Critical Patient Identification Using Radio Frequency Identification (RFID)

by

Mohd Amirul Adam Bin Abdul Aziz

Dissertation submitted in partial fulfillment of
the requirement for the
Bachelor of Technology (Hons)
(Business Information Systems)

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CERTIFICATION OF APPROVAL

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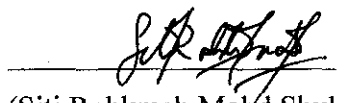
Approved by,



(Siti Rohkmah Mohd Shukri)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
July 2007

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

MOHD AMIRUL ADAM BIN ABDUL AZIZ

ABSTRACT

The increased focus on patient safety in hospitals has yielded a flood of new technologies and tools seeking to improve the quality of patient care at the point-of-care. Hospitals are complex institutions by nature and are constantly challenged to improve the quality of healthcare delivered to patients while trying to reduce the rate of medical errors and improve patient safety. Some simple mistakes that usually happened are such as patient misidentification, specimen misidentification, wrong medication or anything that can cause the loss of a patient's life.

In order to avoid these problems, RFID has coming with its solution. RFID stands for Radio Frequency Identification. It is an automatic identification technology whereby digital data encoded in an RFID tag is captured by a reader using radio waves. In other words, RFID is similar to bar code technology but uses radio waves to capture data from tags, rather than optically scanning the bar codes on a label. The most important characteristic is that RFID does not require the tag or label to be seen to read its stored data.

Radio Frequency Identification (RFID) uses radio waves to identify different objects. There are a wide range of uses for RFID technology, from identifying retail products to tagging surgical instruments to locating patients. RFID technology has grown in its uses and importance in many industries. As more and more businesses started utilizing RFID technology, the RFID solution itself became much more reliable, easy to use, and less expensive. Many hospitals and healthcare facilities have expanded the use of RFID technology to include tracking patients, maintaining inventory, locating equipment, and monitoring medications.

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ABBREVIATIONS AND NOMENCLATURES

FYP	Final Year Project
BIS	Business Information Systems
UTP	Universiti Teknologi PETRONAS
WWW	World Wide Web
RFID	Radio Frequency Identification
PC	Personal Computer
VB	Visual Basic
COM	Component Object Model
CPU	Central Processing Unit
RAM	Random Access Memory
MB	Megabyte
SAR	Severe Acute Respiratory
ICU	Intensive Care Unit
EPC	Electronic Product Code
ISO	International Standards Organization
IT	Information Technology
ID	Identification
ERP	Electronic Road Pricing
IU	In-vehicle Unit
RAD	Rapid Application Development
GHZ	Giga-Hertz
CPIS	Critical Patient Identification System

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

In this new millennium era, information technology has been a main agenda in our country development and it is not a new now a days. The development covered all fields and purposely done either for saving the time or to improve efficiency. But sometimes, we as human always forget to cover main things that really important in our life. Thing that the author wants to touch here is information technology development in medical institution especially in patient identification system.

Although a lot of information technology project has been implemented but most of medical institutions in Malaysia were still using traditional way (paper form) in record or managing the patient record. This type of system can lead not only to unorganized patient information but more than that. Misidentification and wrong diagnosis to the patient are the other bad consequences that can lead to the death of the patient. These incidents will embarrass our country that aiming to compete with developed country especially in information technology development.

In order to overcome the above bad consequences, the author has come out with Critical Patient Identification System using RFID. The focus of this study is to develop a prototype of patient identification system that uses radio frequency identification (RFID) to identify patients. In this approach, each patient is given a RFID wristband which contains demographic information (patient ID number and patient summary) of the patient. A system equipped with computer and a RFID reader is then used by the medical staff to read the patient's wristband and identify the patient especially for critical department such as Intensive Care Unit (ICU), X-RAY checkup or blood test checkup department.

1.2 EXISTING SYSTEM

From the research and observation that has been made, most of our medical institutions in Malaysia are still using the traditional way (paper from) and apply in their operations and management activities.

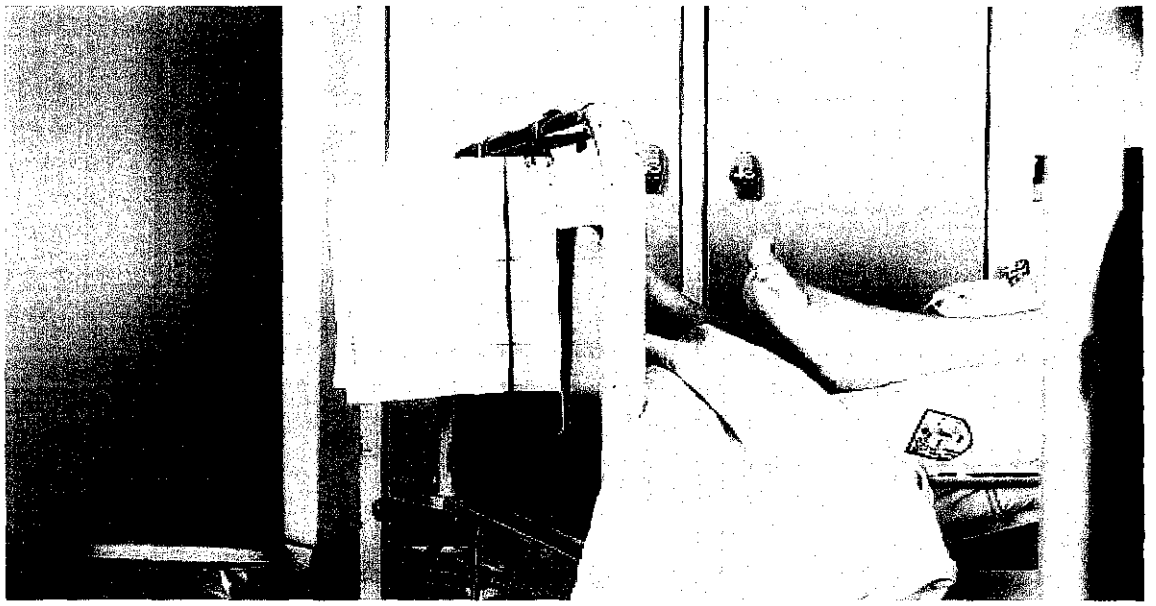

Figure 1.0: Traditional way (paper form)

Like the author has mentioned before, the paper form usage can creates a lot of bad consequences as it will involved human participant in recording the information into the paper. Sometimes the accuracy and the integrity of filling form activities (especially if medical staff was tired or lack of focusing condition) can be questioned. The other problem is the retrieving process of existing patient information will take time as the medical staff has to search it from the paper form file. Although the file can be found, but it require the medical staff to filing and organize it from time to time. This process will continuous and it such wasting of time for the medical staff to focus on organize the file rather than take care the patient.

1.3 PROBLEM STATEMENT

The extent to which patient misidentification occurs within a hospital is usually widely underestimated by the medical staff as very often they may be unaware that a misidentification has occurred. For this reason, misidentification incidents are difficult to track and document as they happen or are rarely reported on daily basis. Common medical error handling practice in some hospitals typically begins with the so called "shame and blame" method where physicians are held personally responsible for mistakes. Patient misidentification errors can lead to all sorts of serious outcomes for patients.

Among the problems that have been identified were;

1. Administration of contagious patient such as SAR's problem happened at Malaysia in 2003.
2. Performance of wrong procedure on the patient led from misidentification.
3. Paper based document still being used in Intensive Care Unit (ICU).

1.4 OBJECTIVES OF STUDY

The main objectives of the project are;

1. To overcome the possibilities of patient misidentification as manual based (paper form) usage in medical institutions.
2. As a medium for inventing new system that can be used by medical staff in organizing patient's information.
3. To develop an application system for critical patient identification.

1.5 SCOPE OF STUDY

The scopes for this project are;

1. SAR's problem in Malaysia

Severe acute respiratory syndrome (SARS) is a respiratory disease in humans which is caused by the SARS coronavirus. There has been one pandemic to date, between November 2002 and July 2003, with 8,096 known infected cases and 774 deaths (a mortality rate of 9.6%) worldwide being listed in the WHO's April 21, 2004 concluding report. Malaysia also included into the statistic for the countries that being attacked by SARs disease. Based on the author research, government has taken action by implement the quarantine process in order to prevent the disease from spreading to the others. System that being used for quarantine process on that day was the manual based (paper form). The problem is this type of administration was quite unorganized and can lead to any possibilities such as form misplaced, patient misidentification and others. So, the author will study the relevancies of RFID usage in overcome this problem.

2. RFID Mechanism

The RFID mechanism will be covered in order to implement the system that can be applied at medical field. The author will also touch the example of fields that have used the RFID for better life.

3. Software (Middleware)

The author also will identify the software that can be used in order to integrate between the reader and tags. This system will act as a middleware and "user-friendly" as to avoid any wrongly key in information that can led to misidentification at the future.

CHAPTER 2

LITERATURE REVIEW / THEORY

2.1 WHAT IS RFID?

RFID stands for **Radio Frequency Identification**, a term that describes any system of identification wherein an electronic device that uses radio frequency or magnetic field variations to communicate is attached to an item. The two most talked-about components of an RFID system are the **tag**, which is the identification device attached to the item we want to track, and the **reader**, which is a device that can recognize the presence of RFID tags and read the information stored on them. The reader can then inform another system about the presence of the tagged items. The system with which the reader communicates usually runs software that stands between readers and applications. This software is called RFID middleware. Figure 2.0 will show how these items being piece together. [1]

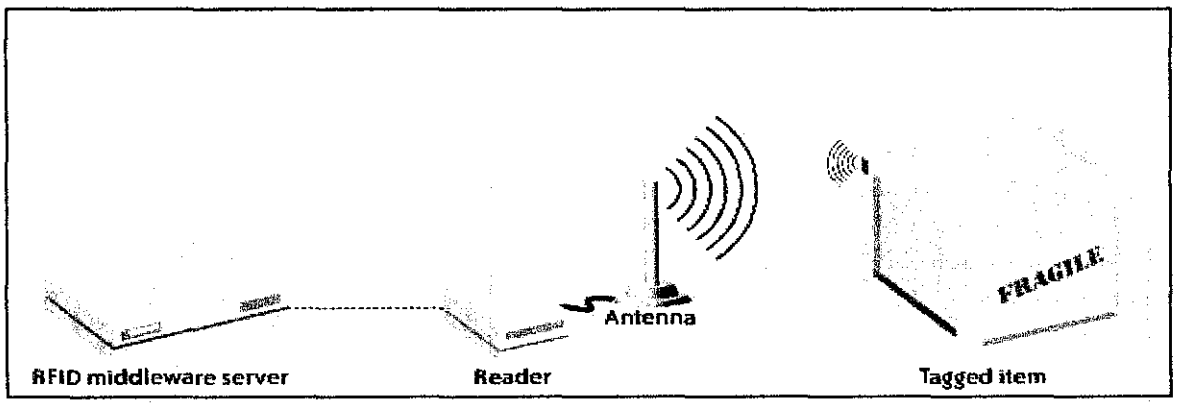

Figure 2.0: RFID mechanism

2.2 RFID SYSTEM COMPONENTS

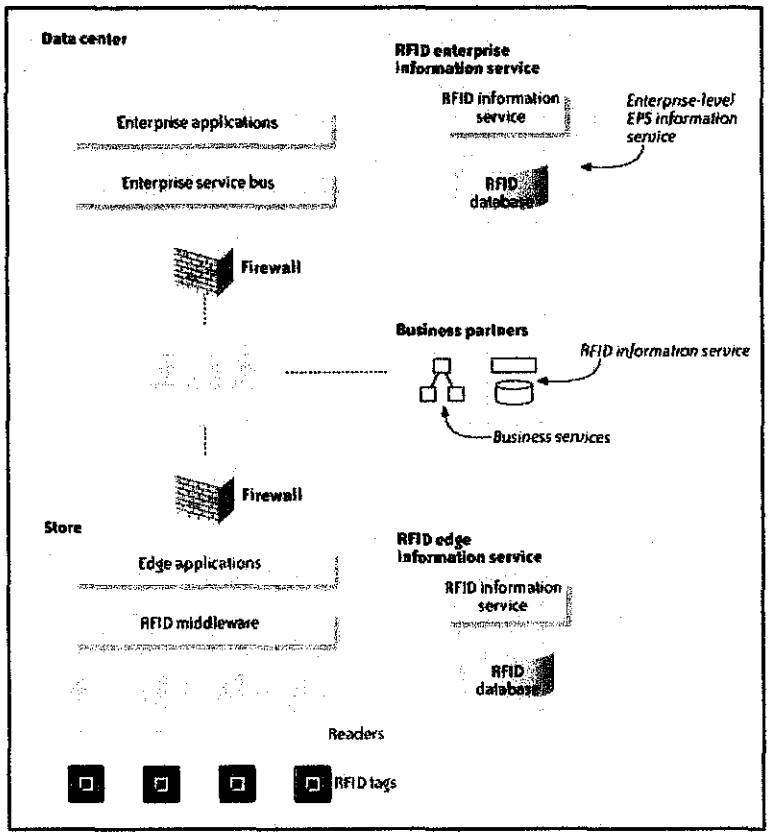

Figure 3.0: RFID system components

Figure 3.0 shows the primary components of an RFID system. The explanation for each of these components will be made, but it will focus at the big picture, starting with the components typically present at the edges.

