DESIGN AND CONSTRUCTION OF AUTOMATIC POWER SWITCH AND HALL POPULATION DETECTOR

BY

ODO SIMON ONAH

REG. NO: 2000/9883EE

A Thesis Submitted to the Department of Electrical and Computer Engineering, Federal University of Technology, Minna, Niger State

OCTOBER, 2006

Dedication

This project is dedicated to GOD ALMIGHTY for his grace and sustenance throughout the period of my study.

Declaration

I ODO SIMON ONAH, with matriculation number 2000/9883EE, 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.

ODO SIMON ONAH	MR.A.U.USMAN
(Name of Student)	(Name of Supervisor)
11/10/06	11/10/06
(Signature and date)	(Signature and date)
ENGR.M.D.ABDULLAHI	
(Name of H.O.D.)	(Name of External Examiner)
(Signature and date)	(Signature and date)

Acknowledgement

I humbly acknowledge my Dear Parents, Engr. and Mrs. S. I. Odo for their financial support, moral support and understanding throughout this period of study. My appreciation also goes to my siblings, uncles and aunties who were of encouragement during our long periods of strike and internal problems.

I also sincerely acknowledge the able support of my supervisor Mr. A. Usman for his understanding and cooperation through the period of this work.

This acknowledgement will not be complete if I fail to appreciate my able lecturers who were instrument of knowledge impartation throughout my study and finally my friends and fellow course-mates for their moral support I say God bless you all.

Abstract

The need for Automisation and efficiency of power switches formed the bases for this project- The design and construction of automatic power switch and Hall population detector. The Project is an improvement of existing automatic light switches because of its additional role of counting or population detection

The design is based on Light Dependent Resistors (LDR) which detects the sensitivity from full light intensity.

The circuit senses a person via interruption of light from the bulbs and triggers ON the circuit with subsequent display of number of people in the hall on the seven segment display. There is continuous up count with respect to entrance and count down with respect to exit of persons from the hall and subsequent triggering OFF of the light system with absence of everybody from the hall as indicated by a zero-count on the display.

Table of Contents

List of Figures

List of Tables

Chapter One

General Introduction

1.1. Introduction

Previously, switching systems were basically on manual operations, which repaired an operator. The discovery of light dependent devices like photo-resistors which responds to light intensity can be applied to reduce the involvement of Mankind in power switching operation. As a result of this man made error is reduced and life becomes more comfortable to live.

The Automatic power switch and Hall population detector is a device that automatically switches ON lighting, when there is a interruption of light rays on an LDR keeps progressive count of persons as they enter the room and switches OFF lighting when no body is in hence conserving power.

An ordinary automatic power switch control normally have one light sensor such that when a person enters the room it gets a pulse and the lights come "ON" and when the person goes out it gets another pulse and the light goes "OFF". But when two person enters the room one after the other, it gets two pulses and the light remains in OFF state.

The circuit described here overcomes the above mentioned problem. The device uses two light dependent resistors (LDRs) placed at the entrance of both doors so that they can separately sense a person going into the room or coming out of the room. The output of the two LDR (sensors), are simultaneously applied to TTL up-down counter which counts in the fashion +1, +2, +3… and -1, +2, -3…. as persons are enter and hall leave the hall respectively. It is then incorporated to a display to give the number of persons in the Hall at any time. Thus switching the bulb ON or OFF automatically or other appliances desired for regulation through a relay.

It is important to know that system is also fitted with a manual switch to off the light if ON at a time not needed hence full power conservation is achieved at all time.

1.2. Aims and Objectives

The motivation behind this project is based on the following:

- To ensure energy conservation and hence subsequently reduction in PHCN Bills
- To minimize the risk of fire incidents which occur as a result of left or forgotten appliances plugged to power source.
- To have a record of how many person are in a particular place per time without manual head to head count.

1.3. Project Methodology

The circuit is based on two LDR. The darkness resistance of LDR is of the order of few mega ohms while its resistance drops significantly in the presence of light.

In darkness the two photo resistors (LDR) do not get sufficient forward bias current and are cut off. The output is applied to a counter.

The output pulse of this counter is applied to a Binary Coded Decimal (BCD) and displayed by a seven segment display which gives us the number of person in the Hall.

1.4. Sources of Materials

Materials were gotten from several sources such sources include textbooks, Websites Lecture Notes. For components and working tools used, they were sourced locally from Minna. These include resistors, relays, capacitors, connecting wires, breadboard few to mention, and the working tools such digital millimeter; soldering iron etc.

1.5. Constraints to Achievable Performance

Certain constraints to the achievable performance of the work were encountered. The realization of an effective working circuit was not really easy. It took the assistance of my fried Chijoke student of the Department of Electrical and Computer Engineering 2005/2006 session to bring out an effective working circuit.

This work uses the public power supply and with the unreliability of power supply in our dear country, this project will remain un-useful without light.

1.6. Project Layout

This work is section into five chapters. Chapter one is focused on the introduction exposes the topic, states the project objectives, scope, problems encountered as well as methodology adopted.

Chapter three focuses on the circuit design and analysis. It specifies the circuit requirements and design approach. The modules and sub modules of various assemblies are analyzed and design.

Chapter four on the other hand treats the system construction and testing. The performance of the system is evaluated using the expected and actual results.

The fifth chapter which is the last summaries the projects works. It specifies the project application, problems encountered limitations of work as well as suggestions for further improvement.

Chapter Two

Literature Review

The industrial revolution came with the technology for the design of mechanical switching system consisting of levers and gears which were bulky and at the same time produce wear hence not reliable.

With the emergence of the computer age, electronic switching circuit using discrete components tends to be more reliable than the mechanical counterpart because they are lighter in nature and operates faster.

The invention of Automatic switching dated far back as the year 1888 [5]. Almon B. Strowger was an undertaker in Kansas City, USA. The story goes that there was a competing undertaker locally whose wife was an operator at the local (manual) telephone exchange whenever a caller was to be put through to Strowger, calls were deliberately put through to his competitor. This obviously frustrated him greatly and he set about devising a system for doing away with the human part of the procedure.

Strowger developed a system of automatic switching using an electromechanical switch based around electromagnets and pawls with the help of his nephew (Walter S. Strowger) he produced a working model in 1888 (US patent No. 447918 10/6/1891). In this selector, a moving wiper (with contacts on the end) moved up to an around a bank of many other contacts, making a connection with any one of them. Strowger did not invent the idea of automatic switching, it was first invented in 1879 by Connolly and McTigthe but Strowger was the first to put it to effective use. Together with Joseph B. Haris and Moses A. Meyer, Strowger formed his company 'Strowger Automatic Telephone Exchange' in October 1891.

In the late 1890's Almon B. Strowger rated and eventually died in 1902. In 1901, Joseph Harris licensed the Strowger selectors to the Automatic Electric Company (AEC), the two companies merged in 1908. The company still exist today as AG communications systems (http.//ww.ages.com/), having undergone various corporate changes and buyouts along the way.

The process of switching lighting system ON/OFF by means of self regulating circuit which depends on the response of sensory element to a natural phenomenon is not entirely new field. There are various sensory elements which can be used at one time or the other to realize such purposes.

The thermistor is one of such sensory device. The thermistor and its symbol is shown below in figure 2.0 [4] page 47.

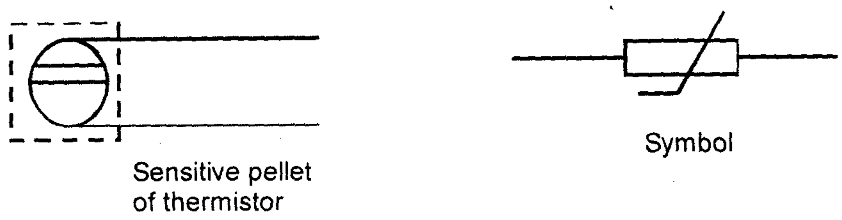


Fig.2.0 thermistor and its symbol

The thermistor is also called thermal resistor that is, temperature dependent [20]. We have two types of themistors positive temperature coefficient (PTC) thermistors whose resistance is high when hot (about 1KΩ at 100°C) and low resistance when cold (about 100Ω at 20°C)

The Negative temperature coefficient (NTC) thermistor (resistance decreases with increase in temperature)

This resistor is best used as a fire alarm and in thermometers [4] page 47.

The photodiode was also one of such sensory device. Photodiodes can carry only microamperes of current but operate more quickly than light dependent resistors LDRS and as such used in "fast" counters where the light intensity changes very rapidly from [3] the symbol is shown below.

The photodiode was basically applicable for laboratory works. The light dependent resistor is very sensitive from full light intensity to extreme darkness.

The resistance of the LDR in total darkness is about 10MΩ, in normal room lighting it falls to about 10KΩ and in bright sunlight to about 100Ω. The LDR, with a surface which is exposed to light can carry several milliamperes, an amount which is sufficient to operate a relay.

LDRS are used to regulate a lighting system based changes in prevailing light condition.

From [4] page 48, the LDR and its symbol is shown

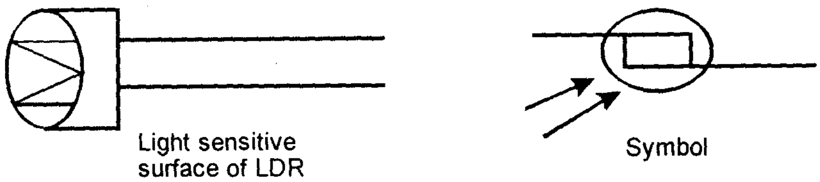


Fig.2.1 The LDR symbol

2.1. Theoretical Background

Previously Automatic room power control circuit has only one light sensor, which ON and OFF the light as a person enters and leaves. That is a single pulse puts ON the light and a second pulse offs the light irrespective of whether in the second pulse person enters or goes out of the room.

