DESIGN AND IMPLEMENTATION OF A BI-DIRECTIONAL VISITORS COUNTER

BY

RAJI OLOLADE HASSAN
(MATRIC NO: EEE/11/0398)

A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, FEDERAL UNIVERSITY OYE-EKITI, IKOLE EKITI CAMPUS.

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) IN ELECTRICAL AND ELECTRONICS ENGINEERING.

SEPTEMBER, 2016

DECLARATION

I RAJI OLOLADE HASSAN do hereby declare that all the work in this project was carried out by me, under the supervision of ENGR. HILARY UGO EZEA to the best of my knowledge, no such work has been submitted to the department of Electrical and Electronics Engineering, Federal University Oye- Ekiti or any other institution for the award of a Degree.

Hastade: O 17/10/2016.

Raji Ololade Hassan **DATE**

(EEE/11/0398)

CERTIFICATION

This is to certify that this project titled BI-DIRECTIONAL VISITORS COUNTER, by **RAJI OLOLADE HASSAN** meets the minimum requirements governing the award of Bachelor Degree in Electrical and Electronics Engineering of Federal University Oye-Ekiti, Nigeria.

17/10/2016

Engr. Hilary Ugo Ezea
(Project Supervisor)

DATE

20/10/2016

Engr. Dr. Akinsanmi O.
H. O. D

DATE

External Examiner

DATE

ACKNOWLEDGMENTS

All glory, adoration, and glorification is to almighty Allah for sparing my life throughout this academic institution.

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Thanks to all that have in one way or the other contributed towards the successful completion of my course in the university, may God Almighty Allah bless you all.

To God be the glory (Alhamdulillah Robil Aalameen).

DEDICATION

This project is dedicated to Almighty Allah who has spared my life throughout my stay in the university, and also to my lovely parent **(DR. RAJI OLALERE WAHEED AND MRS. RAJI BASIRAT OLATOYOSI)** who have helped me so greatly towards my academic pursuit.

ABSTRACT

This report presents a design and implementation of a bi directional visitors counter. It helps in determining the number of visitors that enter or leave a confined place. The entire system is based on microcontroller that makes it to be smarter and easy to modify. The system ranges from the power supply to the logical control unit, the microcontroller unit, and to the display unit which shows the number of people that has entered or leave the place. The system was tested repeatedly and it worked perfectly and efficiently. This system helps to be assured of the exact number of visitors in a confined place in case of any emergency. This system can be used in an Auditorium, Halls, banks, or any other places where counting of visitors is of paramount importance. For further study about counter system, the system can be improved by solving the problem occurred by distance sensor, therefore for long distance sensing Laser Technology can be employed. Calibration for sensor and bright LED can be used to increase the accuracy of the distance sensor.

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ABBREVIATIONS

IC	=	Integrated circuit
PCB	=	Printed circuit board
OP-AMP	=	Operational Amplifier

CHAPTER ONE

INTRODUCTION

1.1 PROJECT BACKGROUND

The Bidirectional Visitor counter" is designed and obtainable in order to count the visitors of a lecture theater, hall, offices, malls, etc. The system counts both the entering and exiting visitors of the auditorium or hall or other places, where it is engaged. Depending upon the interrupt from the sensors, the system recognizes the entry and exit of a visitor. On the successful implementation of the system, it displays the number of visitors present in the area in question. This design is based on the principle of Power electronics technology, using electronic circuits to convert and control electric energy with optimum efficiency. Today, this technology is employed in most electrically powered machines and devices. Moreover, center researchers have made significant contributions in three areas critical to power electronics evolution: powering of a new generation of microprocessors; developing technologies for integration of power electronics components, such as circuits and sensors; and using the integrated components for standardized methods of assembling power converters, which are still custom-designed [1]. This system helps to be assured of the exact number of visitors in a confined place in case of any emergency.

1.2 PROBLEM STATEMENT AND METHODOLOGY

PROBLEM STATEMENT

Manual Counting of the number of people entering and leaving an Auditorium or Hall may be very difficult, so this project intends to solve that.

METHODOLOGY

The methodology in this project involves the software implementation and the Hardware implementation.

The software implementation includes:

i. Definition of task
ii. Designing the system

iii. Writing the control program
iv. Testing and debugging the program.

The Hardware implementation includes:

i. Designing of the power supply circuit
ii. Designing of the logical control unit
iii. Designing of the microcontroller unit
iv. Designing of the display unit.
v. Integrating the power supply, logical control, microcontroller and the display units together.
vi. Coupling of the whole design.

1.3 AIM

The aim of this project is to design a bi-directional visitor's counter

1.4 OBJECTIVES

This system is designed to count and display the total number of people entering and leaving a particular place. The objectives includes:

i. To design a system that will automatically tell the exact number of people that enters or leaves a confined place.
ii. To design a system that will not require human intervention in determining the total number of people inside a confined place. (So as to know the number of people to cater for in case of any Emergency).
iii. To design a system that can automatically monitors the attendance of a place and also helps in emergency budgeting or planning.

1.5 SCOPE OF WORK

This project is mainly concerned with the design a counter that will count visitors that enters or leaves a particular place where it is installed. It helps in reducing human effort in counting entry and exit, and in deducing the remaining number of people in the room. However, there are a few limitations on this project, this includes:

i. More than one candidate or person cannot enter or leave the room at the same time. If it happens, it will count them as a single person.
ii. This system cannot distinguish between a person and other obstacle interfering the sensor.

iii. Also this is a short range system, since it cannot sense a far object owing to the sensing limitation of the IR sensors used.

1.6 PROJECT OUTLINE

Chapter Two covers the theoretical background of the design and discusses the principles upon which the various components used in this project are based on.

Chapter Three presents the methodology of the project. This chapter is divided into two main parts which are the design of software and the design of hardware. The discussion on the methodology software implementation and hardware assembly will be explained in detail.

Chapter Four covers on result and discussion. All the results obtained from the project through testing and calibration process are explained and analyzed. This part concern more on the problem occurred and solution to overcome the weaknesses.

Last part, chapter Five is the conclusion and recommendation. This chapter testifies the success of the project, limitation and the suggestion for the future development related to this work.

CHAPTER TWO

THEORETICAL BACKGROUND

2.1 LITERATURE REVIEW

Bi directional visitors counter is of extreme importance in our security and counting system as compared with the manual system of counting in which an officer will be at the gate monitoring and counting the number of people that enter or leave a confined place.

"Counter system using microcontroller for visitors", this project was designed for counting the visitor entering a confined place. A microcontroller with PIC 18F452 was used and a LCD display was used to display both the information about the design and the result [2]. Part of the limitation of this project is that the result will not be properly seen at the display output. In order to solve that particular problem, I introduced a seven segment display to display the counting results and a LCD display unit to display the project information.

Also an "Automatic room light controller with Bi directional visitors counter" was designed using two IR sensors, an 8085 microcontroller unit and a single seven segment display [3]. Due to the fact that 8085 microcontroller is old and will require more stress and time in programming it, therefore this is a limitation and it has been taking care of by using PIC 16F86which is easier in design. Also in the same year, a similar project "Bi directional visitor's counter" was carried out using IR sensors, two flip plops, an 8085 microcontroller unit and three seven segment displays as the output [4]. Due to the fact that 8085 microcontroller is old and will require more stress and time in programming it, therefore this is a limitation and it has been taking care of by using PIC 16F86which is easier in design.

A project "Digital visitor's counter" was also designed, this system uses two IR sensors, a microcontroller unit, two flip-flops plus a LCD display screen. In all cases, they made use of two IR sensors, different MCU families for the operation of the project and either a LCD or seven segment display [5]. For easy and time saving design, we redevelop the logical control unit using comparators and 555 timers. This will enable us to get a smooth output signal that will be later processed by the microcontroller unit.

This current work is based on the same principle with some little modifications in that the project utilizes two IR sensors, a pair of comparator and 555 timer, a microcontroller unit, a LCD display screen to display the information about the project plus three seven segment displays to display the entry and exit values plus the value of the difference between the entry and exit values.