Figure 3.0 shows the typical components found in a retail store. In the bottom-left corner of the diagram, there is a set of RFID tags that represent the tagged merchandise. The store also has readers stationed within the shelves and at the checkout lanes. These readers may read tags hundreds or even thousands of times per minute, but most of these reads will not be interesting to the application. The readers must also be configured and managed and must know how to work together to cover blind spots should a reader fail. The box marked RFID middleware represents one or more software modules that handle these responsibilities. The box marked Edge applications represents any enterprise applications that have components running inside the store for instance, POS system components. The box marked RFID information service represents a mechanism to store RFID events and related data at the edge.

Based on the figure above, it shown similar RFID information service boxes in the enterprise's data center and in its business partners' data center. This is because RFID information is stored at various points in the infrastructure: at the edges, within the data center, and with business partners.

The two other components shown inside the enterprise data center in Figure 3.0 are the enterprise service bus and enterprise applications. The enterprise service bus is any mechanism that the company may have selected for application integration. Standards-based products that facilitate this are now available. Enterprise applications are any applications that are clients of, or are otherwise affected by, RFID data in the enterprise that are using RFID system.

2.2.1 TAGS

The term **"RFID"** is typically used to describe systems where in a base station of some sort (a reader) is able to recognize another electronic device (a tag) using one of several possible wireless transmission mechanisms. These mechanisms may include microwave but not infrared or visible light systems. Since a reader is able to identify a particular tag, the system can claim to have identified the object to which that tag is attached. Tags may be housed in small plastic buttons, glass capsules, paper labels, or even metal boxes. They may be glued to a package, embedded in a person or an animal, clamped to a garment, or hidden in the head of a key.

To understand how an RFID tag notifies a reader about its presence and identity, consider the simple scenario depicted in **Figure 4.0 (below)**. In this figure, the RFID reader transmits radio signals at a preset frequency and interval (usually hundreds of times every second). Any radio frequency tags that are in the range of this reader will pick up its transmission because each has a built-in antenna that is capable of listening to radio signals at a preset frequency. The tags use energy from the reader's signal to reflect this signal back. Tags may modulate the signal to send information, such as an ID number, back to the reader.

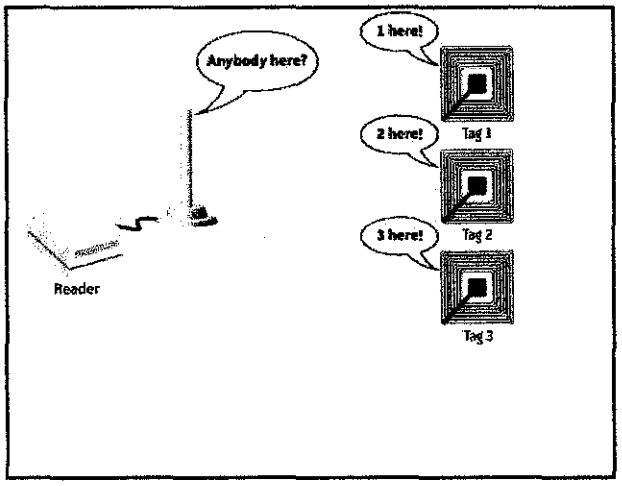

Figure 4.0: Communication between RFID tags and a reader

Many considerations are involved in selecting tags. They include the following:

- Required read range

  Active tags provide a longer read range than passive tags. For retail applications, the read ranges offered by passive tags are usually sufficient.

- Material and packaging

  Different materials have differing RF characteristics. For example, liquids may impede the flow of radio waves. Metal containers also pose interference challenges to the readers.

- Form factors

  RFID tags come in different sizes. The form factor for the tags used for individual products will depend on the packaging used for these products.

- Standards compliance

  It is important to consider whether most of the readers that are generally available will understand the RF tag that being selected. EPC (Electronic Product Code) global and the International Standards Organization (ISO) provide standards for communications between RFID tags and readers.

- Cost

  The cost of a single RFID tag plays an important role in its selection because most applications use many tags.

2.2.2 READERS

RFID readers, also called ***interrogators***, are used to recognize the presence of nearby RFID tags. An RFID reader transmits RF energy through one or more antennas. An antenna in a nearby tag picks up this energy, and the tag then converts it into electrical energy via induction. This electrical energy is sufficient to power the semiconductor chip attached to the tag antenna, which stores the tag's identity. The tag then sends the identity back to the reader by raising and lowering the resistance of the antenna in a kind of Morse code. This is only one scenario, and different tags can work in slightly different ways, but this is typical of the way readers and tags interact.

The selection of a reader is constrained by the tag that being selected. Some readers are compatible with certain types of tags but not with others. Readers, as powerful radio transmitters, must also conform to local regulations concerning frequency, power level, and duty cycles (how often the reader is actually transmitting). When selecting a reader, also pay close attention to the physical environment in which it will be operated. The reader must be small enough to be out of the way of personnel and equipment and tough enough to withstand exposure to dust, shock, humidity, or temperature extremes. Finally, an often-overlooked consideration in selecting a reader is how well it will cooperate with your current IT monitoring and management tools.

2.2.3 RFID MIDDLEWARE / SOFTWARE

Choosing the right tags and readers and determining where to put the antennas is only the first step in building a working RFID system, because identifying items is only the first step in managing them. The capability to read millions of tags as they move through the supply chain and the need to tie tag codes to meaningful information will generate large amounts of data with complex interrelationships. One of the primary benefits of using RFID middleware is that it standardizes ways of dealing with the flood of information these tiny tags produce. In addition to event filtering, RFID need a mechanism to encapsulate the applications so as to prevent them from knowing the details of the physical infrastructure (readers, sensors, and their configurations). Ideally, RFID need a standards-based, application-level interface to the RFID infrastructure that applications can use to request meaningful RFID observations.

2.3 SIGNIFICANCE TO USE RFID

RFID and barcodes both carry information about products. However, there are important differences between these two technologies:

- Barcode readers require a direct line of sight to the printed barcode; RFID readers do not require a direct line of sight to either active RFID tags or passive RFID tags.
- RFID tags can be read at much greater distances; an RFID reader can pull information from a tag at distances up to 300 feet. The range to read a barcode is much less, typically no more than fifteen feet.

- RFID readers can interrogate, or read RFID tags much faster; read rates of forty or more tags per second are possible. Reading barcodes is much more time-consuming; due to the fact that a direct line of sight is required, if the items are not properly oriented to the reader it may take seconds to read an individual tag.
- Barcode readers usually take a half-second or more to successfully complete a read.

- Line of sight requirements also limit the ruggedness of barcodes as well as the reusability of barcodes. (Since line of sight is required for barcodes, the printed barcode must be exposed on the outside of the product, where it is subject to greater wear and tear.) RFID tags are typically more rugged, since the electronic components are better protected in a plastic cover. RFID tags can also be implanted within the product itself, guaranteeing greater ruggedness and reusability.
- Barcodes have no read/write capability; that is, you cannot add to the information written on a printed barcode. RFID tags, however, can be read/write devices; the RFID reader can communicate with the tag, and alter as much of the information as the tag design will allow. [2]

2.4 RFID AND MEDICAL INSTITUTION

According to **McDermott at Bio-Logics** [3], "While the RFID technology is still relatively new, it may eventually replace barcodes. Our discussion with hospital managers, however, reveals a limited appeal of RFID technology in its current state. Still, there are a few areas where RFID could provide some significant benefits today. For example, **infectious isolation** — verification could be done from just outside the room or contaminated area, eliminating the need to cleanse or sterilize the device." Another area is for critical operation such as surgery operation. Many procedures such as liver operation require the patient be draped and then the drape is tucked in underneath the patient's torso. This usually makes any access to an ID band for scanning impossible. Lifting the drape to see or scan the ID band would invade the sterile field and is not allowed. If an RFID device were used, the ID band could be scanned right through the surgical draping and allowing for positive verification during the procedure.

One of the early applications of RFID in hospitals is the patient locator systems. **Awarix, Birmingham, Alabama,** makes a system to track patient movement using RFID technology. **CEO Gary York** explains that their basic approach is to address operational efficiencies and capacity management issues. The first approach is to track patients using

an active tag. It will be used for entry and exit points from units because it is easier to locate the patient. The patient can be determined by using this approach whether they are available in their room or not. By this approach also, staff would have the idea to monitor patient location. [4]

As described by Zebra, **Printing Solution for Business Improvement (2006)**, *'RFID tags consist of an integrated circuit (IC) attached to an antenna—typically a small coil of wires—plus some protective packaging (like a plastic card) as determined by the application requirements'.* [5]

The tags are used by the readers to fetch information stored in the tags. They come from different sizes and types and can be either "passive" (no battery) or "active" (self-powered by a battery). The data is stored in the Integrated Circuit that transmitted through the antenna to the reader. It can be in read-only, read/write, or both combinations. Based on Zebra, smart labels can be described as Zebra mentioned about "smart labels" as *'tag that functioning by combining human-readable information and bar code technology with RFID.'*A smart label consists of an adhesive label that is embedded with an ultra-thin RFID tag. In on-demand applications, it is said that the tag inlay can be encoded with fixed or variable data and tested before the label is printed, and the label can retain all existing formats and layouts that are required to support bar codes, text, and graphics used in established applications. A read/write smart label also can be programmed and reprogrammed.

According to **Amal Graafstra (2003)**, *'tags are the heart of RFID systems'*.
They store the data, enabling the entire point of the system—identification. The data is being stored, accessed, changed, and transmitted over the air is different based on the producer of the tag. Many manufacturers of RFID equipment have come up with their own methods of storing data on RFID tags and developed their own protocols for reading, writing, and transmitting data although a few standards are in place. [6]

2.5 SARS

Severe acute respiratory syndrome (SARS) is a respiratory disease in humans which is caused by the SARS coronavirus. There has been one pandemic to date, between November 2002 and July 2003, with 8,096 known infected cases and 774 deaths (a mortality rate of 9.6%) worldwide being listed in the WHO's April 21, 2004 concluding report. [7] Malaysia also included into the statistic for the countries that being attacked by SARs disease. Based on the author research, government has taken action by implement the quarantine process in order to prevent the disease from spreading to the others. System that being used for quarantine process on that day was the manual based (paper form). The problem is this type of administration was quite unorganized and can lead to any possibilities such as form misplaced, patient misidentification and others.

2.6 TYPE OF RADIO FREQUENCIES

Basically, the integration between research study and technical operation against the problem statement is the key determination on either success or failure of this project if there is no more obscurity while testing, the project is said to be successfully developed and thus can be used by the end users.

RFID system is used in this project as the author is keen to study and to know more on the technology of the RFID system. Research and studies on the system showed that there are many types of RFID tags and readers. They can consist of different frequencies, uses and ranges. As concluded by **Extreme Tech**, there are several types of RFID that can be used. The table below; taken from Extreme Tech web site, shows a quick cross-section of the types of RFID technologies out there, their uses, and their typical read ranges:

RFID Frequencies, Uses, and Typical Ranges

Frequency	Type	Uses	Pros and Cons	Range
125 KHz–148 KHz	Passive	Animal tracking (ISO 1174/11785), access control, OEM applications	Signal negotiates liquids and metals fairly well. Higher tag cost because of long solid copper antenna.	1/2 to 4 inches typical; 6 to 12 inches possible with special equipment
13.56 MHz	Passive	EAS (antitheft), book and document management, access control, and OEM apps.	Antennas can be printed on substrate or labels, lowering tag costs. Serious interference from metals.	Can range from inches to several feet depending on reader hardware and tag type.
433 MHz and 2.5 GHz	Active	Highway toll payment systems, vehicle/fleet management, asset tracking.	Very long range. Very high tag cost. Uses a battery, so tags have a finite lifespan (typically 5 years).	Typically around 30 feet, but can range up to hundreds of feet.
915 MHz	Passive	Supply chain tracking and OEM applications.	Very low cost tag. Long range. Anti-collision capabilities allow simultaneous tag reads. Serious interference from liquids and the human body.	About 10' from a single antenna and 20' between two antennas. Longer ranges can be realized with special hardware.