This circuit is well designed to overcome this problem, the circuit uses two LDRS as sensors whose sensing is activated by interruption of light from the filament bulbs.[20] gives us a full understanding of this function. The LDRS are of very high Resistance in Darkness and a decreased resistance in presence of light.

The circuit operates such that at maximum resistance of the LDR that is when there is an interruption of the light coming from the filament bulb, the 74132IC is activated. At every time of interruption whether a person is entering or going out of the Room, the output from the 74132IC is fed unto the 7447 decoder driver.

The input pins A, B, C, D were grounded to make count start from (zero)

When a person is entering the room (first person), with initial display reading is 0 (zero), the up clock is activated. Outputs are sent though the output pins to the 7447 decoder driver to give a display on the 7-segment common Anode display. This output from 7447 also pass through diodes and unto a transistor which activates the relay and the electrical appliances connected unto it are put ON. when persons enters the room subsequently, the display count only keeps increasing with entering of each person. If a person leaves the room the down clock is activated reducing the count on the display by one (1).

As people progressively walk out of the room, the count decreases consequently until the display reads zero (0) and the relay is activated switching OFF appliances connected to it.

In case of emergency when people leave the room through means other than the entry or exit doors, the circuit is insensitive to know hence the reset (clear) pin is used to reset the counter to start a fresh count.

Chapter Three

Design and Implementation

3.1. Introduction

The design and implementation of this project is based on the available components and devices, which are incorporated to form different units of system. Each unit consists of different components, which perform different operations necessary for the overall functioning of the system.

The Automatic controller comprises basically of five units namely: The power unit, the control sensory unit, the counter unit, he Display unit and the switching unit (Fig 3.0)

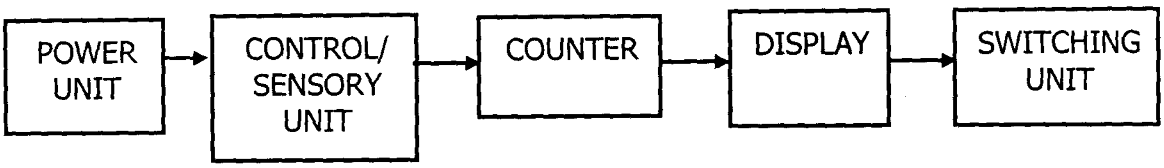


Fig. 3.0. Block Diagram of Basic Unit of the Project

3.2. The Power Unit

Almost all electronic devices and circuits require a direct current supply for their operation. Dry cells and batteries are forms of d.c sources and are advantageous to convert this alternating current (a.c) supply to d.c voltage.

The process of converting the a.c voltage to d.c involves voltage transformation, rectification, filtration and voltage regulation before your d.c output is obtained.

These processes are obtained by transformer, full Bridge rectifier, filter capacitor and voltage regulator.

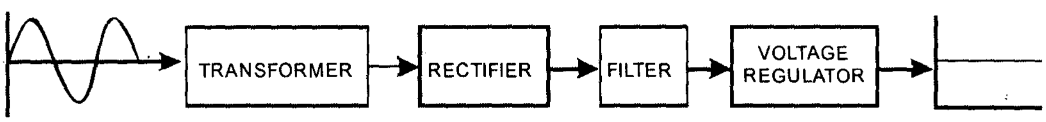


Fig 3.1. Block Diagram of Regulated d.c power supply

The power supply unit is made up of the 240Vac/12Vac at 200mA step down transformer, the rectifier, the 2200µf capacitor and the regulator. This section or unit supplied the entire circuit with the needed power.

The transformer converts the a.c voltage from voltage level to another [1, 2]. It is a step down transformer which steps the voltage down to 12Vac.

The Bridge rectifier converts the a.c. voltage into d.c voltage.

From [1] a rectifier is a circuit which employs one or more diodes to convert a.c voltage into pulsating d.c voltage. Rectification is either full wave or half wave. Full wave consist of four discrete diodes incorporated together to form bridge rectifier circuit is shown below.

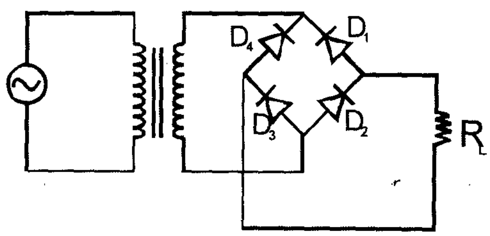


Fig 3.2. Full wave bridge rectifier circuit

The full wave rectifier was however used for this circuit. The 2200µf capacitor (filter capacitor) is used to filter the a.c ripples to obtain and output d.c voltage by a process called filtration. The value of filter capacitor used are;

(i) Determines the magnitude of ripple voltage reduced.

(ii) Increases V_{dc} towards the limiting value V_{ip} (peak rectified output voltage) [1]

The regulator (7805) makes the terminal voltage of the d.c supply constant even when a.c. input voltage to the transformer varies [2].

It is a three leg device shown below (Fig 3.3)

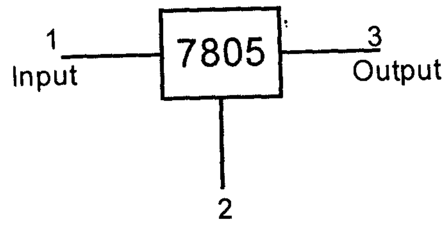


Fig. 3.3: Symbol of a Voltage Regulator (5 volt regulator)

Voltage regulators are available in variety of outputs, typically, 5volts, 9vols and 13volts. The last tow digits in the name indicates the output voltage.

Table 3.0. The Voltage regulator series

Name	Voltage
LM 7805	+5Volts
LM 7809	+9Volts
LM 7812	+12Volts
LM 7905	- 5VOLTS
LM 7905	- 9VOLTS
LM 7912	- 12VOLTS

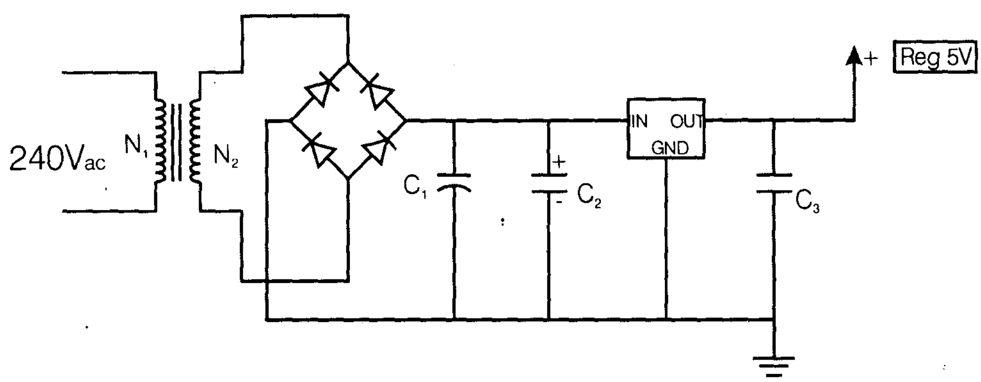


Fig 3.4. Complete Power Circuit

3.3. Control/Sensory Unit

This unit comprises of the filament bulb, the light dependent resistor (LDR), the variable resistors and Transistor, Transistor Logic (TTL) 74LS123 IC (swift trigger input NAND gates) to provide good noise immunity are ideal for slowly changing of noisy signals.

The filament bulbs are two parallel 4v, 0.5A bulbs connected in series and powered directly from the transformer before regulation. The bulbs act as light source o the LDR which whose resistance varies with light intensity [2, 3]. The symbol of the LDR is shown below (fig 3.5).

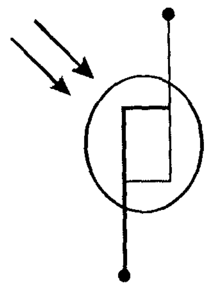


Fig 3.5. Typical Symbol of an LDR

The LDR is linked to the 74192 IC which transfers the signals to the 74192 counter. The output of the counter passed unto the Binary coded decimal (BCD) decoder driver and finally to the segment display.

3.3.1. Transistor Transistor Logic (TTL)

Transistor transistor logic (TTL) integrated circuits (ICS) are fabricated from bipolar junction transistors (BJTS). Integrated circuits contain many components fabricated on a single semiconductor wafer. TTL ICS are found in dual in-line packaging (DIP).

With this type of packaging the IC contains two parallel sets of pins on opposite sides of the IC. The pins are numbered in a counter clockwise fashion with pin 1 starting on the lower left corner. Pin 7 is normally ground, and pin 14 normally Vcc.

TTL ICS come in many different sizes and can have more than 14 pins. The TTL IC with pin configuration is shown figure 3,6 below.

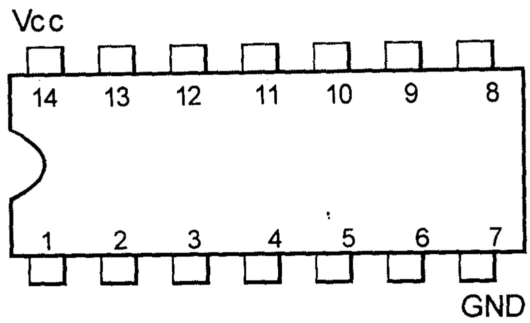


Fig. 3.6. The TTL IC [6]

3.3.2. TTL Logic Levels [6]

TTL ICs accept a range of input voltage to represent logic level 1 (high) and logic level 0 (low). TTL ICs accepts voltage ranging from 2v – 5v as high or logic 1 and voltages that are in-between 0.8v and 2v fall within the undetermined range and should not be allowed. TTL output voltages also fall within certain ranges. The typical logic 1 output voltage for TTL is 3.4volts but the voltage could fall anywhere in-between 2.4v and 5.0v.

