

**DESIGN AND CONSTRUCTION OF AN  
INTELLIGENT ROOM MONITOR AND  
CONTROLLER**

**BY**

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(2003/15319EE)**

**DEPARTMENT OF ELECTRICAL AND COMPUTER  
ENGINEERING**

**SCHOOL OF ENGINEERING AND ENGINEERING  
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**FEDERAL UNIVERSITY OF TECHNOLOGY MINNA**

**NIGER STATE NIGERIA**

**NOVEMBER, 2008.**

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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE AWARD OF THE  
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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA,  
NIGER STATE.**

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## **DEDICATION**

I hereby dedicate this project to my creator, Lord Almighty, to my wonderful parents;

Mr. J.O.W. Amadi, Mrs. M.I. Amadi, my late elder sister: Nurse Chioma Rose line


Amadi, my beloved brothers and sisters and friends.

## ATTESTATION/DECLARATION

I AMADI PETER CHIDINGOZI declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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All glory and adoration belongs to the creator of the world. Without him, this project would have been a mirage. A sublime tradition says, he who is ungrateful to God, will be ungrateful to man.

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## ABSTRACT

Quite often, students enter into lecture halls, switch on the appliances – bulbs, fans, Air-conditioners (ACs.), fluorescent tubes, etc and leave them on when leaving the halls. The implication of this is liabilities of fire outbreak through upsurge voltage, as the appliance are on. Again there will be high electric bill as a result of careless use of power. This ill can be corrected using **intelligent room monitor and controller**. It uses infrared emission to sense human beings when going in or out the lecture hall. As students go into the lecture hall, the first person to enter the hall, it switches ON all the appliances – bulbs, fans, ACs, fluorescent tubes, refrigerators etc. It has 3 display units – one; to display the number of students going in, two; to display the number of students going out, three; to display the number of students in the hall. When the last person leaves, it will automatically switch off all the appliances.

The interesting part of this project is that it is designed and constructed to be able to use only one entrance door and will be able to differentiate people going in and out of the hall and accurately do the counting and control all the appliances correctly.

## TABLE OF CONTENTS

DEDICATION.....	i
DECLARATION.....	ii
ACKNOWLEDGEMENT.....	iii
ABSTRACT.....	iv
TABLE OF CONTENTS	
LIST OF FIGURES AND TABLES	
<b>CHAPTER ONE</b>	
1.0 INTRODUCTION	1
1.1 OBJECTIVES OF THE PROJECT	2
1.1.2 MOTIVATION	2
1.1.3 ECONOMIC IMPORTANCE OF THE PROJECT	2
1.2 METHODOLOGY	3
1.2.1 CONSULTATION	3
1.2.2 RESEARCH AND DESIGN	3
1.2.3 CONSTRUCTION	3
1.3 ORGANIZATION OF THE PROJECT	3
<b>CHAPTER TWO</b>	
2.0 INTRODUCTION	4
2.1 LITERATURE REVIEW	4
2.2 PC INTERFACES	5
2.2.1 PARALLEL PORTS	6

2.2.3	EVOLUTION OF THE PARALLEL PORTS	6
2.2.4	TYPES OF PARALLEL PORTS	7
2.2.5	ALTERNATIVES TO PARALLEL PORTS	9
2.2.6	SERIAL INTERFACES	9
2.2.7	PC CARDS	11
2.2.8	PROGRAMMING THE PARALLEL PORT	11
2.2.9	MICROSOFT VISUAL BASIC	12
2.3	COMPONENT THEORY	
2.3.1	TRANSISTORS	13
2.3.2	COMPARATOR IC (LM358)	14
2.3.3	RELAY	15
2.3.4	PROTECTION DIODE FOR RELAY	16
2.3.5	IC 555 TIMER	17
<b>CHAPTER THREE</b>		
3.0	INTRODUCTION	20
3.1	DESIGN OBJECTIVES AND CONSIDERATIONS	20
3.2	THE SYSTEM BLOCK DIAGRAM AND GRAPHIC USER INTERFACE	21
3.2.1	THE OPERATION OF THE SYSTEM	22
3.3	HARDWARE INTERFACE	23
3.4	THE INFRARED SYSTEM	
3.4.1	THE INFRARED TRANSMITTER CIRCUIT	29
3.4.2	THE INFRARED RECEIVER CIRCUIT	30

3.4.3	THE POWER SUPPLY CIRCUIT	31
3.4.4	THE SWITCHING CONTROL	32
<b>CHAPTER FOUR</b>		
4.1	TESTING	33
4.1.1	HARDWARE TESTING	35
4.1.2	SOFTWARE TESTING	37
4.1.3	COMPLETE SYSTEM TESTING	38
4.2	PACKAGING	38
4.3	PROBLEMS ENCOUNTERED	38
4.4	COST ANALYSIS	40
<b>CHAPTER FIVE</b>		
5.1	CONSTRUCTION	41
5.2	RECOMMENDATION	42
<b>REFERENCES</b>		43-44
<b>APPENDIX 1</b>		45
<b>APPENDIX 2</b>		51
<b>APPENDIX 3</b>		52

## LIST OF FIGURES AND TABLES

- Figure 2.0 Transistors as a Switch
- Figure 2.1 Top View of LM 358
- Table 2.1a Types of Parallel Ports
- Figure 2.2 Circuit Symbol of a Relay
- Figure 2.3a Relay Connected in a Protected Mode
- Figure 2.3b Functional Diagram of 555 timer
- Figure 3.1 Block Diagram
- Figure 3.2 Graphic User interface of the System
- Figure 3.3 View Data Tab of Operation
- Figure 3.4 Pin-out components of the parallel port
- Table 3.5a Parallel Port Signal Assignments
- Table 3.5b Parallel Port Addresses
- Table 3.5c Line Printer Addresses in the Bios Data Area
- Figure 3.6 Infrared Transmitter Circuit
- Figure 3.7 Infrared Receiver Circuit
- Figure 3.8 Power Supply Circuit
- Figure 3.9 The Switching Control Circuit

# CHAPTER ONE

## 1.0 INTRODUCTION

Over the years, the advancement in the field of science and technology has been rapid based on the development in electronics and computer. The duty of the engineer is to ensure that this advancement are undertaken and maintained with available minimum resources. The most important 1<sup>st</sup> step in an intelligent monitor and controller is the awareness that risk exists in reckless abandon of electrical and electronics appliances when switched on.

One of the most valuable ways of making the assessment is to consider what one would do to control these appliances. This motivated the design of intelligent room monitor and controller. With advancement in engineering technology over the years, life has been made easier as engineering has and is always devising new methods of identifying and solving problems.

Electrical engineering can now be agreed to be finding of electrical and electronics solutions to various human needs and problems. This is achieved using electronics components and circuits. Engineering's greatest goal is to satisfy all man's needs found within its fields and current capabilities because man always had needs and desires which are numerous.

One of the most the problems faced by is protection against electrical disaster or faults in our homes, offices, schools etc. In spite of the various complex measures and means employed to combat this problem of protection, all proved effective. Like most cases of

over current and over voltage which results into damages on the appliances. Incessant PHCN bills due to reckless abandon of appliances also increases the risk of electrical mishap. The primary aim of this project is to give a simple cost-effective and reliable circuit which will aid in monitoring and controlling electrical devices in our homes, offices etc with ease.

### **1.1.1 AIMS AND OBJECTIVES OF THIS PROJECT**

The aims/objectives of this project are to design and construct an electronic gadget that will be interfaced to a computer system to:

- Detect human motion and differentiate when one is going in or out of a room.
- Count the number of persons that have passed through door post and give a balance of the number of persons inside the room.

Switch off appliances in the room when there is no body inside and switch on all appliances when there is a person inside the room.

### **1.1.2 ECONOMIC IMPORTANCE OF THE PROJECT**

The computer intelligent room controller when implemented will ensure quite safety in the use of electrical appliances. The automated switching off the appliances when there is nobody in the lecture hall, and switching on when there is a person in ensures great safety in the handling of the appliances. It is equally effective in utilizing electric billing, where the appliances are switched off when not in use.

The counting of the number of students going inside and outside of the lecture hall or where this gadget is installed could be used to access students' usage of the lecture hall, library, hospital, etc. The data obtained could equally be used for statistical analysis. The



design consideration and specification provide easy operation of the system, reliability, maintenance, low cost and low power consumption.

The computerized intelligent monitor and controller system can have valuable applications schools, banks, government houses, hotels, confidential houses where there is a need to monitor movement.

## **1.1 METHODOLOGY**

### **1.2.1 Consultations**

This involved seeking expertise advice about what the project would entail in terms of cost and time. Advice was sought from fellow students with the technical know-how about how the project could be achieved.

### **1.2.2 Research and Design**

This involved checking specific materials and books about how to carry out the project. Relevant websites with useful information about the designs, constructions and implementation of electronic devices were also visited. The aim is to get the most effective and economically viable design for the project. This stage also involved the simulation of the circuit design on an electronic work bench.

### **1.2.3 Construction**

This was the actual fabrication of the project. Here the circuit was first tested on a bread board, before transfers could be made to the Vero board. This stage involved component testing, soldering and the packaging of the project design.

### **1.3 ORGANIZATION OF THE WORK**

This work is organized in five chapters. Chapter one is the introduction which includes aim\objectives, motivation, economic importance, and methodology. Chapter two gives the literature review of the system, which reveals the materials used for the construction of the project. Chapter three gives the design analysis of the system to ensure accuracy, reliability, and efficiency of the system. Chapter four is the implementation of the system and chapter five gives the recommendation and conclusion.

## **CHAPTER TWO**

### **LITERATURE REVIEW/THEORITICAL BACKGROUND**

#### **2.0 INTRODUCTION**

The intelligent room monitor and controller consists of a transmitter and receiver (transceiver), signal processor, computer and control switch. The transmitter, which sends signal by binary code into the receiver. This signal commands the receiver what to do, goes into the control switch which controls the relay. Here the automatic ON/OFF processes of the appliances is achieved.

The infrared control is made up of a transmitter and receiver (photo-detector). The transmitter transmits light with a particular frequency of 2.65KHZ.

