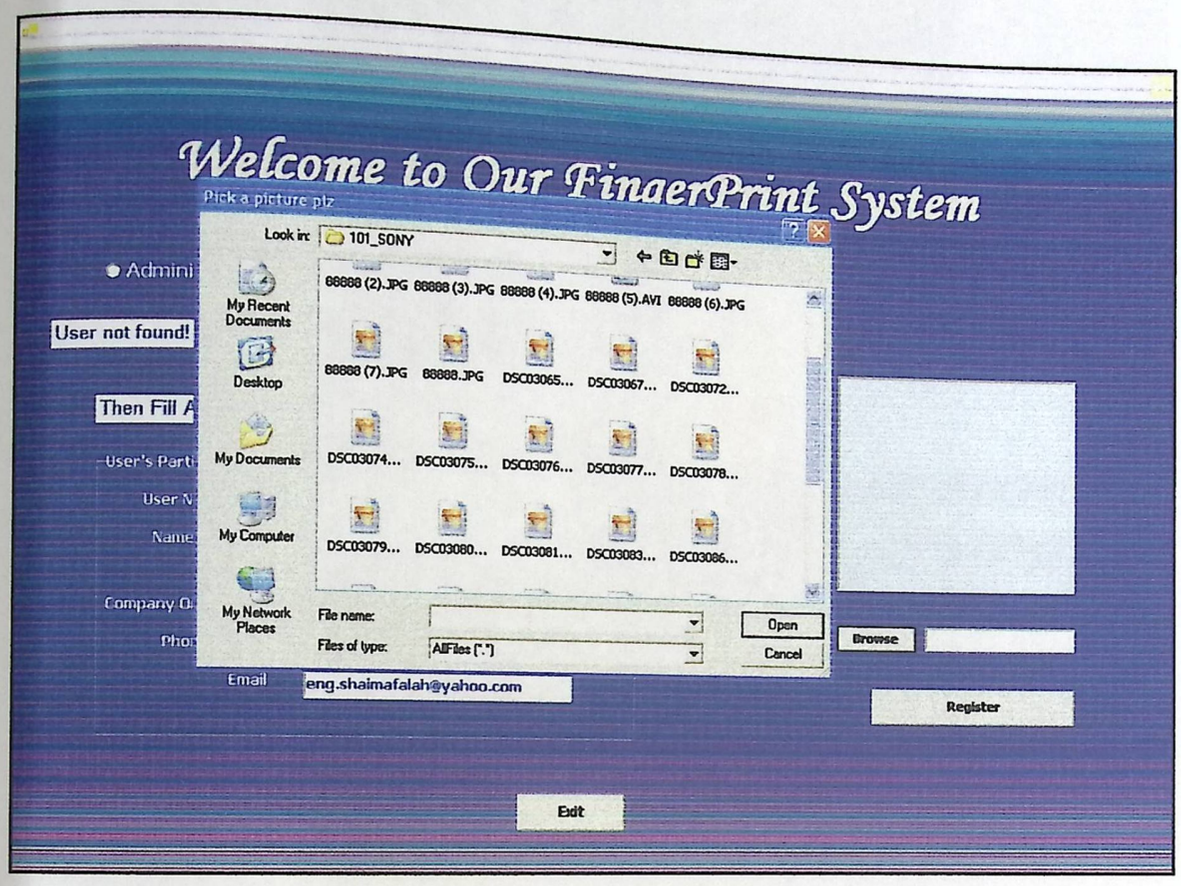


Figure 6-5: Registration Last Step (Add Personal Photo)

Finally the last step the user presses the registration button to complete this operation and stores all the data in the system database, if all the information were valid the system completes the operation and gives a voice message to the user to inform this operation. See figure 6-6.

Figure 6-6: Confirm the Registration

General Interface for the Employees

For each entering or leaving of the employees the system gives a voice message for the user and shows the date and time for this operation, in addition at the entering the system will give full information about the employee, and shows his photo. See Figure 6-7 and 6-8.