The typical logic 0 output voltage is 0.1v but fall anywhere between 0v and 0.4v.

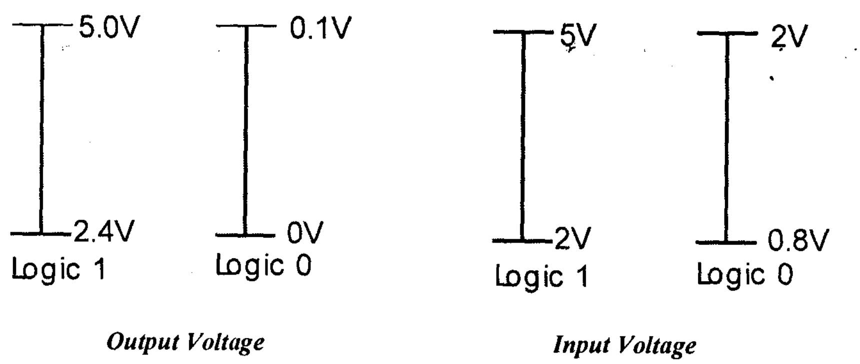


Fig 3.7. Voltage Level of TTL IC.

3.3.3. The 74LS132 TTL IC [6, 7]

The 74132 has a Schmitt trigger (Quad 2-input gates) input to provide good noise immunity. They are ideal for slowing changing or noisy signals [6], i.e. noise signals which do not respond speedily, such Schmitt trigger input gates are ideal for use in such condition.

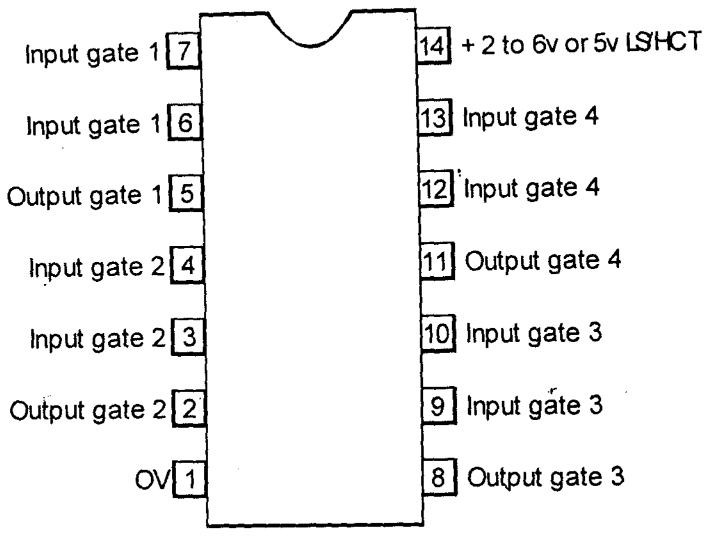


Fig. 3.8: The 74132 with Pin Configuration [6]

The 74132 Schmitt Trigger effect is performed by its four two input NAND gates which accepts standard TTL input signals and provide TTL output levels. The Schmitt triggering effect makes them capable of transforming slowly changing input signs into sharply defined jitter free output signals. In addition, they have greater noise Margin than conventional NANDATES.

The Schmitt trigger uses positive feed back to effectively speed up slow input transition and provide different input threshold voltages for positive and negative going input threshold (typically 800mv) is determined internally by resistor ratios.

The internal structure of the 74132 is n. it is shown below

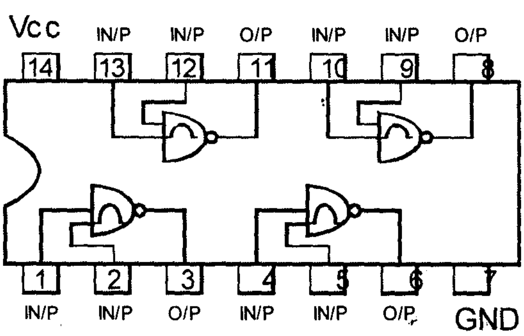


Fig 3.9. Logic Connection and Connection Diagram (Top View) [6]

The Control circuit is shown in Figure 3.10 Below

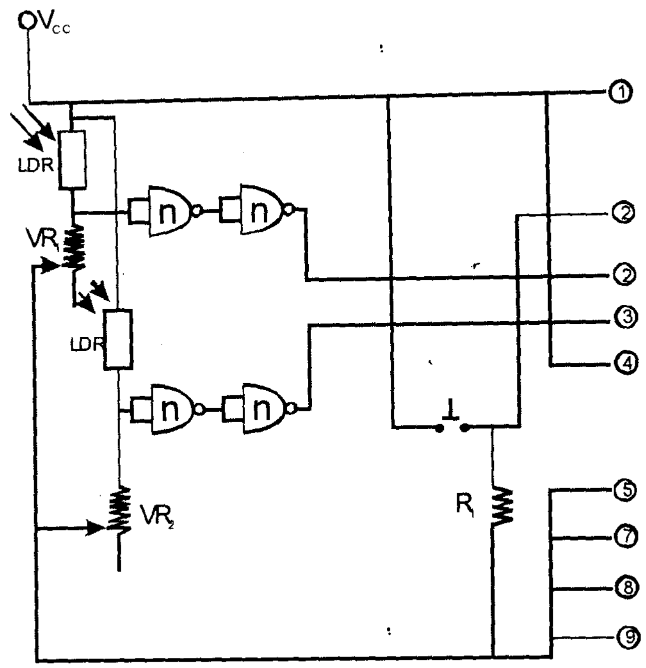


Fig 3.10. The Control Unit

3.4. The Counter

Counting function is a very important digital process. There are many types of digital counters, but their basic purpose is to count events represented by changing levels or pulses or to generate a particular code sequence. To count, the counter must remember the present number so that it can go to the next proper number in sequence. Stronger capability is therefore an independent characteristic of all counters and flip-flops are normally used to implement them.

The 74192 TTL TC is used as the counter in this device, it is a 16 Dip and categorized as a synchronous counter with their outputs changing on each clock pulse. They are up down decade (0 – 9) counters. [6, 9].

These counters has separate clock input for counting up and down. The count increases as the up clock input becomes high on the rising edge and decreases as down-clock input becomes high on the rising edge. In both cases their input should be high.

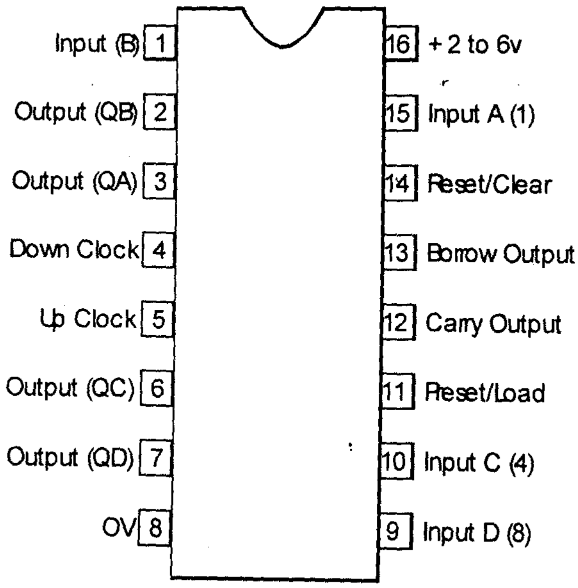
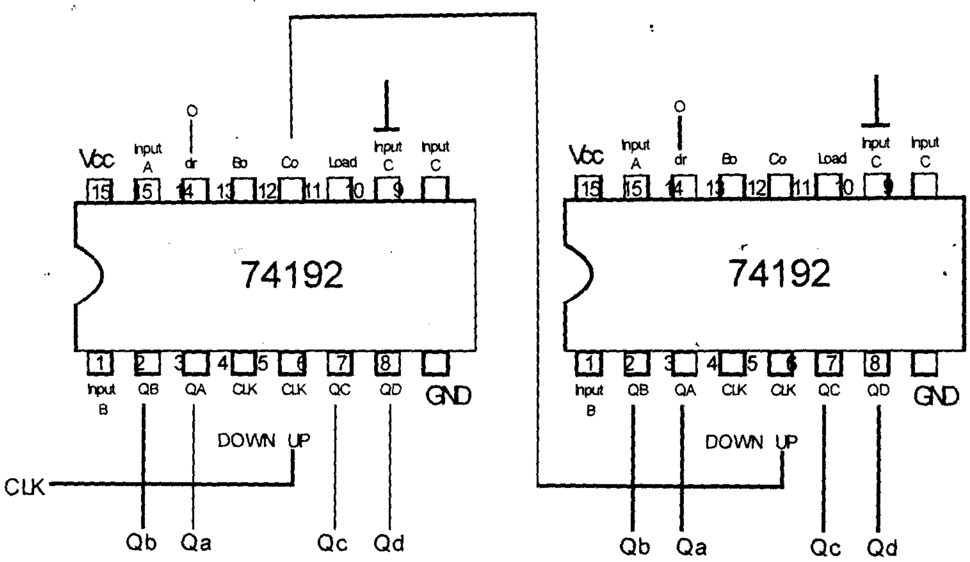


Fig 3.11. Pin Label of Up/Down Decade (0 – 9) Counter [6]

3.4.1. Cascading the 74192 IC

The 74192 can be cascaded to form counters of larger modules. Two 74912, can be cascaded together to form a 00 – 99 counter. The carryout of the least significant bit IC needs to be connected to be clock input (count up) of the next IC counter. This configuration is shown below



One's Position Ten's Position

Fig 3.12. Cascading 74192 Decade Counter [6]

The counter unit is shown in figure 3.12 below

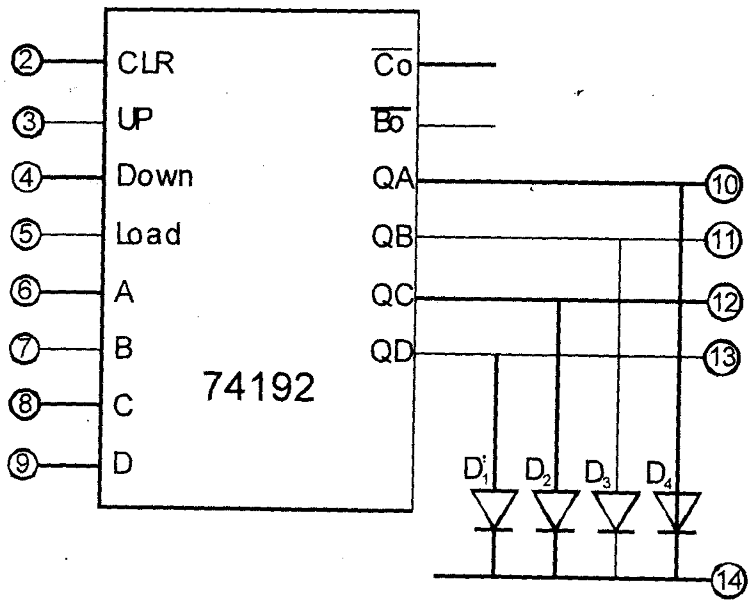


Fig 3.13. The Counter

3.5. The Display

The display unit is subdivided into

- 7447 TTL Binary decoded decimal (BCD) to -7-segment display driver.
- The 7 – segment common Anode Right hand Display.

