RFID LOGIN SYSTEM
For COMPUTERS

By

MUHD. SHAFIQ BIN SHAZIMAN

FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
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CERTIFICATION OF APPROVAL

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Approved:

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UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

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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.

Muhd. Shafiq Bin Shaziman

ABSTRACT

This report covers the implementation of RFID Login System for computers. The objective of this project is to replace the existing smart card used to login to a computer, with RFID technology. RFID technology is identified as the best alternative for smart card, due to its high level of security. The project scope is to fabricate RFID tag and reader for computer login. The transponder will transmit the signal containing user's information upon activation and the reader will process the information for verification purposes. The scope of the study is mainly about the architecture of RFID and how to develop hardware related to RFID. A prototype mainly consists of microcontroller application, radio frequency data transmission circuitry and graphical user interface was successfully developed. The prototype can be effectively used for computer login, based on RFID technology.

ACKNOWLEDGEMENTS

In the name of Allah the most merciful the most compassionate.

First, I would like to thank my supervisor, Dr. Mohamad Naufal Mohamad Saad, for his continuous support for this project. He was always there to meet and talk about my ideas. He showed me different ways to approach a problem and the need to be persistent to accomplish my goals.

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LIST OF ABBREVIATION

CMOS	Complementary metal-oxide-semiconductor
CPU	Central Processing Unit
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
GUI	Graphical User Interface
IC	Integrated Circuit
ICC	Integrated Circuit Card
PC	Personal Computer
ROM	Read Only Memory
RAM	Random Access Memory
RF	Radio Frequency
RFID	Radio Frequency Identification
RX	Receiver
TTL	Transistor-Transistor Login
TX	Transmitter
UHF	Ultra High Frequency

CHAPTER 1
INTRODUCTION

Smart card technology has been around for more than 20 years. Since its first introduction into the market, its main application is for the payphone system. As card manufacturing cost decreases, smart card usage has expanded. Its use in Asia is expected to be growing at a much faster pace than in Europe. According to a survey performed by Ovum Ltd. [Microsoft1998a], the number of smart card units will reach 2.7 billion by 2005. The largest markets will be in prepayment applications, followed by access control, and electronic cash applications.

In the article "Smart cards: A primer" [DiGiorgio1997a], the smart card is defined as a "credit card" with a "brain" on it, the brain being a small embedded computer chip. A contact smart card, or integrated circuit(s) card (ICC), is defined as any pocket-sized card with embedded integrated circuits. This integrated circuit may consist only of EEPROM in the case of a memory card, or it may also contain ROM, RAM and even a CPU. Contact smart cards require insertion into a smart card reader with a direct connection to a conductive micro-module on the surface of the card.

Smart card technology had been widely used for computer login especially at workplace. Employees use contact smart card to log in to common computers in the office. Smart cards need to be slotted in the card reader for verification purpose before the computer can be used. Different users have different account settings such as software usage and storage capacity based on their job scope and level in the company.

1.1 Problem Statement

This project focuses on the problems faced by computer login system using smart card. The mechanical contact used in the smart card is often impractical. The problem appears in faulty contacting situation between the silicon chip and the card reader's electronics head. Any obstruction between the two of them will result in inability to retrieve data from the silicon chip of the smart card. The obstruction may be the result of dirt, sabotage, etc.

Human factor contributes to breach of confidential information. Normally, smart card users need to slot in their card using the log in process. They may accidentally left the card in the card reader after logging out, due to their carelessness. The smart card left may be manipulated by irresponsible personnel to access confidential files of the owner. Breach of information may cause bad implications to the company.

The plastic card is fairly flexible. The larger the chip embedded on the card, the higher the probability of card to break. Smart cards are also often carried in wallets or pockets. It is a fairly harsh environment for a chip. The chip may be damaged due mishandling of smart card.

1.2 Project Objectives

The objectives of this project are as follows:

(i) To design and construct a prototype which is able to replace and enhance the existing smart card system for computer login.

(ii) The prototype designed should follow the concept of radio frequency identification (RFID) system.

The significance of this project is to improve the smart card system used in computer login. The problem of mechanical contact mechanism used in embedded silicon chip smart card was solved by implementing a wireless device system using RFID technology. The new system proved to be more cost effective as RFID tags cost less than smart cards.

1.3 Scope of Study

Researches had been made to identify a reliable computer identification system. A contact less transfer of data between the data carrying device and its reader is far more flexible. In the ideal case, the power required to operate the electronic data carrying device would be transferred from the device using contact less technology.

RFID (Radio Frequency Identification) technology was identified as the alternative for this problem, referring to Appendix B. It has the capability to transfer power and data wirelessly. The advantages of RFID will be discussed further in the literature review section.

This project will focus on designing and building a prototype based on RFID system. There are several topics and issues that must be considered before proceeding any further in the design of the system. The scope of study depends mainly on these few areas:

- storing user's information from a microcontroller circuitry
- data transmission via radio frequency from transmitter to card reader and vice versa.
- interfacing the controller to the PC via serial communication
- database application to verify the user's entry

The PIC16F84 microcontroller is made the microcontroller of choice for the specified task. This choice is obvious as this microcontroller is competitively priced, not to mention its sound applicability in this system. It is also good to note that this microcontroller comes with many interesting features.

Data transmission is accomplished using miniature QAMT-434 transmitter and QMR2-434 receiver radio module. The pair enables the implementation of a simple telemetry link at data rates of up to 10Kbit/s as the modules are compatible with one another. They operate at 433.92MHz and are able to receive at distances of up to 200 meters.

To interface the PIC16F84 microcontroller to the PC, the serial port is chosen. This method is easy to implement and practical, since the serial port is compact and available on almost all PCs.

The last area to be considered is the database application. Since Microsoft Access has Visual Basic commands embedded in it, it is efficient to record and store the necessary user authorization information. Microsoft Access is also a very popular choice for database applications.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction to RFID

A Radio Frequency Identification (RFID) system comprises a transponder, an interrogator (the reader) and a host system. Figure 1 illustrates a basic component setup of a RFID system. The essence of (RFID) is the ability to carry data in a suitable carrier and recover that data (read) or modify (write) it as and when required by a non-contact electromagnetic communication process across what is essentially an air interface [6].

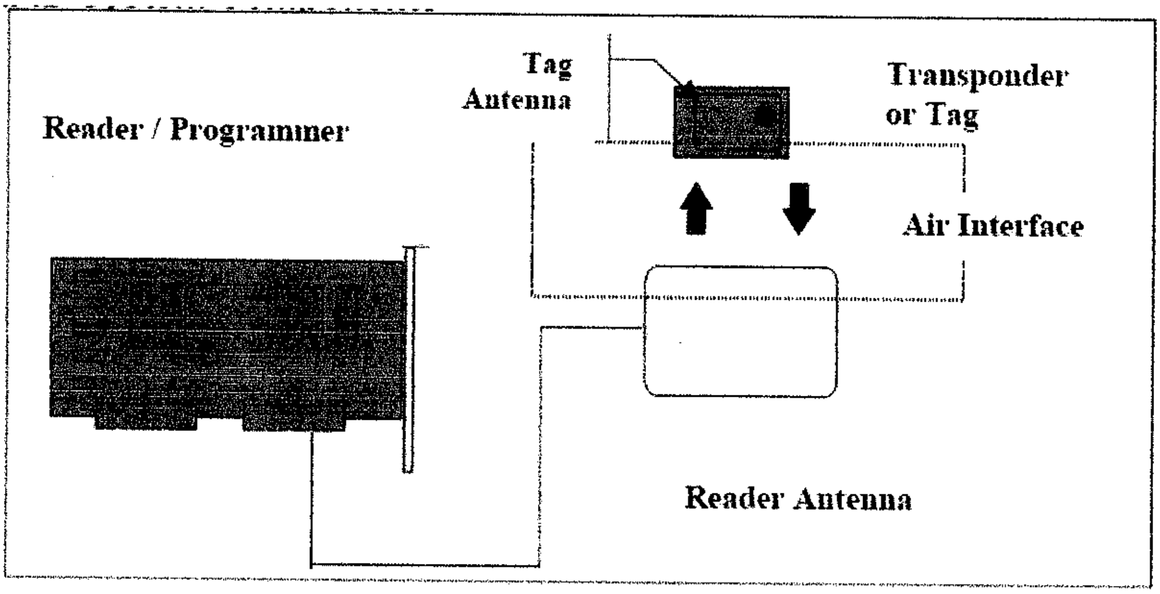


Figure 1 : Basic component setup of RFID

The transponder or tag carries data to be transmitted to the reader. The reader contains a radio frequency module, a signal processing and microcontroller unit, a coupling element and the interface to a host system. There are many different kinds of readers on the market, such as desktop, hand-held, tunnel or gate/gantry style readers. The host computer manages the information flow, sending and receiving to and from the reader and tag.

The data flow between the reader and tag occurs over the air interface, or radio frequency (RF) link. The air interface non-contact data transfer between a tag and its interrogator (reader/programmer) is seen as a fundamental feature of RFID, the transfer invariably being achieved without the need for obstacle-free, line-of-sight alignment.

The RF tags could be divided in two major groups:

- Passive, where the power to energize the tag's circuitry is draw from the reader generated field.
- Active, in this case the tag has an internal power source, in general a battery that could be replaceable or not, in some case this feature limited the tag lifetime, but for some applications this is not important, or the tag is designed to live more than the typical time needed.

RFID system operates according to one of two basic procedures: full duplex (FDX)/ half duplex (HDX) systems, and sequential systems (SEQ) [1]. In full duplex and half duplex systems the transponder's response is broadcast when the reader's RF field is switched on. In contrast, sequential procedures employ a system whereby the field from the reader is switched off briefly at regular intervals. These gaps are recognized by the transponder and used for sending the data from the transponder to the reader.

RFID has the additional advantages as follows:

- provide error-free, wireless data transmission that is battery-free and maintenance-free
- do not require line-of-site scanners for operation
- allow stored data to be altered during sorting or to capture workflow process information
- work effectively even in harsh environments with excessive dirt, dust, moisture, and temperature extremes

2.2 Microcontroller Application

A microcontroller is a single-chip computer. Micro suggests that the device is small, and controller tells that the device might be used to control objects, processes, or events. Another term to describe a microcontroller is embedded controller, because the microcontroller and its support circuits are often built into, or embedded in, the devices they control.

Microcontrollers can be found in all kinds of things these days. Any device that measures, stores, controls, calculates, or displays information is a candidate for putting a microcontroller inside. The largest single use for microcontrollers is in automobiles-just about every car manufactured today includes at least one microcontroller for engine control, and often more to control additional systems in the car.

In desktop computers, microcontrollers can be found inside keyboards, modems, printers, and other peripherals. In test equipment, microcontrollers make it easy to add features such as the ability to store measurements, to create and store user routines, and to display messages and waveforms. Consumer products that use microcontrollers include cameras, video recorders, compact-disk players, and ovens. And these are just a few examples.