#### **2.1 LITERATURE REVIEW**

A method for monitoring a plurality of devices in a common environment. The method comprises of receiving usage information from one of the devices and storing the usage information on a memory device of a computer. The method further comprises the steps of using the computer to automatically access a remote database containing information regarding the device and transmitting the stored usage information to the remote database. The information is received from the remote database and as the action to be taken by the device is generated using the information from remote database and stored usage information. [1]

Method and circuit system for controlling a lightning electronics. This is a typical situation in appliances used in lightning electronics. [1]

System for monitoring and controlling electrical consumption. Monitoring in addition to control (supervising) individual electrical appliances and outlets which they are connected. [2]

Power control circuits; an electronic circuit device for monitoring electrical/electronic appliance or a device to control other appliances, devices and accessories. User assisted programmed appliance control combined transmitter/ receiver integrated circuit. [2]

Power control circuits with enhanced non-linear circuit sensing. Analogue and digital power control switching circuits and power strips for use. [2]

Appliances and sensors; logic electrical signal can easily be processed by an electronic control system. This uses relatively inexpensive infrared sensors. Control system for testing electrical appliance; an electronic relay circuit is responsible for switching between the inverter and the keywords control system. [2]

## **2.2 PC INTERFACES**

An interface is the line of communication between two pieces of equipment so arranged to produce harmonious operation. It can therefore be said that an interface to the personal computer is such a communication line so configured as to produce harmonious operation between it and other equipment. This could be another computer, a computer peripheral device, a fax machine or a telephone.[3]

There are special-purpose, multi-purpose and general-purpose interfaces. The keyboard, sound card, mouse etc. connectors represent the special-purpose interfaces. They cannot be used for any other device.

The parallel port (printer port), serial port, inverse serial bus (USB), and IEEE 1394 represent multipurpose interface since they can be used for various peripheral devices, including data storage device.

The slots on the motherboard, such as the PCI and ISA slots, can be used to connect various (via the plug-in cards) and represent truly general-purpose interfaces.[3]

A basic definition of an interface is a hardware and or software data transmission regulator that controls data exchange between the PC and other devices and peripherals.

The interface is supported by the electronics of the data transfer controller and the device electronics. There are standards adopted for the interface protocols allowing connection of any standard peripheral device.

### **2.2.1 PARALLEL PORTS**

The parallel port was originally created for communicating with the printer and thus is called a 'printer port'. It is the most commonly used port for interfacing home projects. This port will allow the input of up to 9-bits or the output of 12-bits at any one given time, thus requiring minimal external circuit to implement many simpler tasks. The port is composed of 4 control links, 5 status lines and 8 data lines. It is found commonly at the back of PC a D-type 25 pin female connector. [4]

### **2.2.2 HISTORY OF PARALLEL PORTS**

In 1981, IBM introduced the personal computer (PC). The parallel port (standard parallel port SPP) was introduced in the first PC and it was added to this like an alternative to the low-benchmark of the serial port. This port has the capacity to transmit 8-bits of data at same time while the serial port made it one at a time. In the moment that the parallel port was presented, the matrix printers were the main devices external to the PC that could be connected to. [5]

### **2.2.3 EVOLUTION OF THE PARALLEL PORTS**

As the design of the PC evolved, several manufacturers introduced improved version of the parallel port. The new port types are compatible with the original design, but add new abilities, mainly for increased speed. Speed is important because as computers and peripherals have gotten information they need to exchange has increased. The original parallel port was pretty fast enough for sending bytes representing ASCII text characters to a dot-matrix or daisy-wheel printer. But modern printers need to receive much more information to print a page with multiple fonts and detailed graphics, often in

colour. [5] The faster the computer can transmit the information, the faster the printer can begin processing and printing the result.

A fast interface also makes it feasible to use portable external versions of peripherals that would otherwise have to install inside the computer. A parallel-port tape or disk drive is easy to move from system to system, and for occasional use, such as making backups, you can use one unit for several systems. Because a backup may involve copying hundreds of Megabytes, the interface has to be fast to be worthwhile.

#### **2.2.4 TYPES OF PARALLEL PORTS**

At the present, four types of parallel ports are available. [4] They are :

- ◆ Standard Parallel Port (SPP).
- ◆ Parallel Port PS/2 (Bi-directional).
- ◆ Enhanced Parallel Port (EPP).
- ◆ Extended Capability Port (ECP).
- ◆ Multimode Ports.

A brief description of each of these is given below:

##### **Original / Standard Parallel Port**

The parallel port in the original IBM PC, and any port that emulates the original port's design, is sometimes called the SPP, for standard parallel port, even though the original port had no written standard beyond the schematic diagrams and documentation for the IBM PC. Other names used are AT-type or ISA-Compatible. The port in the original PC was based on an existing Centronics printer interface. However, the PC introduced a few differences, which other systems have continued.

SPPs can transfer eight bits at once to a peripheral using a protocol similar to that used by original Centronics interface. The SPP does not have a byte-wide input port, but for PC-to-Peripheral transfers, SPPs can use a Nibble mode that transfers each byte 4-bits at a time. Nibble mode is slow, but has become popular as a way to use the parallel port for input. [4]

#### PS/2-Type (Simple Bi-directional)

An early improvement to the parallel port was the bi-directional data port introduced on IBM's model PS/2. The bi-directional port enables a peripheral to transfer eight bits at once to a PC. The term PS/2-type has come to refer to any parallel port that has a bi-directional data port but does not support the EPP or ECP modes described below. Byte mode is an 8-bit data-transfer protocol that PS/2-type ports can use to transfer data from the peripheral to the PC.

#### Enhanced Parallel Port (EPP)

The EPP (Enhanced Parallel Port) was originally developed by chipmaker Intel, PC manufacturer Zenith, and Xircom, a maker of parallel port networking products. As on the PS/2-type port, the data lines are bi-directional. An EPP can read or write a byte of data in one cycle of the ISA expansion bus, or about 1 microsecond, including handshaking, compared to four cycles for an SPP or PS/2-type port. An EPP can switch directions quickly, so it is very efficient when used with disk and tape drives and other devices that transfer data in both directions. An EPP can also emulate an SPP, and some EPPs can emulate a PS/2-type port.

#### Extended Capabilities Port (ECP)

The ECP (Extended Capabilities Port) was first proposed by Hewlett Packard and Microsoft. Like the EPP, the ECP is bi-directional and can transfer data at ISA-bus speeds. ECPs have buffers and support for DMA (direct Memory Access) transfers and data compression ECP transfers are useful for printers, scanners, and other peripherals that transfer large blocks of data. An ECP can also emulate an SPP or PS/2-type port, and many ECPs can emulate an EPP as well.

#### Multimode Ports

Many newer ports are multimode ports that can emulate some or all of the above types. They often include configuration options that can make all of the port types available, or allow certain modes while locking out the others.

In the following chart synthesized information is shown of each one of these types of ports. [6]

Table 2.1a – Types of Parallel Ports

	SPP	PS/2	EPP	ECP
Dates of Introduction	1981	1987	1994	1994
Maker	IBM	IBM	Intel, Xircom and Zenith Data Systems	Hewlett Packard and Microsoft
Bi-directional	No	If	If	If
DMA	No	No	No	If
Speed	150Kbyte /seg	150Kbytes/se g	2Mbytes/seg	2Mbytes/seg



## 2.2.5 ALTERNATIVES TO THE PARALLEL PORT

The parallel port is just one of many ways to interface inputs and outputs to a computer. A few of these alternatives to parallel port are treated below.

## 2.2.6 SERIAL INTERFACES

One large group of parallel port alternatives is serial interfaces where data bits travel on a single wire or pair of wires (or in the case of wireless links, a single transmission path) both ends of the links require hardware or software to translate between serial and parallel data. There are many types of serial interfaces available for PCs, ranging from the ubiquitous RS-232 port to the newer RS-486, USB, IEEE-1394, and IrDA interfaces. [4]

### → RS-232

Every PC has at least one RS-232 serial port. This interface is specifically useful when the PC and the circuits that you want to connect are physically far apart.

As a rule, parallel-port cables should not be longer than 10 to 15 feet, though the IEEE-1284 standard describes an improved interface and cable that can be 10 metres (33 feet).

In contrast, RS-232 links can be 80 feet or more, with the exact limit depending on the cable specification and that speed of data transfers. RS-232 links are slow. However, along with each byte, the transmitting device adds a start and stop bit. Even at 115200 bits per second, which is a typical maximum rate for a serial port, the data-transfer rate with one start and stop bit per byte just 11,520 bytes per second.[3]

### → RS-485

Another useful interface is the RS-485, which can use cables as long as 4000 feet and allows up to 32 devices to connect to a single pair of wires. You can hold an expansion card that contain an RS-485 port, or add external circuits that convert an existing RS-232 interface to RS-485. Other interfaces similar to RS-232 and RS-485 are RS-422 and RS-423.

### → **UNIVERSAL SERIAL BUS**

The USB interface is designed for easy hassle-free and relatively inexpensive low-and medium speed applications. It is a new option for I/O interfacing, a project of a group that includes Intel Microsoft.

In theory, a USB interface can support up to 127 individual USB peripherals/devices at one time. The practical maximum number of devices is less since some of them reserve USB bandwidth. Each device connected to the USB port can communicate at either 1.5-Megabits/second or 12-Megabits/second over a 4-wire cable. USB makes adding peripheral devices easy and is quickly replacing different kinds of serial and parallel port connectors with one standardized plug and port combination.

The USB standard describes both the hardware interface and software protocols. Newer PCs may have a USB port built-in, but because it is so new, most existing computers can't use it without added hardware and software drivers.

### → **IrDA (Infrared Data Association)**

The IrDA (Infrared data Association) interface allows wireless serial communication over distances of 3 to 6 feet. The links transmits infrared energy at up to 115200 bits/second. It is intended for convenient (no cables or connectors) transmitting of files between a desktop and Laptop computers, or any other short-range communication where a cabled

interface is inconvenient. Some computers and peripherals now have IrDA interface built-in.