3.5.1. The 7447 TTL BCD to 7-Segment Display Driver

Below is the 7447 TTL driver showing the pin orientation

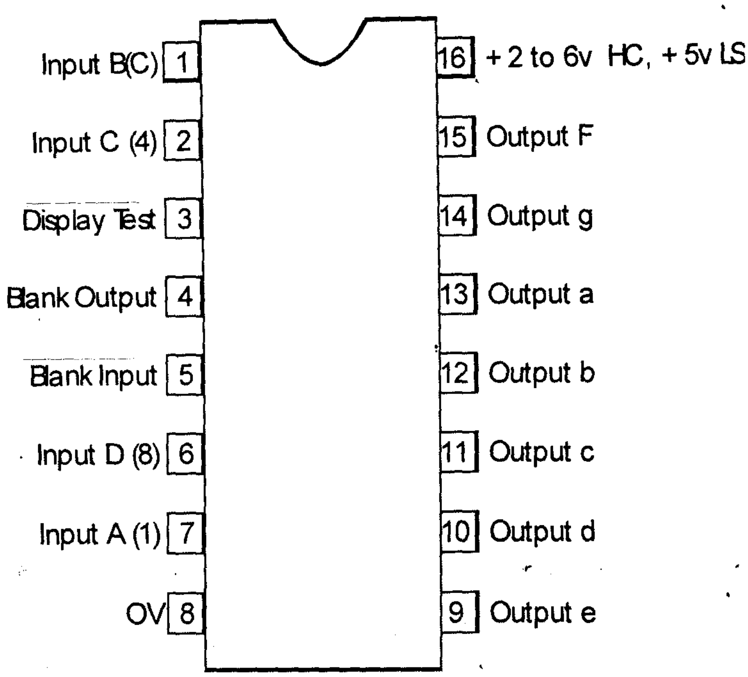


Fig 3.14 Pin Configuration of the 7447 Display Driver [6]

The seven outputs (a – g) on the 7447 IC are all normally HIGH and become low when activated to display the BCD number supplied on the inputs A – D. The 7–segment is connected between +Vs and the outputs and a resistor to limit amount of current flowing through each in series with a 5v supply.

Display test and blank inputs are active – low and become high for normal operation. When display test is low all the display segments should light (showing number 8).If the blank input is low the display will be blank when the count input is zero (0).

The 7447 driver is connected to a common Anode display. To display the decimal number 2, for instance (a, b, d, e and g) are activated and hence go low while segments (c and f) are not and remains high

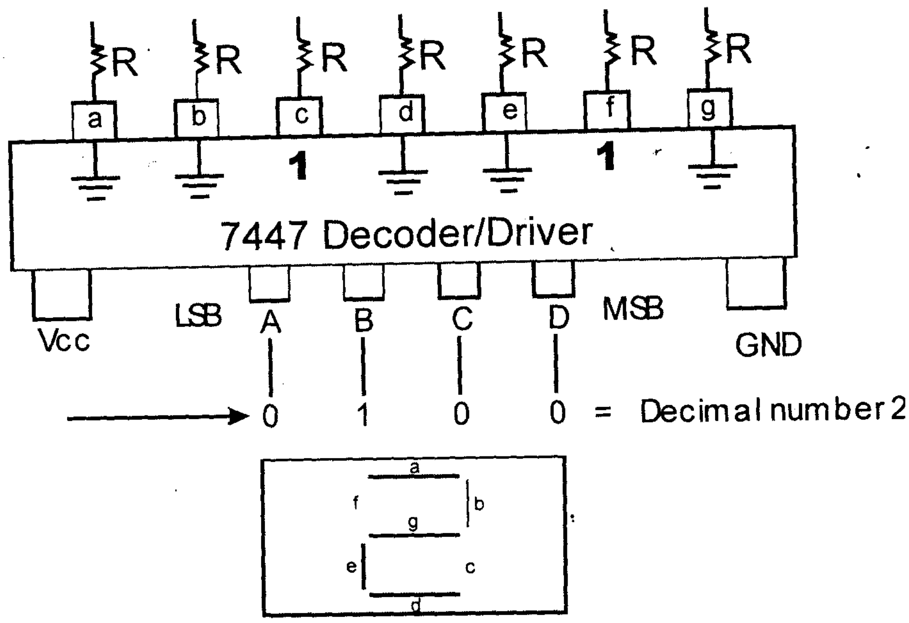


Fig. 3.15. 7447 Showing high and low input when Decimal 2 number (2) is displayed.

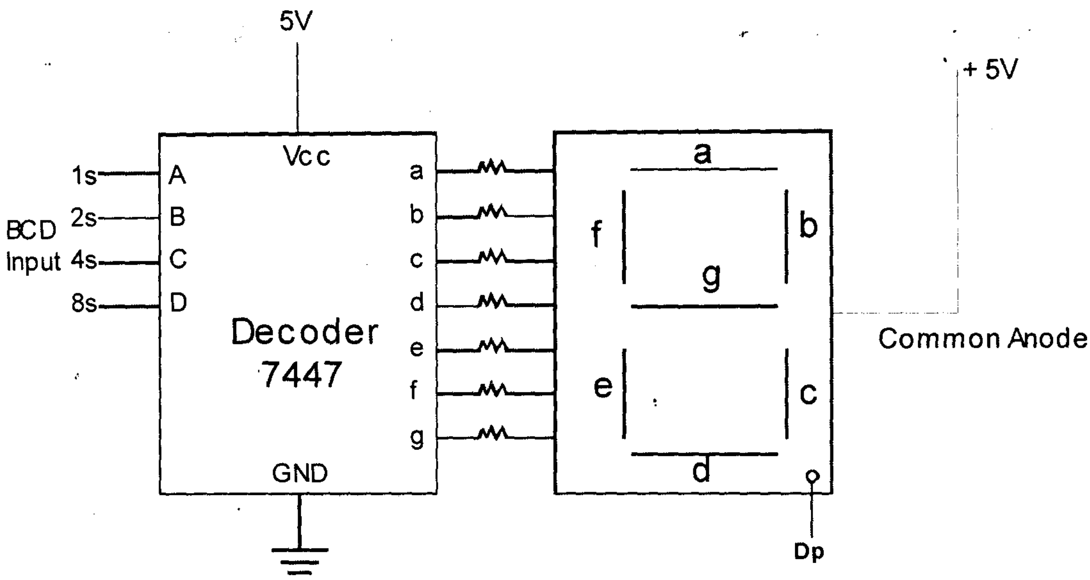


Fig 3.16. Wining 7447 Decoder and Seven Segment LED Display [3]

3.5.2. The Seven Segment Common Anode Right Hand Decimal [7, 8]

Seven segment displays are used to connect four bit BCD number into a visible readout. The seven segment display may be of LED (Light Emitting Diode) type or LCD (liquid crystal type), But for the purpose of this project LED type was used. A typical

LED seven segment display is shown in Fig. 3.20. Each segment is a LED and emits light when current flows through it.