A microcontroller is similar to the microprocessor inside a personal computer. Examples of microprocessors include Intel's 8086, Motorola's 68000, and Zilog's Z80. Both microprocessors and microcontrollers contain a central processing unit, or CPU. The CPU executes instructions that perform the basic logic, math, and data-moving functions of a computer.

To make a complete computer, a microprocessor requires memory for storing data and programs, and input/output (I/O) interfaces for connecting external devices like keyboards and displays.

In contrast, a microcontroller is a single-chip computer because it contains memory and I/O interfaces in addition to the CPU. Because the amount of memory and interfaces that can fit on a single chip is limited, microcontrollers tend to be used in smaller systems that require little more than the microcontroller and a few support components. Examples of popular microcontrollers are Intel's 8052 (including the 8052-BASIC, which is the focus of this book), Motorola's 68HC11, and Zilog's Z8.

After 30 years of constant evolution in chip manufacturing, this embedded technology is no stranger is the daily-used applications. Generally, they can be divided to 5 broad markets:

- Consumer segment – home appliances and home entertainment
- Automotive – a modern car has nearly 50 microcontrollers providing intelligence and control, like keyless entry, antilock braking and air bas.
- Office automation – PCs, keyboards, copiers, printers etc
- Telecommunications – cell phones, pagers and answering machines
- Industrial products – door locks in hotel rooms, automatic faucets and industrial machinery

Among the main features that contribute to the wide popularity of microcontrollers are:

- Speed
- Instruction set simplicity
- Integration of operational features
- Programmable timer options
- Interrupt control
- Powerful output pin control
- I/O port expansion
- Serial programming via two pins
- EPROM support
- Mail-order support

2.2.1 PIC16F84A Microcontroller

The PIC16F84 belongs to the family of low-cost, high-performance, CMOS, fully-static, 8-bit microcontrollers. All PICmicro™ microcontrollers employ an advanced RISC architecture. PIC16F84 have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources. The separate instruction and data buses of the Harvard architecture allow a 14-bit wide instruction word with a separate 8-bit wide data bus. The two stage instruction pipeline allows all instructions to execute in a single cycle, except for program branches (which require two cycles). A total of 35 instructions (reduced instruction set) are available. Additionally, a large register set is used to achieve a very high performance level.

PIC16F84 microcontrollers typically achieve a 2:1 code compression and up to a 4:1 speed improvement (at 20 MHz) over other 8-bit microcontrollers in their class. The PIC16F84 has up to 68 bytes of RAM, 64 bytes of Data EEPROM memory, and 13 I/O pins. A timer/counter is also available.

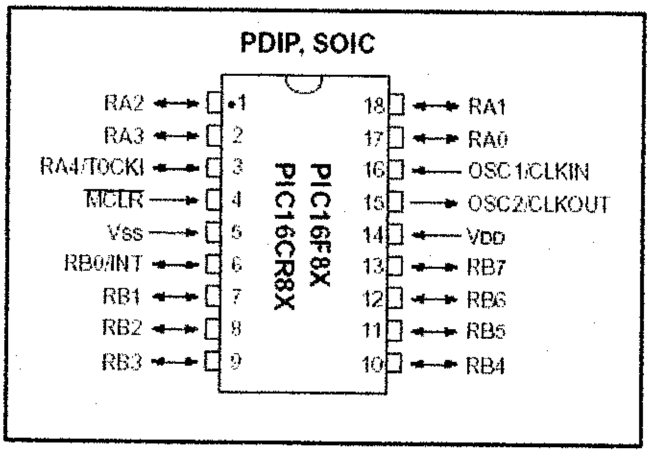


Figure 2 : PIC16F84 pin out

There are four oscillator options, of which the single pin RC oscillator (refer Figure 2) provides a low-cost solution, the LP oscillator minimizes power consumption, XT is a standard crystal, and the HS is for High Speed crystals.

The interesting features in the PIC16F84 are:

- The SLEEP (power-down) mode offers power saving. The user can wake the chip from sleep through several external and internal interrupts and resets.

- A highly reliable Watchdog Timer with its own on-chip RC oscillator provides protection against software lockup.

The devices with Flash program memory allow the same device package to be used for prototyping and production. In-circuit reprogrammability allows the code to be updated without the device being removed from the end application. This is useful in the development of many applications where the device may not be easily accessible, but the prototypes may require code updates. This is also useful for remote applications where the code may need to be updated (such as rate information). The lists of the features of the PIC16F84 are attached to Appendix C. A simplified block diagram of the PIC16F84 is shown in Figure 3.

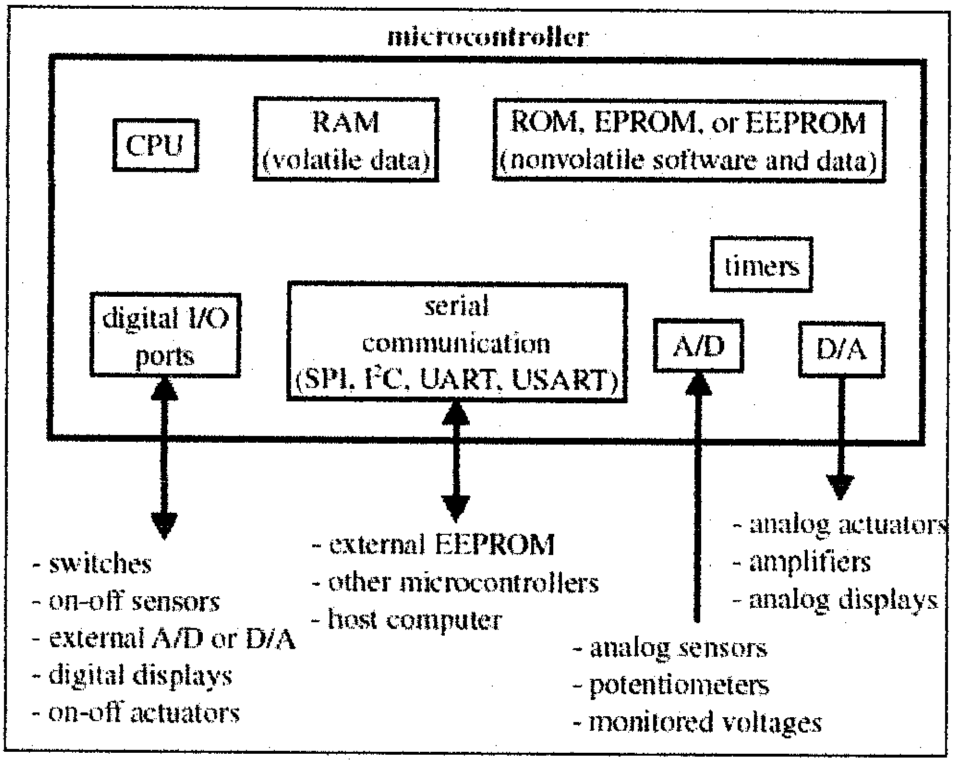


Figure 3 : Components of a Microcontroller

The PIC16F84 fits perfectly in applications ranging from high speed automotive and appliance motor control to low-power remote sensors, electronic locks, security devices and smart cards. The Flash or EEPROM technology makes customization of application programs such as transmitter codes, motor speeds, receiver frequencies and security codes extremely fast and convenient. The small footprint packages make this microcontroller series perfect for all applications with space limitations. Low-cost, low-power, high performance, ease-of-use and I/O flexibility make the

PIC16F84 very versatile even in areas where no microcontroller use has been considered before (example: timer functions; serial communication; capture, compare and PWM functions; and co-processor applications).

2.3 Serial Communication

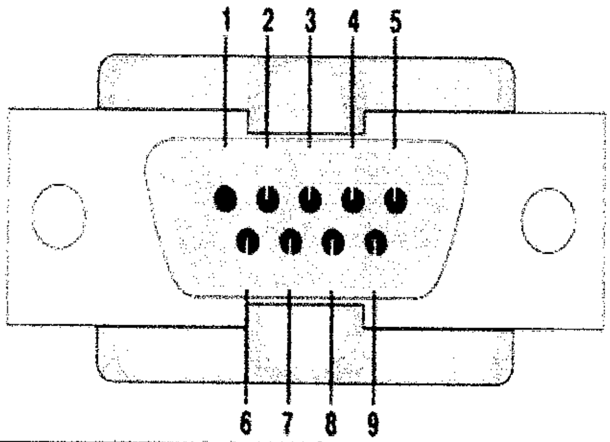
Serial communication was chosen as mode of communication between PIC16F84 and the computer. As far as interfacing between the PIC16F84 and PC is concerned, initialization is the first consideration by modifying the settings on both ends to accommodate each other. These settings include:

- Baud rate: 9600
- Parity bit: None
- Data bits: 8
- Stop bits: 1

These initializations will coincide with that of the PIC16F84. The two pins from PIC16F84 that interacts with the serial port are:

- Transmit pin (A0)
- Receive pin (A1)

Old PC's used 25 pin connectors but only about 9 pins were actually used so today most connectors are only 9-pin. Each of the 9 pins (refer Figure 4) usually connects to a wire. Besides the two wires used for transmitting and receiving data, another pin is signal ground. The voltage on any wire is measured with respect to this ground. Thus the minimum number of wires to use for 2-way transmission of data is 3. Despite this method, it has also been known to work with no signal ground wire but with degraded performance and sometimes with errors.



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

Figure 4 : RS-232 Pin Out on a DB-9 Pin Used for Asynchronous Data

Almost all digital devices used nowadays require either TTL or CMOS logic levels. Therefore the first step to connecting a device to the RS-232 port is to transform the RS-232 levels back into 0 and 5 Volts. This is done by RS-232 level converters. Two common RS-232 level converters are the 1488 RS-232 driver and the 1489 RS-232 receiver. Each package contains 4 inverters of the one type, either drivers or receivers. The driver requires two supply rails, +7.5V to +15V and -7.5V to -15V. As expected, this may pose a problem in many instances where only a single supply of +5V is present. However the advantages of these IC's are their cheap prices.

Besides the RS-232, another device is the MAX-232. It includes a charge pump, which generates +10V and -10V from a single 5V supply. This IC also includes two receivers and two transmitters in the same package. This is handy in many cases when only the Transmit and Receive data Lines are needed. This eliminates the usage of two chips, one for the receive line and one for the transmit line. However all this convenience comes at a price, but compared with the price of designing a new power supply it is very cheap. The pin out and the typical operating circuit are attached to Appendix H.