### **2.2.7 PC CARDS [4]**

Finally, some I/O cards plug into a PC card slot, which accepts slim circuits cards about the size of a playing card. An earlier name for these was PCMCIA cards, which stands for the Personal Computer Memory Card International Association, whose members developed the standard. Many portable computers and some desktop models have PC-card slots. Popular users include Modems and data acquisition circuits. There are even an internal expansion slots and you do not have to open the computer to plug the card in the PC.

After a careful analysis of all the variations of PC interfaces available, the standard parallel port was chosen to execute this project (Computer Interface to control home appliances). The choice of the standard parallel port as the preferred interface was borne out of its various advantages, which are listed below.

- ◆ The Standard Parallel Port is a simple and inexpensive tool for building computer controlled devices and objects.
- ◆ The Standard Parallel Port interface is more widely available.
- ◆ The Standard Parallel Port is highly compatible with most existing and new PCs.
- ◆ The Standard Parallel Port interface has better speed performance than most serial interfaces.
- ◆ The Standard Parallel Port interface is highly flexible also, its simplicity and ease of programming makes parallel ports popular in the electronics world.

## 2.2.8 PROGRAMMING THE PARALLEL PORT

Almost all programming languages allow programmers to access the parallel port using some library functions.

QBasic is perhaps the easiest language to program the parallel port with. Almost every PC should have access to QBasic. The command for sending data to the parallel port in QBasic is OUT. The format is:

OUT port, value

Programming the parallel port can also be accomplished with Visual C++. Visual C++ provides two functions to access I/O mapped peripherals, `'_inp'` for reading and `'_outp'` for writing. Both functions can be accomplished in Visual C++ with the help of the header library `conio.h`.

Assembly language programming can often be complicated, however; writing to the parallel port can easily be done using x86 Assembly language. It employs a simple instruction called `out` to write to the port. Its format is:

Out accumulator, port

## 2.2.9 MICROSOFT VISUAL BASIC

Microsoft Visual Basic has long been a favourite programming language for real-world projects that access the world beyond a computers keyboard, display and the usual assortment of peripherals. Its ease of use and many abilities have made it one of the PC's most popular programming languages. A Visual Basic program and an available port such as the standard parallel port are often utilized in projects involving flipping switches, reading sensors, spinning motors, or controlling or watching the outside world in a unique way.[4]

Irrespective of its ease of use, Visual basic has one hitch– it does not have any functions or support to access the parallel port directly. However, it is possible to add such capabilities to Visual Basic applications by writing a DLL (Dynamic Link Library) in Visual C++ and calling its exported functions from Visual Basic thus enabling any windows program to access ports.

The DLL is a file that contains program routines for reading and writing to ports. It must be stored on the user's system, and an application that uses the DLL must include a declaration for each routine it calls. The declaration tells the operating system where to find the routines.

When the application runs, the DLL loads into systems memory and the application may call any of the declared routines. The Visual-basic statements that call the DLL's routines are identical to QBasic's Inp and Out statements. DLL are available for free downloads on the Internet. One of the DLLs – Inpout16.dll is for use with 16-bit programs while the other Inpout32.dll is for use with 32-bit programs. Although the program code to call the Inp and out routines is identical for both types, each requires a different DLL and declarations.[7]

Finally, for this project, we have chosen Visual Basic because of its ease of use and flexibility to enable us program the parallel port.

## **2.3 Component Theory**

### **2.3.1 Transistors**

Transistors are active components used basically as amplifiers and switches. The two main types of transistors are; the bipolar junction transistors whose operation depends on the flow of both minority and majority carriers, and the unipolar or field effect transistors (called FETs) in which current is due to majority carriers, and (either

electrons or holes). The transistor as a switch operates in a class 'A' mode. In this mode of bias the circuit is designed such that current flows without any signal present. The value of bias current either increased or decreased about its mean value by input signals (if operated as an amplifier), or ON and OFF by the input signal if operated as a switch.

Fig 2.0 shows the transistor as a switch.

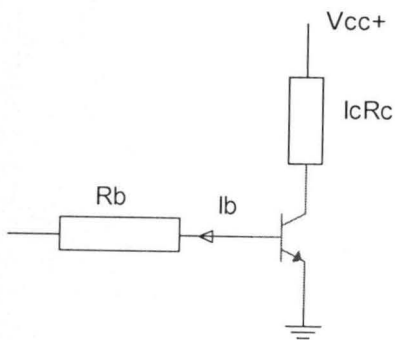


Fig 2.0 Transistor as a switch

For the transistor configuration, since the transistor is biased to saturation

$V_{ce} = 0$ , when the transistor is ON,

This implies that;

$$V_{+} = I_c R_c + V_{ce} \dots\dots\dots (2.1)$$

$$V_{in} = I_b R_b + V_{be} \dots\dots\dots (2.2)$$

$$I_c = h_{fe} I_b \dots\dots\dots (2.3)$$

$I_b$

$$R_b = \frac{V_{in} - V_{be}}{I_b} \dots\dots\dots (2.4)$$

$I_b$

Where

$I_c$  = collector current

$I_b$  = base current

$V_{in}$  = input voltage

$V_+$  = supply voltage

$V_{ce}$  = collector emitter voltage

$h_{fe}$  = current gain

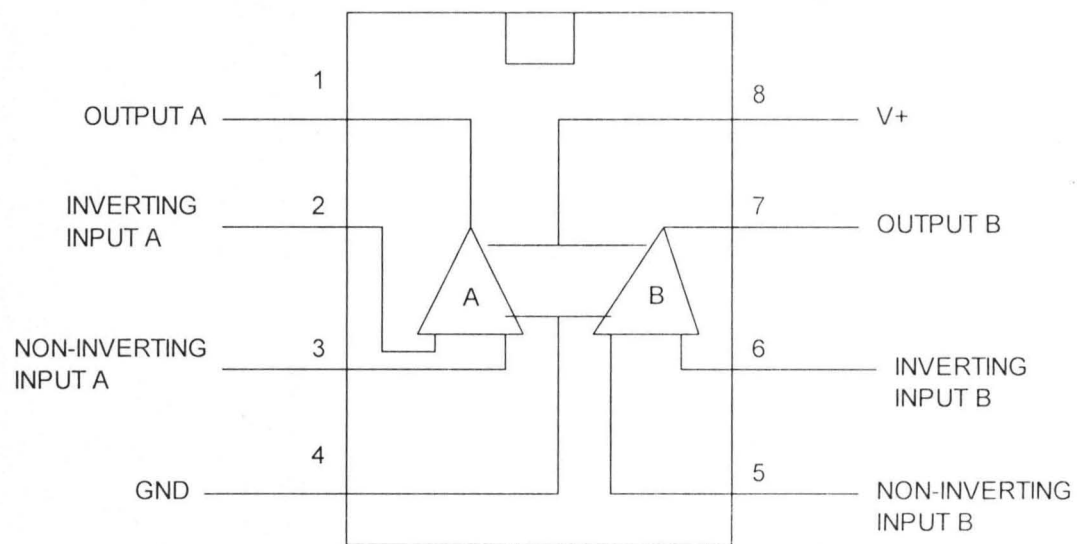
$V_{be}$  = base emitter voltage

### 2.3.2 Comparator IC (LM 358)

#### General Description

This IC is used for the detection of the received signal. It consists of two independent precision voltage comparators with an offset voltage specification as low as 2.0 mV max for two that were designed to

Fig 2.1 Top view of LM358



### 2.3.3 Relay

A relay is an electromagnetic switch, current flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch contacts. The coil



current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

It is an electrically operated switch. The contact point opens or closes by responding to change in some physical quantities such as current, voltage, frequency, light sensitivity, temperature etc. Relays allow one circuit to switch a second circuit, which can be completely separate from the first.

A relay in a normally closed position, opens when activated, and in normally closed position, opens when energized. When energizing potential is removed, the spring returns the contact to its original state. Relays are usually SPDT or DPDT but can have many more set contacts.

Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit.

To prevent damage you must connect a protective diode across the relay coil.

The relay's switch connections are usually labelled; COM, NC, NO;

- . COM = Common, always connect to this; it is the moving part of the switch.
- . NC = Normally Closed, COM is connected to this when the relay coil is off.
- . NO = Normally Open, COM is connected to this when the relay coil is on.
- . Connect to COM and NO if you want the switched circuit to be on when the relay coil is on.
- . Connect to COM a NC if you want the switched circuit to be on when the relay coil is off.

A relay is a switch operated by an electromagnet; it is useful if we want a small current in one circuit to control another circuit

containing a device such as lamp or electric motor which requires a large current, or if we wish several different contacts to be operated simultaneously. In this project, a relay was used to control the switching effect of electronic appliance. Figure below shows the symbol of a relay. The current needed to operate a relay is called the pull-in current and the drop-out current is the current in the coil when the relay stops working.



If the coil resistance of a relay  $R$  and its operating voltage is  $V$ , then the pull-in current:  $I = V/R$ . Fig 2.2 shows circuit symbols of a relay

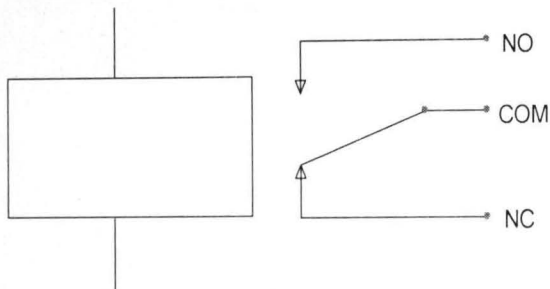


Fig 2.2 circuit symbol of a relay

### 2.3.4 Protection Diode for Relays

Transistors and ICs (chips) must be protected from the brief high voltage 'spike' produced when the coil is switched off. The diagram shows how a signal diode (IN4001) is connected across the relay coil to provide this protection. Note that the diode is connected 'backwards' so that it will normally not conduct. Conduction only occurs when the relay coil is switched off, at this moment current tries to continue flowing through the coil and is harmlessly diverted through the diode. Without the diode no current could flow and the coil would produce a damaging high voltage 'spike' in its attempt to keep the current flowing.