Figure 5.0: Type of RFID frequencies

2.7 OTHER APPLICATIONS USING RFID

2.7.1 Toll collection scheme at Singapore

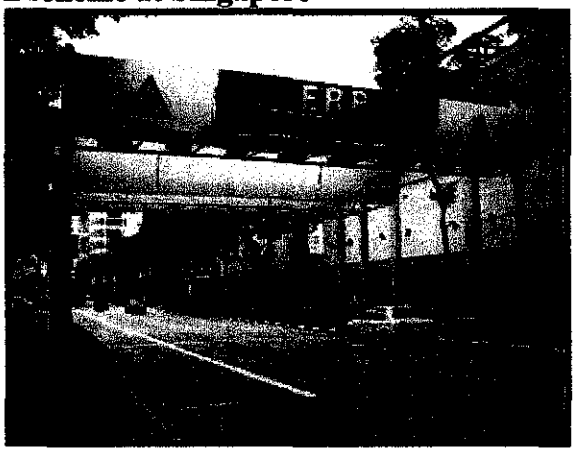

Figure 6.0: ERP gantry at North Bridge Road

The **Electronic Road Pricing** scheme is an electronic toll collection scheme adopted in Singapore to manage traffic by road pricing, and as a usage-based taxation mechanism to complement the purchase-based Certificate of Entitlement system. It was implemented by the Land Transport Authority in September 1998 to replace the Singapore Area Licensing Scheme after successfully stress-testing the system with speeding Lamborghinis, Porsches and Ferraris. It is the first city in the world to implement an electronically toll collection system.

The scheme consists of ERP gantries located at all entrances to Singapore's central business district – areas within the Central Area such as the Downtown Core. They may also be located along roads with heavy traffic to discourage usage during peak hours. A device known as an in-vehicle unit (IU) is affixed on the lower front windscreen within sight of the driver, in which a stored-value card, the CashCard, is inserted. Installation of IU in all Singaporean cars is mandatory. Non-Singaporean cars entering Singapore must either rent an IU or pay a daily flat fee.

When a car equipped with an IU passes under a gantry, a toll is deducted from Cashcard. Sensors installed on the gantries communicate with the chip in the CashCard via a dedicated short-range radio communication system, and indicate the deducted amount to the driver via an LCD screen on the IU. The deducted amount is

dependent on the time and location (varying from S$0.25 to S$3.00 for passenger cars). No toll is imposed during off-peak hours.

2.7.2 Clothing Industry

Figure 7.0: Touch screen being used for selecting the preferred clothes

As technology keeps on increasing day to day, the used of bar-codes and RFID tags on consumer goods are now commonly applied. Both bar-codes and RFID tags are applied to make sure that the shopkeepers, supermarket owners, boutiques proprietors can keep track on their items as well as to ease them to keep records of every single items or products that is sold or in the inventory.

The main idea of this application is to enhance the use of RFID in customer's buying trend. In this project, the RFID tag is used basically to change the trend of customers on buying clothes. The implementation of the tags will not only helps the customers to know the price of their desired clothes – current usage of RFID tags in market/business, but will also helps the customer to choose other apparels, shoes or trousers, that are matched with their clothes as well as to know the location (in the same shopping mall or boutique) of the matched ones. For example, a customer wants to buy a shirt in a boutique. The customer tries it on in the fitting room and at the same time, the RFID reader in the fitting room will detect the RFID tag attached to the cloth, and the display panel (monitor) in the fitting room will display pictures of what matched or relevant to the cloth.

CHAPTER 3

METHODOLOGY

3 METHODOLOGY & PROJECT TASK

The system development methodology for that will be used is the Rapid Application Development methodology (RAD). This methodology is a compression of series of short, iterative development cycles which consists of analysis, design, build and test phases. Comparing to the traditional sequential development model e.g. Waterfall Methodology, this method have a number of advantages.

The objective of choosing this model is to build fast system development and delivery of a high quality system at a relatively low investment cost. It can reduce project risk by breaking the project into smaller segments and providing more ease-of-change during the development process. While this system concentrates on fulfilling the business need, and while technological or engineering excellence is of lesser importance, RAD is most suitable choice.

The project control involves prioritizing development and defining delivery deadlines or "time boxes". If the project starts to slip, emphasis is on reducing requirements to fit the time box, not in increasing the deadline. Standard systems analysis and design techniques can also be fitted into this framework. The RAD methodology is most appropriate to be adopted in a small to medium scale and of short duration, where the project scope is focused, such that the business objectives are well defined and narrowed.

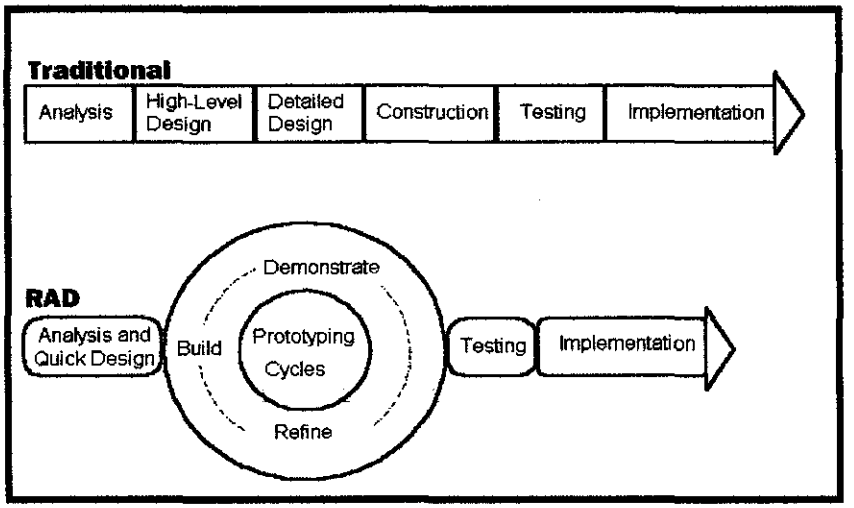

Figure 8.0: Traditional way versus Rapid Application Development methodology

3.1 PLANNING

Planning phase is related on the source of the project, identifying the problems faced and determining the objectives of the project to overcome the problems faced. Gathering information from experts, friends, professional individuals and lecturers are also conducted in this phase to give the main idea, capability and feasibility of the project. Survey has been done in order to purchase suitable RFID kits for the project.

A broad idea to avoid those types of problems as the author mentioned earlier in the Problem Statement section has been raised by doing researches or preliminary studies. During this study, a suitable initiative has been chosen which is to make use the RFID system to solve or reduce the problems. The purpose of this study is to obtain as much information in order to better understanding of RFID system.

3.2 ANALYSIS

User and system requirements information are gathered and documented in this phase. Research and literature reviews about related information of the system are studied by gathering journals, books, articles, and surfing through the internet. Main areas of studies

for this project are implementation of RFID, RFID technology, RFID devices and applications, database software and other related hardware devices such as computers. Software and hardware which will be used for the project development could also be determined during this phase.

3.3 DESIGNING

In this phase, storyboard of the system is drafted based on the information gathered during analysis phases. Draft of the system interface and algorithms of the system will also be identified during this phase. The sub-systems and functional part of the system will be developed. The designing part will start at building a database to store information about the patient. Then, the system interface will be developed followed by developing coding and source code for the system. Continuing the design part, the next step is to configure the RFID system so that the system will allow the connection between the RFID system, the database and computers (interface). This step will be simultaneously designed with the hardware assembling. After all the functional parts developed is combined, the whole system will be up and running.

Current idea that is to be suggested is the architecture of the system, which emphasize on data transmission through RFID system and how the system will react to display pictures. There is also a possibility that the design might change during the development task due to the change of requirements.

3.4 TESTING

During testing phase, the functionality of the RFID kit will be tested especially in several aspects such as distance, speed limit and other aspects that necessary. Other than that, the integration between hardware and software will be tested as to make a system to execute in the smoothest way.

During the testing phase, the author has used one program downloaded from the internet in order to test the connection of RFID device with this program. It was purposely done as to ensure that the RFID reader can read the tag that has been provided into the package.

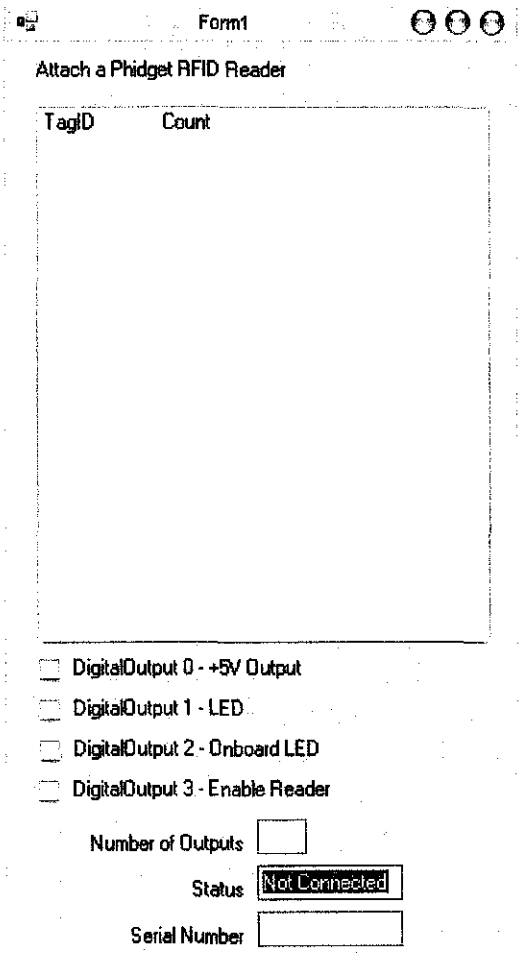

Figure 9.0: Simple RFID program

In order for the software to be functioned, it has to integrate with the device (RFID tag and reader). The above program was functioning with Phidget RFID kit and the direct purpose is to verify whether the Phidget RFID kit was functioning or not.

Below is portion of the coding that being used to implement above sample program;

```
Public Class Form1
    Dim WithEvents RFID1 As Phidgets.RFID


    Private Sub Form1_Load(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        'To reduce code complexity we assume that there is one
PhidgetRFID
        'attached to the PC before the program is run.
        RFID1 = New Phidgets.RFID()
        RFID1.Open()
        'Defaults for text fields
        txtStatus.Text = "Not Connected"
    End Sub

    Public Sub New()
        ' This call is required by the Windows Form Designer.
        InitializeComponent()
        ' Add any initialization after the InitializeComponent() call.
        lvPhidgetInfo.MultiColumn = False
        lvPhidgetInfo.Items.Insert(0, "TagID              Count")
    End Sub

    Private Sub RFID1_Attach(ByVal sender As Object, ByVal e As
Phidgets.Events.AttachEventArgs) Handles RFID1.Attach
        'When the Phidget RFID attaches update the form text boxes
        Label1.Text = "Phidget RFID Reader has Attached"
        txtStatus.Text = "Connected"
        txtNumOutputs.Text = RFID1.outputs.Count
        txtSerialNumber.Text = (Str(RFID1.SerialNumber))
        RFID1.Antenna = True
        CheckBox3.Checked = True
        RFID1.LED = true
        CheckBox2.Checked = True

    End Sub
    Private Sub RFID1_Detach(ByVal sender As Object, ByVal e As
Phidgets.Events.DetachEventArgs) Handles RFID1.Detach
        'If the Phidget RFID detaches close the form
        Me.Close()

    End Sub
```

Figure 10.0: Simple RFID program coding

3.5 IMPLEMENTATION

The implementation of the system will be done interchangeably with the testing phase to ensure the quality of the system and to reduce failure. The system will be released and used by normal users. Feedback and further suggestion for the system improvements is gathered for future enhancement.

3.6 SYSTEM HARDWARE AND SOFTWARE

3.6.1 Minimum Software Requirements

i. Visual Basic 6.0

This software is used to develop the user interface for the system. The interface is basically to display patient information by clicking on necessary buttons.

ii. Database Application

The database will enquire Microsoft Access as the database program.

iii. Phidget Manager web services

This application acts as a driver and panel for controlling RFID devices.