There are of two arrangements

(i) Common Cathode

(ii) Common Anode

For this project the common Anode Right hand decimal was used. Its internal circuitry is shown below

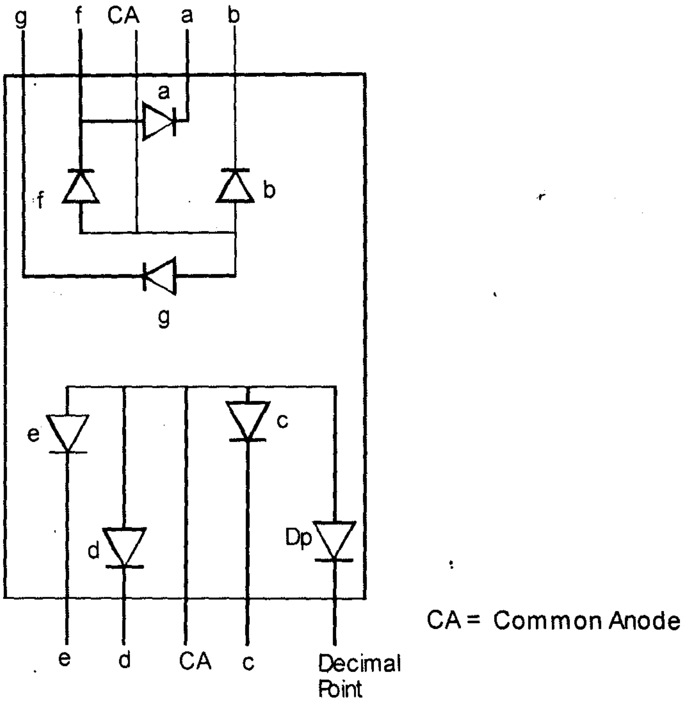


Fig 3.17. Internal Circuitry of the Common Anode Right hand Decimal Display

The segment patterns used to display the various digits are as shown below

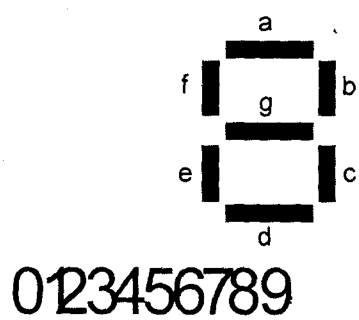


Fig 3.18. Display of Decimal digit with a 7-Segment

The Display Unit is shown in Fig 3.19 below

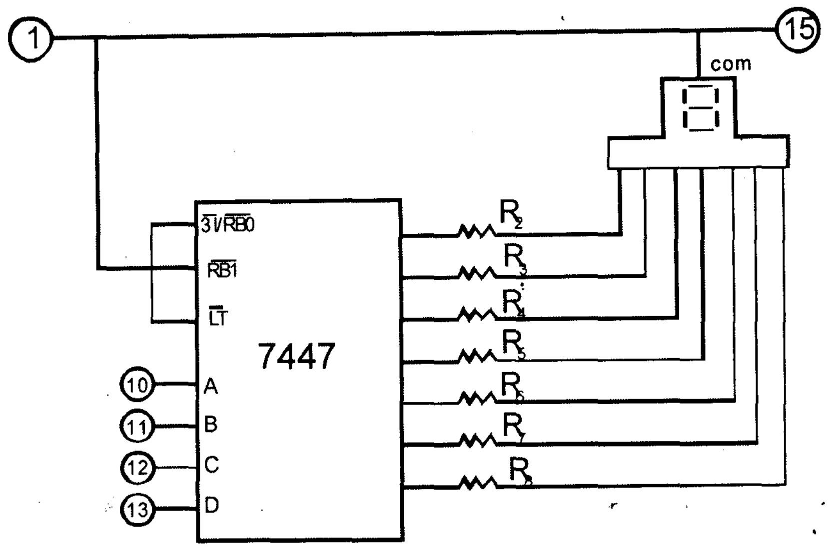


Fig 3.17. The Display Unit .

3.6. The Switching Unit

The switching unit comprises of transistor and a relay which is used for triggering the circuit with response to the signal from the control unit.

3.6.1. Transistor

The transistor is a three terminal semi-conductor device usually manufactured from either silicon (Si) or Germanium (Ge). Transistors are usually used in amplifying electrical signal or act as an electronic switch. There basically two types of transistors. The Bipolar Junction Transistor (BTT) and field effect transistors (FET) [10]

The BTT consist of a combination of two junction diodes available in two basic convention, he NPN and the PNP [12]

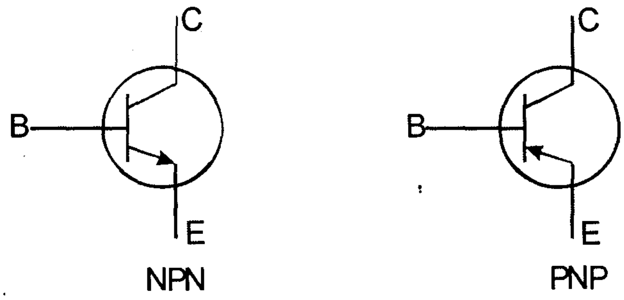


Fig 3.20. Transistor Symbols

3.6.2. Relay [12, 13, 14]

A relay is an electromagnetic device operated by varying the input, which in turn is used to control other devices connected to its output [12].

A relay opens and closes contacts to effect the operation of other devices in the same circuit or a different circuit connected to it.

Thus relays are used for the following [14]

- To control a high-voltage circuit with a low-voltage signal
- To control a high-current circuit with a low-current signal
- To detect and Isolate faults on transmission and distribution lines by opening and closing circuit breakers (protective relays) [13]
- To perform time delay functions. Relays are modified to delay opening or delay closing a set of contacts.

Normally open contact is that which when the relay has not operate remains open i.e. the contact connect the circuit when the relay is activated [12] and the contact which is closed when the relay has not operate i.e. contacts disconnect the circuit when the relay is activated is called a normally closed contact [14].

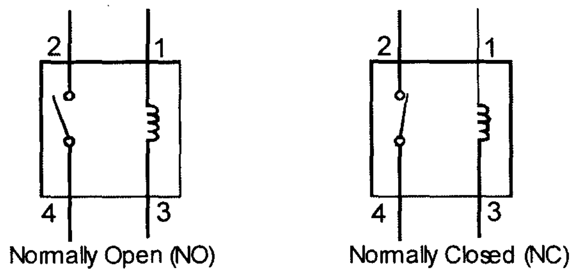


Fig 3.19. Normally Open and Normally Closed Contact [14]

3.6.2.1. Principle of Operation of Relay [12]

An electromechanical relay is said to have been operated when sufficient current or voltage has passed through the operating coil to cause contact to open or close depending on the design and purpose of the relay.

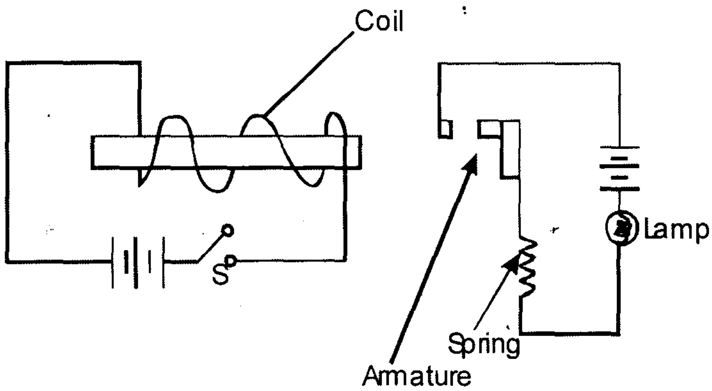


Fig 3.21. The Relay [12]

As shown above when electric current is passed through its coil, a magnetic field is formed around it which is proportional to the amount of current flowing through the coil. This cause an armature to be attracted and thus opening or closing contact attached to it at some point [12].

The circuit of the switching unit is shown in Fig 3.21 below.