2.2 TIMER

The 555 timer IC is an exceptionally useful accuracy timer that can act as either a timer or an oscillator. In timer mode, also known as *monostable mode*—the 555 basically acts as a "one-shot" timer; when a trigger voltage is applied to its trigger lead, the chip's output goes from low to high for a period set by an external *RC* circuit. In oscillator mode—well known as *astable mode*—the 555 acts as a rectangular-wave generator whose output waveform (low duration, high duration, frequency, etc.) can be attuned by means of two external *RC* charge/discharge circuits.

[6] 555 timer IC is easy to use (requires few constituents and calculations) and cheap and can be used in an astonishing number of applications. For example, with the aid of a 555, it is possible to generate digital clock waveform generators, LED and lamp flasher circuits, tone-generator circuits (sirens, metronomes, etc.), one-shot timer circuits, bounce-free switches, triangular-waveform generators, frequency dividers, etc. In this design, we configure 555 Timer in Monostable Mode.

How 555 Timer works in monostable mode.

IC 555 hooked up in the monostable configuration (one-shot mode). Unlike the astable mode, the monostable mode has only one stable state. This means that for the output to switch states, a visibly applied signal is needed. The internal circuitry of a 555 timer is shown in figure 2.1.

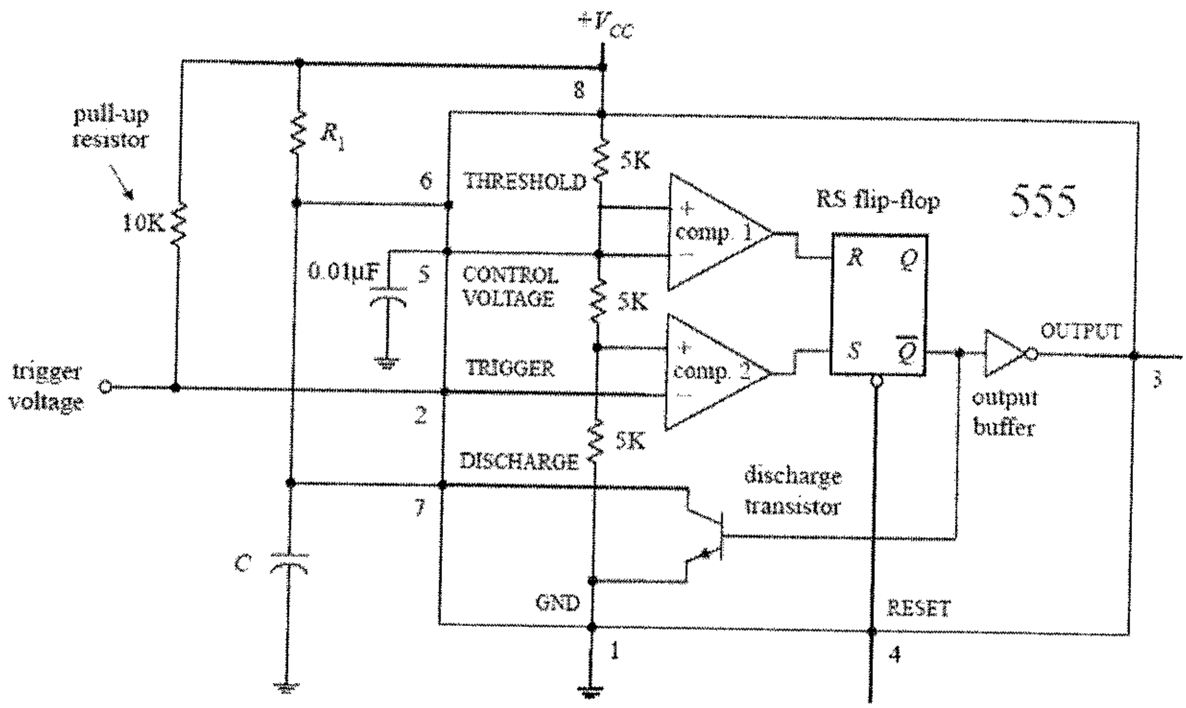
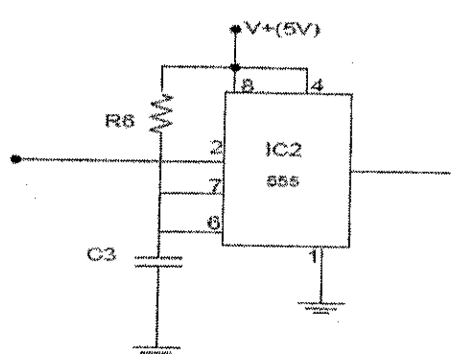


Figure 2.1: Internal circuitry of a 555 timer configured in monostable mode [6]

The monostable circuit only has one stable state. That is, the output rests at 0 V (in reality, more like 0.1 V) until a negative-going trigger pulse is applied to the trigger lead—pin 2. (The negative-going pulse can be implemented by momentarily grounding pin 2, say, by using a pushbutton switch attached from pin 2 to ground.) After the trigger pulse is applied, the output will go high (around $VCC - 1.5$ V) for the duration set by the $R1C$ network. Without going through the derivations [6], the width of the high output pulse is t width = $1.10R1C$. The configuration of a one



shot monostable timer is shown in figure 2.2.

Figure 2.2: One shot monostable[7]

2.3 COMPARATOR

A comparator circuit compares two voltage signals and determines which one is greater. The result of comparison is indicated by the output voltage: if the op-amp's output is saturated in the positive direction, the non- inverting input (+) is greater or more positive than the inverting input (-), all voltages are measured with respect to ground. If the op-amp's voltage is near the is near the negative supply voltage (i.e 0 or ground potential), it implies the inverting input (-) has a greater voltage applied to it than the non-inverting input(+) [8]. A non-inverting comparator is shown in figure 2.3.

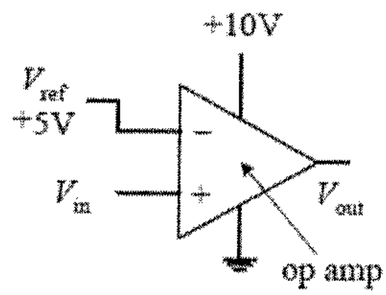


Figure 2.3: Non inverting comparator [6]

2.4 COUNTER

[9] Counter that can change its state in either direction, under control of an up–down selector input as an up–down counter. The circuit can count numbers in up and down modes subject to the state of the selector. It can be used to count the number of persons entering a hall in the up mode at entrance gate. In the down mode, it can count the number of persons leaving the room by decrementing the count at exit gate. It can also be used at gates of parking areas and other public places. This circuit divided in three parts: sensor, microcontroller and counter display. The sensor would observe an interruption and provide an input to the controller which would run the counter in up/down mode depending upon the selector setting. Based on the distance sensor that will be used in this system, the distance is the main factor that will affect the output of the sensor. However, the output will be the type of analog and in this stage; an analog to digital programming converter will be needed to convert to the analog to digital output. Within a little range from the side of the door,

sensor will sense the present of visitor, send signal to microcontroller and save the updated data. All the data will be displayed on the seven segment display with red backlight through the controller.

CHAPTER THREE

SYSTEM DESIGN

3.1 INTRODUCTION

The visitor blocks a projected infrared beam (in an opto-isolator) and generates a clock pulse when a visitor enters a particular place where this device is installed. The opto-isolator is made up of an infrared transmitter and a photo-diode receiver.

When the beam is broken, the output of the LM393 op-amp in the detector stage goes low, to allow for the appropriate trigger condition of the monostable stage. The one shot monostable gives a clock pulse each time the object passes the opto-isolator (sensor) point. The clock pulse is sent to the microcontroller for counting and to display the output on a seven segment display.

3.2 THE POWER SUPPLY UNIT

The power supply stage provides the appropriate DC voltage requirements to ensure the circuit components (especially the Active components) are powered properly. The circuit uses +5VDC supply. The power supply stage is a linear power supply type and involves a step down transformer, Rectifier, Filter capacitor, and a voltage regulators, to give the regulated DC voltage.