2.4 Ultra High Frequency (UHF) Transceiver

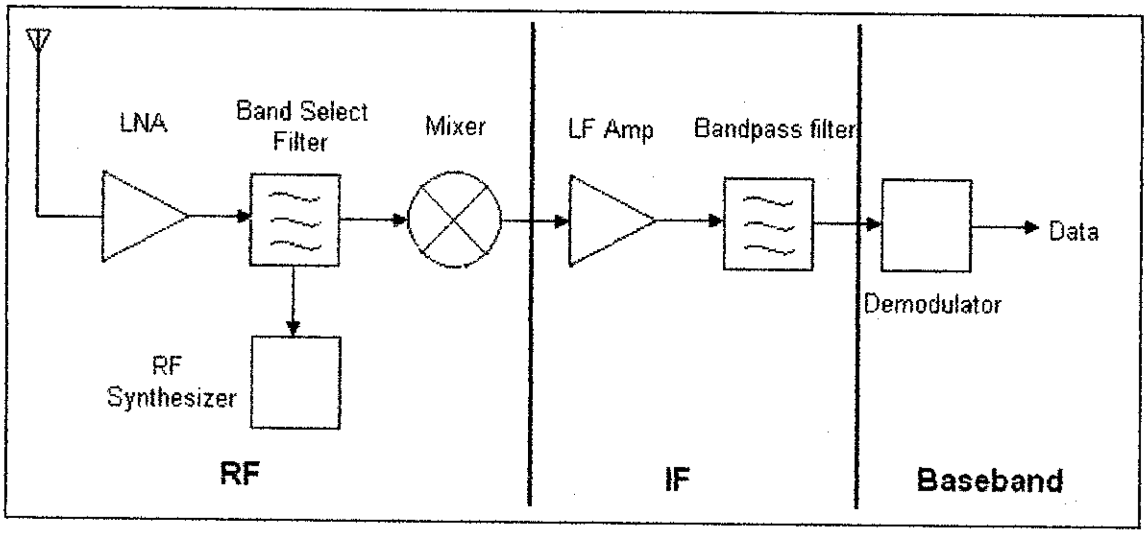


Figure 5 : Typical wireless receiver architecture

Figure 5 shows a typical wireless ultra high frequency (UHF) receiver. The whole receiver is usually constructed with three partitions: radio frequency (RF), intermediate frequency (IF) stage and base-band circuits. RF/IF function includes three major functions: signal amplification and filtration, frequency translation and frequency generation. The low noise amplifier (LNA) amplifies the RF input signal, which is then passed through a band-select filter for selecting the band signals. The mixer and RF synthesizer are used for frequency translation. The band-pass filter performs channel select. Finally, the digital data outputs are generated by the demodulator. The data output can be used to activate or deactivate another device.

2.5 QMR2-434 Receiver

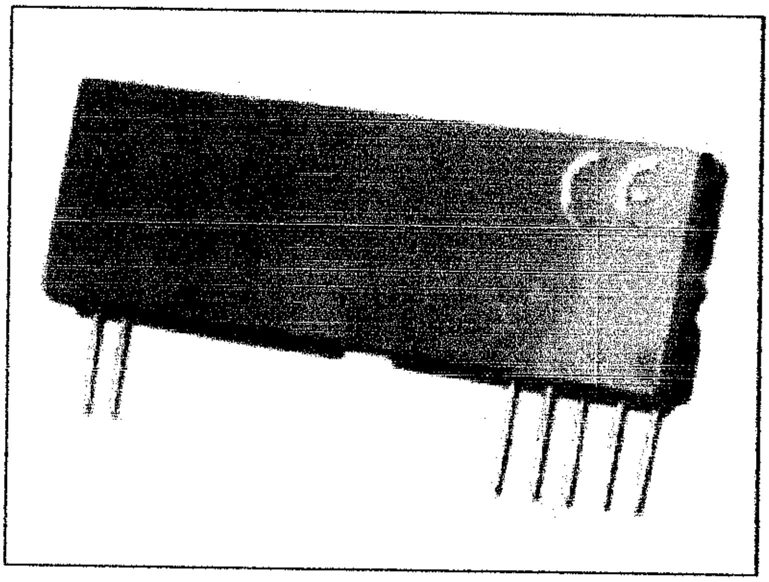


Figure 6 : QMR2-434 Receiver

This miniature UHF receiver radio module (refer Figure 6) enables the implementation of a simple telemetry link at data rates of up to 10Kbit/s when used with one of the compatible transmitter modules. It is available for operation at 433.92 and it is able to receive at distances of up to 200Mtrs. The QMR1 / QMR2 modules will suit one-to-one and multi-node wireless links in applications including building and car security, remote industrial process monitoring and computer networking. Because of its small size and low power requirements, the module is ideal for use in portable battery powered wireless applications. The features of this transmitter are as follows:

- Data Rates Up To 10kbits/s
- Optimal Range 200m (433.92MHz Versions)
- Very High Sensitivity (-112 dBm)
- Very Low Current Consumption
- Single 5v Supply
- Signal Strength Output (RSSI)
- High Selectivity (20KHz B/W Possible on QMR1)
- Immune to FM Threshold Effect

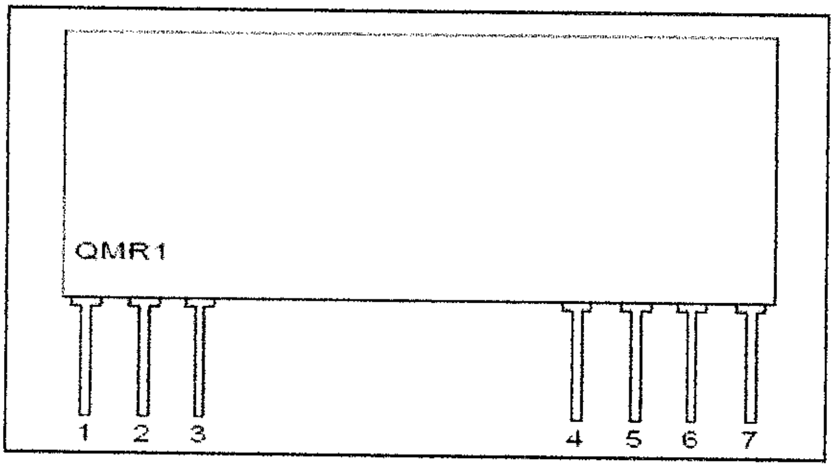


Figure 7 : QMR2-434 pin out

The pin out description of the receiver (refer Figure 7) is as follows:

(i) Vcc (Pin 1) - Operation from a 5V supply able to source 2mA at less than 10mVP-P ripple.

(ii) GND (PIN 2) - Supply ground connection, preferably connected to a solid ground plane.

(iii) RF IN (PIN 3) - 50W RF input from antenna, connect using shortest possible route. Capacitively isolated from internal circuit.

(iv) RSSI (PIN 6) - Test output providing a voltage that is proportional to the level of the RF input on pin 3.

(v) Data Out (PIN 7) - CMOS compatible output. This may be used to drive external decoders.

The receiver module (refer Figure 8) is a quasi AM /FM (QM) superhet receiver capable of handling data rates of up to 10Kbits/s. With an on board data buffer and phase locked loop at –110 dBm sensitivity is achieved. Utilizing the quasi AM/FM modulation technique and the latest phase locked loop receiver technology with one of the compatible transmitter modules will yield a highly efficient wireless link.

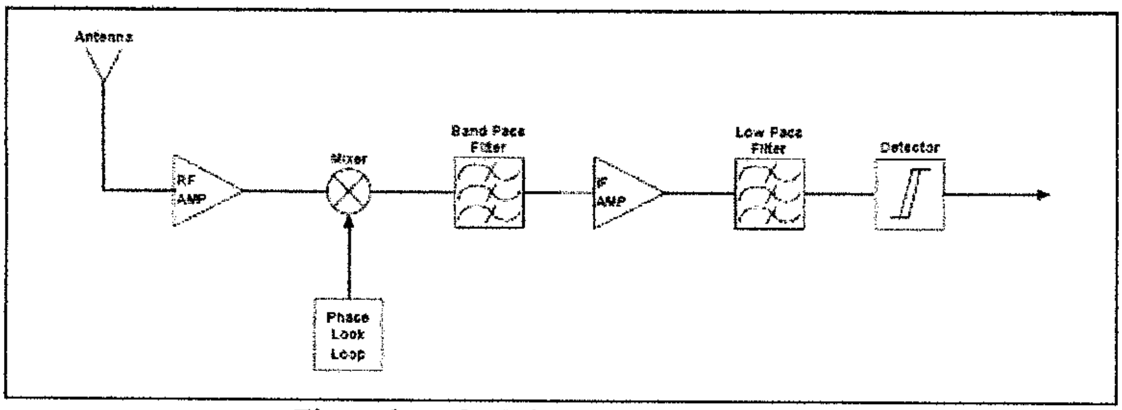


Figure 8 : QMR2-434 Receiver Block Diagram

2.6 QAMT2-434 Transmitter

The QAMT2-434 miniature transmitter UHF radio module enables the implementation of a simple telemetry link at data rates of up to 2400 bit/s when used with one of the compatible Quasar receiver modules. It is available for operation at 433.92MHz and the module is able to transmit at distances of up to 100m (433.92 MHz version).

The QAMT2-434 module will suit one-to-one and multi-node wireless links in applications including building and car security, remote industrial process monitoring and computer networking. Because of its small size and low power requirements, the module is ideal for use in portable battery powered wireless applications. The features of the receiver are as follows:

- SAW Resonator 100% AM Modulation
- Data Rates up to 2400 BitS/S
- Optimal Range of 100m
- CMOS/TTL Compatible Input
- Low current consumption (typically 5mA)
- Single Supply Voltage 1.5 – 13V

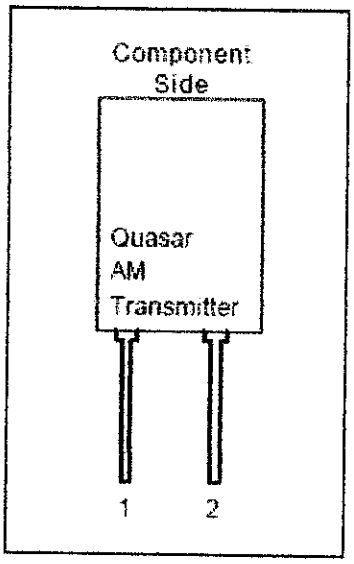


Figure 9 : QAMT2-434 Transmitter pin out

The pin out description of the receiver (refer Figure 9) is as follows:

(i) CMOS/TTL compatible input. Must be driven with appropriate current limiting resistor to provide the module with 5mA.

(ii) GND (PIN 2) - Ground connection, preferably connected to a solid ground plane.

CHAPTER 3
METHODOLOGY

3.1 Procedure Identification

The focus is to build a prototype based on RFID system. The procedures involved in accomplishing the project work were divided into several systematic steps. The flowchart of the project could be referred at Appendix E. Series of researches were done in order to identify the suitable hardware and software to be implemented. The design was made after researches had been done in the first phase of this project. Testing and troubleshooting requires the most time as lot of things overseen during the design process causes lot of problem.