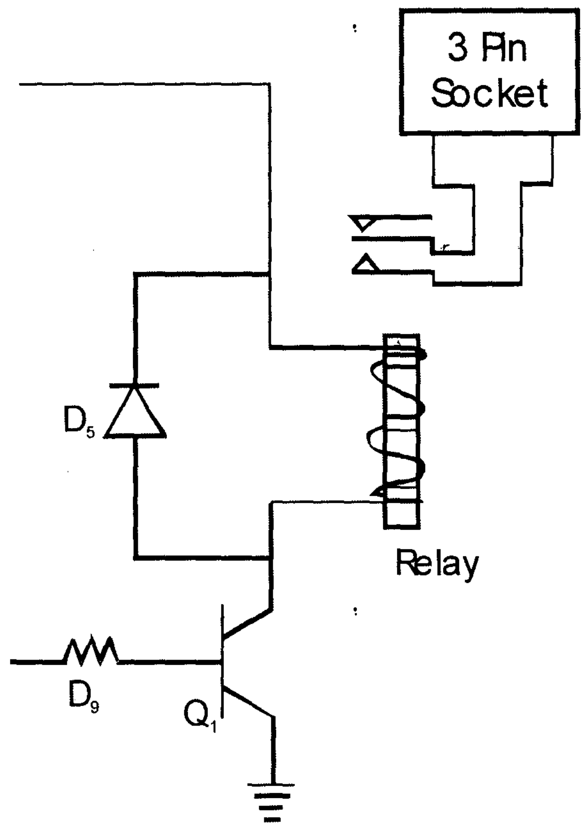


Fig 3.22. The Switching unit

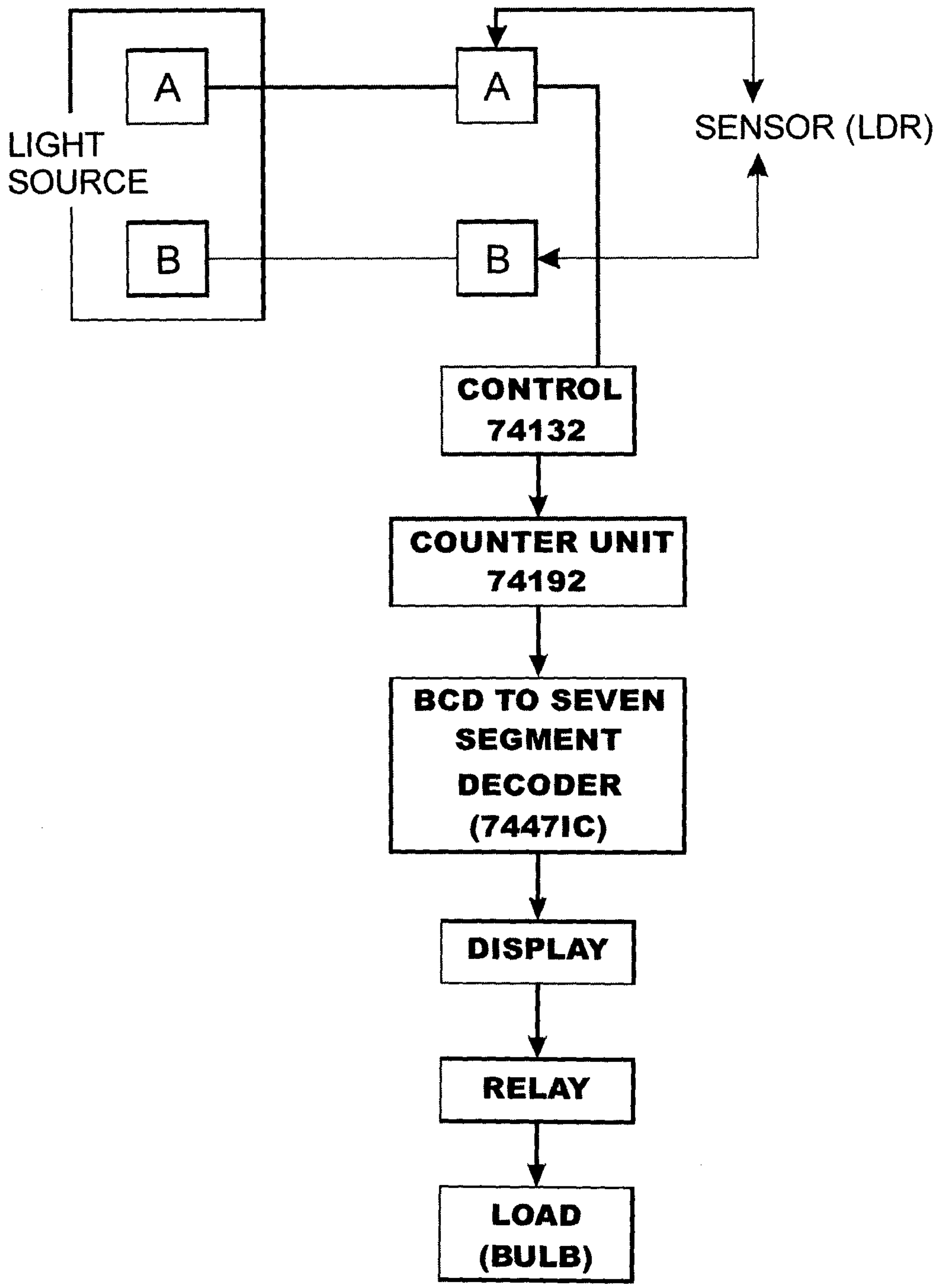


Fig. 3.22. Detailed Block Diagram of Circuit

3.7 Transformer Selection

The insulated core transformer used to transform the input voltage to circuit was selected taking into consideration the current rating of the circuit components making sure the sum total current of these circuit component does not exceed the current rating of the transformer to be used.

- 3 The TTL IC, sinking current = 16mA x 3 = 48mA.
- 7 Segment, each led can normally take between 10mA – 15mA with a voltage drop of 1.5v – 2.5v [9].
- Relay: Current rating I = V/R

  = 5v/107Ω = 46.73mA.
- Resistors: Total Resistance = (200 x 7 + 2200 + 360)

  = 1400 + 2200 + 360

  = 2760Ω

  I = V/R= 5/27600 = 1.18mA
- 2 Light bulbs, V = 4V = 4 x 2 = 8v

  = 1A
- Other (Diodes & Transistors) = Current flowing through Diodes and transistor is source current from the output pins of the 74192 IC.

  That is:

  4 output pins x 2mA source current

  = 8mA

Hence Total circuit current.

= 48mA + 15mA + 46.73mA + 1.18mA + 1000mA + 8mA = 1118.91mA.

= 1119mA = 1.12A

Hence a transformer of current rating 2A was chosen to give allowance to fluctuation.

3.8 Selection of Filter Capacitor [19]

Peak voltage V_{pk} = Vs x √2

V_s = Secondary voltage = 12V

V_{pk} = 12v x 1.414

= 16.97V_{pk}

Ripple voltage V_{ripple} = V_{pk} x ripple percent

Assuming a ripple of 5%

= 16.97 x 0.05 = 0.8485V_{ripple}

Capacitor value C = $\frac{I_{load}}{2fV_{ripple}}$

I_L = 200.91mA = 0.20091A.

f = 50Hz

$$C = \frac{0.20091}{2 \times 50 \times 0.8485} = 23678\mu f$$

Hence 2200µf being the closes value available in the market was used.

3.9. Selection of 74132, 74192 and 7447 TTL Logic ICs [6]

The 74 series TTL ICs have common characteristics, they have the following specification:

Specifications

Required voltage ±2.5V – 5V (must be very smooth regulated supply).

Normal supply smoothing = 0.1µf capacitor

Sinking Current (Current it can give) = 16mA (which is enough to light a LED i.e. each LED of the up segment)

Source Current (Current it takes) = 2mA

Power consumption = P = VI

V = 5V, I = 2mA

$P = 5 \times 2 \times 10^{-3}$

= 0.01W = 10mW

Hence the 74 series TTL ICs were chosen since its source current is low with low power consumption and uses a source voltage of 5V regulated (maximum) which is what is required or used for the entire circuit.

3.10. Selection of Diodes

The diode 1N4148 was used in the whole circuit

Specifications [16]

- It is fast switching diode
- Rectified Average current = 150mA
- Peak Reverse voltage V_{RM} = 100V
- Reverse Voltage V_R = 75V

Hence from the specifications above, the diode can withstand the circuit rating or working conditions such as ICs source and current. The output pins of the 74192 counter sources 2mA each and the Diode can take an average Rectified current of 150mA which is much far higher than that given out by the output pins hence the Diode can withstand the current source by the counter effectively.

3.11. Selection of R1

One of the characteristic of 74LS family is that inputs float high to Logic 1 if unconnected, but this is not reliable in a permanent (soldered) circuit because input may pick up electrical noise [6]. 1mA must therefore be drawn out to hold input at Logic 0 and connect any unused inputs to +Vs to ensure good immunity to noise [16].

Hence the Load pin which indicates where your count should start is connected to +Vs and to keep Reset pin at Logic 0.

$R = V/I = 5V/1mA = 5/1 \times 10^{-3} = 5000\Omega$

But Sinking Current of pin = 16mA

$R = V/I = 5/16mA = 5/1x10^{-3} = 312.5\Omega$

Hence any Resistor between this range [312.5 – 5000] Ω will effectively keep it at Logic 0.

3.12. Selection of Resistors $R_2 - R_8$

Resistors are normally connected to reduce the current through the seven segment display i.e. the current through the LEDS.

Specification

A LED will normally take a current of 10mA and 15mA with a voltage drop of 1.5v – 3.0V.

Hence,

Supply voltage – maximum drop

5v – 3v = 2v

Resistor value to drop the voltage from 5v to 3v is obtained as

$R = 2V/15 \times 10^{-3} = 133.33\Omega$

Considering the Lower Limits of 1.5V and 10mA

5V – 1.5V = 3.5V

$$R = \frac{3.5V}{10 \times 10\text{-}3} = 350\Omega$$

Hence Resistor values of between 133.33Ω to 350Ω could be used but the higher the resistor value, the lesser the brightness of the Leds (the display)

Hence the low value range of 200Ω was chosen.

3.13: Selection of Resistor R9

The Resistor value R8 was chosen based on the transistor used for switching the relay and the sinking current of the 74192 IC.

Specification

Source voltage = 5V

Sinking Current of 74192 = 2mA

V_{BE} of 2N3904 Transistor = 0.6V

Hence $V_s - V_{BE} = 5V - 0.6V$

$= 4.4V$

But V = IR

R = V/I

$= 4.4/2 \times 10^{-3} = 2200\Omega$

Hence the switching transistor 2N3904 needs a resistor value of 2200Ω to drop a voltage of 4.4 from its Base-emitter junction

3.14: Selection of Transistor

The Transistor 2N3904 is used for relay switching. It is a general purpose NPN (Common emitter Transistor).

Specification [17]

Maximum collector emitter voltage [V_{cto}] = 5V

Frequency = 300MHz

h_{FE} = (gain = Ic/IB) = 100

Imax = 200mA

$I_{BO(max)}$ = 50nf

Hence it has an I_{max} which is far above what is passing through it in the circuit, it perfectly fits the purpose its been used for in the circuit hence its selection.

3.15: Selection of Relay

The Relay selected from the manufacturers specification that has the following properties

V = 6Vdc

R = 107Ω

Although 5V dc regulated voltage is passed 6V dc has been used in the circuit.

3.16: Selection of Seven Mode Display

- Common Anode seven segment display driver with a common Anode display
- Average power per segment or Decimal point = 82mW [18]
- Peak forward current per segment or Digital [18]

Comparing, we see that the Average power for segment and specifications above, the Display meets the circuit working condition. Hence the display is chosen.

3.17: Design Implementation

After the completion of design phase, the circuit diagram was simulated using multism software on the computer. The circuit worked hence construction work proceeded. The project was then implemented on a bread board to make sure it is actually working. The power supply unit was however constructed directly unto a vero-board.