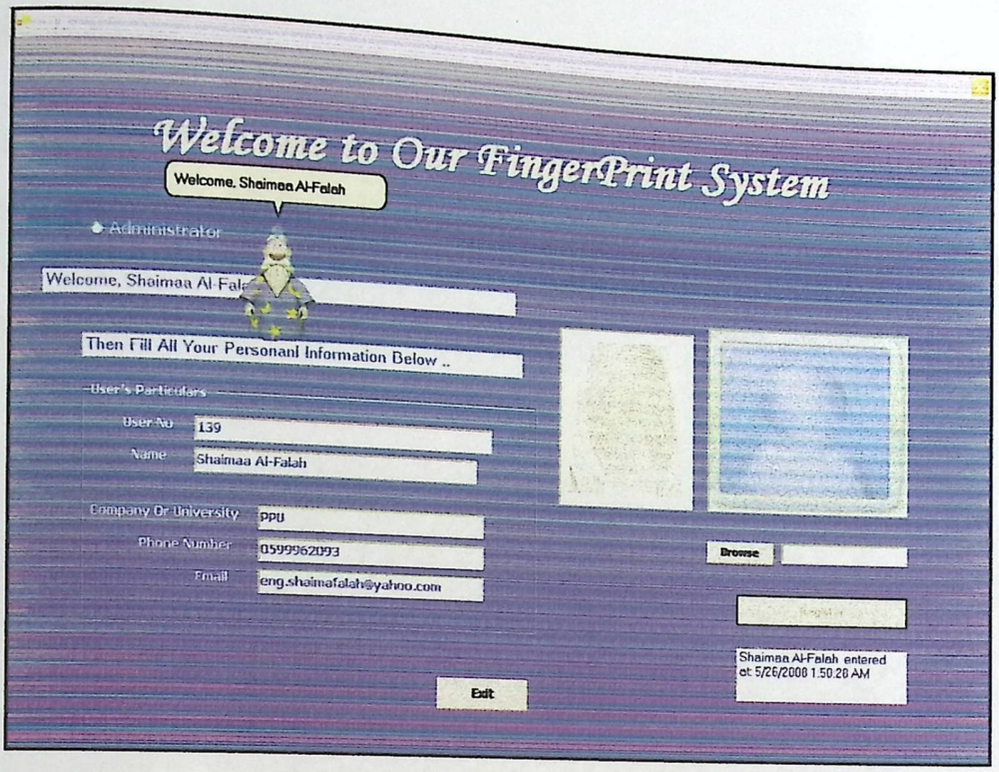


Figure 6-7: Employee's entering

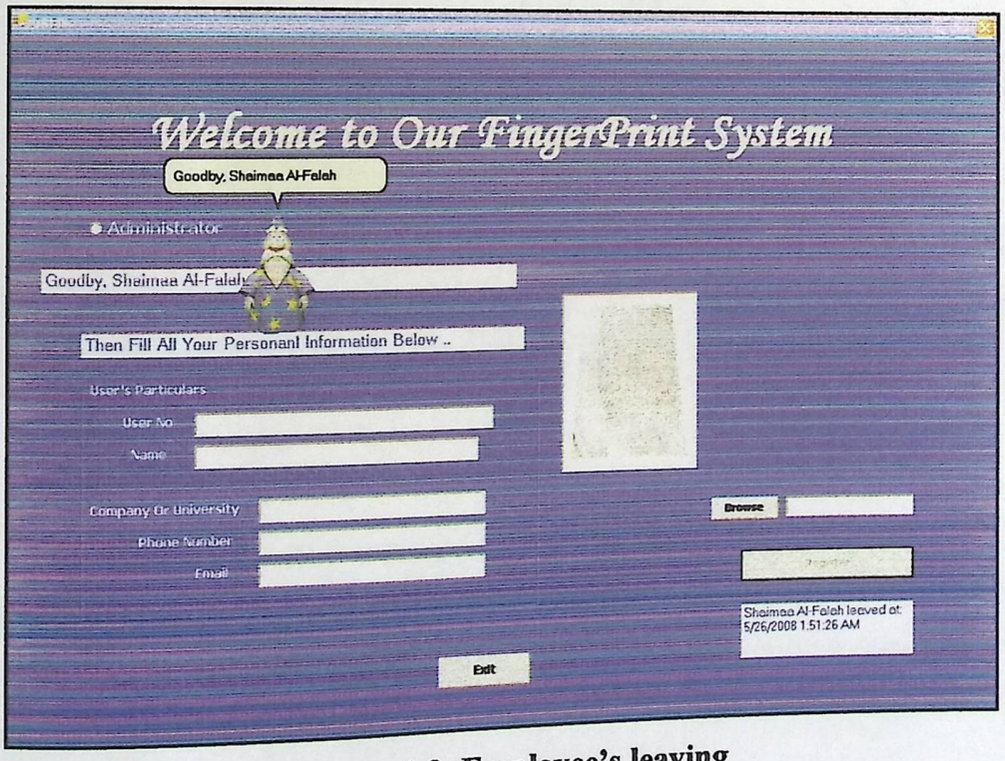


Figure 6-8: Employee's leaving

Administrator interface

This system gives the administrator more control possibilities through a separate interface, this interface asks the administrator about his ID and password for security purpose, if the administrator typed a wrong ID or password the system gives him an error message to check them again. See figure 6-9.