A flowchart (refer Appendix F) was developed in order to determine the whole operation of the system. The flowchart was the main reference on how the system should be built. The prototype design was simplified to a block diagram (refer Figure 10).

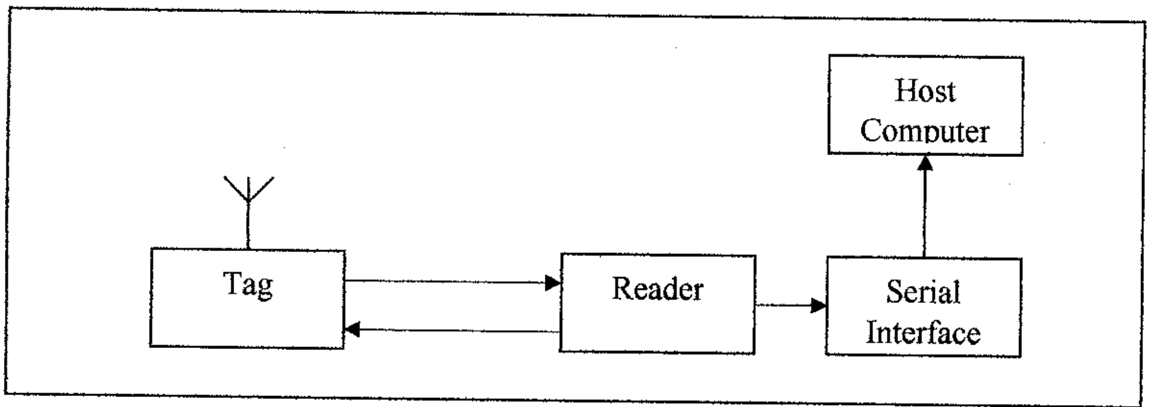


Figure 10 : Prototype block diagram

The basic structure of this system consists of:

1. An input which consists of the microcontroller PIC16F84A that contains the information of the user.
2. A tag which send data to the reader upon activation.
3. A receiver circuit to activate tag and to collect data from tag.
4. A graphical user interface (GUI) to extract the input from the receiver via serial port of the PC.
5. A database interface to provide the necessary storage for the log in verification.

3.1.1 PIC16F84A Implementation

Generally, several steps were taken to implement the microcontroller PIC16F84a. Figure 11 provides better understanding for the implementation process.

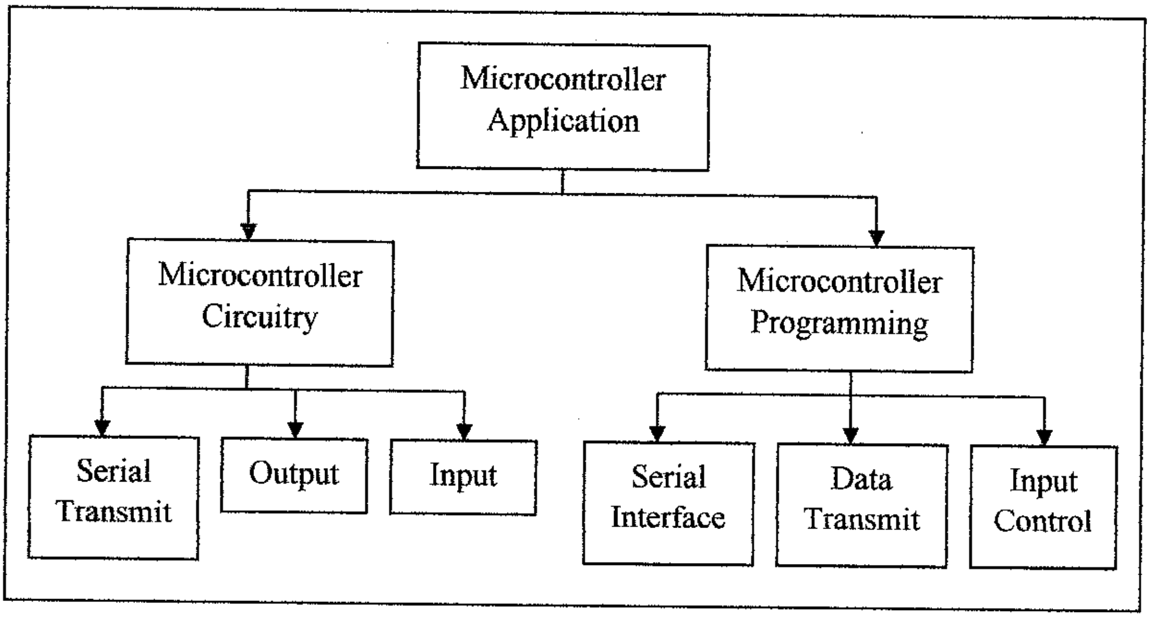


Figure 11 : Microcontroller application details

As shown, this interface was divided into two important sections:

- Microcontroller circuitry
- Microcontroller programming

In microcontroller circuitry, the pins need to be set for the input, output and serial transmit. This was to ensure that the microcontroller is utilized to its optimum performance. All the pins at port B of the PIC16F84 was utilized as the inputs from the reader. This leaves port A, which was utilized as the outputs and serial transmit.

The programming of PIC16F84a was done after defining the pins. C language was chosen to program the microcontroller. The programming must therefore coincide with all the pins that will be utilized. The three main considerations for the programming were:

- Input control
- Serial interface
- Data transmit

The initializations for serial interface allowed the microcontroller to communicate with the serial port of the PC. The format of the data to be transmitted to the serial port was defined using standard string output command of C language.

Before downloading a program into a PIC, the program was verified and compiled with the C Compiler. The program was into a hex file. Then, the EPROM of the PIC was cleared and blanked. Once this stage is successful, the program was downloaded into the PIC. This was done using the Max Loader programmer.

3.1.2 Radio Frequency Data Transmission

Data transmission was done using miniature QAMT-434 transmitter and QMR2-434 receiver radio module. They enable the implementation of a simple telemetry link at data rates of up to 10Kbit/s as the modules are compatible with one another. They operate at 433.92MHz and are able to receive at distances of up to 200 meters.

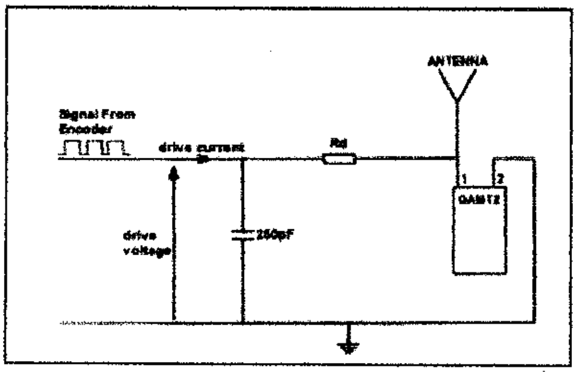


Figure 12 : Application circuit of QAMT2-434 transmitter

Figure 12 shows the circuitry implementation for the QAMT-434 transmitter. The QAMT2-434 requires a limiting resistor (Rd) to source the module with the correct drive current.

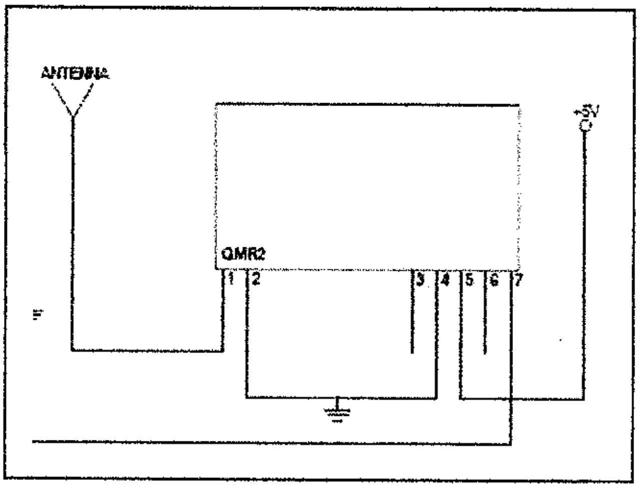


Figure 13 : Application circuit of QMR2-434 receiver

Figure 13 indicates the application circuit of the QMR2-434 receiver. It describes how the QM receiver can easily be integrated into a system to form a wireless link. The data output is pushed through Pin 7.

3.1.3 Serial Interface

This interface comes in between the microcontroller circuitry and the serial port of the PC. The details are shown in the Figure 14.

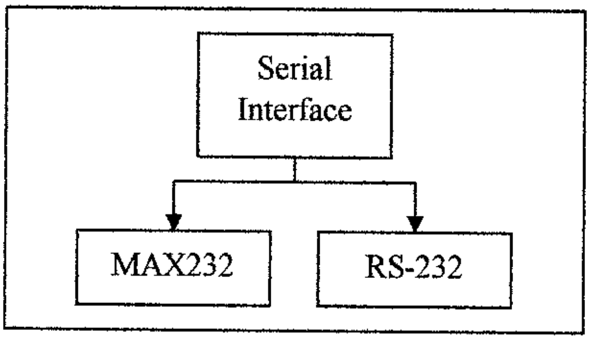


Figure 14 : Serial Interface Details

Basically, the data transmitted from the microcontroller will be managed by two important components. They are:

- MAX232
- RS-232

The MAX232 is a component that converts TTL logic levels (0V to 5V) to swing between 12V to -12V. From here, it will go through RS-232 to complete the communication with the serial port of the PC.

3.1.4 Graphical User Interface (GUI)

Microsoft Visual Basic 6 was chosen to design the GUI interface for the system. Therefore, it must accomplish several important characteristics of the interface. The details are as in Figure 15.