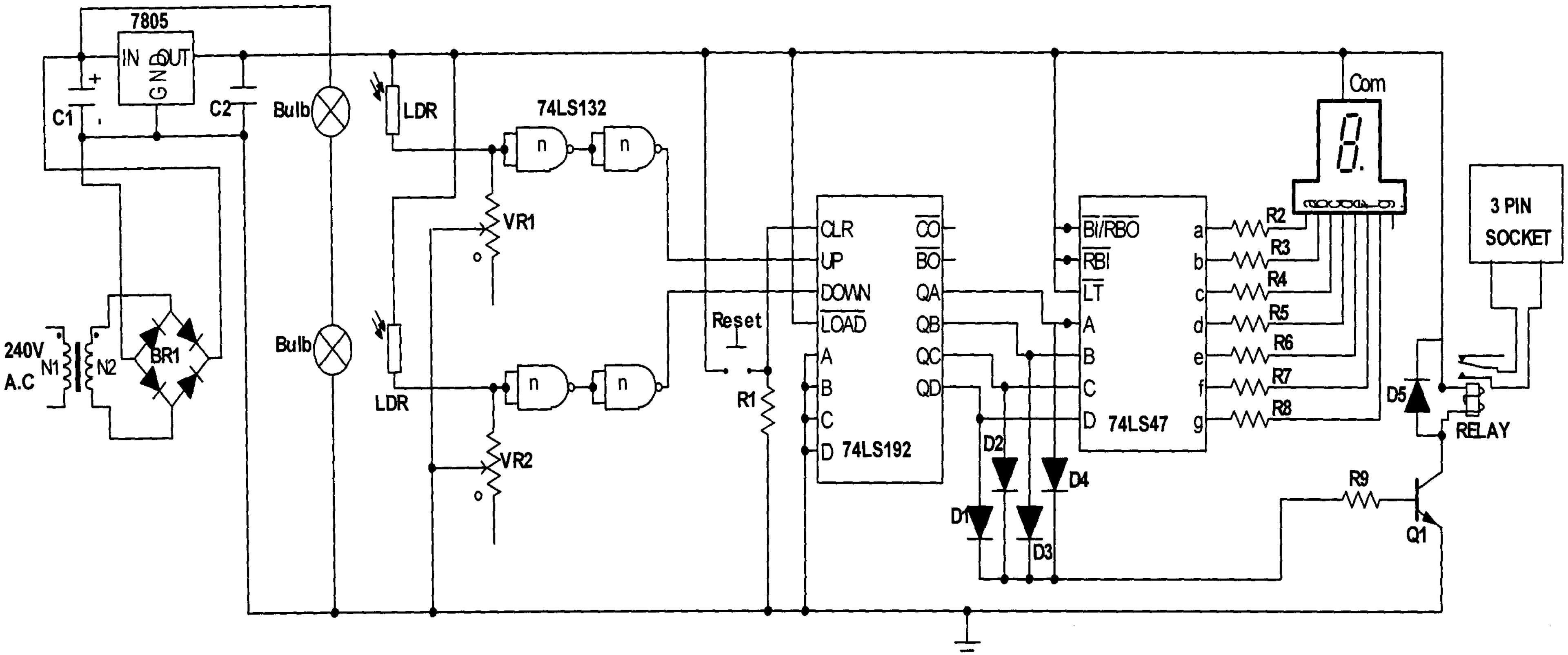
After the building of the project on the bread board, the project did not work. Trouble shooting of components was done using multimeter although all the components were functioning, the project still didn't work. But since on simulation it worked, it was assumed that the connectors were not making proper contacts, hence the vero-board connection continued.

3.18. Construction Steps

- The circuit was first implemented on a breadboard and few adjustments made before final transfer onto vero-board.
- The position of the components on the vero-board was made in such a way that unnecessary distance between components were eliminated to reduce length of connecting wires used and also to reduce overall circuit size after design.
- Components like resistors, diode, transistor, seven segment display were soldered directly onto he vero-board, while appropriate IC sockets were soldered on the board before the TTL ICs were inserted on them
- A digital multimeter was used to check voltages at each section including the output. The contacts of the components were equally checked for continuity and short-circuiting where necessary

3.23. Precautions Taken

- Components were chosen to obtain high functionality and be as economical as possible
- The use of little but enough solder was ensured for proper contact of every joint
- Testing for continuity and short circuiting were done using digital multimeter, this is to ensure proper working of the constructed circuit


7805
IN
OUT
GND
C1
C2
Bulb
Bulb
LDR
LDR
74LS132
VR1
VR2
Reset
R1
CLR
UP
DOWN
LOAD
CO
BO
QA
QB
QC
QD
74LS192
BI/RBO
RBI
LT
74LS47
R2
R3
R4
R5
R6
R7
R8
R9
Com
3 PIN
SOCKET
D1
D2
D3
D4
D5
RELAY
Q1
240V
A.C
N1
N2
BR1

TX = 2000mA, 240 volts to 12 volts step down transformer

BR1 = Bridge rectifier IC

C1= 2200μF   C2= 0.1μF

Bulb= 6 volts tungsten filament bulb

VR1 = VR2 = 33kΩ

R1=200Ω R2 to R8 = 330Ω   R8=2.2k Ω

D1 to D5 =1N4148

7805 = 5 volts 3 pin regulator

74LS132 = Quad-four Schmitt trigger NAND gate IC

74LS192 = Up / down Synchronous 4 bit decade counter

74LS47 = BCD to seven segment decoder / driver

Com = Common anode seven segment display

RELAY = 6 volt 10amps D.C relay

Q1 = 2N3904 BJT NPN transistor.

Chapter Four

Test, Result and Discussion

4.1 Test and Results

During the construction of this project all the components were first tested to confirm their values before they were use for construction though the first testing of the constructed project was done on the bread board, the real testing was done after the real construction work has been carried out on the Vero board. The circuit gave interesting and desired result.

The output of the project was found to switch on the load board (bulb) on first interruption of light on the LDR and keep progressive count up or down depending on which of the light source was interrupted.

Immediately the count on the display is zero (0), the relay is triggered and the bulb is put off. At this point it is assume that the automatic power switch and the hall population dictator senses nobody in the hall again.

Thus when the counter count up to nine (9) and the tenth (10^{th}) interruption occurs, it does not sense the interruption since it can only count from zero to nine (0-9).

The reset button is used to reset the counter to zero at will. The display returns to zero and the bulb is put off automatically irrespective of whether people are still in the hall or not. The essence of the reset button is actually to restart the count or interrupt the count at any time as may be desired.

One major limitation during testing was distance limitation. If the light source is placed far from the LDR it does not give a good focus on the LDR. To increase the distance at which the bulb should be placed, a bulb or light source of higher voltage was used.

	Bulb Response	
Action	**Circuit Result**	**Expected Result**
Count at 0	BULB OFF	BULB OFF
Count at 1	Switches on	Switch on
Count increases (2,3..9)	Bulb on	Bulb on
Reset	Switches on	Switch off

Table 4.0 results obtained

4.2 Discussion of Results

The result of the project work compared favorably with the expected result. This could be as a result of choices made in regard to the difficult components used especially the choice of the bulb (water bulb).

Proper alignment of the light source on the LDR is also majorly responsible for the circuit operation as a whole.

4.3. Circuit Casing

A wooden casing was used to house the circuit. Originality was taken into Consideration before the casing was chosen. Various factors which were considered before the choice of the dimensions of the casing include:-

- space occupied by components
- portability of the project
- Allowance for heat dissipation.

The casing is also perforated on one side to give room for ventilation from the transformer and other components.

The casings are in a four small segment because of the nature of the project.

Schematic diagrams of the projects are shown below.

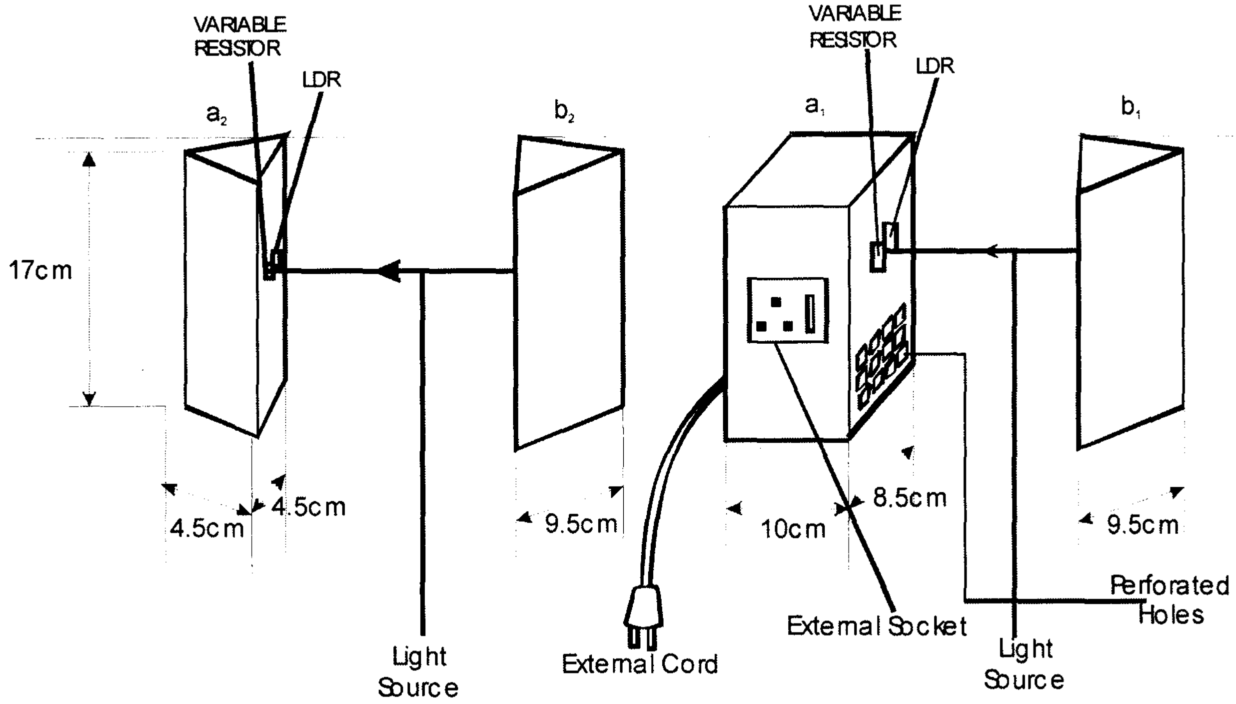


Fig. 4.0. Casing Setup

Chapter Five

Conclusion and Recommendations

5.1 Conclusion

The automatic power switch and hall dictator have been successfully designed. Results obtained compared favorably well with the expected results. The practical results were in conformity with all the theorem, hypothesis and theoretical design procedures applied within limits of research design and construction errors.