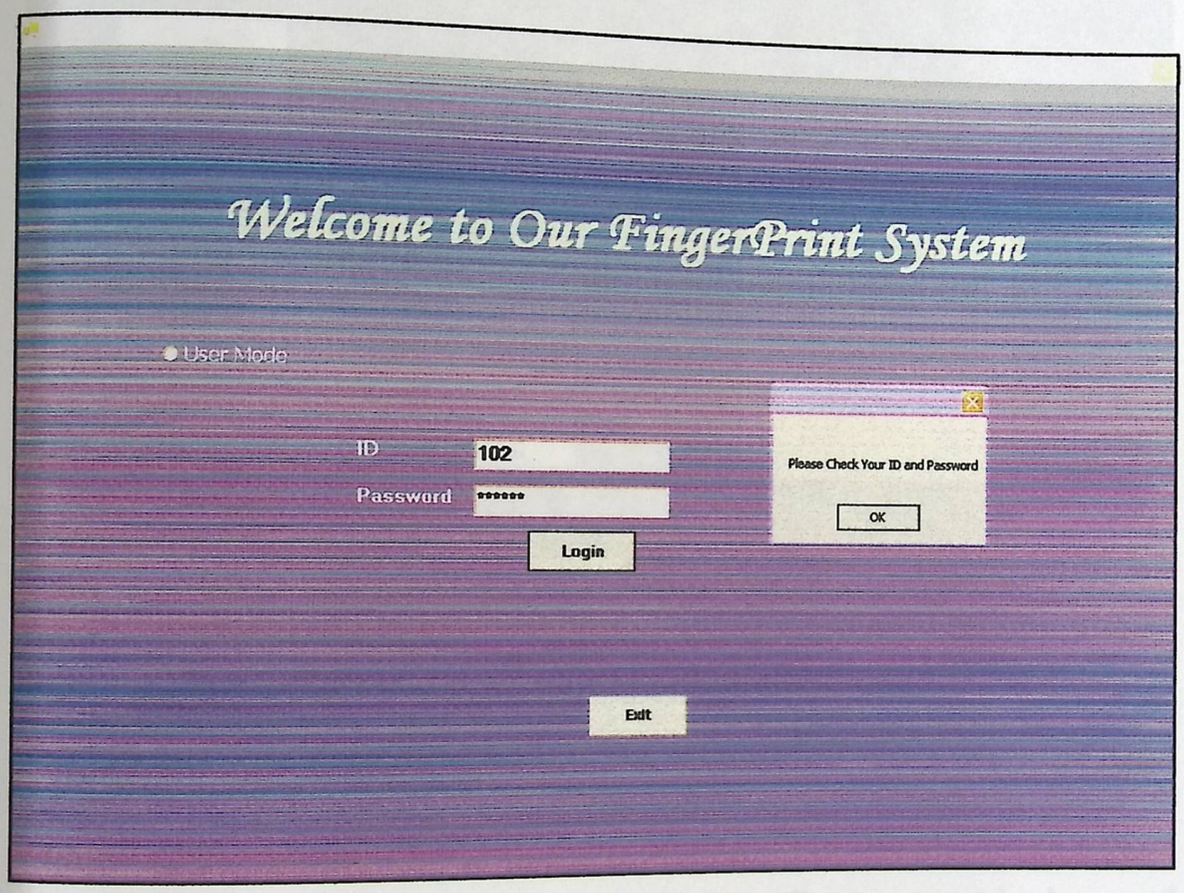


Figure 6-9: Administrator Authentication

The administrator can view specific information for the employees. Also he/she can see the analysis for the fingerprint when the index placed on the fingerprint reader, this analysis is important for registration in order to accept the high quality ones, also this analysis may be useful when some errors occurred at the employees entering and

leaving. The administrator also can view the record time for the employees entering and leaving time. See figure 6-10.