The circuit for the power supply stage is shown in figure 3.1.

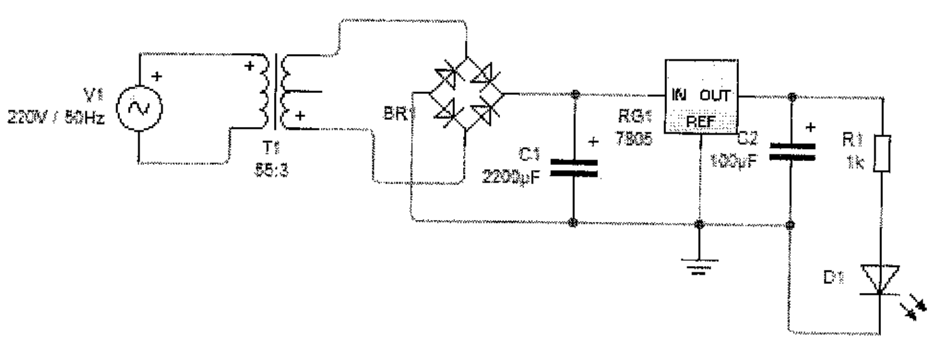


Figure 3.1:Power supply circuit

3.2.1 SELECTION OF FILTERING CAPACITOR

The rectifier is designed with four diodes to form a full wave bridge network C1 is the filter capacitor while C2 is inversely proportional to the ripple gradient of the power supply. Figure 3.2 shows the ripple gradient of the power supply.

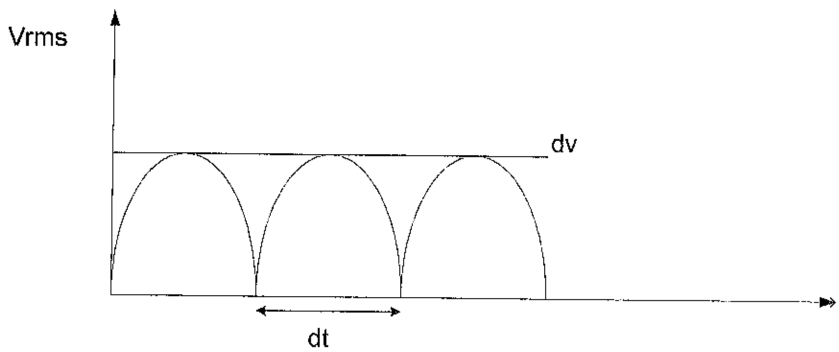


Figure 3.2: The ripple gradient of the power supply. [6]

Where dv is the ripple voltage for time dt, where dt is a dependent in power supply frequency.

ANALYSIS

$$\frac{dv}{dt} = \frac{1}{c}i - - - - - - - - - - - - - (1)$$

Where: dv = ripple voltage

dt = period

c = capacitance value (C1) and,

i = load current

Since the output of the transformer is 15v rms, the peak value of the voltage will be;

Vpeak = Vrms × $\sqrt{2}$

$Vpeak = 15 \times \sqrt{2} = 21.2V$

If we set an allowable ripple of 16%, then

$\partial v = \frac{16}{100} \times 21.2 = 3.39$

From (1), $c = i\frac{dt}{dv}$ $- - - - - - - - - - - - - - - -(2)$

Where dt is 10ms for 50HZ

CV= It

C= IV/t

T= 1/F = 1/50 = 0.02S

BUT;

$\partial T = \frac{0.02}{2} = 0.01S = 10mS$

From equation (2), we have;

$$C = 0.5\ X\ {}^{0.01}/_{3.39} - - - - - (for\ i = 0.5A(\max),\ and\ \delta t = 10ms\ )$$
$$= 1475\mu F$$
$$= 2200\mu F\ (preferredvalue\ )$$

The value of dt = 10ms for a frequency of 50Hz, full wave rectification, while the maximum. Current expected from the power supply is 0.5A. C2 filters any noise at the output of the regulator to ensure smooth operation of the ICs.

3.2.2 SELECTION OF RECTIFIER DIODES

IN4001 Diode was used in the rectifying circuit for it is perfect for most low voltage circuits where the current is less than 1A. It was ensured that the current flowing through these Diodes from the transformer output would not cause any damage since their forward voltage drop is almost constant irrespective of the current passing through them.

- The DC voltage across the diode was calculated as follows;

$V_{DC} = \sqrt{2 \times V_{s(rms)}}$ -------------------------------- (3)

Where $V_{DC} = Voltage\ across\ Bridge\ Rectifier$

Vs (rms) = Secondary AC voltage (15V)

Therefore,

$$V_{DC} = \sqrt{2 \times 15}$$

$$V_{DC} = 5.477V$$

Hence we go for the available one which is 7.07V.

3.2.3 SELECTION OF TRANSFORMER

In order to achieve the required DC power by the IC's, a step down transformer of primary windings voltage of 220V and secondary winding voltage of 15V was used. The transformer was assumed in an ideal situation which implies a unity power factor.

For an ideal transformer, we have;

$$\frac{V1}{V2} = \frac{N1}{N2} \text{ ------------------------------ } (4)$$

Therefore, $\frac{220}{15} = \frac{44}{3} = \frac{N1}{N2}$

This implies that the turns ratio for the transformer used is 44:3.

3.2.4 SELECTION OF VOLTAGE REGULATOR

This is the last stage in ripple elimination and setting the DC output to a fixed value. In order to derive a quality precision, LM7805 is used in performing the task of AC to DC step down. Its features includes: Maximum output current of 1.5A, fixed output voltage of 5V, thermal shutdown, etc.[8]. We ensured that the input voltage to a voltage regulator is within the stated input voltage range as a result, the designed input voltage of LM7805 regulator.

3.3 SENSING STAGE

The opto-isolator is made up of an infrared transmitter and a photo-diode receiver. When the beam is broken, the output of the LM393 op-amp in the detector stage goes low, to allow for the appropriate trigger condition of the monostable stage. Figure3.3 shows the break-beam sensor stage.

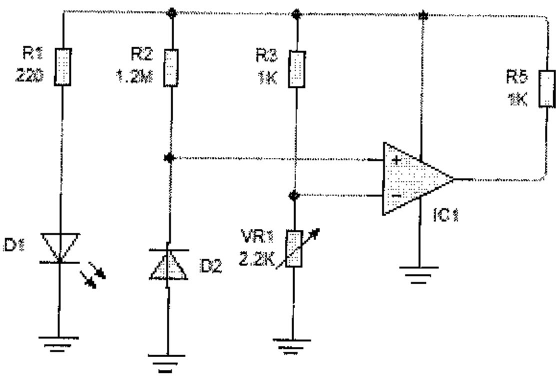


Figure 3.3: Break-beam sensor stage.

ANALYSIS

For the infrared emitter (D1),

$$Forward\ voltage\ (Vf = 1.7V), forward\ current(If = 150mA)\ \ -\ from\ data\ sheet.$$

$$hence\ R1 = \frac{(V+)-(Vf)}{If} \quad \text{-------------------------------} \ (5)$$

$$= \frac{5-1.7}{0.15} = 22\,\Omega$$

This value is however for maximum range. To conserve current 220Ω has been used since the lab model is for a very short range.

The photo diode was used as the main opto-sensor due to its ability to resist day light interference better than the other optical devices mentioned. The photodiode is operated in reverse biased condition. In darkness (i.e. without infrared transmission) or during break-beam the photodiode has a high resistance, and a low resistance upon reception of infrared light. The change in resistance causes a change in the drop across the diode, which is fed to the input of the comparator IC1. The resistance measured from the photodiode when there is no transmission is approximately 1MΩ. From Fig 3.3 R2 forms a potential divider network with the photo diode.

DESIGN CALCULATIONS.