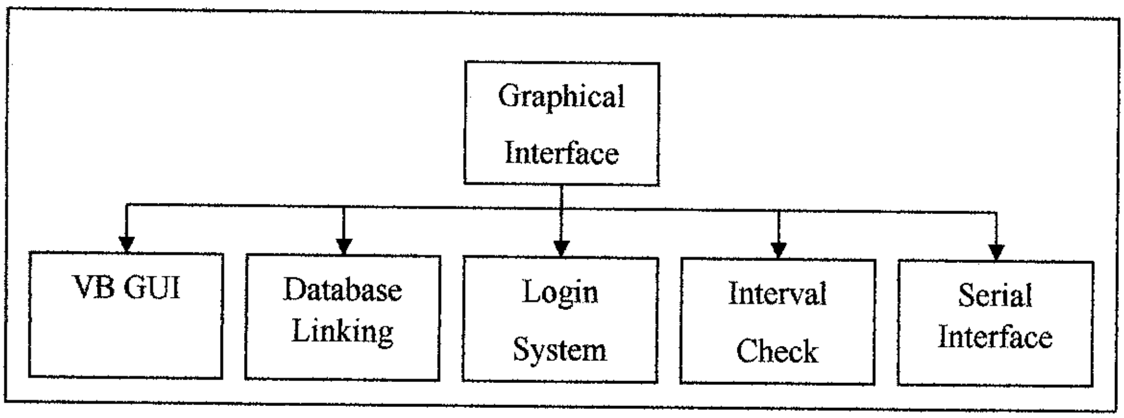


Figure 15 : GUI details

As visualized in the figure, the main characteristics are:

- VB GUI interface which show the login page and allow the user to communicate with the tag
- Database linking with Microsoft Access to allow data transfer
- Constant interval check where the tag was activated during some interval. Should the user with the tag is not present, the login startup page is activated
- Serial interface which coincide with the serial settings at the PC and microcontroller

The required characteristics mentioned for the system is very important to guide the design of the program in Visual Basic 6. This was to ensure that the system is capable of achieving a safe login environment

3.1.5 Database Application

The last part of the system was to be able to store the user log history for future references. The details are presented in Figure 16.

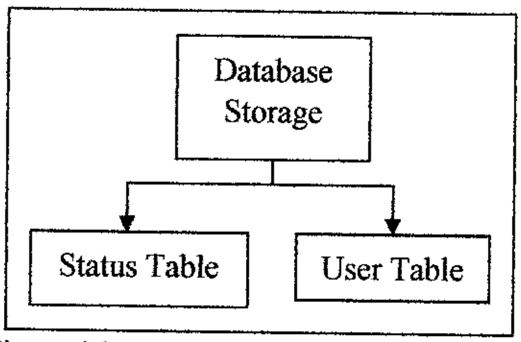


Figure 16 : Database application details

As presented in the figure above, besides login system for the software or the computer, there is also a need for storage of the user identity for the login system. A time log of the software or computer usage is created for reference in certain situation.

3.2 Tools Required

Hardware requirements:

1. A PC equipped with at least Pentium III or equivalent processor, 128 MB RAM, Microsoft 2000/ME/XP operating system and DB-9 serial port.
2. Radio frequency transmitter
3. Radio frequency receiver
4. Microcontroller – PIC16F84
5. RS-232 port connector – female
6. MAX232 level converter IC

Software requirements:

1. CCS Compiler - Microchip PIC C programming software
2. MAX Loader – Microchip PIC Programmer
3. Microsoft Visual Basic – Windows GUI programming software
4. Microsoft Access – Database software

CHAPTER 4
RESULTS AND DESICUSSION

4.1 Detailed system design

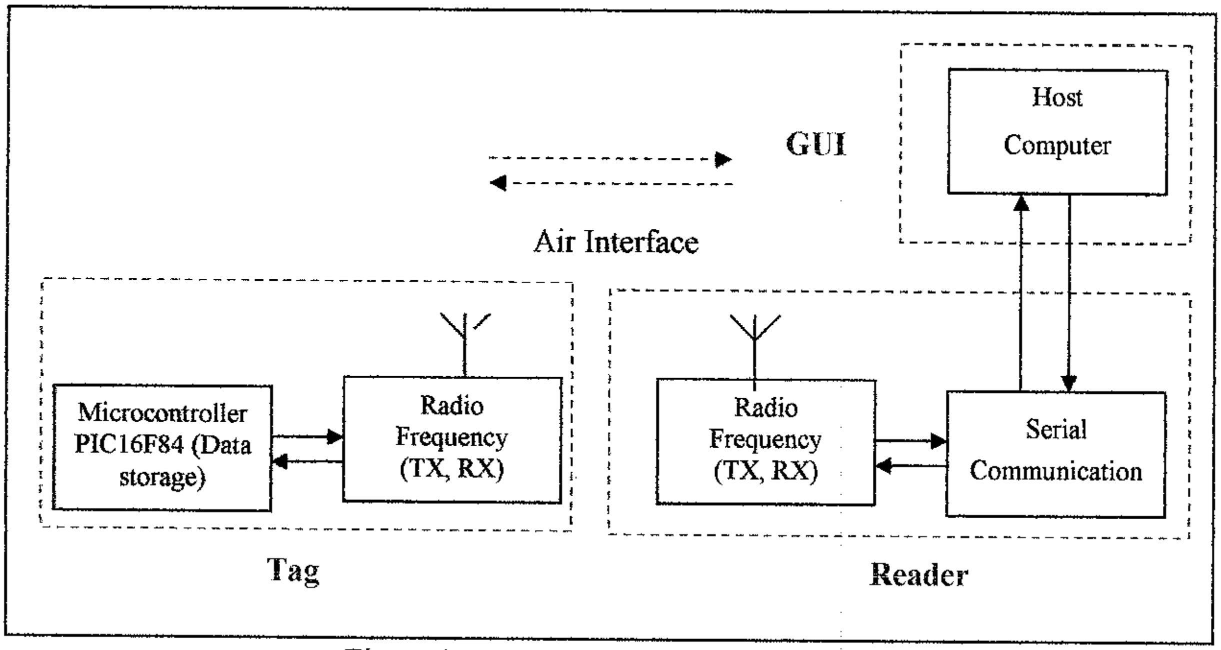


Figure 17 : RFID prototype system design

Figure 17 shows the detailed system design of the prototype. Basically, the system mainly consists of:

(1) Tag
(2) Reader
(3) GUI (Graphical User Interface)

Tag consists of a microcontroller to store data and a receiver to receive the activation signal. When it receives activation signal from reader, tag will transmit data stored in the microcontroller to the reader.

Reader acts as an interface between the host computer and the tag. User who wish to log in would click the 'log in' button' at the startup screen. When 'log in' button was pressed, reader will send activation signal to tag. If tag exists within the range, reader would receive the signal from tag and forward them to the host computer for verification purpose.

A GUI was built at the host computer to provide user interface to the system. The GUI of the system was built using Microsoft Visual Basic 6. A database was connected to the GUI. Basically, the GUI is to receive data from the reader, and to compare the data with data in the database. If the database verified the data from the tag, user had been granted access to the computer.

4.1.1 Tag circuitry

The tag circuitry mainly consists of an Ultra High Frequency (UHF) receiver, microcontroller PIC16F84 IC and QMR2-434 IC transmitter circuitry. The tag circuitry could be referred at Appendix J. Figure 18 indicates a simplified block diagram for reader circuitry, according to the circuitry at Appendix J.

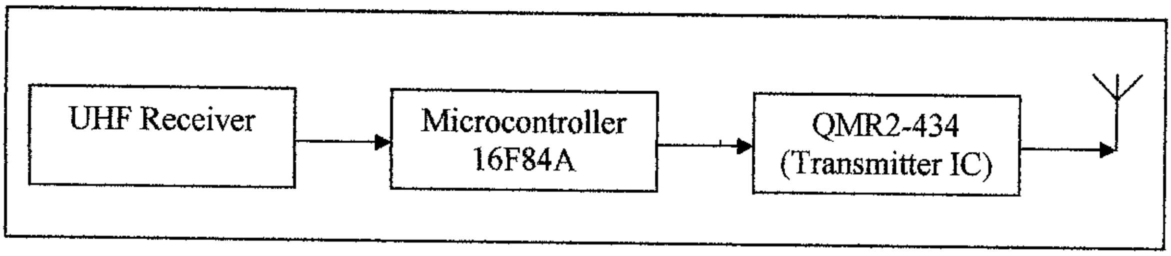


Figure 18 : Simplified block diagram for Tag circuitry

UHF receiver was used to detect activation signal from reader. Signal was detected at the RF portion of the (UHF) receiver. The low noise amplifier (LNA) amplifies the RF input signal, which is then passed through a band-select filter for selecting the band signals [10]. The mixer and RF synthesizer are used for frequency translation. The band-pass filter performs channel select. Finally, the digital data outputs are generated by the demodulator which was the LM567 IC. Figure 19 shows the pin layout of the LM567 IC. The filtered signal was passed to Pin 3 of the LM567 (refer Appendix D).

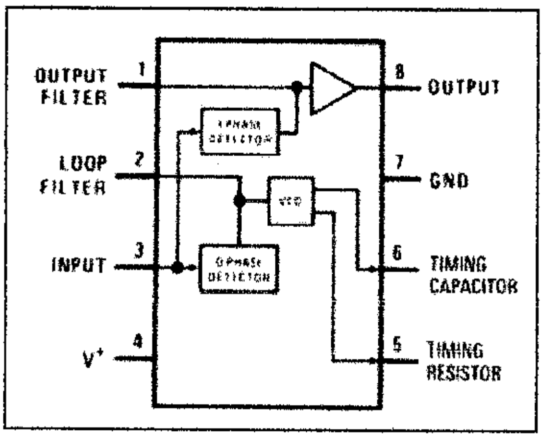


Figure 19 : LM567 Pin Out

The output was connected to the base of transistor Q3 which is 2N3906. If the Pin 8 produces output 1, current flows from the collector to the emitter of Q3. The emitter of the 2N3906 was connected to Pin B1 of the microcontroller PIC16F84A.

C language was used in programming the microcontroller. The PIC was programmed that if it received a 1 input at pin B1, data of "3753" which is the user's student id was to be transmitted. In order to run this program smoothly, several important initializations must be included. They are:

- PIC16F84 header file
- Declare the desired fuses
- Declare the usage of RS-232 which includes the baud rate, receive and transmit pins
- Define the delay or the clock oscillation speed

```
#include <16f84a.h>
#fuses XT,NOPROTECT,NOWDT

#use delay(clock=4000000)
#use rs232(baud=1200, xmit=PIN_A0, rcv=PIN_A1)
```

The complete C program for the microcontroller could be referred at Appendix G. Upon activation, data was pushed through Pin A1 to Pin 1 of QAMT2-434 transmitter. QAMT2-434 transmitted the data through the medium to the QMR2-434 receiver. Data sent and received by the pair of IC was the same as the pair was compatible with each other.

4.1.2 Reader Circuitry

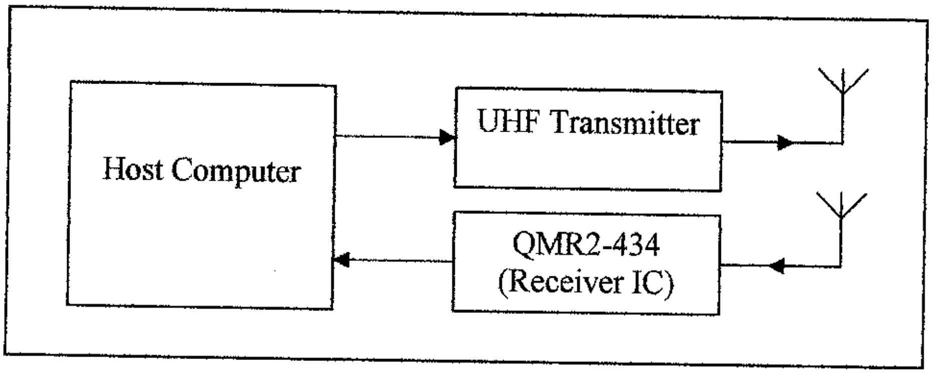


Figure 20 : Reader circuitry block diagram

Basically, there was three main elements in a reader; host computer, UHF transmitter and QMR2-434 circuitry. The circuitry of the reader may be referred at Appendix I. Voltage regulator 7805 is used to supply voltage to QMR2-434 receiver.