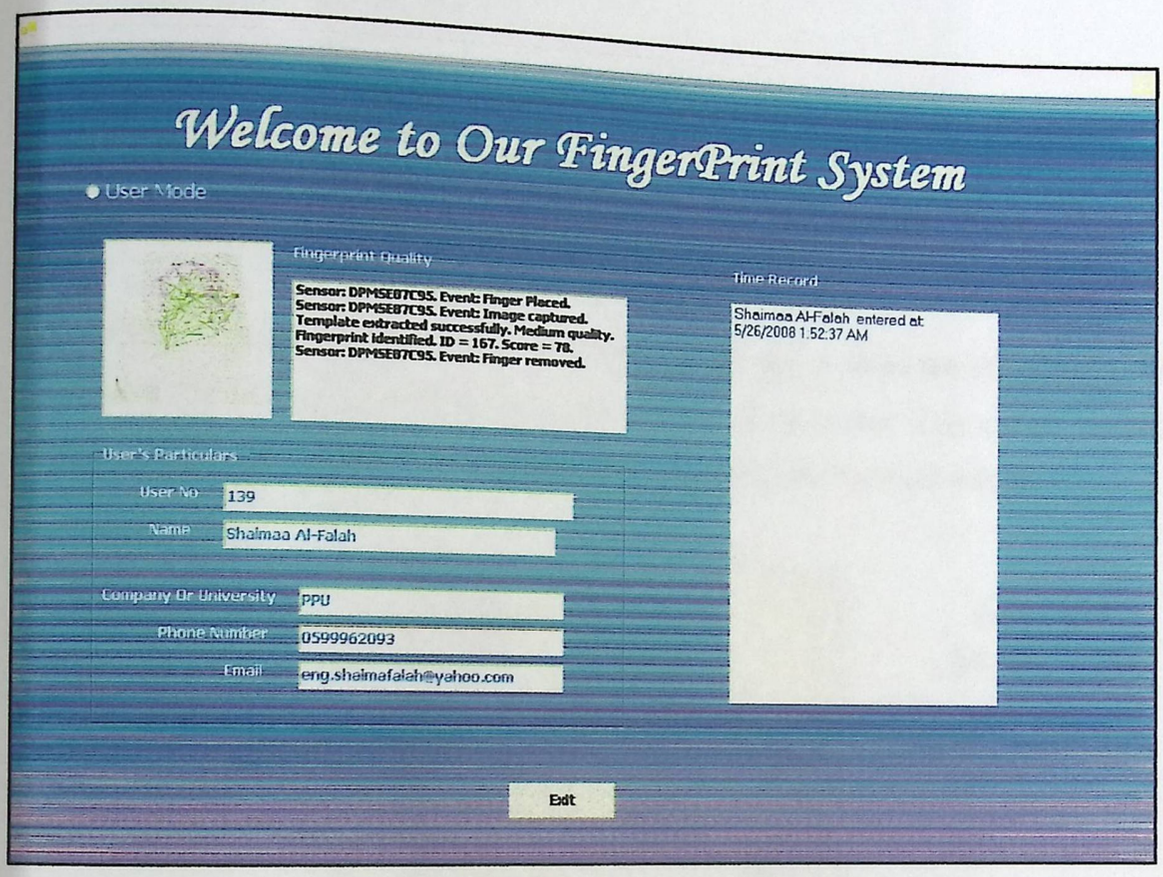


Figure 6-10: Administrator Mode Properties

٦,٣ Testing the System

This section describe the whole system testing according to connect hardware and software parts of the system.

6.3.1 Testing the Hardware System

In this system there are three electrical circuits that are used to control the operation of door's moving when the signal comes from the PC.

- Control signal's generation circuit.
- LDR circuit.
- Motor's speed control circuit.

٦,٣,١,١ Testing Control Signal's Generation Circuit

This electrical circuit is used to generate 12V signal when the PC sends a 5V signal to it, if there is a match in order to turn on the motor. This circuit worked successfully after testing and supplied the system with the required voltage.

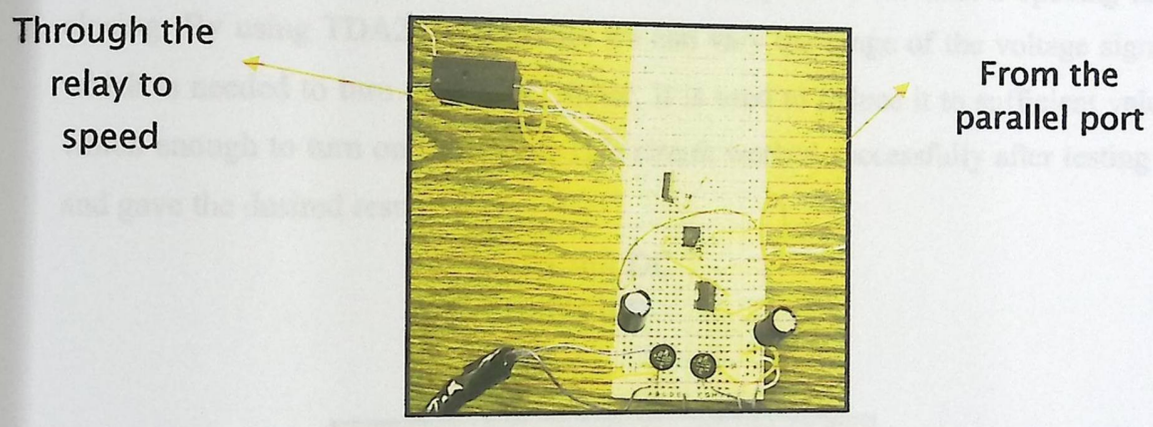


Figure 6-11: Control Signal's Generation Circuit

6.3.1.2 Testing LDR Circuit

This electrical circuit is used to check if there is a person stand in front of the door or not; to avoid any accident that can be happened when the employee want to enter or leave the company. If there is a person stands in front of the door; the door keeps open until the person enters or leaves. Also gives the person an attention by

using a ring. This circuit worked successfully after testing it and gave the desired result.