Transmission resistance --------- 10kΩ

Break-beam resistance----------- 1MΩ

Voltage across diode during transmission,

$V_{DT} = \frac{R_D}{R_2+R_D} \times V_+$-- (6)

$= \frac{10\times10^3}{1\times10^6+10\times10^3} \times 5V$, $(letting\ R2 = 1M\Omega)$

$= 0.05V$ (This value is approximately zero volts. Hence during transmission the diode output gives 0V).

Voltage across diode during break-beam is,

$V_{DB} = \frac{R_D}{R_2+R_D} \times V_+$ -- (7)

$= \frac{10\times10^6}{1\times10^6+10\times10^3} \times 5V$, $(letting\ R2 = 1M\Omega)$

$= 4.95V$

The two voltage levels are still influenced by the presence of daylight interference and the separation distance between the transmitter and the receiver. To ensure two distinct levels a voltage comparator is used. The comparator stage allows a precise point to be set where the output voltage will change. This is achieved by adjusting VR1 in fig 3.3 above.

Setting VR2 to 2.0V means any voltage above 2.0V in the inverting input (as the beam is broken) will make the comparator LOW. This LOW output is used to trigger a 555 timer one shot Monostable that generates the clock pulse for the counting.

Since

Vout = $A_0 \times$Vin

Where A_0 = open loop voltage gain.

And Vin = $V^+ - V^-$

Vout will drop to V+ for the slightest positive difference in voltage since A0 is often very large (in order of 20000).

The comparator is meant to give an HIGH when the beam is broken and a LOW when the infrared is transmitting to D2 (the photo diode).

3.4 LOGICAL CONTROL UNIT
COMPARATOR DESIGN

A comparator circuit compares two voltage signals and determines which one is greater. The result of comparison is indicated by the output voltage: if the op-amp's output is saturated in the positive direction, the non- inverting input (+) is greater or more positive than the inverting input (-), all voltages are measured with respect to ground. If the op-amp's voltage is near the negative supply voltage (i.e 0 or ground potential), it implies the inverting input (-) has a greater voltage applied to it than the non-inverting input (+). Figure 3.4 shows a comparator design.

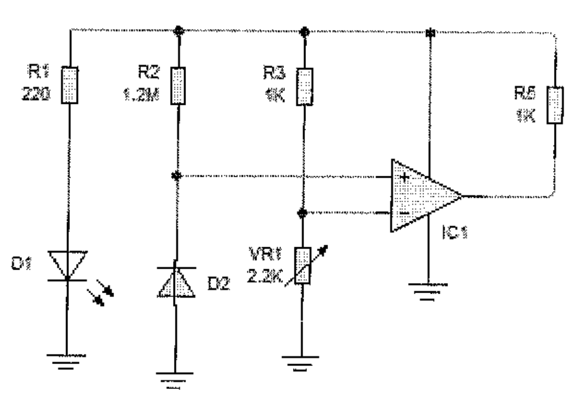


Figure 3.4: Comparator design circuit

IC555 TIMER DESIGN

The 555 timer IC is an exceptionally useful accuracy timer that can act as either a timer or an oscillator. In timer mode, also known as *monostable mode*—the 555 basically acts as a "one-shot" timer; when a trigger voltage is applied to its trigger lead, the chip's output goes from low to high for a period set by an external *RC* circuit [3]. In this design, IC555 timer was configured in a monostable mode so as to achieve the required task. Figure 3.5 shows an IC 555 timer configuration.

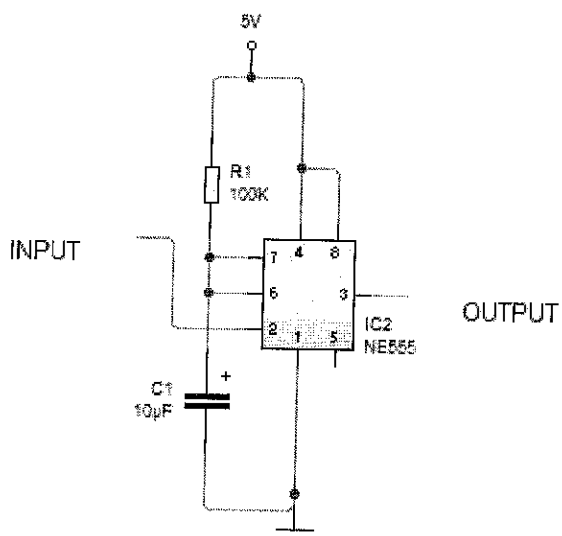


Figure 3.5: IC555 timer configured in a monostable mode

If the period (T) of the IC is 1.1seconds and the capacitor C1 is chosen to be 10uF, then the design analysis for the IC555 Timer goes thus;

$T = 1.1RC$ ------------------------------------- (8)

$1.1 = 1.1 \times R \times 10 \times 10^{-6}$

$R = \frac{1.1}{11 \times 10^{-6}} = 1 \times 10^{6} = 100k\Omega$

Therefore the value of Resistor R1 will be 100kΩ.

3.5 THE MICROCONTROLLER UNIT

The microcontroller is an exciting new device in the field of electronics control. It is a complete computer control system on a single chip. Microcontrollers include EPROM program memory, user RAM for storing program data, timer circuits, an instruction set, special function registers, power on reset, interrupts, low power consumption and a security bit for software protection. Some microcontrollers like the 16F818/9 devices include on board A to D converters. The microcontroller is used as a single chip control unit for example in a washing machine, the inputs to the controller would be from a door catch, water level switch, and temperature sensor. The outputs would then be fed to a water inlet valve, heater, motor and pump [10].

3.5.1 THE MICROCONTROLLER SYSTEM

The block diagram of the microcontroller system is shown in figure 3.6.

Figure 3.6: Basic microcontroller system

[10] The output components would consists of digital devices such as switches, push buttons, pressure mats, float switches, keypads, radio receivers etc. and analogue sensors such as light dependent resistors, thermistors, gas sensors, pressure sensors, etc. The control unit is of course the microcontroller. The microcontroller will monitor the inputs, as result the program would turn outputs on and off. The microcontroller stores the program in its memory, and executes the instructions under the control of the clock circuit.

The output devices would be made up from LEDs, buzzers, motors, alpha numeric displays, radio transmitters, 7 segment displays, heaters, fans etc. According to [7], the most obvious choice then for the microcontroller is how many digital inputs, analogue inputs and outputs does the system require. This would then specify the minimum number of inputs and outputs (I/O) that the microcontroller must have. If analogue inputs and outputs are used then the microcontroller must have an Analogue to Digital (A/D) module inbuilt. The next consideration would be what size of program memory storage is required. This to a large extent determines the choice of microcontroller to be used. This is important if any lengthy calculations are being undertaken. Other considerations are the number of interrupts and timer circuit required how much data EEPROM if any is need.

3.6 DISPLAY UNIT

This is the stage where the total output from the design is displayed. This unit consists of two types of displays i.e. the seven segment display and the LCD (Liquid Crystal Display) Display. The seven segment display used here are three in number, one is used to display the number of people that enter the Auditorium or hall, the second one is used to display the number of exit from the building, while the third one is used to display the difference between the entry and exit. The seven segment display used is a common cathode display.

The liquid crystal display (LCD) is used to display the information about the project. The LCD used is a 16 by 2 Display. The PCB layout of the design is shown in figure 3.7.