During the course of this research work more knowledge about regulators, TTL, ICS, relays and other components used and their application were acquired. The total cost of constructing this project was minimal and quite reasonable bearing in mind that subsequent production in large quantity will further drop the cost.

Before the completion of this project work, certain problems were encountered and they include:

- cost of materials in Minna were quite very high compared to cities like Lagos and Kaduna
- Challenge of focusing the light source properly on the LDR was tasking. A good focus is necessary to make the LDR very sensible to obstruction from an external source.

These projects can find its application in the auditorium, stadium, library, banks and a few to mention.

5.2 Recommendations

Having completed the project, the following are here by recommended for the project improvement.

- An infra-red light source should be used to increase the distance of the light source from the LDR. This will give a better commensurate distance with respect to a door and also give a better focus on the LDR.
- Bigger relay should be used to be able to trip higher volts appliance or light source.
- The number of counts should be increased to at least four digits to give a good representation of a hall.

References

[1] B. L. Theraja, and A.K Theraja, A Textbook of Electrical Technology, S. Chand & Company Ltd, Ram Nagar, New Delhi-110055, 2000, pp 919 – 930, 1700 – 1710

[2] P. Horowitz and W. Hill, The art of electronics, Second Edition, Reprint 2004, Cambridge University Press pp 42 – 43, pp 344 – 345, pp 484 – 488

[3]. M. D. Abdullahi, Lecture Material on Analogue Electronics I (ECE 314) 2003/2004 Session, pp 16 – 19.

[4] M. D. Abdullahi, Lecture Material on Physical Electronics (ECE 328), 2003/2004 Session, pp 47 – 49.

[5] http://www.Seg.co.Uk/telecomm/automatic 1. htm

[6] http://www.kpec.freeuk.com/components/74Series.htm

[7] T. L. Floyd, Digital Fundamentals, 6th Edition, Prentice-Hall, Inc, 1997. pp 197 – 199.

[8] C.A.Schuler, Electronics Principles and Application, 5th Edition, Glencoe/McGraw-Hill, 1999, pp 30 – 39.

[9] L. Warnes, Electronics and Electrical Principles and Practice, Glencoe/McGraw-Hill, 1994, pp 385 – 389.

[10] Y. A. Adediran, Applied Electricity, Finom Associates, Minna Nigeria, pp 128 – 132.

[11] P. E. Gray and C. L. Searle, Electronic Principles Physics, Models and Circuits, John Wiley & Sons, Inc. 1969, pp 97 – 99, pp 113 – 118.

[12] M. S. Ahmed, Industrial Electronics Lecture note (ECE 529), 2005/2006 Session

[13] A. Chuniktin and M. Zhavoronkov, High Voltage Switch gear Analysis and design, Mir Publishers, 1989, pp 40 – 41.

[14] C. R. Manson, Art and Science of Protective Relaying pp 30 – 32, 1999.

[15] R. L. Boyles and L. Nashelsky, Electrical Devices and Circuit theory, prentice – Hall of India private Limited, 2004, pp 41 – 42

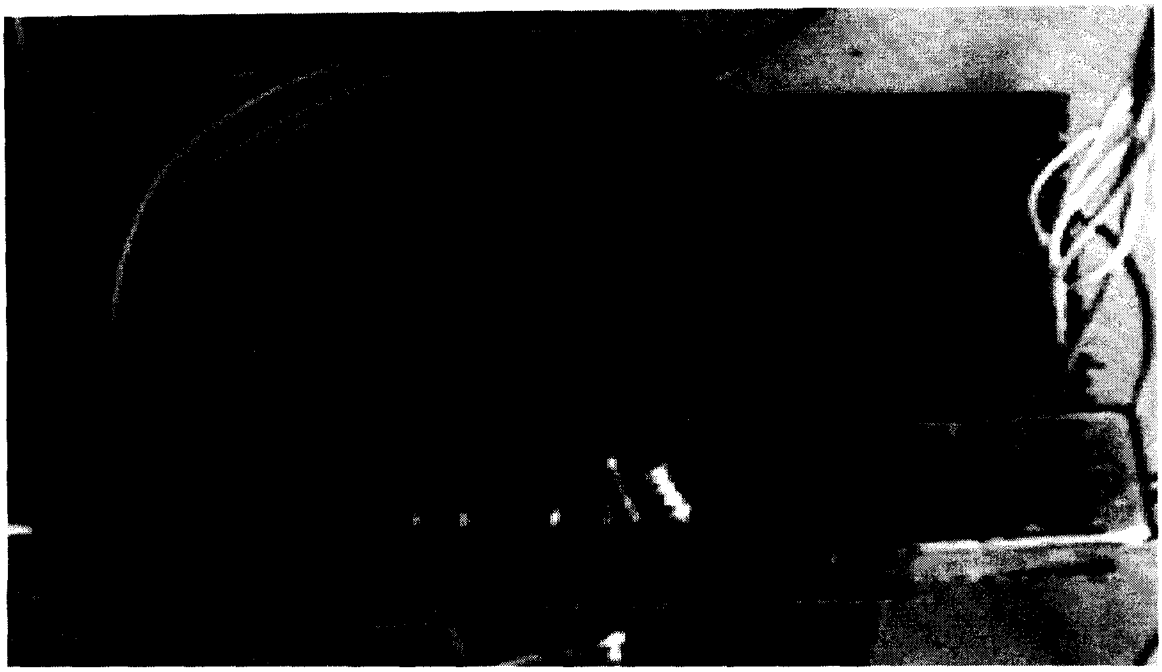
[16] http://www.datasheetcatalog.com/datasheets-pdf/1/N/4/1/1N4148.shtml

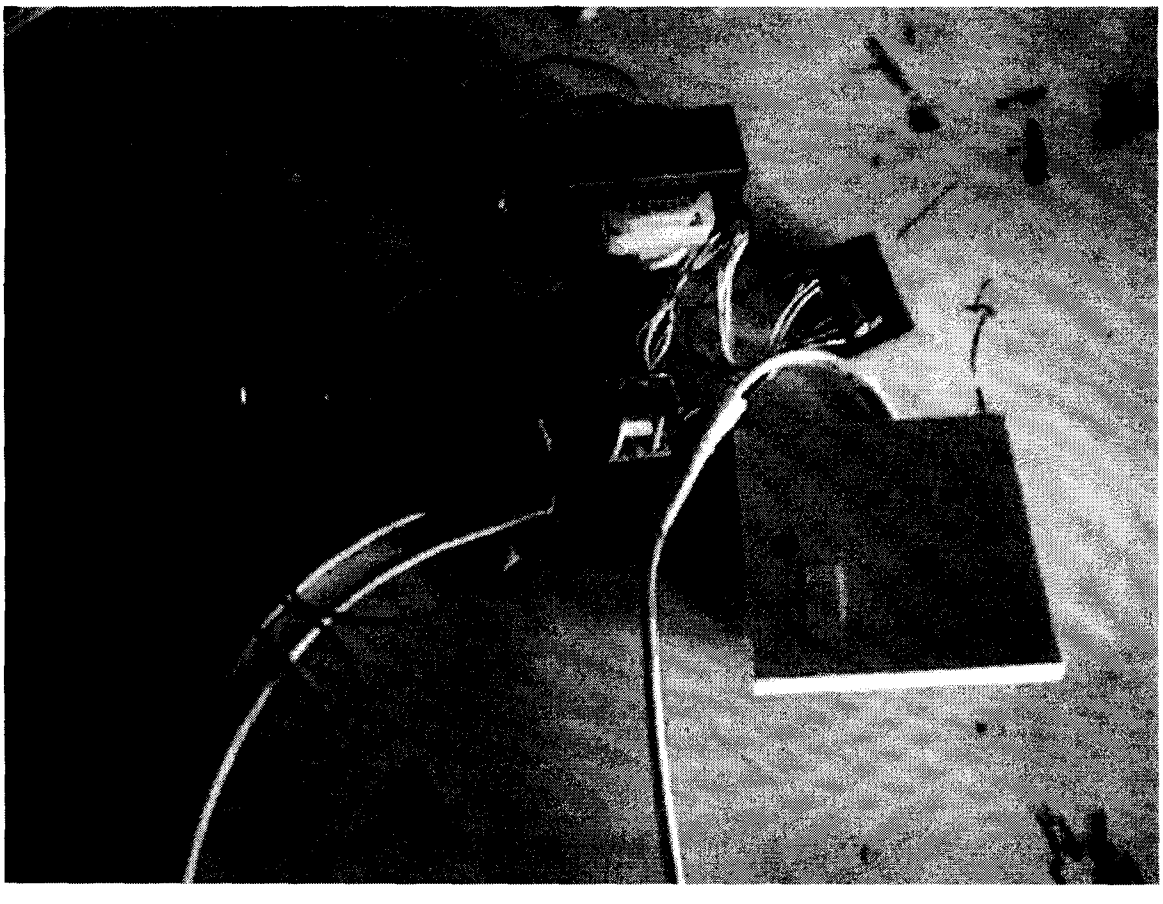
[17] http://www.onsemi.com/pub/collateral/2N3903-D.pdf# Search = %222N3904%22

[18] C. A. Wiatrowski and C. H. House, Logic Circuits and Microcomputer systems, McGraw-Hill book company, 1988, pp 97 – 99 and pp 113 – 118.

[19] J. J. Hatch, Electronics for Technicians-Troubleshooting and Applications –BJTs, FETS & MOSFETS, Glencoe New York pp 55 – 56

[20] G. R. JONES, M. A. Laughton and M. C. Say, Electrical Engineer's Reference Book, Fifteenth Edition, George Newnes Ltd, Britain, 1998, pp 41/8 – 41/12





Appendix 1.0: Internal Circuitry of Project