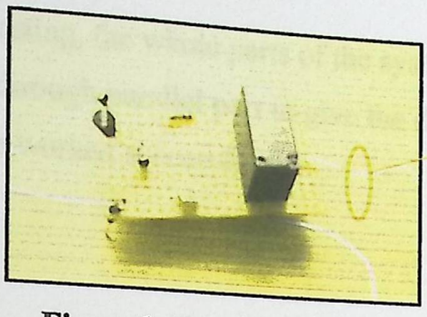


Figure6-12: LDR Circuit

٦,٣,١,٢ Testing the Motor's Speed Control Circuit

This electrical circuit is used to control the speed of the door's opening and closing. By using TDA2030 amplifier we can vary the range of the voltage signal which is needed to turn on the DC motor. It is used to reduce it to sufficient value which enough to turn on the motor. This circuit worked successfully after testing it and gave the desired result.

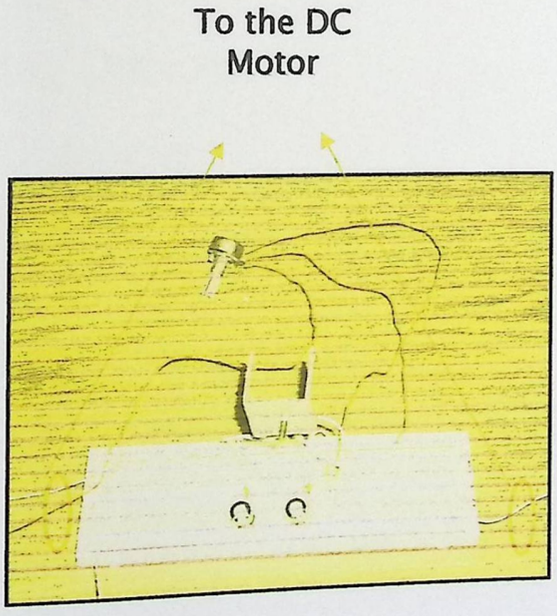


Figure 6-13: Speed Control Circuit

6.3.2 Testing whole system

In this stage of the system testing, the whole parts of the system (hardware and software was connected together by through parallel port to give the desired output of the system. After many trails the system worked successfully.

Chapter 7

CONCLOUSION AND FUTURE WORK

Overview

Expected learning Outcomes

Real Learning Outcomes

Future Work

Chapter Seven

Conclusion and Future Work

7.1 Overview

The project was successfully designed; implemented and tested the entire objective, which has been done, was a step for applied the fingerprint recognition upon a security system for companies and organizations. Meanwhile we have some recommendations and suggestions for the future work.

For us it was challenging to design, implementing and testing the whole work

7.2 Learning Outcomes

We can say that as a group "students" we learned the following aspects

- The basic principles about the fingerprint; its structure, its classification, the different methods that are used to make fingerprint matching, and many facts about the fingerprint.
- Understanding and using full information about the fingerprint reader device; is useful application such as ours project.
- Learning how we can use VB.NET2005 for implementing this system.
- Learning how to create system database and connect it with this system's code.
- Learning how to use SDK software to support this system.

- Learning how to deal with specific hardware components that are used in our system and build the necessary electrical circuits.
- Learning how to make connection between hardware and software of this system using the parallel port.

7.3 Problems

During designed, implemented and testing our project; we faced many problems which are:

- **Software implementation problems:**

  We had faced many problems in the programming of the code. These problems appeared in specific parts of the code:

  - In connecting SDK software with fingerprint reader device to take the fingerprint image and do the matching operation.

  - In connecting software with hardware through the parallel port, and in programming the timer to control the speed of door's moving.

- **Hardware implementation problems:**

  We had faced many problems in building the hardware parts of the system:

- The mechanism of the door's moving , we tried many techniques , such as using magnetic system to open and close the door ; but this system didn't work properly since the door's movement needs a large force , also the way to fix the magnet is not practical . Other technique that we used was mechanical mechanism by using a DC motor. We faced many difficulties in using this technique such as fixing the motor on the door.
- How to control the speed of the door's moving. By using electrical control circuit. The basic IC (TDA2030) in this circuit was heated quickly and it was destroyed many times, so it couldn't give the desired result.