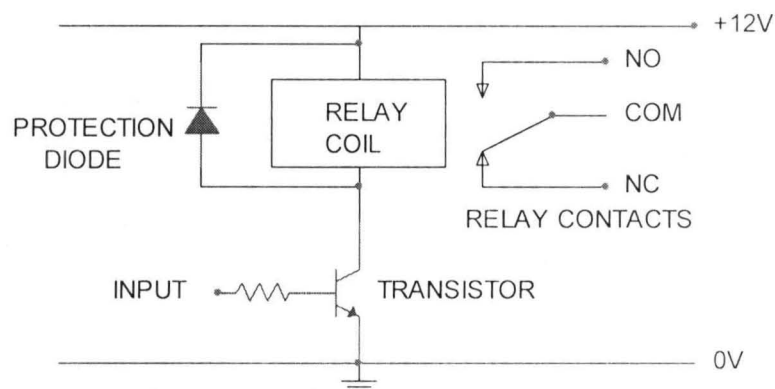


Fig 2.3a Relay connected in a protective mode

The relay acts as a switch and as an isolator in this project because it was used to isolate the main circuit from the AC supply line, and switches the power supply of a given room ON or OFF as the case may be.

### 2.3.5 IC 555 Timers

The 555 timer was introduced around 1971 as the IC timing machine. There are now two types of 555 timers, the regular type consisting of junction bipolar transistors and the CMOS version. Inside the 555 timer is a relatively stable IC capable of being operated as an accurate bi-stable, monostable or astable multivibrator. The timer comprises of 23 transistors, 2 diodes and 16 resistors in

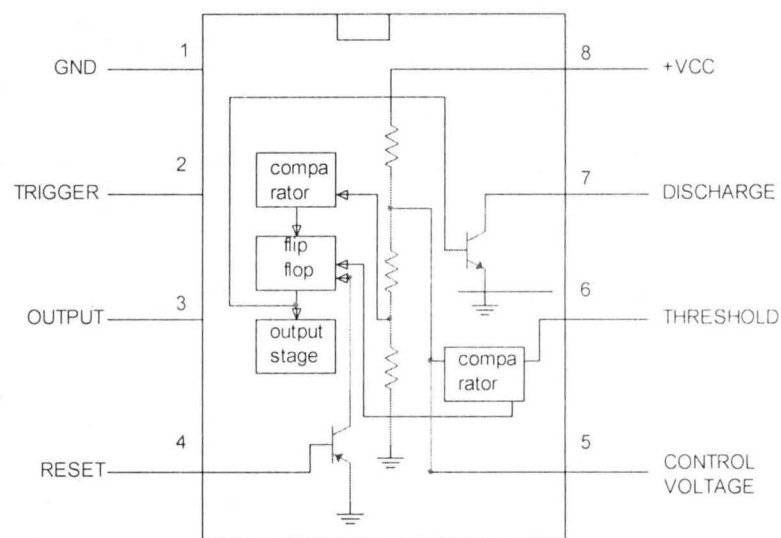


Fig 2.3b functional diagram of 555 timer.

The inverting input of the upper comparator is held at  $2/3$  of the supply voltage  $V_{cc}$  and the non-inverting terminal of the lower comparator is fixed at a reference voltage  $1/3 V_{cc}$  by potential divider (ladder network)

Pin 1 is the ground or common terminal to which the negative pole of the power supply is connected.

Pin 2 is the trigger input. A negative going voltage pulse applied to this pin when falling below  $1/3 V_{cc}$  causes the comparator output to change state. The output level then switches from LOW to HIGH. The trigger pulse must of shorter duration than the time interval set by the external CR network otherwise the output remains high until trigger input is driven high again.

Pin 3 this is the output and is capable of sinking or sourcing a load repairing up to 200mV and can drive TTL circuits. The output voltage available is approximately 1.7V.

Pin 4 this is the rest pin and is used to reset the flip flop that controls the state of output pin3. Reset is activated with a voltage level of between 0V and 0.4V and forces the output to go low regardless of the state of the other flip flop inputs. If reset is not required, then pin 4 should be connected to same point as pin 8 to prevent resetting.

Pin 5 takes the control voltage which allows direct access to the reference level.  $2/3 V_{cc}$  of the upper comparator, making it possible to control the width of the output pulse independent of the external RC components. When not required, it is connected to ground , via a 10nF capacitor, to eliminate electrical noise.

Pin 6 is the threshold input, the non inverting input of the upper comparator used to reset the flip flop, which causes the output to go LOW. Resetting is accomplished by taking this terminal from below to above  $2/3 V_{cc}$ , provided the trigger input is greater than  $1/3 V_{cc}$ , otherwise the trigger input will override the threshold input HIGH. The threshold input impedance is high about 10 Mega-Ohms.

Pin 7 is connected to the open of an npn transistor, the emitter of which goes to ground. When the transistor is turned on, pin 7 is effectively shortened to ground (as is the output), facilitating the discharge of the external (timing) capacitor to almost 0V.

Pin 8 is connected to the positive supply terminal. The voltage supply

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## **CHAPTER THREE**

### **HARDWARE DESIGN AND ANALYSIS**

#### **3.0 INTRODUCTION**

The designing phase of this project took effect with the representation of the various modules that could carry out the expected functions by blocks. This was followed by the replacement of the component blocks by the electronic device that would carry out the feature represented by the block.

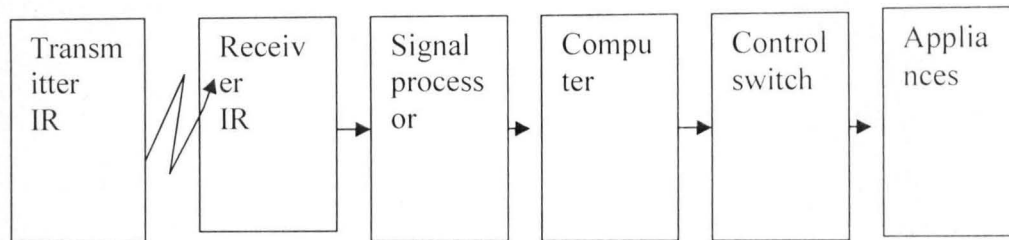
#### **3.1 DESIGN OBJECTIVES AND CONSIDERATIONS**

In order to effectively achieve our design objectives, the following factors were considered

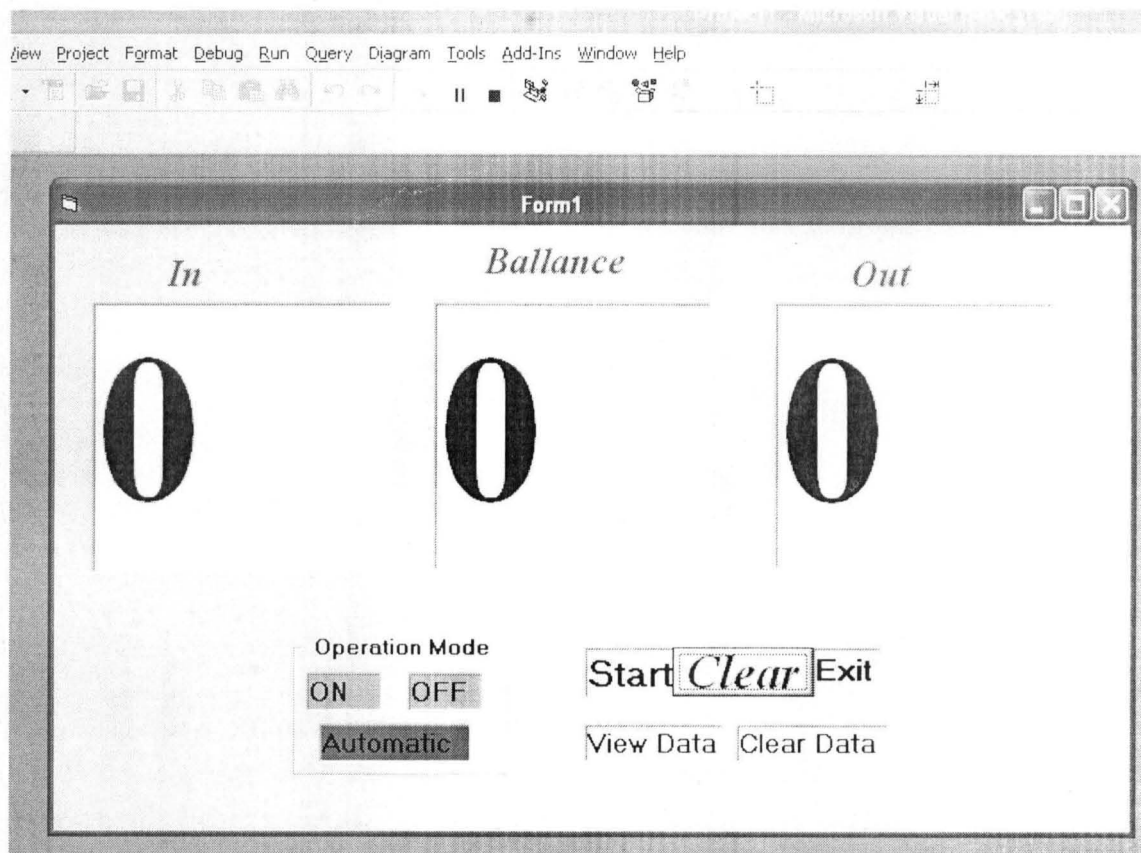
1. The Interface to the PC through the parallel port (printer port) and using the standard printer (DB-25) cable. The parallel port though limited in distance and cost, has a high data-rate than the serial RS-232 port. It transfers over 8-lines simultaneously.
2. The preferential use of parallel port to the serial port, the printer port is an inexpensive and yet powerful platform for implementing projects dealing with the control of the real world peripherals and in the control and switching lighting and home appliances.
3. The printer port has eight TTL outputs; four bi-directional leads and five inputs thereby providing a very simple means to use the PC interrupt structure. This feature served as the external unit for the main functions.

### 3.2 The System Block Diagram and Graphic User Interface (GUI).

The block diagram of the system is shown Fig 3.1 below.