3.6.2 Minimum Hardware Requirements

i. Standalone Server

Operating System	: Window XP Professional Service Pack 2
Processor	: Intel Pentium 4 1.8 GHz
Memory	: 512 MB DDR RAM
HardDisk	: 10 GB

ii. Phidget RFID TAG and READER (RFID Kit)

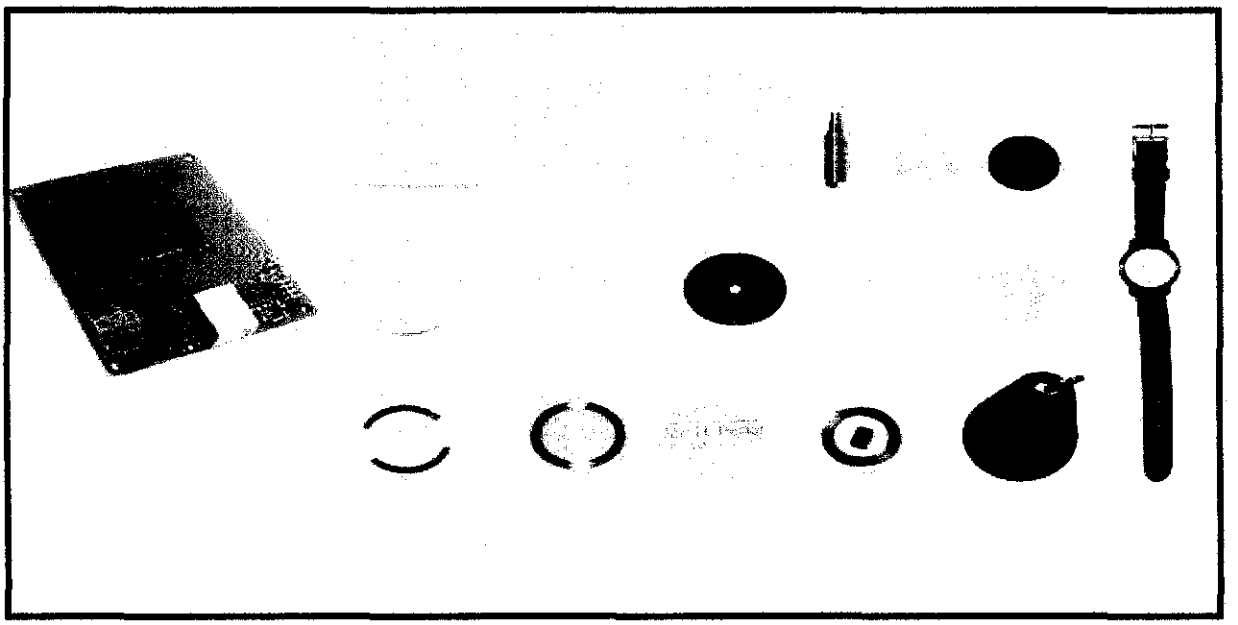

Figure 11.0: PhidgetRFID Kit

The **PhidgetRFID** uses a USB connection, which is actually easier because almost all computers today support USB devices. And because it draws power from the USB connection, it doesn't need to provide an external power source. It's simply connecting the **PhidgetRFID** to the computer and start scanning.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 CRITICAL PATIENT IDENTIFICATION SYSTEM (CPIS)

Here is the standard operating procedure and demonstration for the system.

4.1.1 RUN THE DEVICE (RFID KIT)

1. Plug in the PhidgetRFID reader to the USB port of the personal computer.

2. Install and run the PhidgetWebService on the computer that has the PhidgetRFID connected. Once the PhidgetWebService is up and running, the program can then communicate with it in order to control the PhidgetRFID reader.

3. Once installed, PhidgetWebService can be found in the C:\Program Files\Phidgets directory. The PhidgetWebService Manager can be invoked (GUI version of the WebService) by running the PhidgetWebServiceManger.exe from this directory. Once it is up and running, it'll be found in the System Tray.

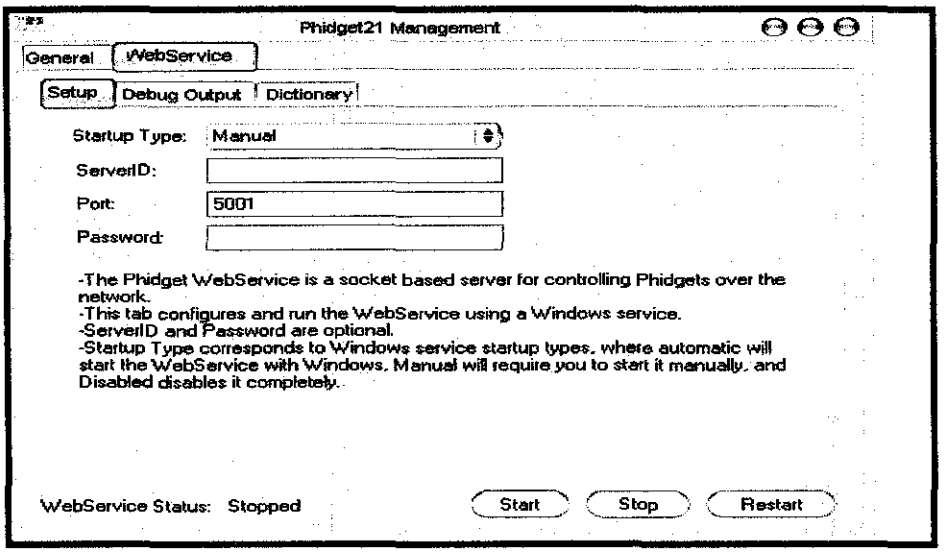

Figure 12.0: PhidgetWebService

4. Double-click on the icon to launch the PhidgetWebService Manager. Using the manager, the settings of the WebService can be changed as well as manage the Phidget devices (not just the PhidgetRFID reader). As shown in Figure 3-2, the PhidgetWebService is in stopped condition (that's mean the RFID reader in off condition). In order to make it run, just click at Start button.

5. After that, the RFID reader will be in standby condition.

4.2 SYSTEM INTERFACE

In order to run the application, double click the **CPIS.EXE** file.

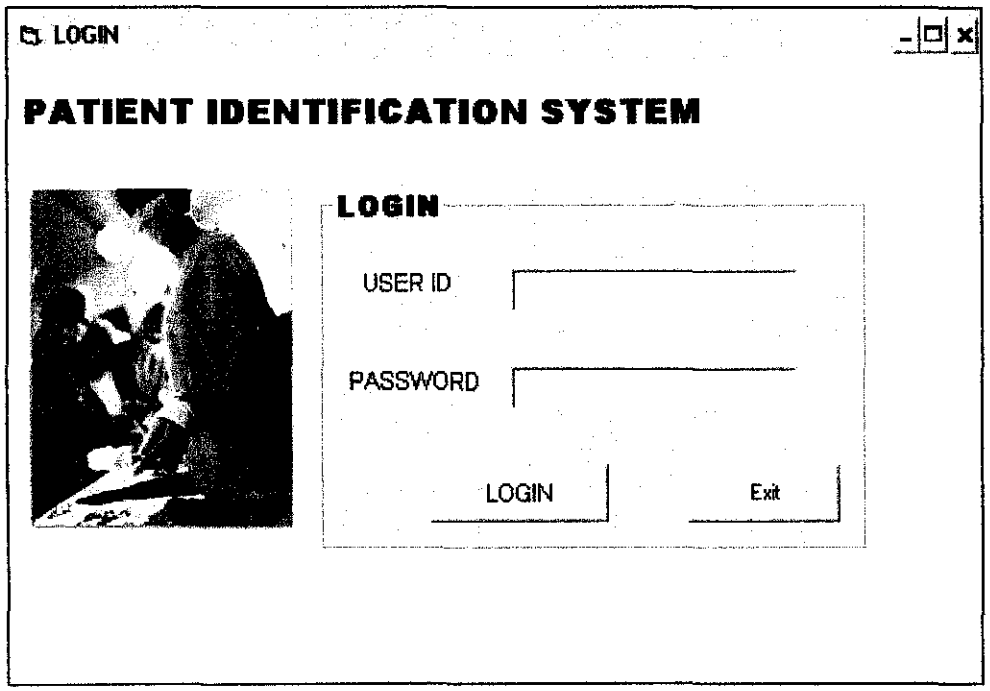

Figure 13.0: Login page

1. After double click the .exe, it will bring the user to login page of Patient Identification System. The user will be granted with unique **user id** and **password.**

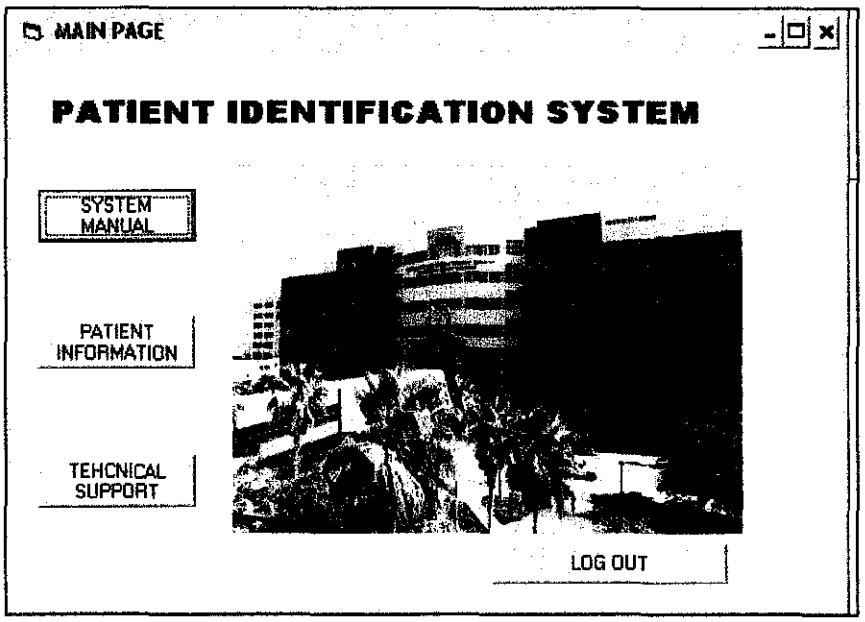

Figure 14.0: Main page

2. After the user successfully login, it will bring the user to the main page of the system that consisting of three buttons that will bring to separate area. The buttons are **System manual**, **Patient Information** and **Technical Support**.

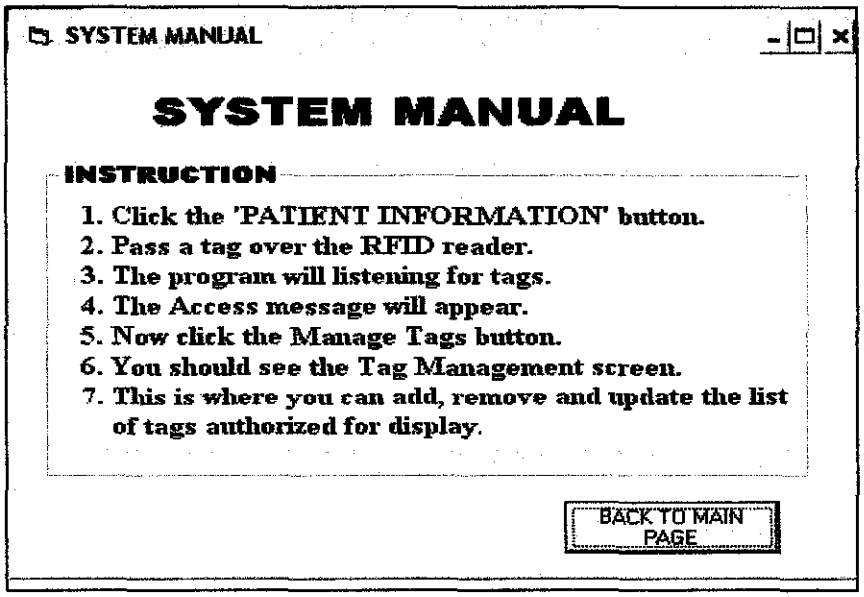

Figure 15.0: System Manual page

3. This is the page that will be appeared if the user key in the **System Manual** button. This page consists of the manual and instructions on how to use the system.

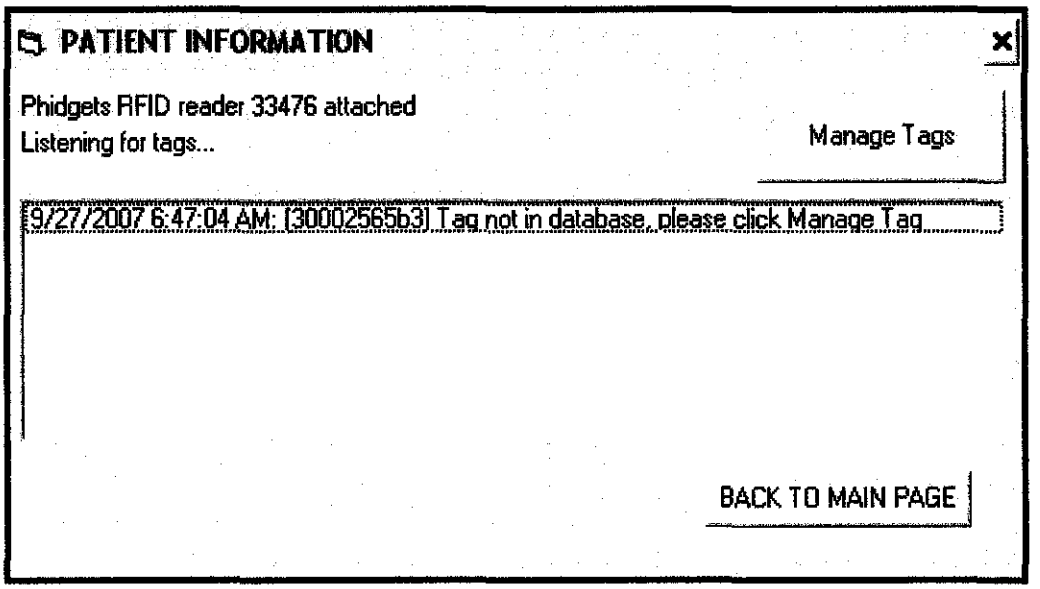

Figure 16.0: Patient Information page

4. If the user clicks the **patient information** button, it will bring the user into patient information page. Here, the program will listen to tags that being swap to the reader. If the tag is never been read before, the above message will be appeared. In order to key in the information, the user have to click the **Manage Tags** button.