Note: After many trials to solve the previous problems, we solve them and the whole system worked successfully.

7.4 Future Work

After our work on this project and after facing many problems during the implementation, we as a project team, see that the following points may be a good improvement for this project.

The system can be enhanced by adding the following features:

١. Using a recording (image) security system such as taking photos to every person attending or trying enter and recorded it.
٢. connecting the system to the police station through a web processes
٣. adding a queuing system such as giving number to customer, or directing the person to a specific office

To make the system more secure; we can connect the system with the specific web location through the internet. This location will contain full information about the most famous criminals (including their photos) in the country, so when any of them try to enter the company. The system must give an attention for the administrator. Then the administrator will take the necessary actions.

REFERENSES

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- I.T. young, J.J. Gerbrands, L.J. van Vliet. Image Processing Fundamental.
- Cameron Wakefield.Henk-Evert Sonder.Wei Meng Lee .VB.NET: Developer's Guide.–Seres Editor
- Albert Malvino, David J. Bates. Electronic Principles: Seventh Edition.

Link:

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[2] http://www.privaris.com/biometric_computer.html

[3] http://agrippina.deakin.edu.au/bcs_courses/forensic/Principles_fingerprints.htm

[4] http://agrippina.deakin.edu.au/bcs_courses/forensic/Principles_fingerprints.htm

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[12] http://www.codeproject.com

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[15] http://www.pha.jhu.edu/~broholm/l18/node3.html
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[18] http://www.engr.sjsu.edu/wbarrett/JainSpectrum.htm

Appendix A

Order this document
by 4N25/D

GlobalOptoisolator™

VDE | UL | CSA | SETI | SEMKO | DEMKO | NEMKO | BABT

6-Pin DIP Optoisolators Transistor Output

4N25*
4N25A*
4N26*
[CTR = 20% Min]
4N27
4N28
[CTR = 10% Min]
*Motorola Preferred Devices

The 4N25/A, 4N26, 4N27 and 4N28 devices consist of a gallium arsenide infrared emitting diode optically coupled to a monolithic silicon phototransistor detector.

- Most Economical Optoisolator Choice for Medium Speed, Switching Applications
- Meets or Exceeds All JEDEC Registered Specifications
- ***To order devices that are tested and marked per VDE 0884 requirements, the suffix "V" must be included at end of part number. VDE 0884 is a test option.***

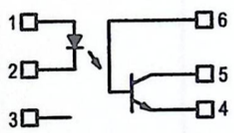
Applications

- General Purpose Switching Circuits
- Interfacing and coupling systems of different potentials and impedances
- I/O Interfacing
- Solid State Relays

STYLE 1 PLASTIC

STANDARD THRU HOLE
CASE 730A–04

SCHEMATIC



PIN 1. LED ANODE
2. LED CATHODE
3. N.C.
4. EMITTER
5. COLLECTOR
6. BASE

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INPUT LED			
Reverse Voltage	V_R	3	Volts
Forward Current — Continuous	I_F	60	mA
LED Power Dissipation @ T_A = 25°C with Negligible Power in Output Detector Derate above 25°C	P_D	120 1.41	mW mW/°C
OUTPUT TRANSISTOR			
Collector–Emitter Voltage	V_{CEO}	30	Volts
Emitter–Collector Voltage	V_{ECO}	7	Volts
Collector–Base Voltage	V_{CBO}	70	Volts
Collector Current — Continuous	I_C	150	mA
Detector Power Dissipation @ T_A = 25°C with Negligible Power in Input LED Derate above 25°C	P_D	150 1.76	mW mW/°C
TOTAL DEVICE			
Isolation Surge Voltage(1) (Peak ac Voltage, 60 Hz, 1 sec Duration)	V_{ISO}	7500	Vac(pk)
Total Device Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	250 2.94	mW mW/°C
Ambient Operating Temperature Range(2)	T_A	–55 to +100	°C
Storage Temperature Range(2)	T_{stg}	–55 to +150	°C
Soldering Temperature (10 sec, 1/16″ from case)	T_L	260	°C

1. Isolation surge voltage is an internal device dielectric breakdown rating.
   For this test. Pins 1 and 2 are common. and Pins 4. 5 and 6 are common.
2. Refer to Quality and Reliability Section in Opto Data Book for information on test conditions.

Preferred devices are Motorola recommended choices for future use and best overall value.

GlobalOptoisolator is a trademark of Motorola, Inc.