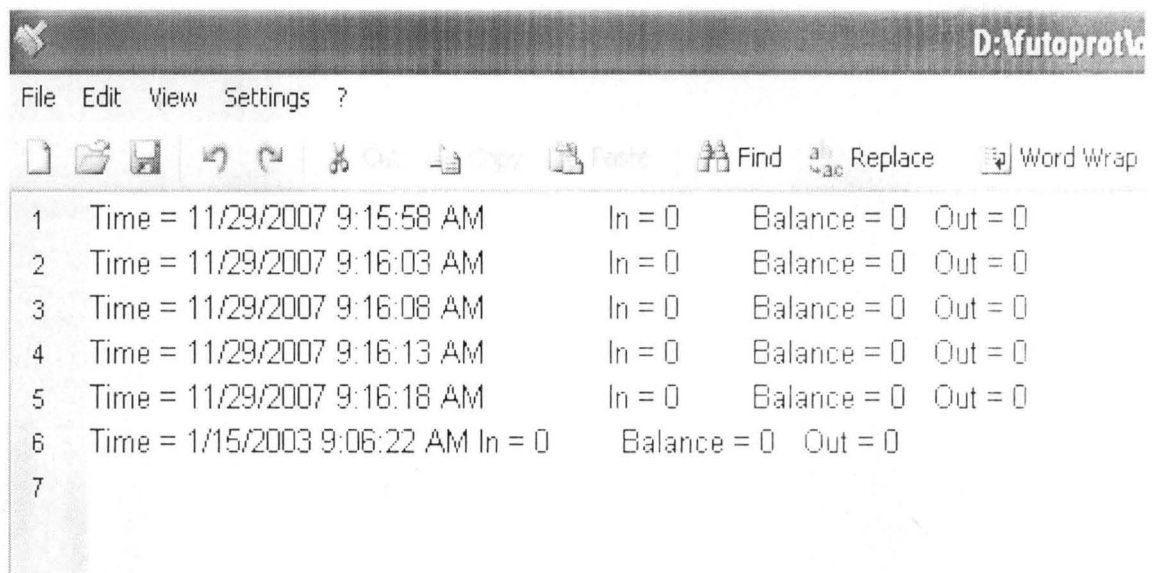


The system GUI is shown in Fig 3.2 below.



### 3.2.1 The Operation of the System.

The Graphic User Interface of the system is shown above. When the hardware is connected and the software is run, the program appears as shown above. In the *operation mode* menu, the operator can click ON to put on the appliances without following the due protocol of ensuring that there students in the lecture hall. If OFF tab is clicked, the system will switch off all the appliances even if there are students in the hall. If automatic is click, then the system will be counting the number of students going in and out the lecture hall. If there is no body in the hall, it will switch off all the appliances and once a person come in, it will switch on all the appliances. The START tab is used to initialize the program. The clear tab is used to clear the number of counts. The EXIT tab is used to quit the program. The VIEW DATA tab is used to number of students going in or out at a particular time interval as shown in the Fig 3.3 below.



The system has an infrared detector system used to detect human movement. When it detects a person going inside the hall, it will increment the *in-box* indicating that the person is going in. if it detects that the person is going out, the *Out-box* will be incremented, showing that the person is going out. It will subtract the number of persons in the *Out-box* from the number of persons in the *in-box* and the balance is shown in the *balance-box*. If the *balance-box* reads zero, it means then that the number of persons that came in have gone out; it will then switch off all the appliances.

### 3.3 HARDWARE PROPERTIES

The pin out of the DB-25 connector is shown in Figure 3.4 below.[3]

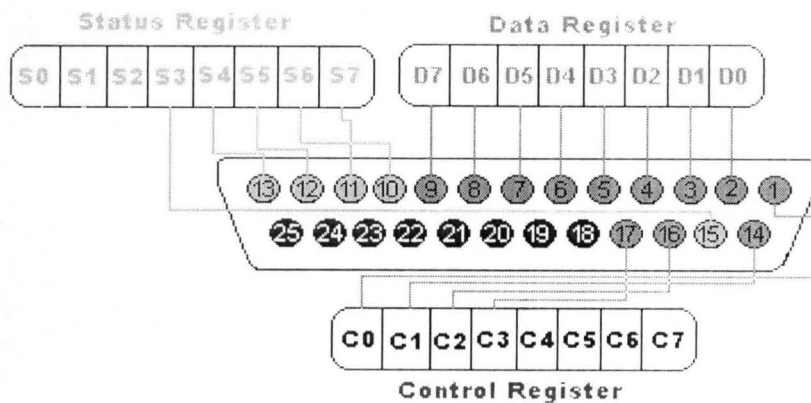


Figure 3.4 Pin-out Components of the Parallel Port

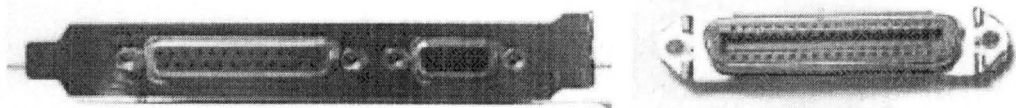


Figure 3.4b The photo on the left shows the back panel of an expansion card, with a parallel port's 25-pin female D-sub connector on the left side of the panel. (The other connector is for a video monitor.) The photo on the right shows the 36-pin female Centronics connector used on most printers.

The lines in the DB-25 connector of the parallel port are divided into 17 signal lines and 8 earth lines. The 17 signal lines are divided into:

1. 4-control lines
2. 5-status lines, and
3. 8-data lines (data bus)

In the original design, the **control lines** are used for the interface control and exchange of messages from the PC to the printer. The **status lines** are used for the exchange and status indication from the printer to the PC. The **data lines** are responsible for the transfer of data from the PC to the printer. The new implementation of the port allows bi-directional communication by means of these lines. Each one of these lines (control, status data) can be indexed in an independent way by means of registers.[3]



**Table 3.5a Parallel Port Signal Assignments.**

Pin No (DB25)	Signal name	Direction	Register - bit	Inverted
1	NStrobe	Out	Control-0	Yes
2	Data0	In/Out	Data-0	No
3	Data1	In/Out	Data-1	No
4	Data2	In/Out	Data-2	No
5	Data3	In/Out	Data-3	No
6	Data4	In/Out	Data-4	No
7	Data5	In/Out	Data-5	No
8	Data6	In/Out	Data-6	No
9	Data7	In/Out	Data-7	No
10	NAck	In	Status-6	No
11	Busy	In	Status-7	Yes
12	Paper-Out	In	Status-5	No
13	Select	In	Status-4	No
14	Linefeed	Out	Control-1	Yes
15	NError	In	Status-3	No
16	NInitialize	Out	Control-2	No
17	nSelect-Printer	Out	Control-3	Yes

18-25	Ground	-	-	-
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### 3.3.1 PARALLEL PORT REGISTERS.

The data, control and status lines are connected to their corresponding registers inside the computer. So by manipulating these registers in a program, one can easily read or write to the parallel port with programming languages such as C and Visual basic. The registers found in the standard parallel port are:[6]

1. The data register
2. The status register, and
3. The control register.

As the names imply, the data register is connected to the data lines, the control register is connected to the control lines and the status register to the status lines (the registers are virtually connected to their respective lines. Whatever is written to these registers will appear in their respective lines as voltages and on the other hand whatever voltage is applied to the parallel port can be read from the registers. For example, if the we write '1' to the data register, the line data '0' will be driven to +5V and as such we can programmatically turn On and Off any of data lines and control lines.

The parallel port has three commonly used base addresses. These are listed in the table below. The 3BCh base addresses was originally introduced for the parallel ports on early video cards. These addresses then disappear for a while when parallel ports were later removed from video cards. They have now reappeared as an option for parallel ports integrated onto the motherboards, upon which their configuration can be changed using BIOS. LTP1 (Line Printer1) is normally assigned based on address378h, while LPT2 is

assigned base on 278. However, this may not always be the case. 378h and 278h have always been commonly used for parallel ports. The lower case 'h' denotes that it is hexadecimal. These addresses may change from machine to machine. [5]

**Table 3.5b Parallel port addresses**

ADDRESS	NOTES
3BCh-3BFh	Used for parallel ports which were incorporated into video cards and now, commonly an option for ports controlled by BIOS. Does not support ECP address.
378h-37Fh	Usual address for LPT1
278h-27Fh	Usual address for LPT2.

When the computer is first turned on, BIOS (Basic Input/ Output System) will determine the number of ports you have and assign device labels LPT1, LPT2 and LPT3 to them. BIOS first look at address 3BCh. If a parallel port is found here, it is assigned as LPT1, then it search at location 378h. If a parallel card is found there, it is assigned the next free device level. This would be LPT1 if not found at 3BCh or LTP2 if a card was found at 3BCh. The last port of calls, it 278h and follows the same procedure like the other two ports. Therefore, it is possible to have a LPT2 which is at 378h and not at the expected address 278h.

**Craig Peacock** in his paper '**Interfacing the PC**' adds that a way to find the address of

the LPT1 or any of the line printer devices, you can use a lookup table provided by BIOS assigns addresses to printer devices it stores the address at specific locations in memory, so that they can be found.

**Table 3.5c LPT Addresses in the BIOS Data Area.**

START ADDRESS	FUNCTION
0000:0408	LPT1'S Base Address
0000:040A	LPT2's Base Address
0000:040C	LPT3's Base Address
0000:040E	LPT1 Base address

### **3.4 The Infrared System**

The infrared system consists of both a transmitter circuit and a receiver circuit.

#### **3.4.1 The Infrared Transmitter Circuit**

This is achieved using 555IC configured in Astable mode. The frequency of operation is 2.6KHZ. This is chosen so that the infrared transmission could travel far.