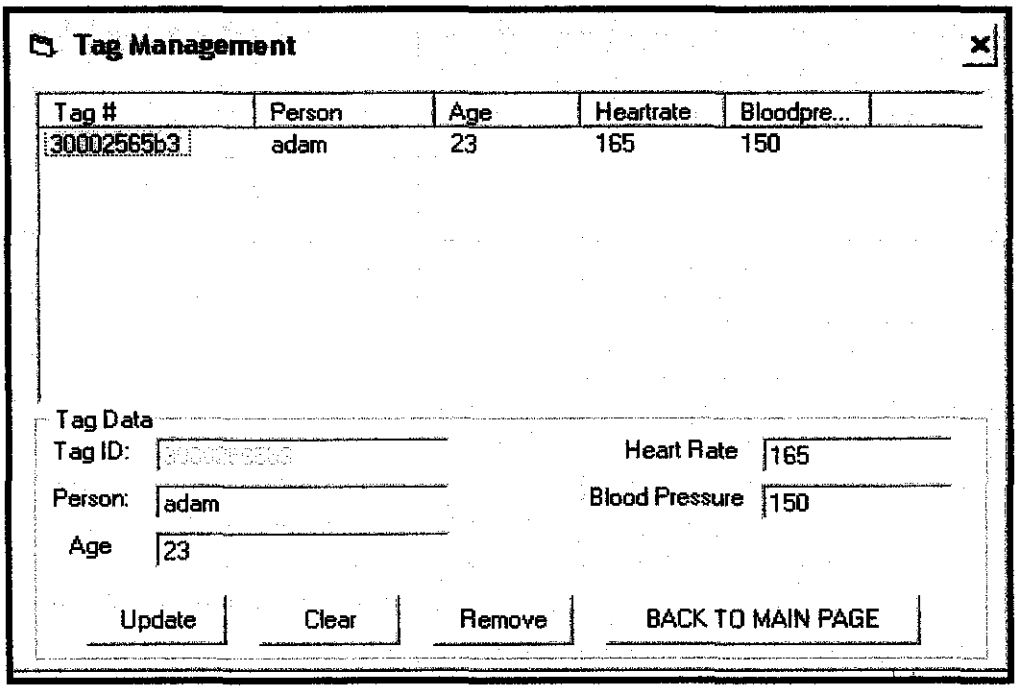

Figure 17.0: Tag Management page

5. Figure 17.0 shown how the **Manage tags** button will bring the user into tag management page that give the opportunity to the user to add, update, clear and remove information.

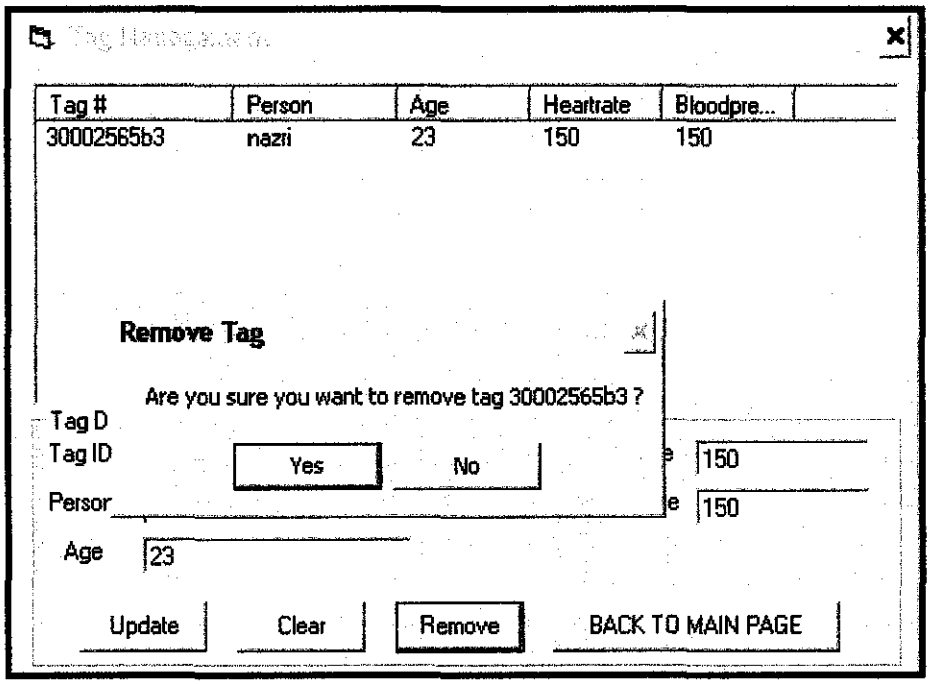

Figure 18.0: Remove tag information

6. If the user wants to remove the information in the tags, they have to click **Remove** button and the above message box will appear to ask their conformity regarding their action.

4.3 FUNCTIONS

There is about 4 functions that being created for CPIS user. CPIS user can;

- *Add new information*

  This function will allow the patient data being kept and stored into database based on the information from the patient and verification from medical staff.

- *Update existing information*

  This function will allow updating purpose of the existing data from database which being displayed on the system interface.

- *Clear information*

  This function will allow the user to clear up the input box column that has been filled in with patient data and available for new information.

- *Remove information*

  This function will allow deleting purpose of the available data from the database which being displayed on system interface.

4.4 DATA INTEGRITY

In order to make sure that this system reliable and integrated with the objectives of the study, the author has equipped with several features;

- *Object identifiers*

  Each patient will be provided with tag that written with unique id as to ensure that there is no redundancy in the database. So, it will be able to call merely one referred data element to gain the necessary data requested.

- *Domain integrity*

  Appropriate controls were designed to ensure that, there is no fields take on the value that is outside of the range of legal values.

- *Access level*

  Access to CPIS, the medical staff will be given with unique and valid username and password. Theoretically, access level only provided for medical staff. As this system will acting standalone, any configuration and modification will be provided by system administrator by contacting the technical support team.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

Based on the final prototype for CPIS system overview using RFID technology, basically it has been done and completed using Visual Basic 6 and PhidgetWeb Services software. This system acts as a medium for medical staff in storing and retrieving patient information in such organized way. 4 functions have been provided that are add, update, clear and remove information from the system.

5.2 PROJECT ACHIEVEMENT

In principle, the system application has been developed in standalone system with minimum function. As to ensure that this system can benefit and be marketable, the development of database has been done to allow the appropriate data to be stored and access by the system. After decision of database implementation has been made, the critical task integrate the RFID device and the software was been focused on. By getting advice from Electrical and Electronic side, my supervisor, research through internet and other sources, I have come out with the solution by getting the language command of Visual Basic 6. After the system testing using sample program being performed, the more confidence that the system has meet the objectives with fully assigned to shift the database record process and data access process can be applied through CPIS system. This definitely will help the medical staff to add, update, remove and delete information from the system.

In term of security matters, the synchronization process by providing unique user id and password has been successfully done. The advantage of this system is the lightest software that can be used at minimum requirements and act standalone.

5.3 CONSTRAINTS

Here are some constraints that have been faced by the author during development of this system;

- Web based system

  Although the author has successfully created this system, but the limitation that has been found was this CPIS system was lack in term of network connectivity. It means that this system can be act standalone. This is due to limitation of the author's time as most of time was focused on the integration part (RFID device and software).

- Not well versed in term of medical practices

  As we know, the author knowledge regarding medical practices was beyond the learning curve. Although a lot of researches have been done, gathered from several sources, but the author still not well versed in this medical field. Lack of participation from medical side also can be considered one of the factors for these constraints.

- Interface

  Same as the web based constraint, the author facing difficulties in designing more attractive system as most of the time was focused on the integration part (RFID device and software)

5.4 RECOMMENDATIONS

Here are some recommendations for future enhancement;

- Interface

  Hopefully, for future enhancement, the author will emphasize more on designing attractive user interface as this will make this system embedded only with useful function but also fine interface. There also will be equipped

with several new functions such as information of this system and other that suitable.

- Collaboration with medical side

  Another future planning is to get opinion or collaborate with medical side in term of analysis and designing the system that suits directly with their requirements. By doing this, this system will be guided with standard protocol of medical field.

- Developing RFID web based system

  Last but not least, the author will look through and study the possibility in developing the RFID web based system so that it can be used more widening within a country or more than that. It will save that time of installation rather than act standalone and required more computers to be used.

5.5 CONCLUSIONS

This study describes the overview of the RFID system development and updates the progress that being done so far. The system utilizes RFID usage in the healthcare institution and the scope are focusing on patient identification. The idea of the system is to overcome the problems faced by healthcare institutions especially in gathered patient information in such a faster way. The report also explains the appropriate and most effective methodology for this type of project which is Rapid Application Development (RAD) and the strategy that will be used in each phase (Planning, Analysis, Design, and Implementation). In the report are also stated on how to integrate the RFID reader with the Middleware/Software. The system is aimed to ensure the RFID system for patient identification will execute in the smoothest way and by inventing in this project, it will create the way to other inventor to widen the usage of RFID in human daily life.

REFERENCES

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[4] Patient Safety and Quality Healthcare: Barcoding and RFID
[www.psqh.com/sepoct05/barcodingrfid2.html]

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[7] Severe acute respiratory syndrome
[http://en.wikipedia.org/wiki/SARS]

[8] Government action against SARs
[http://www.hospitals-malaysia.org/index.cfm?menuid=59&parentid=49]

APPENDICES

APPENDIX 1-1

- Manual based
  (paper form)

http://www.hospitals-malaysia.org/index.cfm?menuid=59&parentid=49

Appendix 3

MONITORING FORM FOR HEALTH STAFFS HANDLING SARS PATIENT

Name of clinic:
District:
State:
Date:

Patient Particulars

Name:
Sex:
Age:
Ethnic group:
Category (eg: Dr, S/N, MA etc):
Place of contact with SARS patient:

Triage area/room	
Physical Examination Room	
Transportation	

Date of contact with SARS patient:
Date of presenting symptoms:
Presenting symptoms:

Fever	
Cough	
Breathing difficulty	
Others	

	Date	Temperature (Morning)	Temperature (Evening)

http://www.hospitals-malaysia.org/index.cfm?menuid=59&parentid=49

- Body temperature must be record from the armpit

- THIS FORM HAS BEEN USED DURING SARs QUARANTINE PROCESS AT GOVERNMENT HOSPITAL DURING 2003.

- THE PROBLEMS THAT BEING OCCURRED ARE SUCH AS PATIENT FORM WILL BE MISPLACED, UNORGANIZED AND OTHER POSSIBILITIES THAT WILL AFFEXT THE PATIENT INTERM OF WRONG PROCEDURE.