MOTOROLA

TDA2030A

18W Hi-Fi AMPLIFIER AND 35W DRIVER

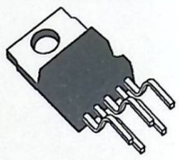
DESCRIPTION

The TDA2030A is a monolithic IC in Pentawatt ® package intended for use as low frequency class AB amplifier.

With $V_{S\,max}$ = 44V it is particularly suited for more reliable applications without regulated supply and for 35W driver circuits using low-cost complementary pairs.

The TDA2030A provides high output current and has very low harmonic and cross-over distortion.

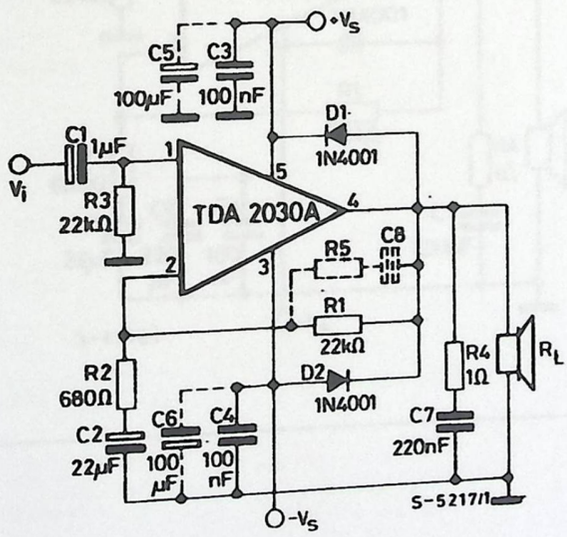
Further the device incorporates a short circuit protection system comprising an arrangement for automatically limiting the dissipated power so as to keep the working point of the output transistors within their safe operating area. A conventional thermal shut-down system is also included.



PENTAWATT

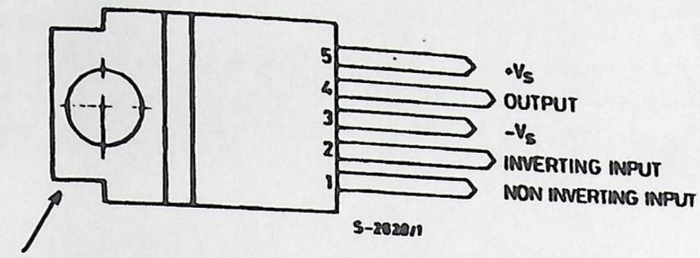
ORDERING NUMBERS : TDA2030AH
TDA2030AV

TYPICAL APPLICATION

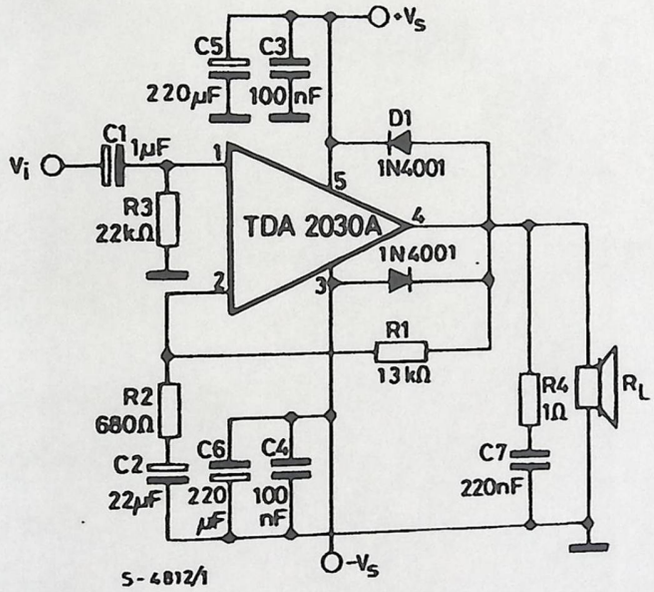


October 2000

PIN CONNECTION (Top view)



TEST CIRCUIT



THERMAL DATA

Symbol	Parameter		Value	Unit
$R_{th\ (j\text{-}case)}$	Thermal Resistance Junction-case	Max	3	°C/W

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_s	Supply Voltage	± 22	V
V_i	Input Voltage	V_s	
V_i	Differential Input Voltage	± 15	V
I_o	Peak Output Current (internally limited)	3.5	A
P_{tot}	Total Power Dissipation at T_{case} = 90 °C	20	W
T_{stg}, T_j	Storage and Junction Temperature	– 40 to + 150	°C

ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, V_S = ± 16V, T_{amb} = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_s	Supply Voltage		± 6		± 22	V
I_d	Quiescent Drain Current			50	80	mA
I_b	Input Bias Current	V_S = ± 22V		0.2	2	µA
V_{os}	Input Offset Voltage	V_S = ± 22V		± 2	± 20	mV
I_{os}	Input Offset Current			± 20	± 200	nA
P_O	Output Power	d = 0.5%, G_v = 26dB f = 40 to 15000Hz R_L = 4Ω R_L = 8Ω V_S = ± 19V R_L = 8Ω	 15 10 13	 18 12 16		W
BW	Power Bandwidth	P_o = 15W R_L = 4Ω		100		kHz
SR	Slew Rate			8		V/µsec
G_v	Open Loop Voltage Gain	f = 1kHz		80		dB
G_v	Closed Loop Voltage Gain	f = 1kHz	25.5	26	26.5	dB
d	Total Harmonic Distortion	P_o = 0.1 to 14W R_L = 4Ω f = 40 to 15 000Hz f = 1kHz P_o = 0.1 to 9W, f = 40 to 15 000Hz R_L = 8Ω		0.08 0.03 0.5		% % %
d_2	Second Order CCIF Intermodulation Distortion	P_O = 4W, $f_2 - f_1$ = 1kHz, R_L = 4Ω		0.03		%
d_3	Third Order CCIF Intermodulation Distortion	f_1 = 14kHz, f_2 = 15kHz $2f_1 - f_2$ = 13kHz		0.08		%
e_N	Input Noise Voltage	B = Curve A B = 22Hz to 22kHz		2 3	 10	µV µV
i_N	Input Noise Current	B = Curve A B = 22Hz to 22kHz		50 80	 200	pA pA
S/N	Signal to Noise Ratio	R_L = 4Ω, R_g = 10kΩ, B = Curve A P_O = 15W P_O = 1W		106 94		dB dB
R_i	Input Resistance (pin 1)	(open loop) f = 1kHz	0.5	5		MΩ
SVR	Supply Voltage Rejection	R_L = 4Ω, R_g = 22kΩ G_v = 26dB, f = 100 Hz		54		dB
T_j	Thermal Shut-down Junction Temperature			145		°C

Microsoft

Fingerprint Reader

Technical Data Sheet

Product Name	Microsoft® Fingerprint Reader
Product Version	Microsoft Fingerprint Reader v1.0
Fingerprint Reader Version	Microsoft Fingerprint Reader v1.0
Fingerprint Reader Length	3.23 inches (82.0 millimeters)
Fingerprint Reader Width	1.97 inches (50.0 millimeters)
Fingerprint Reader Depth/Height	0.60 inches (15.7 millimeters)
Fingerprint Reader Weight	3.78 ounces (107 grams)
Fingerprint Reader Cable Length	55.9 ± 1.18 inches (1420 ± 30.0 millimeters)
Interface	USB Compatible
Operating Systems	Microsoft Windows® Vista™ and Windows XP Professional/Home/Media Center/Tablet PC Edition
Top-line System Requirements	• Requires a PC that meets the requirements for and has installed one of these operating systems: Microsoft Windows Vista or Windows XP Professional/Home Edition/Media Center Edition/Tablet PC Edition • 45 MB of available hard disk space (significant additional hard-disk space may be required if System Restore is enabled.) • Microsoft Internet Explorer® 6.0 and MSN® Explorer 8.0 and 9.0 • USB Port • CD drive • digitalPersona Fingerprint Password Manager software version 2.0
Compatibility Logos	• Designed for Microsoft Windows XP • Certified USB logo
Storage Temperature & Humidity	-40 °F (-40 °C) to 140 °F (60 °C) at <5% to 65% relative humidity (non-condensing)
Operating Temperature & Humidity	32 °F (0 °C) to 104 °F (40 °C) at <5% to 80% relative humidity (non-condensing)
Scanner Type	Optical
Fast User Switching	Yes
Browser Password Replacement	Yes
Country of Manufacture	People's Republic of China (PRC)
ISO 9001 Qualified Manufacturer	Yes
Agency and Regulatory Approvals	• FCC Declaration of Conformity (USA) • UL and cUL Listed Accessory (USA and Canada) • ICES-003 report on file (Canada) • TUV-GS Certificate (Germany) • CE Declaration of Conformity, Safety and EMC (European Union) • GOST Certificate (Russia) • VCCI Certificate (Japan) • ACA Declaration of Conformity (Australia) • BSMI Certificate (Taiwan) • MIC Certificate (Korea) • NOM Certificates (Mexico) • CB Scheme Certificate (International)
Windows Hardware Quality Labs (WHQL)	ID: 1210759 Micrososft Windows XP (x86) and Windows Vista (x86)