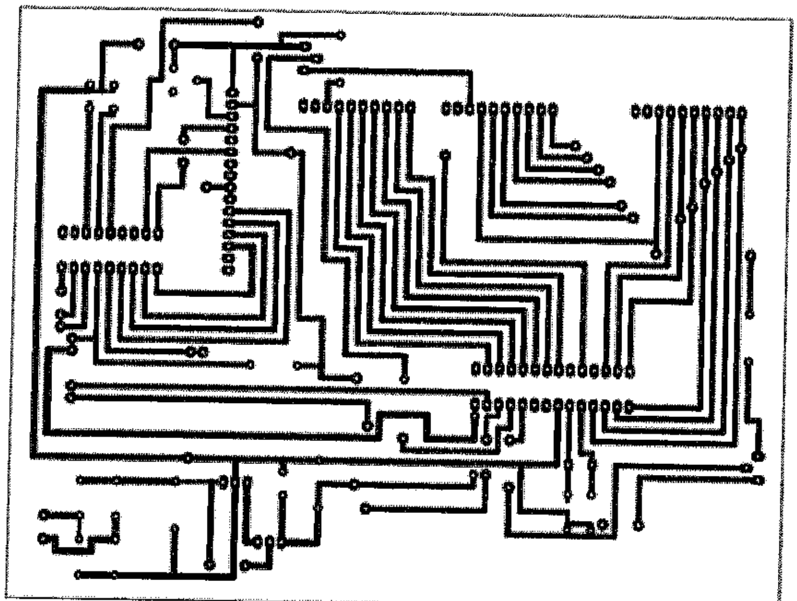


Figure 3.7: PCB layout of the design

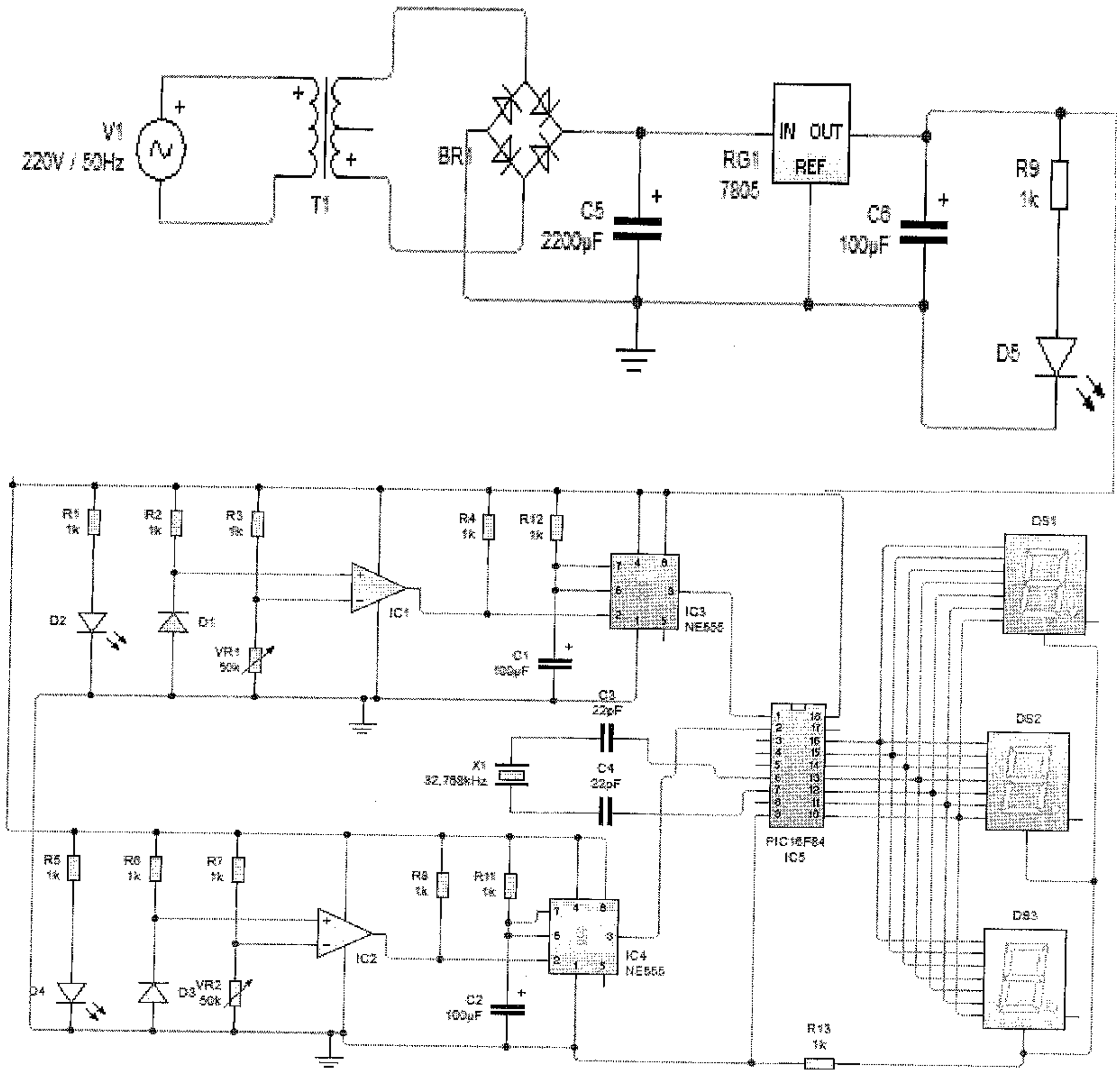


Figure 3.8: Complete circuit diagram

CHAPTER FOUR

TESTING AND CONSTRUCTION

4.1 TESTING

The physical realization of the project is very vital. This is where the fantasy of the whole idea meets reality. The designer will see his or her work not just on paper but also as a finished hardware.

After carrying out all the paper design and analysis, the project was implemented and tested to ensure it's working ability, and was finally constructed to meet desired specifications. The process of testing and implementation involved the use of some test and measuring equipment stated below.

I. **BENCH POWER SUPPLY**: This was used to supply voltage to the various stages of the circuit during the breadboard test before the power supply in the project was soldered. Also during the soldering of the project the power supply was still used to test various stages before they were finally soldered.

II. **OSCILLOSCOPE:** The oscilloscope was used to observe the ripples in the power supply waveform. The output voltage from our variable bench power supply was checked to make sure the frequency is 0 (i.e. dc). Figure 4.1 shows the output from the oscilloscope.

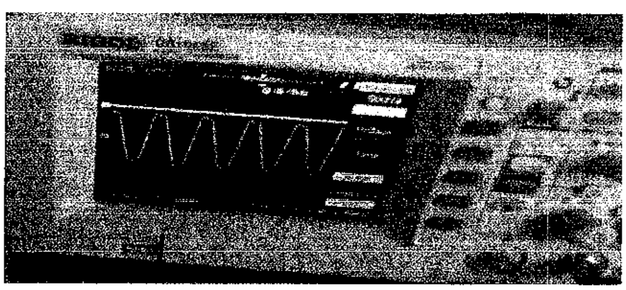


Figure 4.1: Output from the oscilloscope

III. **DIGITAL MULTIMETER:** The digital multimeter basically measures voltage, resistance, continuity, current, frequency and transistor hfe. The process of implementation of the design on the board required the measurement of parameters like, voltage, continuity, current and resistance values of the components. The digital multimeter was used to check the output voltage supply in this project. Figure 4.2 shows the design during testing stage.

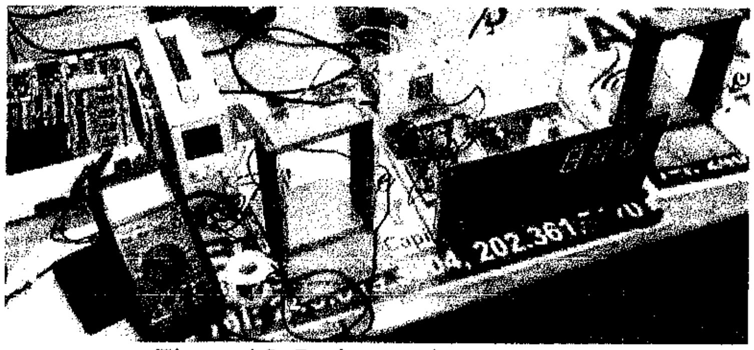


Figure 4.2: Project testing

During testing, it was discovered that Infrared sensors have non-linear characteristics and they depend on the reflectance properties of the object surfaces. So knowledge of the surface properties must be known. In other words, the nature in which a surface scatters, reflects, and absorbs infrared energy is needed to interpret the sensor output as distance measure. To determine the sensors behavior with different colored targets two paper sheets were used, one white and the other black, shown below. The previous shown tests used the white target. Figure 4.3 shows the output curve for two different targets.