APPENDIX 1-2

- Screenshots

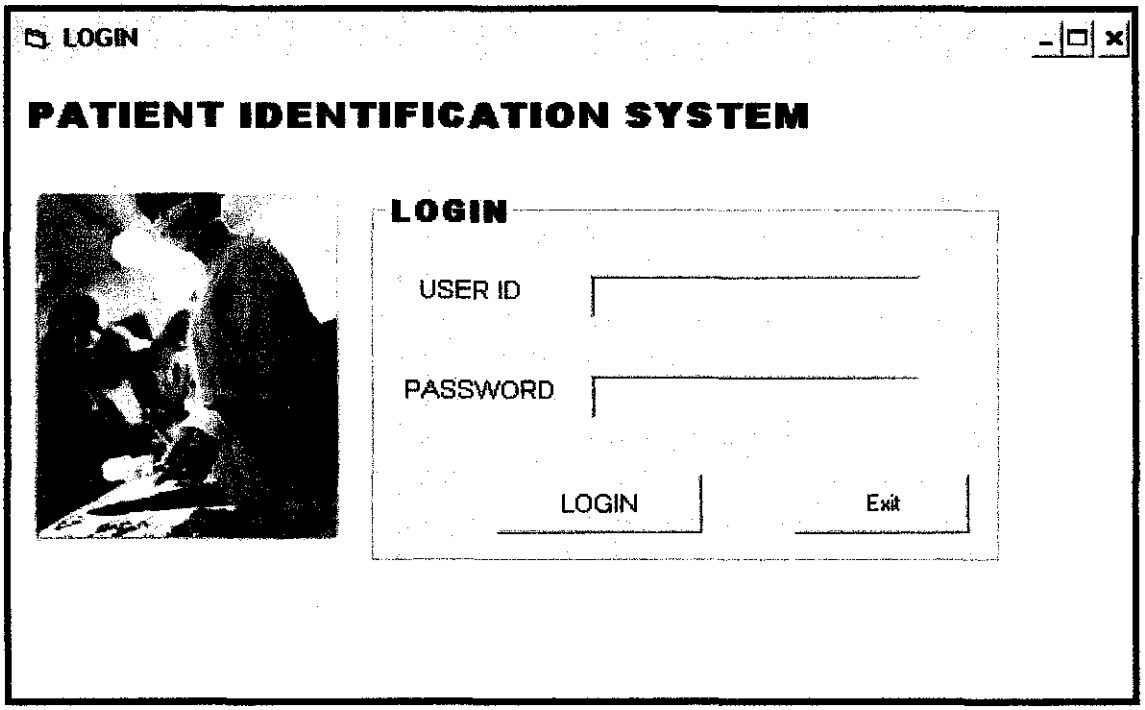

Figure 1-2-1: Login page

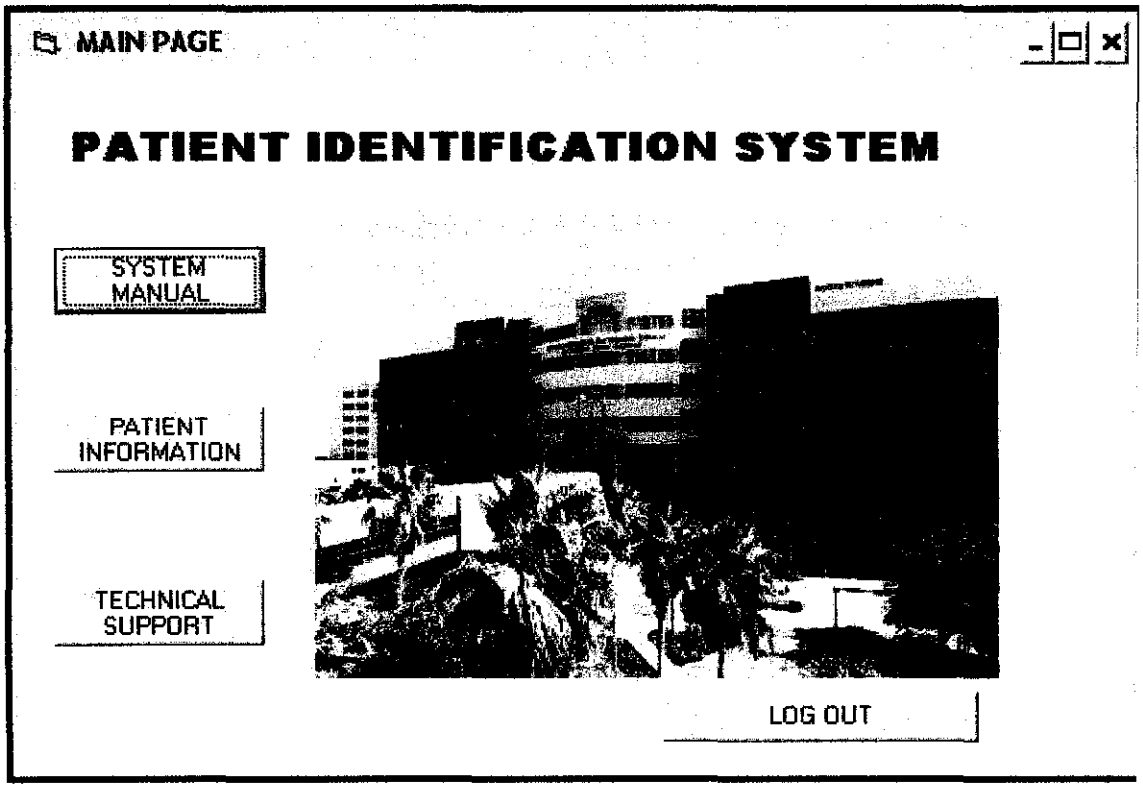

Figure 1-2-2: Main page

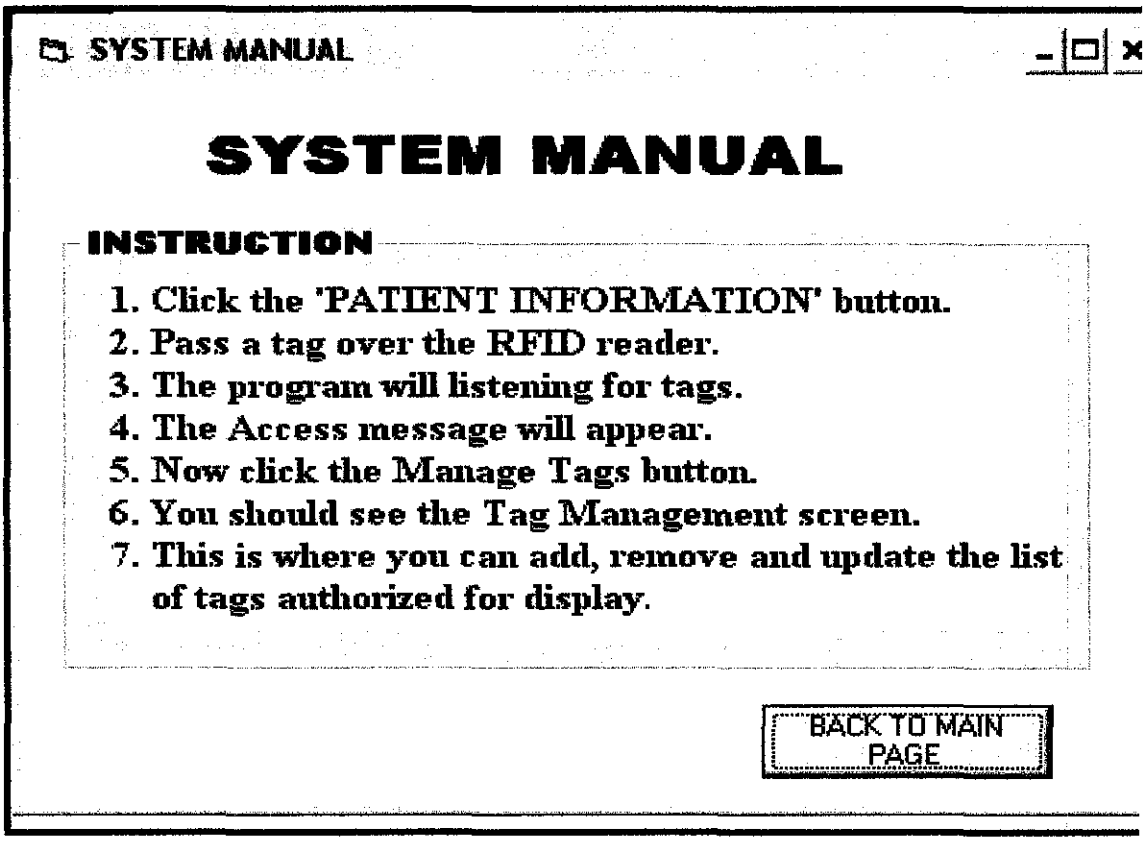

Figure 1-2-3: System manual page

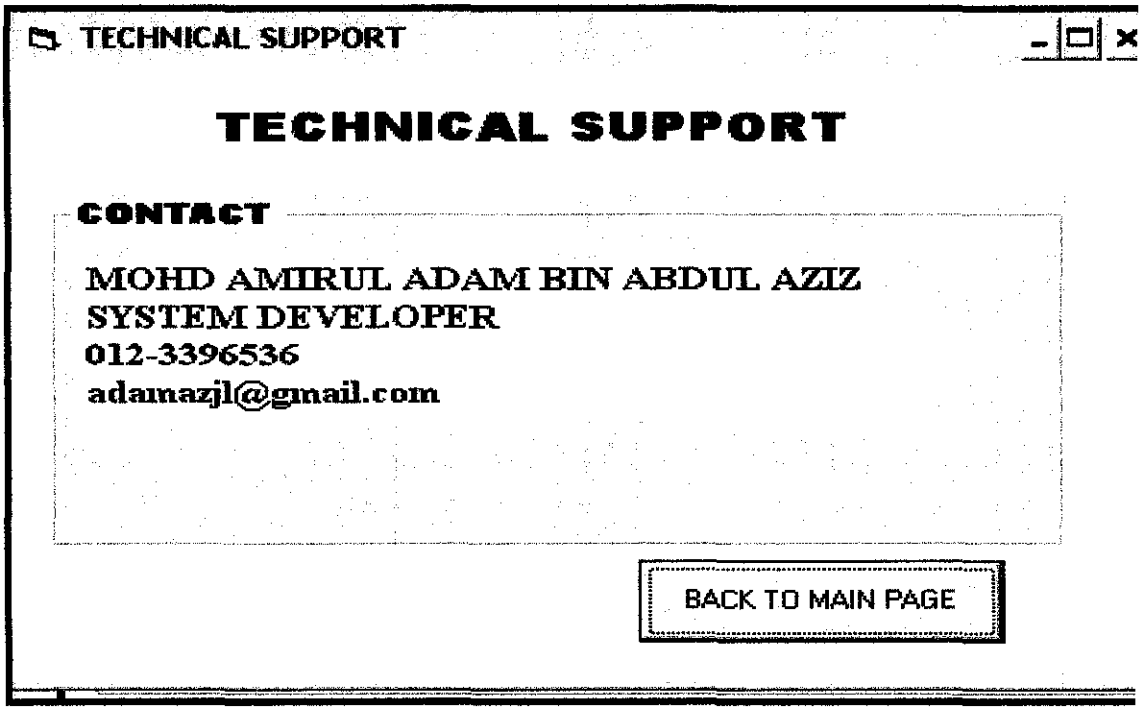

Figure 1-2-4: Technical support page

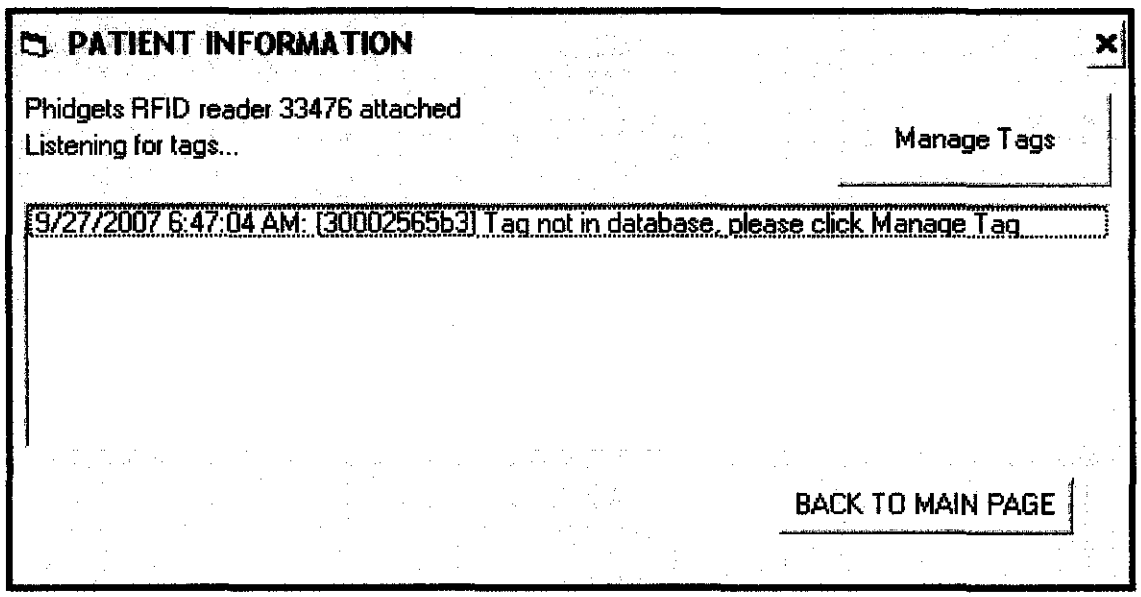

Figure 1-2-5: Patient information page

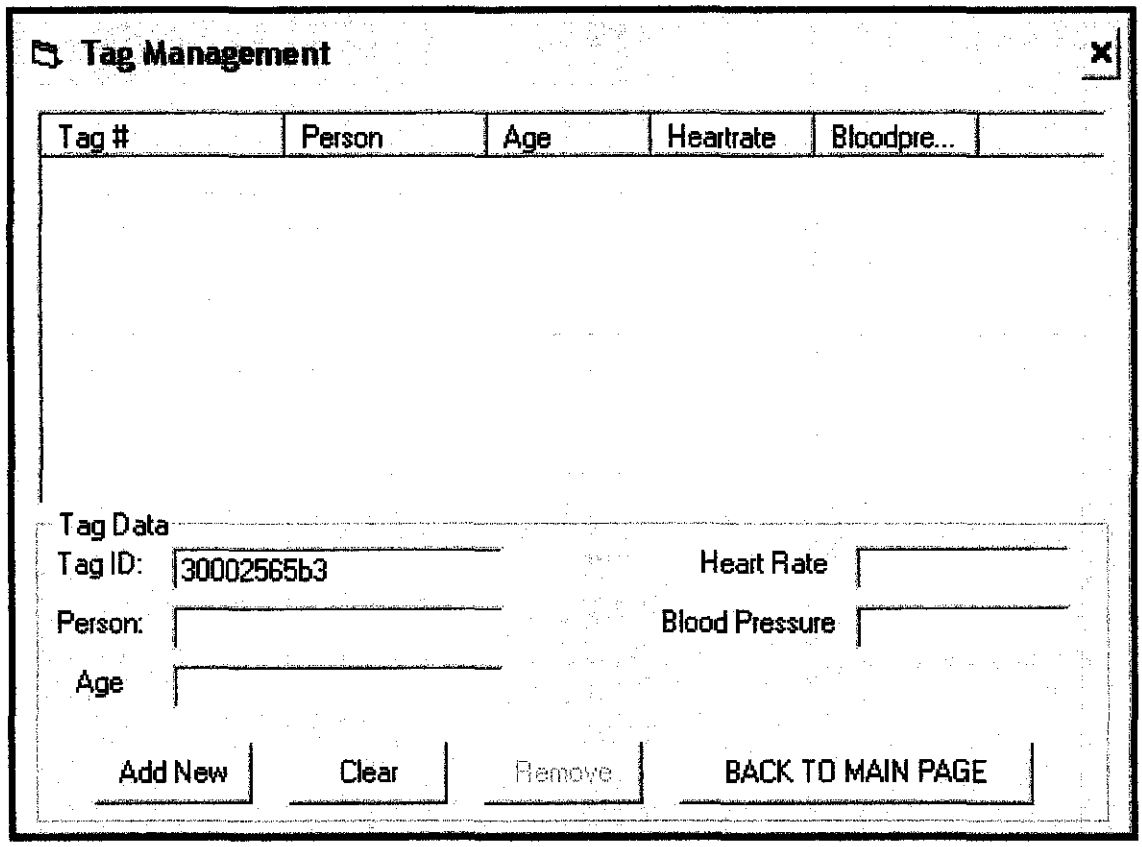

Figure 1-2-6: Tag management

APPENDIX 1-3

- Programming Codes

(Visual Basic 6)