User may use graphical user interface designed (GUI) in the host computer to send command to log in. When the button "log in" was hit, it would send logic 1 through Pin 3 of the DB-9 to the UHF transmitter. The output from the computer was 7V which is able to turn on the UHF transmitter. "log in" command in the GUI is used to activate the UHF transmitter which sends activation signal to the tag.

If tag exists in the range, data consists of "3753" was received via QMR2-434. Data received from Pin 7 of QMR2-434 was pushed to Pin 2 of the DB-9. Data from the DB-9 is then passed to the GUI through Microsoft Comm. Control 6.0.

4.1.3 Graphical User Interface (GUI)

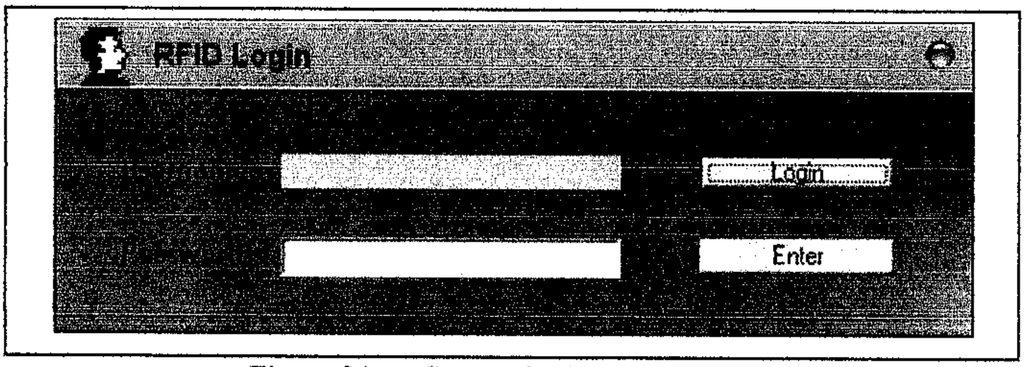


Figure 21 : Startup login interface

Graphical user interface was designed in order to guide users in using this prototype. The GUIs were developed using Microsoft Visual Basic 6. Basically, it was connected with two elements:

(i) Microsoft Access - stores the database of users and the corresponding passwords.

(ii) Reader – The program sends and receives data from the reader. Reader acts as an interface between program and tag.

This project was to enable RFID login system to a computer, and it also could be used to login to any software. Thus, the functionality of this prototype is to login to either a computer or to a software. In this case, login system was built to access sample software. Upon login, user will have access to designated sample software.

Figure 21 shows the startup screen for the login system. The complete code could be referred at Appendix K. The first part of the code was to set up the communication port connection setting with the reader. The commands are as follows:

```
Comm.InputMode = 0            'take ascii as input
Comm.CommPort = 1
Comm.Settings = "1200,N,8,1"
Comm.InputLen = 4             'limitation for input
Comm.RThreshold = 1
```

The baud rate was set to 1200 baud/s. The parity bit was set to none and 8 bits of data transmission was allowed. Users need to hit the login button to log in to the software or computer. Upon login, the GUI will send an output signal which is as follow:

Comm. output = "111111"

The output was sent to the reader where it was transmitted to the tag for activation. Upon receiving data from tag, the data was compared with the connected database, by the command

Adodc1.Recordset.Find "StudID='" & RS & "'"

The field StudID in the database is where the verified user's name was stored. Data from tag was stored in the string "RS" and compared with the list in the database. If it was verified, the login was continued with the password insertation.

Users need to key in password in the password field to login. If it matched with the database, they were able to access the computer or the software. In this case, a sample software was developed (refer Figure 22). If tag and password matches, a sample software will appear.

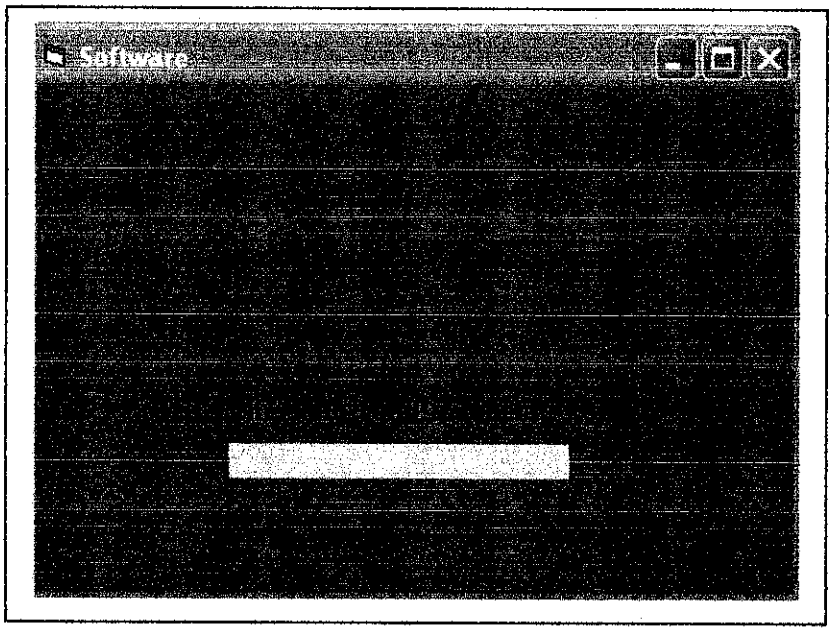


Figure 22 : Example of Software attached to the login program

The software keeps checking for the presence of tag at a constant interval. In this case, a timer of 10 seconds was set and activation signal was sent at every 10 seconds. If tag was detected, the software would keep on running, else the startup login page was activated. This was to avoid security breach, should the computer was left unattended.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This project was designated to design and construct a robust and reliable login system. The designated system should be able to replace or enhance smart card system. The main idea is to improve the capability of login system without the disadvantages of faulty contacting (sabotage, dirt, unidirectional insertion, time consuming insertion, etc.). A contactless transfer of data between the data carrying device and its reader is far more flexible. RFID was identified as the best solution of the problem.

Basically, the prototype was designed according to RFID system. The prototype consists of tag, reader and computer, which is similar to RFID component setup. Power source of this prototype may be different from RFID technology. A passive RFID tag obtains energy by induction of electromagnetic field created by the reader. Induced voltage serves as a power supply for passive RFID tags. The prototype uses 9V battery as its source of energy.

From the financial view, this project is definitely cost effective as it comprises of components that are generally low in terms of cost. Furthermore, they are also widely available in the market. This certainly proves to be a boost as this system is not only practical, but also competitive in performance and cost. Though this system is small scale at this stage, with some improvisations, it can adapt and be implemented in various domestic and industrial operations.

5.2 Recommendation

Some improvements need to be made for the benefit of the project. Engineers must have the capability to improvise and modify systems to better and more reliable. This project can be adapted to suit different applications.

Data transmission via radio frequency may cause security issues. Data encryption should be implemented in the transmission process. A suggested method of encryption is masking. The use of masking leads to data substitution. Often message is masked in such a way that the resulting message that goes out in an open communication channel, seems harmless and inconspicuous. Further research would be made to ensure a higher level of security in data transmission.

Serial communication should be replaced with Universal Serial Bus (USB) technology. Nowadays, serial communication technology can be considered as 'traditional'. Most modern personal computers use USB as their main mode of communication with other peripherals.

Usage of more powerful and higher range of PIC microcontroller will be needed to accommodate a more complex input. Currently, the PIC16F84A was used to store users' information. Higher capacity PIC such as PIC16F877 should be used to accommodate more complex functions for security purposes.

All these recommendations will definitely improve the current system into a more reliable identification system.

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APPENDICES

APPENDIX A

PROJECT GANNT CHART

No.	Detail/ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Selection of Project Topic														
	-Propose Topic														
2	Preliminary Research Work														
	-To study features of RFID system														
3	In-depth study about subject matter														
	- To study frequency ranges regulation														
4	To identify hardware related to RFID														
	- To acquire hardware (self-develop or buy)														
	- To do practical work (laboratory test)														
6	Project work continue														
	-Practical/Laboratory Work														
7	Submission of Interim Report Final Draft														
8	Oral Presentation														
9	Submission of Interim Report														

APPENDIX B

COMPARISON OF DIFFERENT IDENTIFICATION SYSTEM

System Parameter	Barcode	OCR	Voice Recognition	Biometry	Smart Card	RFID Systems
Typical data quantity (bytes)	1-100	1-100	-	-	16-64k	16-64k
Data density	Low	Low	High	High	Very high	Very high
Machine readability	Good	Good	Expensive	Expensive	Good	Good
Readability by people	Limited	Simple	Simple	Difficult	Impossible	Impossible
Influence of dirt/damp	Very high	Very high	-	-	Possible	No influence
Influence of covering	Total failure	Total failure	-	Possible	-	No influence
Influence of direction and position	Low	Low	-	-	Unidirectional	No influence
Degradation/ wear	Limited	Limited	-	-	Contacts	No influence
Purchase cost	Very low	Medium	Very High	Very High	Low	Medium
Operating Costs	Low	Low	None	None	Medium	None
Unauthorized copyrighting	Slight	Slight	Possible	Impossible	Impossible	Impossible
Reading Speed	Low ~4s	Low ~3s	Very low >5s	Very Low >5-10s	Low ~4s	Very fast ~0.5s
Maximum distance between data carrier and reader	0-50cm	<1cm Scanner	0-50cm	Direct contact	Direct contact	0-5m, microwave