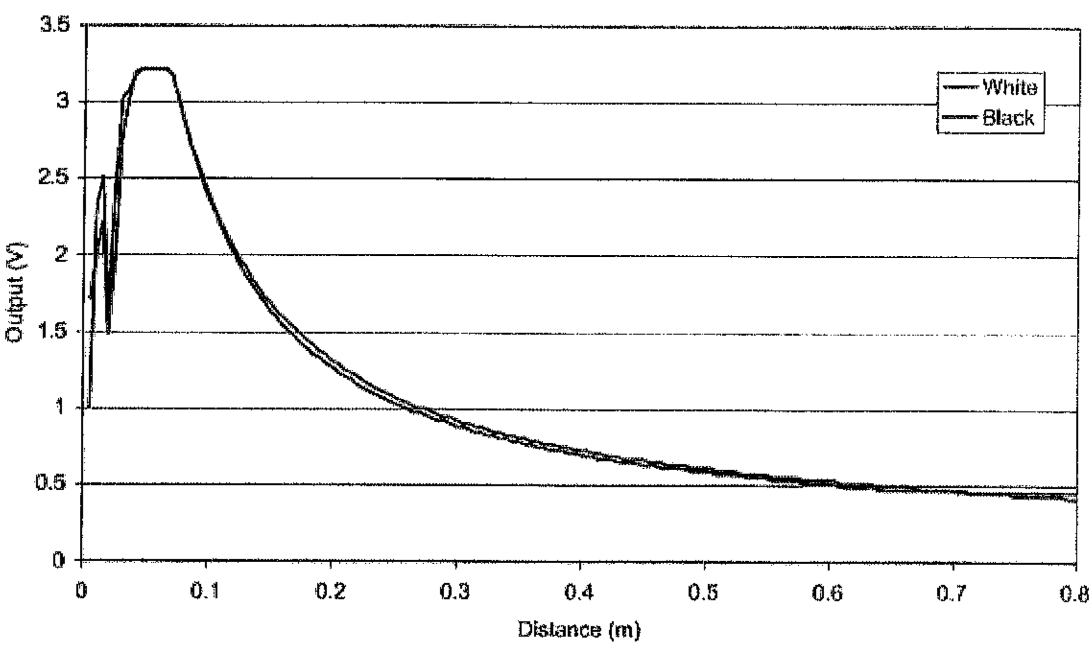


Figure 4.3: Output voltage to distance curve for two different targets

According to [11] this sensor usability depends largely on its ability to work adequately with non-perpendicular targets. The previous tests were all made with sensor in a right angle with its target. In order to decrease measuring error by moving direction of obstacle, it is recommend by the manufacturer to mount the sensor as shown in figure 4.4.

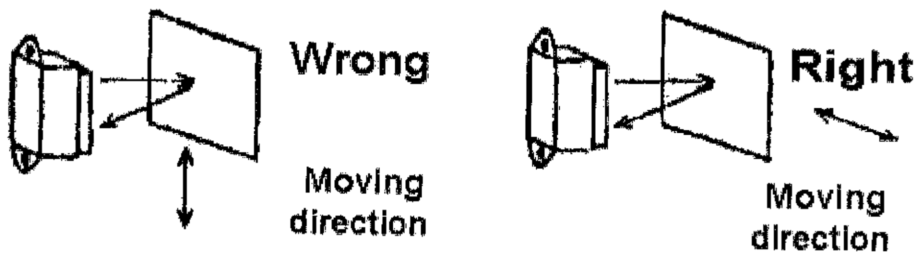


Figure 4.4: Sensor position technique

The sensors output is highly non-linear presenting its higher sensitivity in distances between 8 cm and 30 cm, for longer distances the output sensitivity is considerably smaller. Although the manufacturer recommends the use of this sensor for distances bigger than 10 cm, this sensor measures correctly distances from 8 cm, as show in Figure 4.5. Once the measurement falls below 8 cm the voltage output drops rapidly and appears to be a longer range reading, this phenomenon can be disastrous in sensor applications.

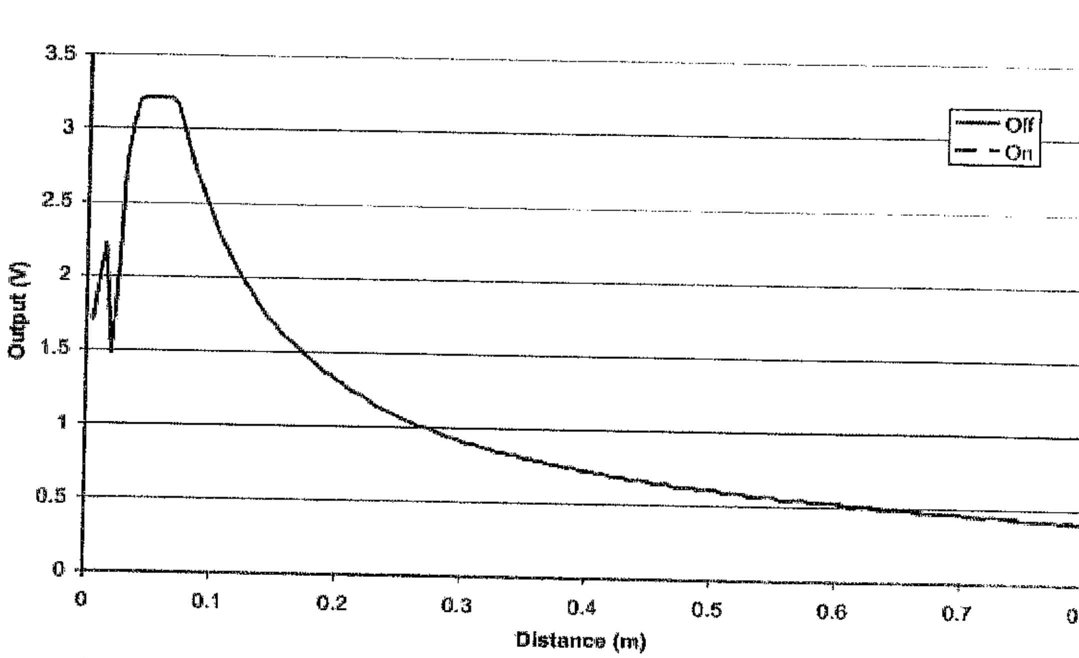


Figure 4.5: Output voltage vs Distance curve

3.2 IMPLEMENTATION

The implementation of this project was done on the breadboard. Stage by stage testing was done according to the block representation on the breadboard, before soldering of circuit commenced on Vero board. The various circuits and stages were soldered in tandem to meet desired workability of the project.

4.3 CONSTRUCTION

The construction commenced with the soldering of the components to the board and testing. For the soldering the following steps were taken;

- All jumper wires were soldered first
- Followed by IC sockets
- The tip of the soldering Iron was tinned to avoid dry solder joints
- Each stage on the Vero-board was tested as soldering progressed

The wires were rated to match necessary power required, like the mains, jumper wires etc. The different construction stages are shown in figures 4.6, 4.7, 4.8, and 4.9 respectively.