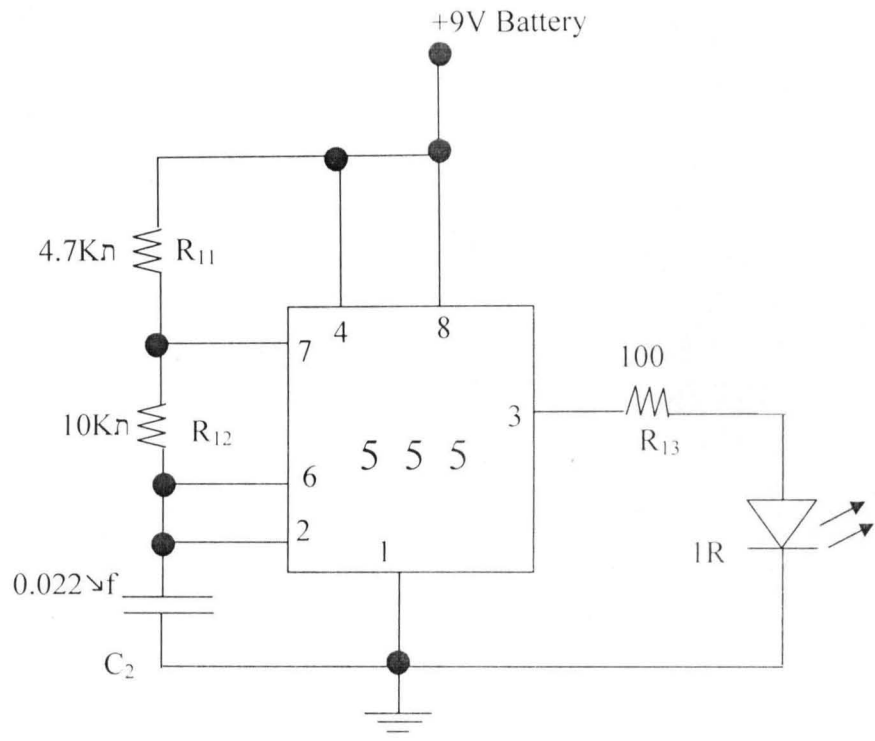


Fig 3.4 infrared transmitter circuit

The frequency of operation is given by Equation 3.3

$$F = 1.44 / (R_a + 2R_b) C$$

Where  $R_a = R_{11} = 4.7K\Omega$

$R_b = R_{12} = 10K\Omega$

$C = C_2 = 0.022\mu f$

↩  $F = 2.65KHZ$

### 3.4.2 The Infrared Receiver Circuit

The infrared module used is SM0038. The circuit diagram is given in fig. 3.5 below.

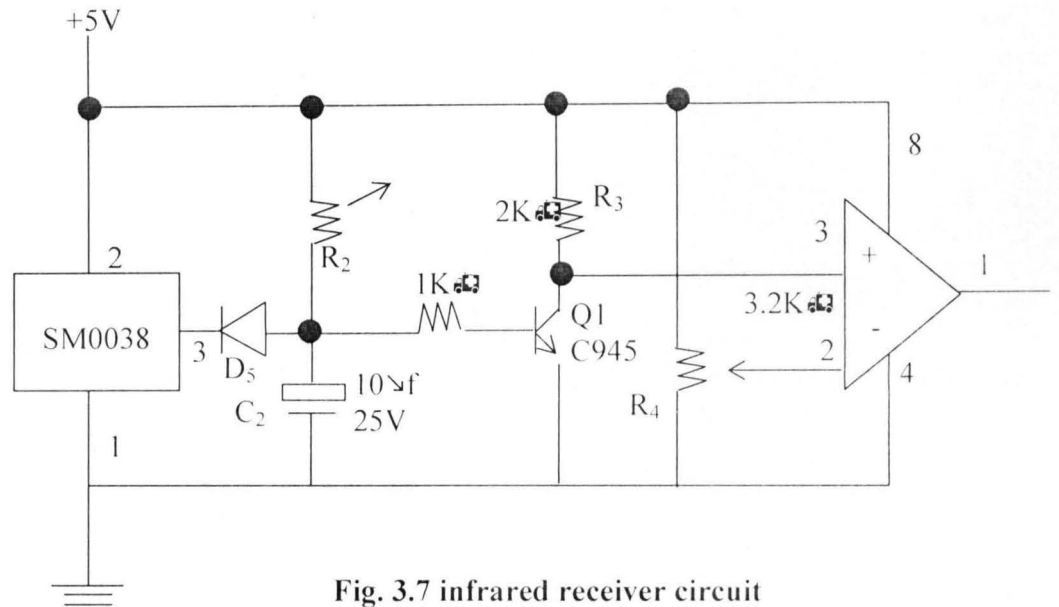


Fig. 3.7 infrared receiver circuit

The infrared module SM0038 receives signal from the infrared transmitter and output LOW at pin 3. Thus the diode D5 does not give any current to bias the transistor Q1 allowing the voltage passing through resistor R3 to the non-inverting pin of LM358 comparator IC greater than the voltage at the inverting pin thus outputting HIGH to the parallel port which has no effect on the microcomputer.

But when an intruder breaks the transmission from the infrared transmitter, the infrared receiver module (SM0038) outputs HIGH voltage which passes through the diode D5 to bias the transistor Q1 which in turns reduces the voltage from R3 to pin 3 (non-inverting pin) thus enabling the voltage at pin 2 (inverting pin) greater thus making the comparator

output LOW at pin 1 which is needed by the parallel port to send signal to the microcomputer.

### 3.4.3 The Power Supply Unit

The active components used in this project require approximately 5V supply. This ensures uniformity and in addition makes for simple power supplies. To ensure a regulated supply, we used two 7805 IC voltage regulators. The transformer provides vital isolation and change in voltage level and has the following important parameters.

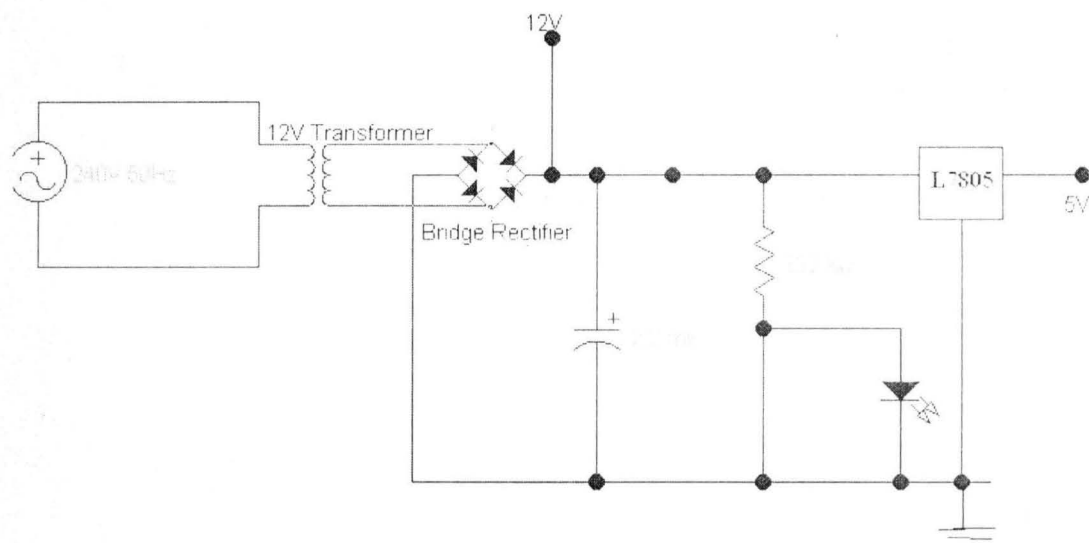


Fig. 3.8 shows the power supply circuit

The 12V transformer steps down 220Vac to 12V. bridge rectifier turns the ac to dc voltage while the 2200uf/25V capacitor filters off the ripples in the dc voltage. The L7805 is a 5V voltage regulator which regulates the voltage to 5V to the ADC. The 220 Ohms resistor limits the current to the LED which serves as an indicator light.

### 3.4.4 The switching Control

The system switching control is made up of a relay driver as shown below.