APPENDIX C

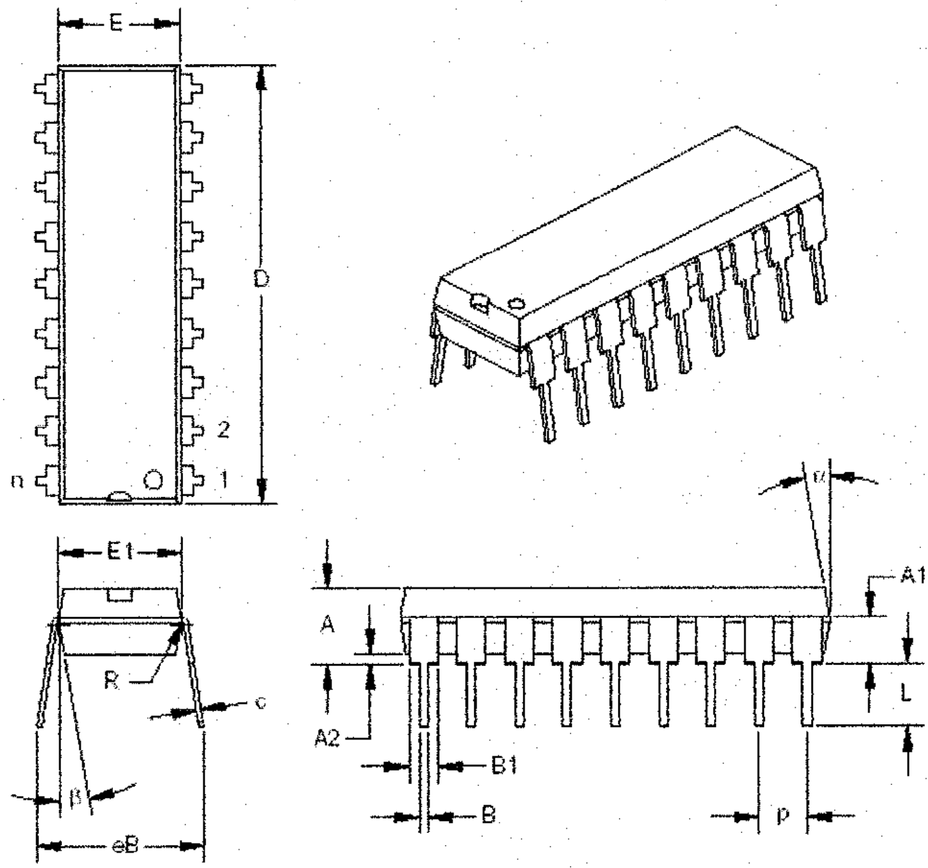
PIC16F84 FAMILY OF DEVICES

		PIC16F83	PIC16CR83	PIC16F84	PIC16CR84
Clock	Maximum Frequency of Operation (MHz)	10	10	10	10
Memory	Flash Program Memory	512	—	1K	—
	EEPROM Program Memory	—	—	—	—
	ROM Program Memory	—	512	—	1K
	Data Memory (bytes)	36	36	68	68
	Data EEPROM (bytes)	64	64	64	64
Peripherals	Timer Module(s)	TMR0	TMR0	TMR0	TMR0
Features	Interrupt Sources	4	4	4	4
	I/O Pins	13	13	13	13
	Voltage Range (Volts)	2.0-6.0	2.0-6.0	2.0-6.0	2.0-6.0
	Packages	18-pin DIP, SOIC	18-pin DIP, SOIC	18-pin DIP, SOIC	18-pin DIP, SOIC

All PICmicro™ Family devices have Power-on Reset, selectable Watchdog Timer, selectable code protect and high I/O current capability. All PIC16F8X Family devices use serial programming with clock pin RB6 and data pin RB7.

APPENDIX D

PIC16F84 HARDWARE PARAMETERS



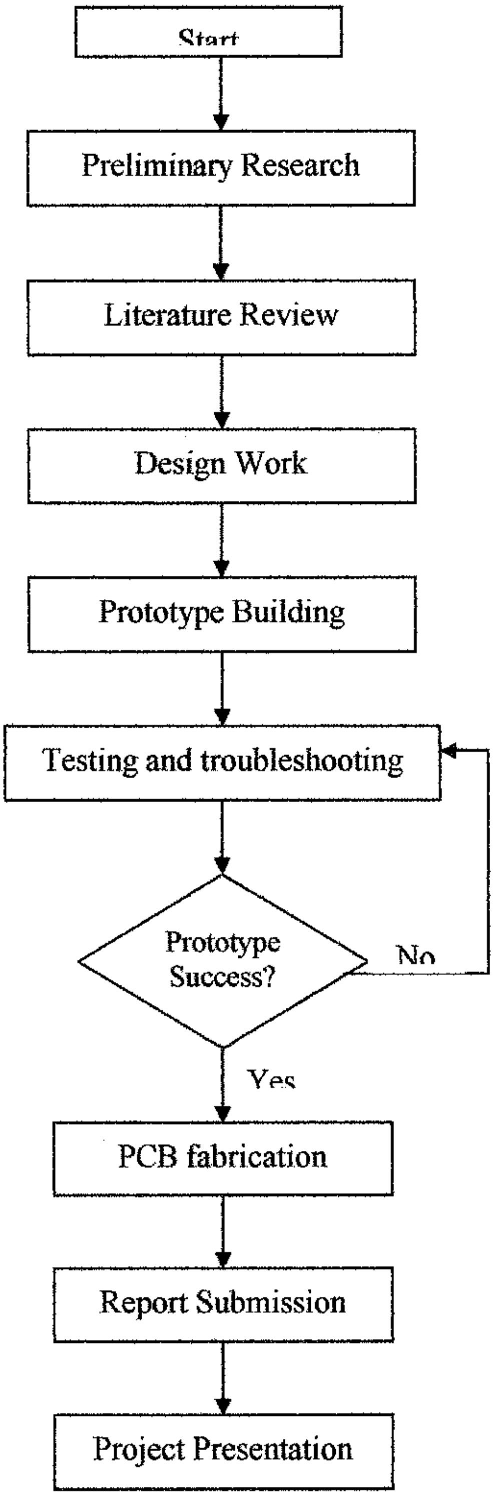
Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
PCB Row Spacing			0.300			7.62	
Number of Pins	n		18			18	
Pitch	p		0.100			2.54	
Lower Lead Width	B	0.013	0.018	0.023	0.33	0.46	0.58
Upper Lead Width	B1†	0.055	0.060	0.065	1.40	1.52	1.65
Shoulder Radius	R	0.000	0.005	0.010	0.00	0.13	0.25
Lead Thickness	c	0.005	0.010	0.015	0.13	0.25	0.38
Top to Seating Plane	A	0.110	0.155	0.155	2.79	3.94	3.94
Top of Lead to Seating Plane	A1	0.075	0.095	0.115	1.91	2.41	2.92
Base to Seating Plane	A2	0.000	0.020	0.020	0.00	0.51	0.51
Tip to Seating Plane	L	0.125	0.130	0.135	3.18	3.30	3.43
Package Length	D‡	0.890	0.895	0.900	22.61	22.73	22.86
Molded Package Width	E‡	0.245	0.255	0.265	6.22	6.48	6.73
Radius to Radius Width	E1	0.230	0.250	0.270	5.84	6.35	6.86
Overall Row Spacing	eB	0.310	0.349	0.387	7.87	8.85	9.83
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

* Controlling Parameter.

† Dimension "B1" does not include dam-bar protrusions. Dam-bar protrusions shall not exceed 0.003" (0.076 mm) per side or 0.006" (0.152 mm) more than dimension "B1."

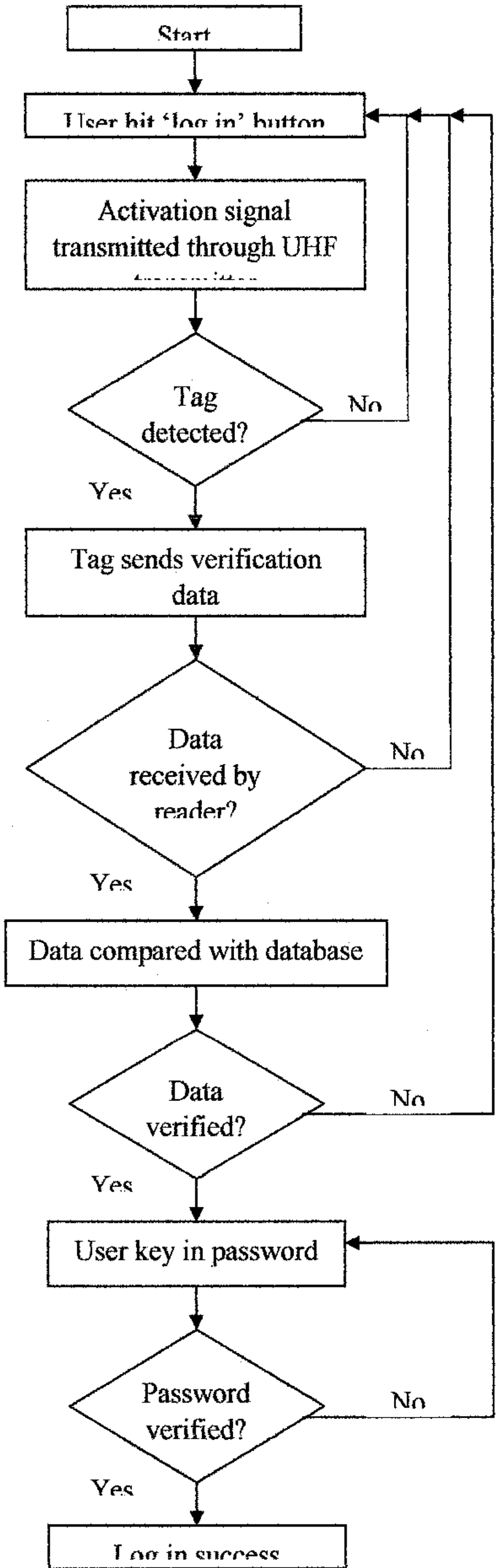
‡ Dimensions "D" and "E" do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010" (0.254 mm) per side or 0.020" (0.508 mm) more than dimensions "D" or "E."