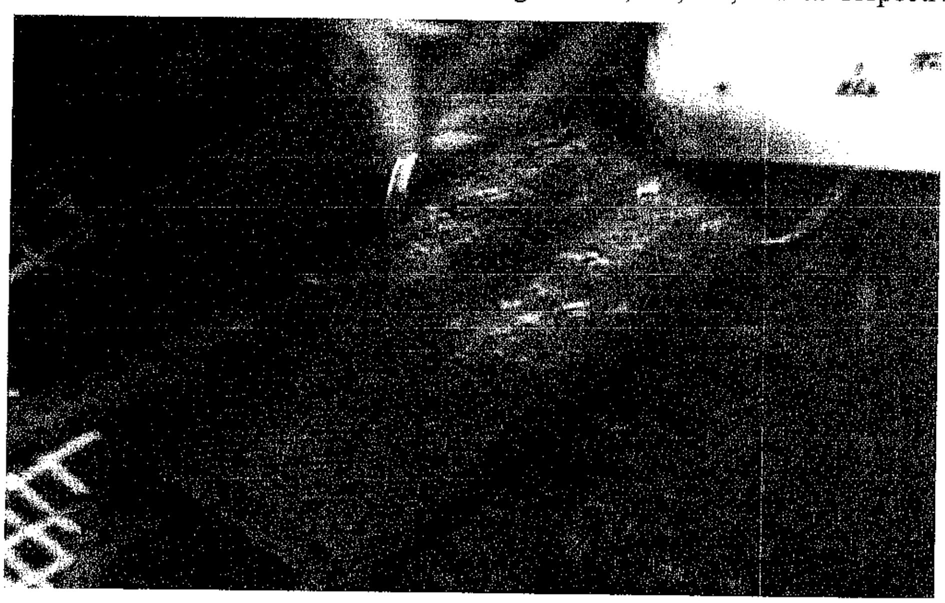


Figure 4.6: Soldering of components

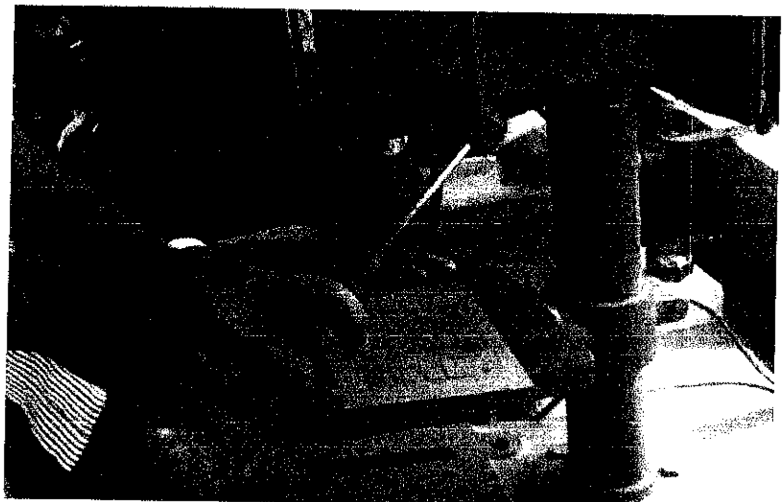


Figure 4.7: Drilling of PCB board

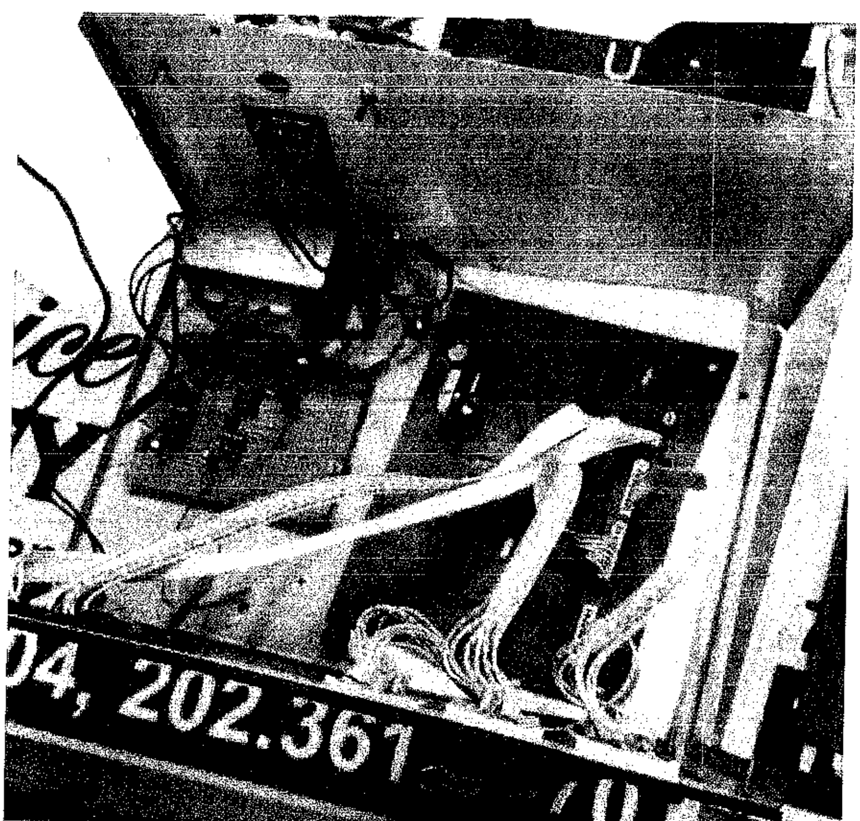


Figure 4.8: Construction stage 1

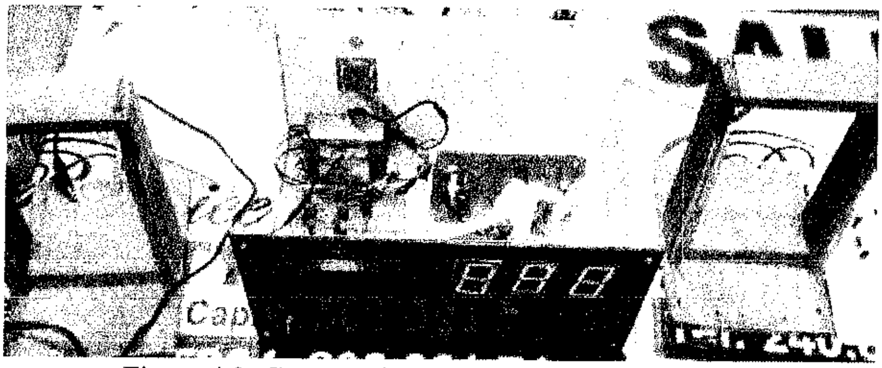


Figure 4.9: Construction stage 2

4.4 CASING

The second phase of the project construction is the casing of the project. This project was coupled to a metal casing. The casing material being wrought metal, designed with special perforation and vents and also sprayed to ensure insulation and give ecstatic value.

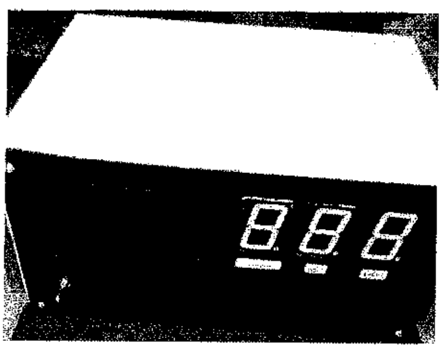


Figure 4.9.1: Complete work

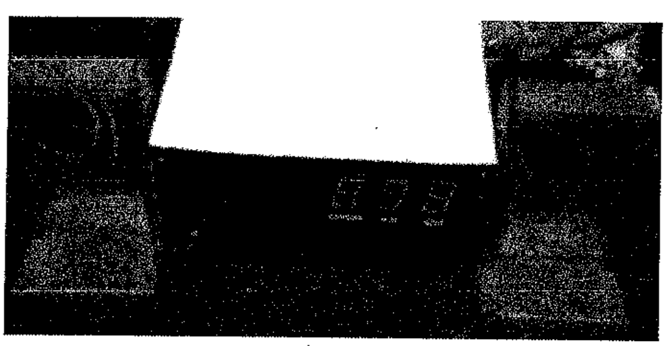


Figure 4.9.2: Front view of the project

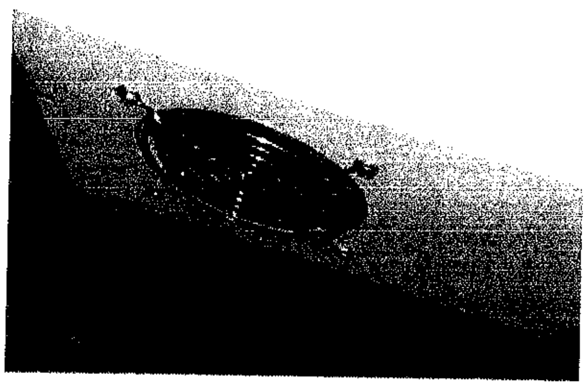


Figure 4.9.3: Side view of the project

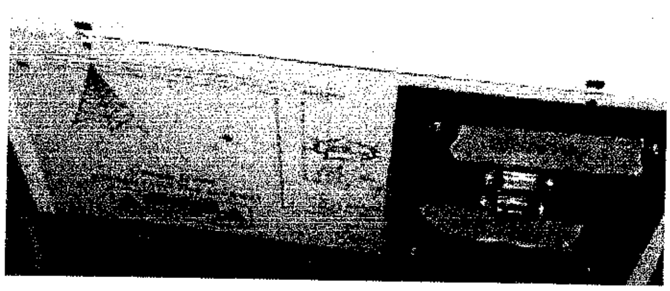


Figure 4.9.4: Back view of the project.