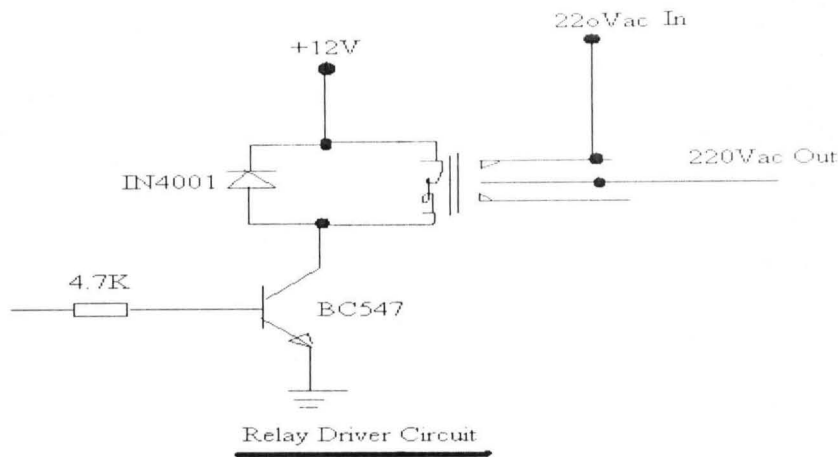


Fig 3.9 shows the switching control circuit

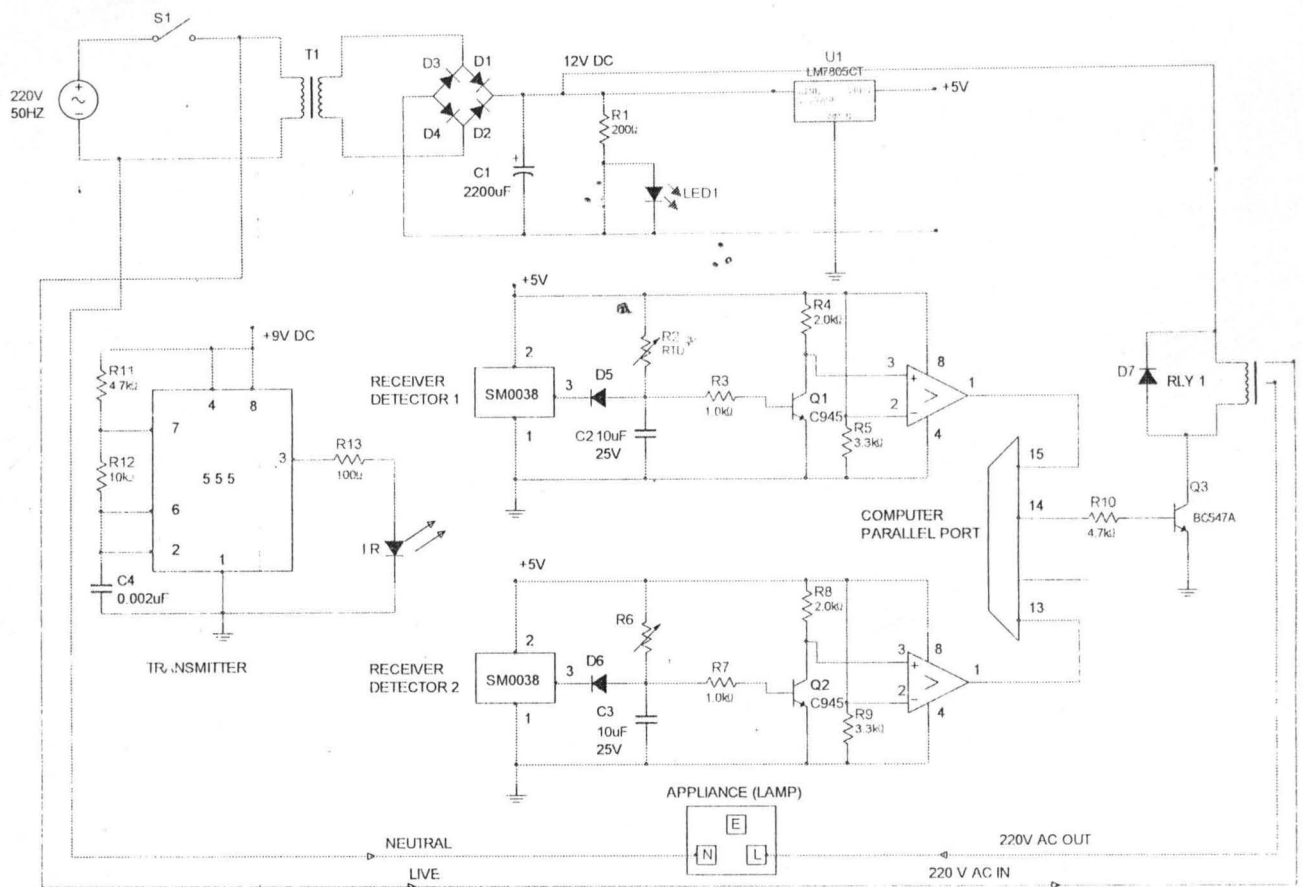
One terminal of the relay is permanently connected to a +12v dc supply.

When a positive voltage (from computer parallel port) is applied to the base of the BC547 transistor via the 4.7K resistor, the transistor is biased and negative voltage is allowed to get to the one the relay's terminals via the collector of the transistor. This will cause the relay to be energized, the 220Vac flows from one input terminal of the relay to the other.

The IN4001 diode is used to suppress sparks which might result due to energizing or de-energizing of the relay.



Fig 3.6 COMPLETE CIRCUIT DIAGRAM OF AN INTELLIGENT ROOM MONITOR AND CONTROLLER



## CHAPTER FOUR

### TESTING, PACKAGING AND PROBLEMS ENCOUNTERED

#### 4.1 TESTING

Testing is a vital stage in the development of a project since it involves ensuring that a given item, component or system meets the design specifications or how far it has deviated. It must commence early in the project development as it becomes difficult with project complexity. This project testing encapsulates both hardware and software testing each carried out both in its pre-implementation stage and post-implementation stage.

##### 4.1.1 Hardware Testing

Testing the hardware for its conformability to the design specifications entails testing the various hardware component parts or modules. This is of great concern since environmental conditions, wear and tear or extremely high current and voltage can easily affect hardware. The basic test equipments used in the design of this project are: digital multimeter and a microcomputer for the hardware interface test.

##### ▪ Pre-Implementation Testing

Pre-implementation stage involves carrying out the appropriate verification test on the components to ensure that they match their functional specification prior to implementation on a project board and subsequently on a Vero board. At this stage the cable for the serial port interface was tested for continuity between its two ends for each of the lines used in the project to ensure reliable transfer of information bits. The following tests were carried out on the discrete components.

## **Resistors**

The two pins of the resistor were probed with the multimeter switched to the ohmmeter range and values obtained were compared with the value of the colour code. Those within the specified tolerance were used. The procedure for testing the light dependent resistors and variable resistors is the same with the procedure for testing a conventional resistor.

## **Capacitors**

The multimeter was switched to the voltage-testing mode to a value slightly higher than the voltage setting for the capacitor. The positive probe of multimeter was placed on the positive terminal of the capacitor while the negative probe was placed on the negative terminal of the capacitor. The capacitor is good if a voltage reading is obtained which gradually decrease with time due to discharging of the capacitor.

## **Diodes**

The multimeter was used to determine the positive (anode) and the negative (cathode) terminals of the diodes (including the LEDs used as indicators) used in this project work. The diodes were also tested for open/short circuit to ensure that current flows through it in only one direction.

## **Integrated Circuits**

The integrated circuits were tested by first of all setting up the entire circuit on a project board. The circuit was then tested by applying different test input (different computerized library cards) to ensure that the entire circuit will function properly when finally implemented on a Vero board.

- **Post-Implementation Testing**

Post –implementation involves testing each module or unit of the hardware after implementation to ensure that they perform their functions/operations as intended in the design. This also includes subsequent tests on the complete system for precision. The following tests were conducted at this stage of the project:

The outputs of the comparator which goes into the serial port were tested.

The disparity between the PC ground and the hardware ground was tested and corrected.

The last test carried out on the hardware was interfacing with the computer to confirm interaction between the hardware and the software especially in function and in timing operation.

#### **4.1.2 Software Testing**

Software design and implementation, which usually take quite a while especially when good quality software is desired, pass through a lot of testing. These tests are usually tasking especially for a library database system where high precision should not be compromised.

Actually, software testing can be done practically at any level or all the stages of its development, though the dominant test type is the post – implementation test.

##### **♦ Pre–Implementation Testing**

This is normally done during the coding process and is mostly associated with syntax errors. Syntax errors occur when the rules or syntax of the programming language is not followed.

Modern compilers now come with Integrated Development Environment (IDE), which possesses features that detect and highlight any syntax error(s), which may occur during the coding process.

During compilation and execution of a program, presence of other forms of errors halts the process thereby making an error undetected by the IDE. Examples are paths left and improper nesting of loops.

#### ▪ **Post-Implementation Testing**

Post implementation test involves the execution of programs with selected inputs called test cases. The results of test executions are then used to decide on acceptable program. The first step is to carefully check the coding forms for possible errors. This is called desk checking and is done before the program is tested on the system. Once the program is desk checked, data is fed into the program and the behaviour is monitored through its output. This is known as Unit Testing.

Also, system testing must be carried out since the database program must interact with each other. System testing is the collective test performed on several programs simultaneously. For instance, when the output of one program is the input of another.

At these stages software should be tested to ensure that it synchronizes with the hardware functions. This is particularly important in noting the status of the hardware and manipulating the records according to design specifications.

#### **4.1.3 Complete System Testing**

After both the software and the hardware have been elaborately and vigorously tested, the whole components were then brought together, assembled and tested to ensure that the complete project work is functioning well.

### **4.2 PACKAGING**

This project work was assembled and packaged in modules. Packaging is very important in any business oriented project since it enhances the maintainability of the given product

or system. This involves the packaging of the database software using the packaging and deployment wizard. The hardware i.e. the card reader system was also packaged to achieve the above objective.

Among the factors considered in the packaging of this project are: the cost, ease of The above considerations were achieved with a good thermoplastic casing. The final maintenance, durability, aesthetics, contact precision and portability. appearance of the project work is shown in the appendix .

### **4.3 PROBLEMS ENCOUNTERED**

No project work can be actualized without encountering some problems at the different stages of implementation. This project work can therefore be no exception. Various problems were encountered at the different stages of this project work.

Since this project work has two main integral parts (*i.e. Hardware and Software sections*). The problems can be categorized under two headings namely;

- ❖ Hardware Problems
- ❖ Software Problems

#### **4.3.1 Hardware Problems**

The problems encounter during the hardware design, implementation, and packaging and testing includes:

1. There was difficulty in soldering and making good electrical contacts on the card.
2. Power failure also constituted huge problems as it often made it impossible for us to work as scheduled thereby prolonging the period of completion.

### **4.3.2 Software Problems**

The software problems include:

1. To develop an accurate method of error correction was difficult because the speed of sliding the card may vary.
2. There was a problem of compatibility with different computer systems especially the ones that do not have port one as its first serial port.
3. Unavailability and high cost of reference materials.
4. Erratic power supply also affected the estimated period for the coding of the program.
5. There was the problem of response time of the System being far greater than that of the hardware (*The comparator to be specific*). Delays had to be integrated in the program codes to cater for the disparity in response times.

### **4.4 COST ANALYSIS**

To end this chapter on test analysis, packaging, and problems encountered, we thought it worthwhile to give a breakdown of the cost of this project a good analysis. It should however be noted that the cost analysis will be based on actual cost incurred in purchasing the various components used in this work. It also includes the cost of fabrication for the packaging of the card reader. This analysis, we deemed necessary in order to show the cost effectiveness of the work.

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 CONCLUSION**

The design and construction of a computer time programmer interface for the control of lighting and home appliances has been implemented in this project work. Although this work is only just a model it can actually be developed and adapted to present day applications. Integrating this setup to a typical building or establishment involves a careful analysis of the electrical wiring and lighting infrastructure and then with careful planning which may include dividing the building into subsections depending on size, this kind of control setup can be effectively integrated without problems.