CODING

LOGIN PAGE

```
Private Sub btnexit_Click()
End
End Sub
Private Sub btnlogin_Click()
    If txtuserid.Text = "admin" Then
    Else
        MsgBox "Invalid User Id! Please try again!", vbCritical + vbOKOnly
        Exit Sub
    End If
     If txtpassword.Text = "123456" Then
    Else
        MsgBox "Invalid Password! Please try again!", vbCritical + vbOKOnly
        Exit Sub
    End If

    txtuserid.Text = ""
    txtpassword.Text = ""

    frmmainpage.Show
    frmlogin.Hide

End Sub
```

****

MAIN PAGE

```
Private Sub btnlogout_Click()
frmlogin.Show
frmmainpage.Hide
End Sub

Private Sub btnpatientinfo_Click()
frmpatientinfo.Show
frmmainpage.Hide
End Sub

Private Sub btnsupport_Click()
```

```
frmtechsupp.Show
frmmainpage.Hide
End Sub

Private Sub btnsysmanual_Click()
frmsystemman.Show
frmmainpage.Hide
End Sub

Private Sub Command1_Click()

End Sub
```

****

SYSTEM MANUAL

```
Private Sub btnbacktomain_Click()
frmmainpage.Show
frmsystemman.Hide
End Sub
```

****

TECHNICAL SUPPORT

```
Private Sub btnbacktomain_Click()
frmmainpage.Show
frmtechsupp.Hide
End Sub
```

****

PATIENT INFORMATION

```
Option Explicit
'Phidgets objects
Private WithEvents phManager As PhidgetManager
Private WithEvents phRFID As PhidgetRFID

Public bTagForm As Boolean 'true if tag form is showing

Private Sub dbConnect()
    'ADO cursor and lock types
    Const adOpenForwardOnly As Long = 0
    Const adOpenKeyset As Long = 1
```

```
    Const adOpenDynamic As Long = 2
    Const adOpenStatic As Long = 3
    Const adLockReadOnly As Long = 1
    Const adLockPessimistic As Long = 2
    Const adLockOptimistic As Long = 3
    Const adLockBatchOptimistic As Long = 4

    'check to make sure the database exists using
    'an old basic command.
    If Dir(App.Path & "\DooRFID.mdb") = "" Then
        'no database exists! we have to create one from scratch
        Call dbCreate 'creates database so we can attach to it
    End If

    'create ADO connection object
    Set oConn = CreateObject("ADODB.Connection")
    'create ADO recordset object
    Set oRS = CreateObject("ADODB.Recordset")

    'connect to database
    oConn.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=" & App.Path & "\DooRFID.mdb;"

    'get recordset from database
    oRS.Open "select TagID, Person, Sex, Race, Room, Temperature, Age, Inactive from Tags", oConn,
adOpenDynamic, adLockOptimistic
  End Sub



Private Sub dbCreate()
    Dim oCatalog As Object 'ADOX.Catalog
    Dim oTable As Object 'ADOX.Table

    'JET engine constants
    Const Jet10 As Long = 1
    Const Jet11 As Long = 2
    Const Jet20 As Long = 3
```

```
Const Jet3x As Long = 4
Const Jet4x As Long = 5

'ADO data types
Const adLongVarChar As Long = 201
Const adVarWChar As Long = 202
Const adBoolean As Long = 11
Const adDate As Long = 7
Const adInteger As Long = 3

'ADO key types and attributes
Const adKeyPrimary As Long = 1
Const adColNullable As Long = 2

'create new catalog object
Set oCatalog = CreateObject("ADOX.Catalog") 'New ADOX.Catalog

'create new database file
oCatalog.Create "Provider=Microsoft.Jet.OLEDB.4.0;" & _
 "Jet OLEDB:Engine Type=" & CStr(Jet4x) & _
";Data Source=" & App.Path & "\DooRFID.mdb"

'create tag table
Set oTable = CreateObject("ADOX.Table") 'new ADOX.Table
Set oTable.ParentCatalog = oCatalog 'link new table object to catalog object
oTable.Name = "Tags"
oTable.Columns.Append "TagID", adVarWChar, 10
oTable.Keys.Append "PK_ID", adKeyPrimary, "TagID" 'set tag ID as the primary key.
oTable.Columns.Append "Person", adVarWChar, 50 'person who has the tag
oTable.Columns.Append "AccessTimeFrom", adDate 'what time will the tag activated
oTable.Columns("AccessTimeFrom").Attributes = adColNullable 'allow these fields to be left blank
oTable.Columns.Append "AccessTimeTo", adDate 'what time will the tag be deactivated
oTable.Columns("AccessTimeTo").Attributes = adColNullable 'allow these fields to be left blank
oTable.Columns.Append "Inactive", adBoolean 'if this yes/no field is set to YES, the tag is hard-set to inactive
oCatalog.Tables.Append oTable 'write new table to new database
Set oTable = Nothing 'close table object
```

```
    'Create access log table
    Set oTable = CreateObject("ADOX.Table") 'New ADOX.Table
    Set oTable.ParentCatalog = oCatalog 'link new table object to catalog object
    oTable.Name = "AccessLog"
    oTable.Columns.Append "ID", adInteger 'create ID column
    oTable.Keys.Append "PK_ID", adKeyPrimary, "ID" 'set primary key
    oTable.Columns("ID").Properties("AutoIncrement") = True 'set ID column to autonumber
    oTable.Columns.Append "TagID", adVarWChar, 10 'records the tag ID presented to the reader
    oTable.Columns.Append "AccessTime", adDate 'the date and time the tag was presented
    oTable.Columns.Append "AllowedAccess", adBoolean 'records if the tag was allowed access or not
    oTable.Columns.Append "Event", adVarWChar, 255 'more of a description as to what happened
    oTable.Columns("Event").Attributes = adColNullable 'allow these fields to be left blank
    oCatalog.Tables.Append oTable 'write table to database
    Set oTable = Nothing 'close table object

    'Close database object
    Set oCatalog = Nothing
End Sub

Private Sub dbDisconnect()
    On Error Resume Next 'enable error skipping
    oRS.Close 'close recordset
    Set oRS = Nothing 'destroy object
    oConn.Close 'close connection to database
    Set oConn = Nothing 'destroy object
End Sub

Private Sub btnbacktomain_Click()
frmmainpage.Show
frmpatientinfo.Hide
End Sub

Private Sub cmdManage_Click()
    frmTags.Show
    Me.Hide
    End Sub
```

```
Private Sub Form_Load()
    'check to make sure we're not running more than one instance
    If App.PrevInstance Then End
  'connect to the database
  Call dbConnect

    'create new PhidgetManager object
    Set phManager = New PhidgetManager
End Sub

Private Sub Form_Unload(Cancel As Integer)

    On Error Resume Next 'skip any errors

    'disable RFID reader and all outputs
    phRFID.OutputState(0) = False
    phRFID.OutputState(1) = False
    phRFID.OutputState(2) = False
    phRFID.OutputState(3) = False

    'destroy objects
    Set phRFID = Nothing
    Set phManager = Nothing

    'disconnect from the database
    Call dbDisconnect

    'end processing
    End
End SuB
Private Sub phManager_OnAttach(ByVal PHIDGET As PHIDGET.IPhidget)
    Dim lOutput As Long

    'check to see if it's an RFID reader
    If PHIDGET.DeviceType = "PhidgetRFID" Then
        'device attached was RFID reader, set reader object
        Set phRFID = PHIDGET
```

```
        'update info label
        lblReaderInfo.Caption = "Phidgets RFID reader " & phRFID.SerialNumber & " attached"

        'reset all the outputs to OFF
        For lOutput = 0 To phRFID.NumOutputs - 1
            phRFID.OutputState(lOutput) = False
        Next lOutput

        'turn on RFID reader
        phRFID.OutputState(3) = True

        'update state label
        lblReaderState.Caption = "Listening for tags..."
    End If
End Sub

Private Sub phRFID_OnTag(ByVal TagNumber As String)
    Dim bAllowAccess As Boolean 'we'll set this true if the tag is allowed access
    Dim strEvent As String
    Dim strPerson As String

    'the first thing we need to do is turn off the RFID reader so multiple read events don't occur
    phRFID.OutputState(3) = False
    DoEvents 'we hand over event processing to ensure the reader is turned off before we proceed

    'check for tag form
    If bTagForm Then
        If frmTags.cmdUpdate.Caption = "Add New" Then
            frmTags.txtTagID.Text = TagNumber
            'frmTags.txtPerson.SetFocus 'set focus on the person text box
        End If

    End If

    'use the FIND method to look for a matching tag
    oRS.Find "TagID='" & TagNumber & "'", 0, 1, 1
```

```
            End If


            'add access granted indication to event string
            If bAllowAccess Then
               strEvent = strEvent & "Patient name"
               If strPerson <> "" Then strEvent = strEvent & " is " & strPerson
            End If
         Else
            'tag is in database, but marked inactive
            strEvent = strEvent & "Access DENIED"
            If strPerson <> "" Then strEvent = strEvent & " to " & strPerson
            strEvent = strEvent & ", tag inactive"
         End If
End If
   Else
      'the tag read by the reader was not found in the database
      strEvent = strEvent & "Tag not in database, please click Manage Tag "
   End If


   'update event list
   lstEvents.AddItem Date & " " & Time & ": [" & TagNumber & "] " & strEvent, 0 '0=add to the top of the list so
scrolling won't be necessary


   'record the event in the database access log
   oConn.Execute "insert into AccessLog (TagID, Person, AllowedAccess, Event) values ('" & TagNumber & "','" &
Date & " " & Time & "'," & Trim(CStr(CInt(bAllowAccess))) & ",'" & Replace(strEvent, "'", "''") & "')"


   'actually allow user access
   If bAllowAccess Then
      phRFID.OutputState(0) = True 'this activates the relay inside the control box
      tmrAllowAccess.Enabled = True 'this timer handles the LED indicator flashing and deactivating the relay after
a few seconds
   Else
      phRFID.OutputState(1) = True 'light the LED solid
      tmrDeniedAccess.Enabled = True 'enable the access denied timer


   End If
End Sub
```

```
Private Sub tmrAllowAccess_Timer()
    Static strTimer As String 'used to record when the timer was first enabled
    Static bLEDOn As Boolean 'used to toggle the LED on and off
    Const lSeconds As Long = 4 ' hold the strike open for 4 seconds

    If phRFID Is Nothing Then
        Exit Sub
    End If

  'toggle LED state
    If bLEDOn Then
        bLEDOn = False
    Else
        bLEDOn = True
    End If
    phRFID.OutputState(1) = bLEDOn 'set LED state

    'check for strTimer value
    If strTimer = "" Then
        'no date/time, record time of first timer run
        strTimer = Date & " " & Time
    End If

    'check to see if we're over our time limit
    If DateDiff("s", strTimer, Date & " " & Time) >= lSeconds Then
        strTimer = "" 'reset timer data
        tmrAllowAccess.Enabled = False 'disable timer
        phRFID.OutputState(0) = False 'shutdown control box relay
        phRFID.OutputState(1) = False 'shutdown LED indicator
        phRFID.OutputState(3) = True 'enable the RFID reader again
    End If
End Sub


 Private Sub tmrDeniedAccess_Timer()
    phRFID.OutputState(3) = True 'enable the reader
```

```
    '0, 1, 1 means: 0 is the number of records to skip while searching,
    '1 means the direction to search (forward, -1 is backward)
    'the second 1 means which record to start the search from (0 = current record, 1=the first record, 2=the last
record)

    'check to see if we found anything.
    'BOF or EOF will be true if nothing found.
    If oRS.BOF = False And oRS.EOF = False Then
        'we found something, process the data

        'check to make sure person field value is not null
        If Not IsNull(oRS("Person").Value) Then
            strPerson = CStr(oRS("Person").Value)
        End If

  'check to see if the tag is inactive or not
        If Not IsNull(oRS("Inactive").Value) Then
            'not null, but check to see if it's deliberately marked inactive
            If CBool(oRS("Inactive").Value) = False Then
            'not marked inactive! proceed.

                'check and process allowed access times
                If Not IsNull(oRS("Person").Value) And Not IsNull(oRS("Person").Value) Then
                    'values for both fields are not null, process them
                    If DateDiff("s", oRS("Room").Value, Time$) > 0 And DateDiff("s", Time$, oRS("Temperature").Value)
> 0 Then
                        'within allowed access time, access granted
                        bAllowAccess = True
                    Else
                        'denied access due to time restriction, update event string
                        strEvent = strEvent & "Patient name"
                        If strPerson <> "" Then strEvent = strEvent & " is " & strPerson
                        strEvent = strEvent & ", please click Manage Tag"
                    End If
                Else
                    'no time restrictions in database, so tag is allowed access
                    bAllowAccess = True
```

```
    phRFID.OutputState(1) = False 'disable the LED

    tmrDeniedAccess.Enabled = False 'disable the timer
End Sub


Private Sub tmrUpdateRecordset_Timer()
 oRS.Requery
End Sub
```