APPENDIX E
PROJECT FLOWCHART



APPENDIX F

IDENTIFICATION SYSTEM FLOWCHART



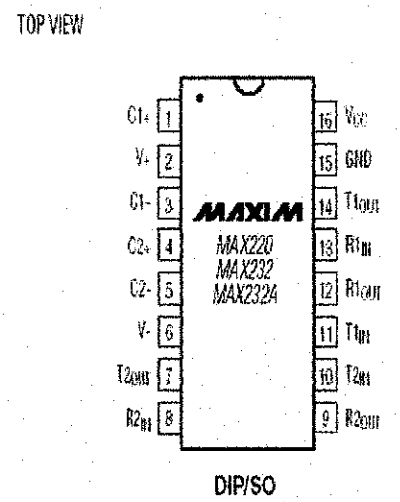
APPENDIX G

PIC16F84A C PROGRAM

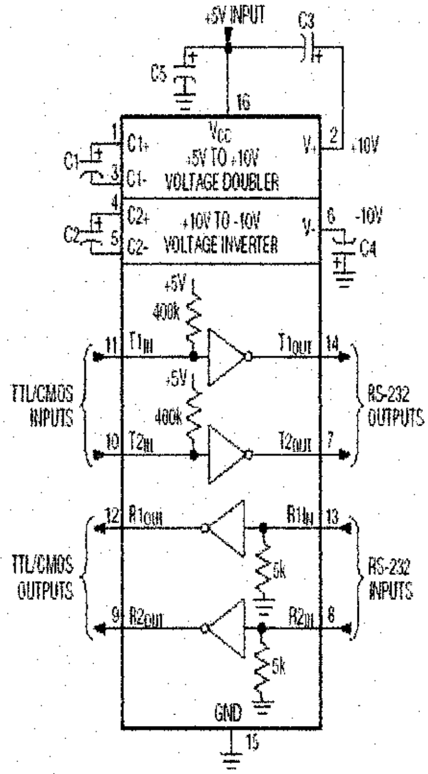
```
#include <16f84a.h>
#fuses XT,NOPROTECT,NOWDT

#use delay(clock=4000000)
#use rs232(baud=1200, xmit=PIN_A0, rcv=PIN_A1)

#define ALL_OUT 0
#define ALL_IN 0xFF

void respond() {

  output_low(PIN_A2);
  output_low(PIN_A3);
  output_low(PIN_A4);

}
main () {

  int i;

  set_tris_B(0xFF);

  do {
  delay_ms(100);
         putc(65);
  if (input(PIN_B1)!=0) {

     printf("3753");
    delay_ms(50);

  }

     } while (TRUE);

}
```

APPENDIX H

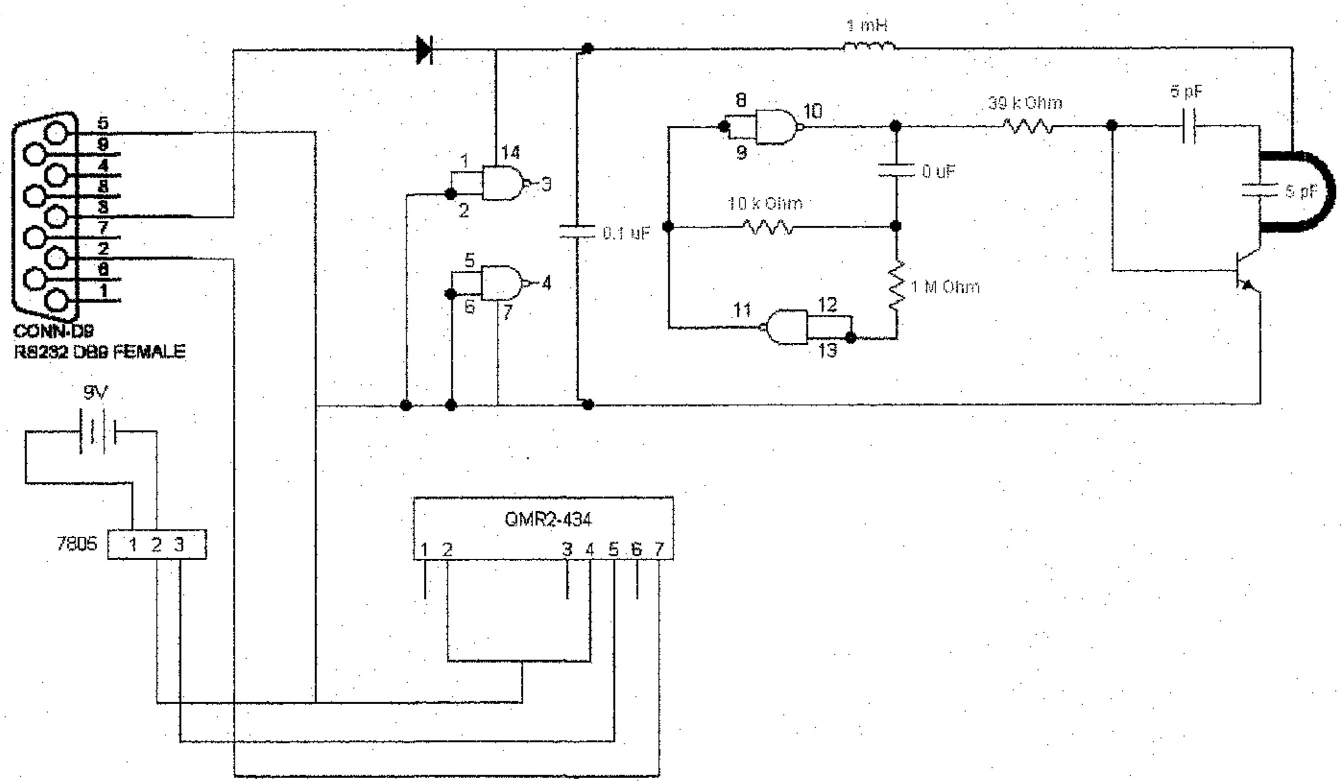
MAX232 PIN OUT AND TYPICAL OPERATING CIRCUIT



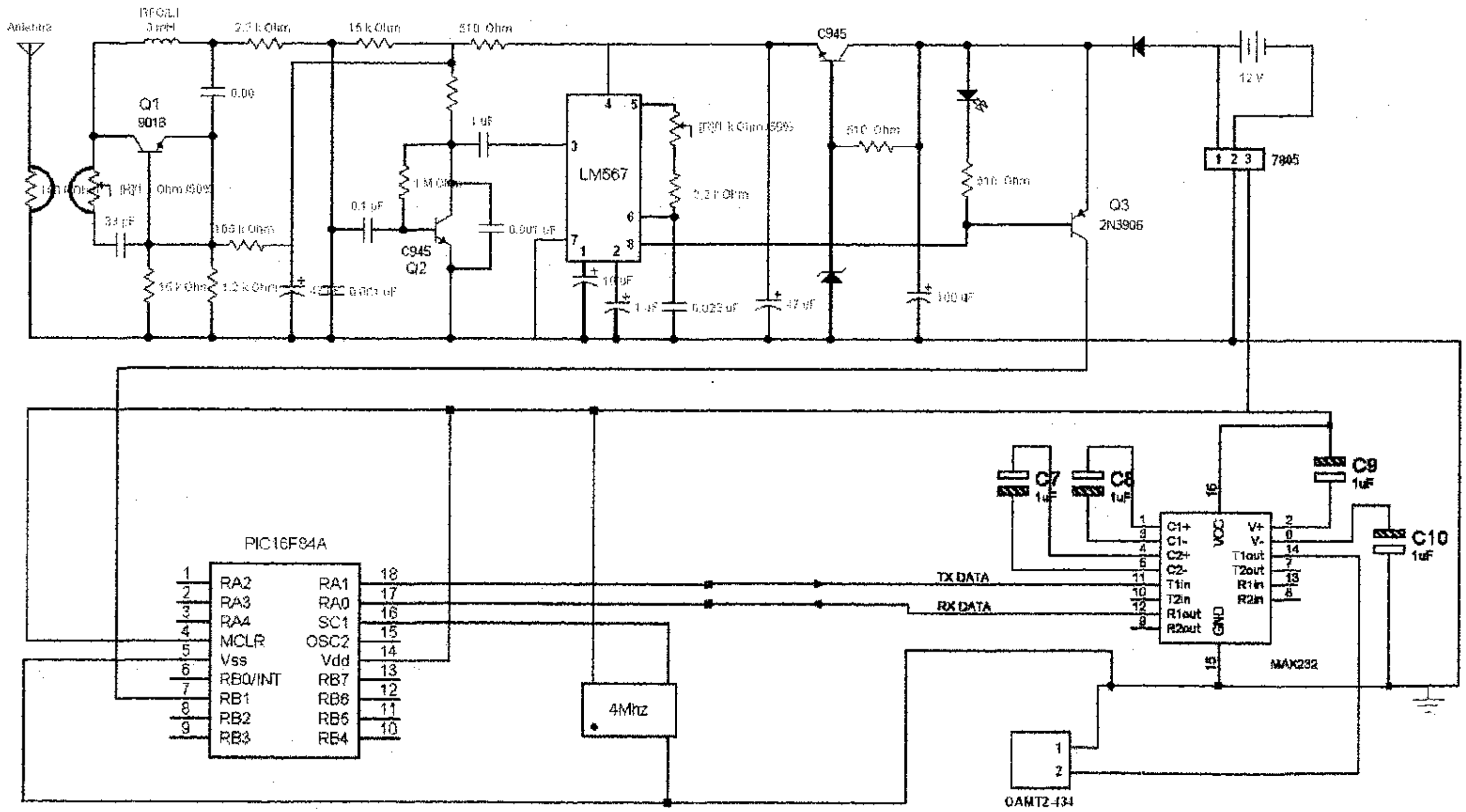
CAPACITANCE (µF)					
DEVICE	C1	C2	C3	C4	C5
MAX220	4.7	4.7	10	10	4.7
MAX232	1.0	1.0	1.0	1.0	1.0
MAX232A	0.1	0.1	0.1	0.1	0.1



APPENDIX I
READER CIRCUITRY



APPENDIX J
TAG CIRCUITRY



APPENDIX K

VISUAL BASIC 6 CODE

```
Option Explicit
Public stat As Integer
Dim RS As String
Dim StudentName As String
Dim SearchVariable As String

Private Declare Function ShellExecute Lib "shell32.dll" Alias "ShellExecuteA" (ByVal hwnd As Long,
ByVal lpOperation As String, ByVal lpFile As String, ByVal lpParameters As String, ByVal
lpDirectory As String, ByVal nShowCmd As Long) As Long

Private Sub Form_Load()

  'Initialize
 Comm.InputMode = 0                    'take ascii as input
 Comm.CommPort = 1
 Comm.Settings = "1200,N,8,1"
 Comm.InputLen = 4                     'limitation for input
 Comm.RThreshold = 1

End Sub

Private Sub Command1_Click()

If Comm.PortOpen = False Then
Comm.PortOpen = True
End If

Comm.Output = "111111111"

If Comm.CommEvent = comEvReceive Then           'check event (receive data)

RS = Comm.Input                        'store data in RS

 Adodc1.Refresh
 Adodc1.Recordset.MoveFirst
 Adodc1.Recordset.Find "StudID='" & RS & "'"      'find RS in database

If Adodc1.Recordset.EOF Then
   MsgBox "There are no such user", vbCritical
Else
   Username.Caption = Adodc1.Recordset("StudName")
End If

Else
  MsgBox "No tag detected"

End If

End Sub

Private Sub Command2_Click()

If Username.Caption = "" Then
  MsgBox "No tag detected", vbCritical
```

```
Else

  Adodc1.Recordset.Find "pass='" & Username.Caption & "'" 'find password in database

  If Adodc1.Recordset.EOF Then
     MsgBox "Wrong Password", vbCritical
  Else
     RFIDSoftware.Visible = True
     Username.Caption = ""
     Text2.Text = ""
     Unload Me

  End If

 End If

End Sub

Private Sub Image2_Click()
Unload Me
End Sub
```