Appliances and devices can be grouped together based on function, location and power consumption. For example, all lightings in a section of a building can form a sub-unit under a main unit; the pumping machine and other outdoor devices can form another sub unit. This will ensure a more or less seamless integration of this kind of control setup to any kind of building or establishment.

Moreover, serial or parallel transmission could be employed as the means of communicating with the remote sites depending on the requirements. Sensors can also be utilized to monitor changes in the environment, which will then trigger off certain programmed responses. Since the system is highly flexible and can always be customised based on demand, use of Uninterruptible Power Supplies (UPS) and high-memory devices can be employed to avoid problems associated with power failure.



## 5.2 RECOMMENDATION

This project work serves as the model; it can be adapted for any number of devices that need to be controlled. Either serial transmission or parallel transmission can be utilized depending on the total number of devices to be controlled, the distance, cost considerations and the existing wiring and electrification of the building.

Use has been made of available technologies and components available in the country to ensure that the system is feasible. Using high-speed components of high reliability can reduce the delay introduced by the components used in the set-up. This will ensure the synchronization of the command and clock signals, and effective handshake with the computer's frequency and speed.

In order words, military standard equipment should be used when real-time applications are to be implemented rather than a model as has been done in this project work. Solar power supply system is recommended as a back up to the main supply system for such real-time application.

Universal Serial Bus ports is recommended for interfacing

JAVA programming software is recommended for the software implementation because of its flexibility.

Microcontroller interfaced with seven segment display is recommended because of its wide variety of use.

A cam coder can be incorporated in the construction for accurate recording and security purposes.

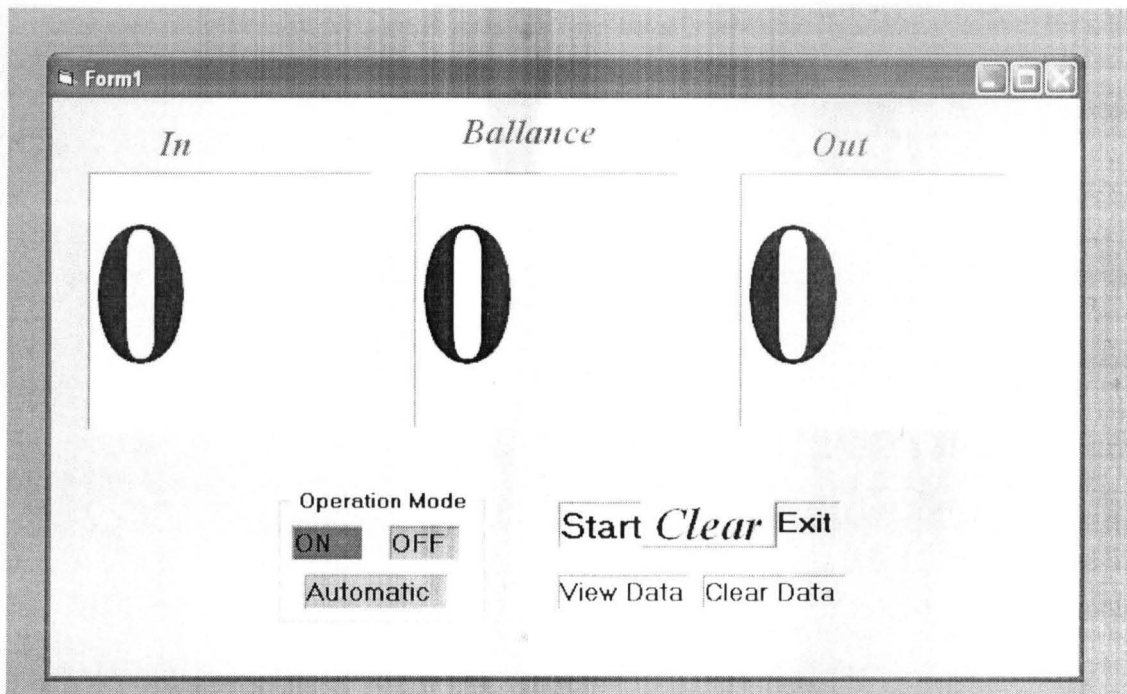
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## APPENDIX 1

The GUI is given below.



The captured data is given below ("view data" is clicked)

```

readin - Notepad
File Edit Format View Help
Time = 1/15/2003 9:41:33 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:41:38 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:41:43 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:41:48 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:41:53 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:41:58 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:03 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:08 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:13 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:18 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:23 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:28 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:33 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:38 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:43 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:48 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:53 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:42:58 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:43:03 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:43:08 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:43:13 AM In = 0 Balance = 0 Out = 0
Time = 1/15/2003 9:43:18 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:09 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:14 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:19 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:24 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:29 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:34 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:39 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:44 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:49 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:54 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:04:59 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:11:31 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:11:36 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:11:41 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:11:46 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:11:51 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:11:56 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:01 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:06 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:11 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:16 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:21 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:26 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:31 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:36 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:41 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:46 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:51 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:12:56 AM In = 0 Balance = 0 Out = 0
Time = 7/21/2008 4:13:01 AM In = 0 Balance = 0 Out = 0

```

VISUAL BASIC 6 PROGRAM CODES

```

Public cnt1
Public cnt2
Public cnt3

Private Sub autom_Click()
swich.Enabled = True
onu.Enabled = False
ofu.Enabled = False
End Sub

```

```
Private Sub chkk_Timer()
```

```
Y = Inp(&H379)  
If Y = 103 Then  
ck.BackColor = vbYellow  
chk.Enabled = True  
inputu.Enabled = False  
Else  
ck.BackColor = vbGreen  
End If  
chkk.Enabled = False
```

```
If Y = 96 Then  
ck.BackColor = vbYellow  
chk.Enabled = True  
inputu.Enabled = False  
Else  
ck.BackColor = vbGreen  
End If  
chkk.Enabled = False
```

```
End Sub
```

```
Private Sub clearr_Click()  
inn.Text = 0  
oot.Text = 0  
bal.Text = 0  
cnt1 = 0  
cnt2 = 0  
cnt3 = 0  
End Sub
```

```
Private Sub clerr_Click()
```

```
On Error Resume Next  
Kill "readin.txt"  
Open "readin.txt" For Append As #1  
Close #1
```

```
End Sub
```

```

Private Sub displayvalu_Timer()
If Ly.BackColor = vbGreen Then
Ly.BackColor = vbRed
Open "readin.txt" For Append As #1
    Print #1, "Time = "; CStr(Now), "In = "; inn.Text, "Balance = "; bal.Text, "Out = ";
oot.Text
    Close #1

Else
Ly.BackColor = vbGreen
End If

End Sub

Private Sub Form_Load()
inn.Text = 0
oot.Text = 0
bal.Text = 0
End Sub

Private Sub inputu_Timer()

Y = Inp(&H379)

If Y = 119 Then          'pin15
ist.Enabled = True
inputu.Enabled = False
Exit Sub
End If

If Y = 112 Then          'pin15
ist.Enabled = True
inputu.Enabled = False
Exit Sub
End If

If Y = 111 Then          'pin13
ost.Enabled = True
inputu.Enabled = False
Exit Sub
End If

If Y = 104 Then          'pin13
ost.Enabled = True
inputu.Enabled = False
Exit Sub

```

End If

End Sub

```
Private Sub ist_Timer()  
otl.BackColor = vbGreen  
inl.BackColor = vbRed  
ost.Enabled = False  
cnt1 = cnt1 + 1  
cnt3 = cnt3 + 1  
inn.Text = cnt1  
bal.Text = cnt3  
ist.Enabled = False  
inputu.Enabled = True  
End Sub
```

```
Private Sub off_Click()  
onu.Enabled = False  
ofu.Enabled = True  
swich.Enabled = False  
End Sub
```

```
Private Sub ofu_Timer()  
Out (&H378), 0  
offf.BackColor = vbRed  
onn.BackColor = vbGreen  
autom.BackColor = vbGreen
```

End Sub

```
Private Sub onn_Click()  
onu.Enabled = True  
ofu.Enabled = False  
swich.Enabled = False  
End Sub
```

```
Private Sub onu_Timer()  
Out (&H378), 1  
offf.BackColor = vbGreen  
onn.BackColor = vbRed  
autom.BackColor = vbGreen  
End Sub
```

```
Private Sub ost_Timer()
```



```
otl.BackColor = vbRed
inl.BackColor = vbGreen
ist.Enabled = False
cnt2 = cnt2 + 1
cnt3 = cnt3 - 1
oot.Text = cnt2
bal.Text = cnt3
ost.Enabled = False
inputu.Enabled = True
End Sub
```

```
Private Sub statt_Click()
inputu.Enabled = True
displayvalu.Enabled = True
statt.BackColor = vbYellow
End Sub
```

```
Private Sub swich_Timer()
If bal.Text >= 1 Then
Out (&H378), 1 'Set pin1 HIGH, switch on appliances
Else
Out (&H378), 0 ' set data register LOW, of appliances
off.BackColor = vbGreen
onn.BackColor = vbGreen
autom.BackColor = vbRed
End If
End Sub
```

```
Private Sub Timer1_Timer()
Text1.Text = Inp(&H379)
End Sub
```

```
Private Sub vdata_Click()
Call Shell("notepad.exe readin.txt", vbNormalFocus)
End Sub
```

## APPENDIX 2

### INSTALLATION PROCEDURES

Step 1- After installing the visual basic 6 software on the system; insert the interface cable into the computer

Step 2- Run the program by clicking on run, the graphic user interface (GUI) will display on the system.

Step 3- Place the two receiver modules with a maximum distance of 1 meter and a minimum of 0.4 meter. At final stage, should be placed on both sides at the door opening ends.

Step 4- Place the monitoring device in between in receivers.

Step 5- Place the transmitter on the center point of the hinged part of the door, should be at the same level with the receiver. For prototype testing place transmitter at a minimum distance of 1.7 meters and maximum of 1.9 meters.

Step 6- After steps have been successfully installed, Go back to the computer, on the GUI click on start and then automatic, and carry out the operation.

Step 7- If the set-up works as expected, the aims and objectives has been achieved, if not then you trouble-shoot or consult a qualified personnel.