****

TAG MANAGEMENT

```
Option Explicit
Dim strPerson As String
    Dim strAge As String
    Dim strRoom As String
    Dim strTemperature As String
    Dim blnString As Boolean
    Dim blnInteger As Boolean

    Public strsex As String
    Public strrace As String

   Private Sub lvPopulate()
    Dim strTagID As String
    Dim strPerson As String
    Dim strRoom As String
    Dim strTemperature As String
    Dim strAge As String
    Dim bInactive As Boolean
    Dim oListItem As Object
    strsex = cbosex.Text
    strrace = cborace.Text

    lvTags.ListItems.Clear 'clear items

    'refresh the recordset
    oRS.Requery
```

```
  'populate list view with tags
  On Error Resume Next 'enable error skipping
  oRS.MoveFirst 'move to the first record in the recordset
  If Err.Number = 0 Then 'check for errors
     'no errors, there are records in the recordset
     Do Until oRS.EOF 'loop through recordset until the end

        If Not IsNull(oRS("TagID").Value) Then strTagID = CStr(oRS("TagID").Value)
        If Not IsNull(oRS("Person").Value) Then strPerson = CStr(oRS("Person").Value)
        If Not IsNull(oRS("Sex").Value) Then strsex = CStr(oRS("Sex").Value)
        If Not IsNull(oRS("Race").Value) Then strrace = CStr(oRS("Race").Value)
        If Not IsNull(oRS("Age").Value) Then strAge = CStr(oRS("Age").Value)
        If Not IsNull(oRS("Room").Value) Then strRoom = CStr(oRS("Room").Value)
        If Not IsNull(oRS("Temperature").Value) Then strTemperature = CStr(oRS("Temperature").Value)
        If Not IsNull(oRS("Inactive").Value) Then bInactive = CBool(oRS("Inactive").Value)

        'add row to list view
        Set oListItem = lvTags.ListItems.Add(, , strTagID)
        oListItem.SubItems(1) = strPerson
        oListItem.SubItems(2) = strsex
        oListItem.SubItems(3) = strrace
        oListItem.SubItems(4) = strAge
        oListItem.SubItems(5) = strRoom
        oListItem.SubItems(6) = strTemperature
        Set oListItem = Nothing 'destroy object
        oRS.MoveNext 'move to the next record
     Loop
     lvTags.SelectedItem.Selected = False 'deselect the first tag
  End If
  On Error GoTo 0 'disable error skipping
End Sub

Private Sub btnbacktomain_Click()
frmmainpage.Show
Me.Hide
```

```
End Sub
Private Sub cmdCancel_Click()
    'reset list view data
    lvTags.Tag = ""

    'clear data in form elements
    txtTagID.Text = ""
    txtPerson.Text = ""
    txtAge.Text = ""
    txtRoom.Text = ""
    txtTemperature.Text = ""

    'update elements
    cmdUpdate.Caption = "Add New"
    'txtTagID.Locked = False
    txtTagID.Enabled = True
    cmdUpdate.Enabled = False
    cmdRemove.Enabled = False
    cmdCancel.Enabled = False
End Sub

Private Sub cmdRemove_Click()
    'remove tag from database and list view

    If MsgBox("Are you sure you want to remove tag " & txtTagID.Text & " ?", vbYesNo, "Remove Tag") = vbNo
Then
        'they weren't sure, exit
        Exit Sub
    End If

    'remove from database
    oConn.Execute "delete from Tags where TagID='" & lvTags.Tag & "'"

    'update form elements
    Call cmdCancel_Click

    'update list view
```

```
    Call lvPopulate
End Sub

Private Sub cmdUpdate_Click()
   strPerson = txtPerson.Text
    CheckString

     If blnString = False Then
        Exit Sub
    End If

    strAge = txtAge.Text
    strRoom = txtRoom.Text
    strTemperature = txtTemperature.Text
    CheckInteger

    If blnInteger = False Then
        Exit Sub
    End If

    If cbosex.Text = "" Then
    MsgBox "Please select either male or female!!", vbOKOnly + vbCritical
    Exit Sub
    End If

    If cborace.Text = "" Then
    MsgBox "Please choose one race!", vbOKOnly + vbCritical
    Exit Sub
    End If

    Select Case cmdUpdate.Caption
        Case "Update"
            'update the data in the recordset as well as in the list view
 oConn.Execute "delete from Tags where TagID='" & lvTags.Tag & "'"
          oConn.Execute "insert into Tags (TagID, Person, Sex, Race, Age, Room, Temperature) values ('" &
txtTagID.Text & "', '" & txtPerson.Text & "', '" & cbosex.Text & "', '" & cborace.Text & "', '" & txtAge.Text & "', '" &
txtRoom.Text & "', '" & txtTemperature.Text & "')"
```

```
        Case "Add New"
          'add new tag to recordset

          ' insert new record
        oConn.Execute "insert into Tags (TagID, Person, Sex, Race, Age, Room, Temperature) values ('" &
txtTagID.Text & "', '" & txtPerson.Text & "', '" & cbosex.Text & "', '" & cborace.Text & "', '" & txtAge.Text & "', '" &
txtRoom.Text & "', '" & txtTemperature.Text & "')"

    End Select
    'update form elements
    Call cmdCancel_Click
    'update list view
    Call lvPopulate 're-populate items from recordset

    clearCBO

End Sub

Private Sub Form_Load()
    Dim Z As Long

    'Set up the list view box
    lvTags.View = lvwReport
    lvTags.GridLines = True
    lvTags.ColumnHeaders.Add 1, , "Tag #", 1500
    lvTags.ColumnHeaders.Add 2, , "Person", 1500
    lvTags.ColumnHeaders.Add 3, , "Sex", 1000
    lvTags.ColumnHeaders.Add 4, , "Race", 1000
    lvTags.ColumnHeaders.Add 5, , "Age", 500
    lvTags.ColumnHeaders.Add 6, , "Room", 800
    lvTags.ColumnHeaders.Add 7, , "Temperature", 1500
    'populate list view with tags
    Call lvPopulate

    'set boolean
    frmpatientinfo.bTagForm = True
```

```
End Sub
Private Sub lvTags_Click()
    'check to see if a user actually clicked on a list item or not
    If lvTags.SelectedItem Is Nothing Then
        Exit Sub 'list item was not clicked on, exit
    End If

    'set TAG property
    lvTags.Tag = lvTags.SelectedItem.Text

    'copy data to form elements
    txtTagID.Text = lvTags.SelectedItem.Text
    txtPerson.Text = lvTags.SelectedItem.SubItems(1)
    txtAge.Text = lvTags.SelectedItem.SubItems(4)
    txtRoom.Text = lvTags.SelectedItem.SubItems(5)
    txtTemperature.Text = lvTags.SelectedItem.SubItems(6)

   'update elements
    cmdUpdate.Caption = "Update"
    cmdUpdate.Enabled = True
    cmdCancel.Enabled = True
    cmdRemove.Enabled = True
    'txtTagID.Locked = True
    txtTagID.Enabled = False
End Sub
Private Sub txtHeartrate_Change()
End Sub

Private Sub txtTagID_Change()
    If Len(Trim(txtTagID.Text)) > 0 Then
        'update buttons
        cmdUpdate.Enabled = True
        cmdCancel.Enabled = True
        cmdRemove.Enabled = False 'can't remove a tag, nothing has been selected from list
    End If
End Sub
```

```
Private Sub txtTagID_KeyPress(KeyAscii As Integer)
    'check to make sure the user is only entering
    'letters, numbers, or pressing special keys
    'like the backspace key
    If Not KeyAscii = 8 And Not (KeyAscii >= 48 And KeyAscii <= 57) And Not (KeyAscii >= 65 And KeyAscii <=
90) And Not (KeyAscii >= 97 And KeyAscii <= 122) Then
        KeyAscii = 0
    End If
End Sub
Private Sub txtTagID_LostFocus()
    Dim lListIndex As Long

    'check to make sure the user has not entered a duplicate tag ID
    For lListIndex = 1 To lvTags.ListItems.Count
        If txtTagID.Text = lvTags.ListItems(lListIndex).Text Then

            lvTags.SetFocus
            lvTags.SelectedItem = lvTags.ListItems(lListIndex)
            Call lvTags_Click
            MsgBox "You have entered a duplicate tag ID, updating existing tag..."
            Exit Sub
        End If
    Next lListIndex
End Sub
Private Sub CheckString()
    Dim nLot1, i1 As Integer
    Dim strLot1 As String
    Dim AlphaNum1 As Boolean
    Dim sChar As String

    bInString = False
    nLot1 = Len(strPerson)
    strLot1 = UCase(strPerson)

    If nLot1 > 0 Then
```

```
    For i1 = 1 To nLot1
        AlphaNum1 = False
        sChar = Mid(strLot1, i1, 1)
        If sChar Like "[A-Za-z]" Or sChar = " " Then
            AlphaNum1 = True
        End If
        If AlphaNum1 = False Then
          MsgBox "Person Name must be in Alphabetic format! Please change.", vbExclamation + vbOKOnly,
"INVALID PASSWORD"
          Exit Sub
        End If
      Next i1
        blnString = True
  Else

  End If
End Sub



Private Sub CheckInteger()

  Dim nLot1, i1 As Integer
  Dim strLot1 As String
  Dim AlphaNum1 As Boolean
  Dim sChar As String

  blnInteger = False
  nLot1 = Len(strAge)
  strLot1 = UCase(strAge)

  If nLot1 > 0 Then
    For i1 = 1 To nLot1
        AlphaNum1 = False
        sChar = Mid(strLot1, i1, 1)
        If sChar Like "[0-9]" Or sChar = " " Then
            AlphaNum1 = True
        End If
```

```
        If AlphaNum1 = False Then
            MsgBox "Age must be in Numeric format! Please change.", vbExclamation + vbOKOnly, "INVALID
PASSWORD"
            Exit Sub
        End If
      Next i1

   Else

   End If

   nLot1 = Len(strRoom)
   strLot1 = UCase(strRoom)

   If nLot1 > 0 Then
     For i1 = 1 To nLot1
        AlphaNum1 = False
        sChar = Mid(strLot1, i1, 1)
        If sChar Like "[0-9]" Or sChar = " " Then
             AlphaNum1 = True
        End If
        If AlphaNum1 = False Then
            MsgBox "Room must be in Numeric format! Please change.", vbExclamation + vbOKOnly, "INVALID
PASSWORD"
            Exit Sub
        End If
      Next i1

   Else

   End If

   nLot1 = Len(strTemperature)
   strLot1 = UCase(strTemperature)

   If nLot1 > 0 Then
     For i1 = 1 To nLot1
```

```
        AlphaNum1 = False
        sChar = Mid(strLot1, i1, 1)
        If sChar Like "[0-9]" Or sChar = " " Then
            AlphaNum1 = True
        End If
        If AlphaNum1 = False Then
           MsgBox "Temperature must be in Numeric format! Please change.", vbExclamation + vbOKOnly,
"INVALID PASSWORD"
           Exit Sub
        End If
      Next i1
         blnInteger = True
   Else

   End If
End Sub

Private Sub clearCBO()

cbosex.Text = ""
cborace.Text = ""

'cbosex.AddItem ("Male")
'cbosex.AddItem ("Female")
'
'cborace.AddItem ("Malay")
'cborace.AddItem ("Chinese")
'cborace.AddItem ("Indian")
'cborace.AddItem ("Others")

End Sub
**********************************************************************************
```