4.5 PROBLEMS ENCOUNTERED

Like every research and practical engineering work, diverse kinds of problems are often encountered. The problems encountered in this project and how they were solved and maneuvered are listed below.

- There were some noise in the power supply which made the counter to be jumping. This was solved by putting a filter capacitor across the power supply stage.
- The LCD routine program was displaying error. This was solved by debugging the software.
- The optical sensor was not sensing sharply, which was due to far distance between the infra-red and the sensor. This was corrected by reducing the distance between the infra-red and the sensor

- The monostable Timer was counting continuously. This was corrected by adjusting it.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This project has successfully achieved its objective. Bi directional visitors counter was successfully designed and implemented using PIC16F84 as the main controller. The designed system works perfectly as a counter at the confined place. Microcontroller is able to differentiate the visitor whether they are entering or exiting the room.

The system displays the total visitor present in the confined place through the seven segment displays, the first seven segment display shows the number of people the enters the place, the second one displays the number of those that exits the place and the third display shows the difference between those that enters and those that leaves the confined place. A programming to count up and down visitor traversing a certain passage or entrance is operating successfully.

The construction was done in such a way that it makes maintenance and repairs an easy task and affordable for the user should there be any system breakdown. The project has really exposed me to practical electronics generally which is one of the major challenges I shall meet in my field now and in future. The design of the variable dc power supply involved research and hard work.

Extensive work was done on the design, analysis and construction of this work. The project was quite challenging and tedious but eventually was a success. I wish to thank the department and my supervisor for giving me the opportunity to do this project. However, like every aspect of engineering there is still room for improvement and further research on the project as suggested in the recommendations below.

5.2 RECOMMENDATION FOR FURTHER IMPROVEMENT

For further study about counter system, the system can be improved by solving the problem occurred by distance sensor, therefore for long distance sensing Laser Technology can be employed. Calibration for sensor and bright LED can be used to increase the accuracy of the distance sensor.

In addition, the study on programming to make the system more flexible is required. This system can be upgrade where both sensors can differentiate the direction of occupant after they stand between the sensors that caused an error.

Other than that, the negative value of the system can be eliminating on further works. The systems will never count to negative value even there are error cause by sensor or microcontroller. The failure of the system to detect person coming in or out of the confined place also can be improved by doing further research and adding new idea. On further research, the idea to calculate height of visitor also can be upgrade so the system is more reliable and accurate.

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APPENDIX A

THE PROGRAM FOR THE COUNTING CIRCUIT

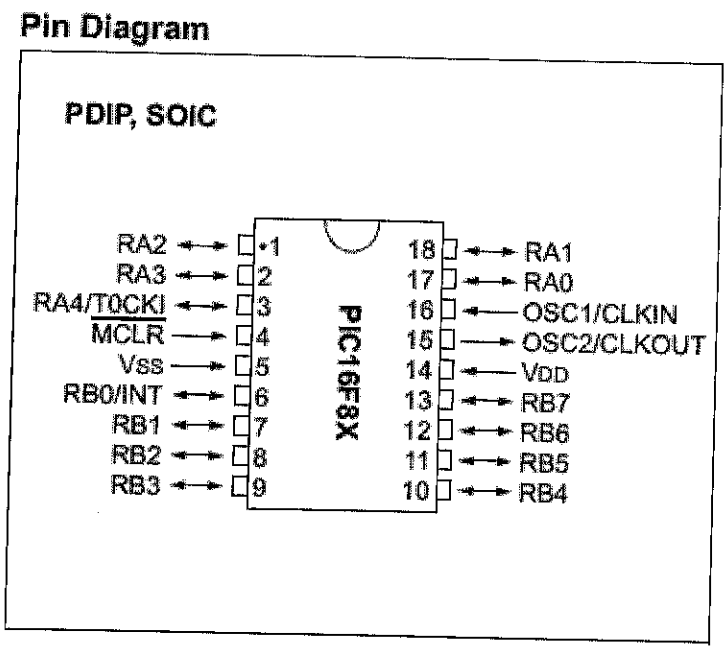
```
;EQUATES SECTION
TMR0 EQU 1 ;
STATUS EQU 3 ;
PORTA EQU 5 ;
PORTB EQU 6 ;.
TRISA EQU 85H ;
TRISB EQU 86H ;
OPTION_R EQU 81H ;
ZEROBIT EQU 2 ;
COUNT EQU 0CH ;
;events.
;*****************************************************
LIST P ¼ 16F84 ;we are using the 16F84.
ORG 0 ;the start address in memory is 0
GOTO START ;goto start!
;*****************************************************
;Configuration Bits
__CONFIG H'3FF0' ;selects LP oscillator, WDT off, PUT on,
;Code Protection disabled.
;*****************************************************
;SUBROUTINE SECTION.
;3/32 second delay.
DELAY CLRF TMR0 ;.
LOOPA MOVF TMR0,W ;
SUBLW .3 ;
BTFSS STATUS, ZEROBIT ;
GOTO LOOPA ;
RETLW 0 ;
```

```
;*******************************************************
;CONFIGURATION SECTION
START BSF STATUS,5 ;
MOVLW B'00011111' ;
MOVWF TRISA
MOVLW B'00000000'
MOVWF TRISB ;
MOVLW B'00000111' ;
MOVWF OPTION_R ;
BCF STATUS,5 ;.
CLRF PORTA ;.
CLRF PORTB ;.
;*******************************************************
;Program starts now.
BEGIN MOVLW .10
MOVWF COUNT ;
PRESS BTFSC PORTA,0 ;
GOTO PRESS
CALL DELAY ;
BCF PORTB,0 ;
RELEASE BTFSS PORTA,0 ;
GOTO RELEASE
CALL DELAY ;
DECFSZ COUNT ;
GOTO PRESS ;
BSF PORTB,0 ;
GOTO BEGIN ;
END
```

APPENDIX B

PIC 16F84 PIN DISCRIPTION

PIC16F84



PIN DESCRIPTION DURING PROGRAMMING

Pin Name	During Programming		
	Function	Pin Type	Pin Description
RB6	CLOCK	I	Clock Input
RB7	DATA	I/O	Data Input/Output
$\overline{MCLR}$	VTEST MODE	P(1)	Program Mode Select
VDD	VDD	P	Power Supply
VSS	VSS	P	Ground

Legend: I = Input, O = Output, P = Power

APPENDIX C
COST ANALYSIS

COMPONENT	COST	QUANTITY	TOTAL (#)
LM393	50	2	100
BPW42(IR emitter)	100	2	200
BPW 41(IR Transmitter)	100	2	200
NE555	50	2	100
PIC 16F873	1500	1	1500
LM7805	75	2	150
IN4001	5	5	25
2200 μF	5	1	5
10μF	5	1	5
PIC 16F84	2000	1	2000
4mHz crystal	100	1	100
Capacitors	5	4	20
Resistor	5	20	100
LCD(16×2)	2000	1	2000
Transformer 220/15v, 2A	150	1	150
Casing	5000	1	5000
7 Segment Display	100	3	300
VGA Connector	100	2	200
Vero board	200	1	200
Soldering Lead	100	2	200
Transportation of items	5000		5000
Miscellaneous	2000		2000
		Grand Total	19,555