DESIGN AND CONSTRUCTION OF AN ELECTRONIC SECURITY MONITORING SYSTEM.

BY

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DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

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SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA

NIGER STATE, NIGERIA.

A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE EQUIRMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER 2004

DECLARATION

mah Okporie do hereby declare that this project was wholly presented by me, under the ervision of **Dr. Y.A. Adediran** This project was presented to the Department of Electrical Computer Engineering, during the 2003/2004 Academic session.

________________ 19-11-2004

Sign **Date**

AMAH OKPORIE (98/6880EE)

CERTIFICATION

is to certify that this project work was carried out by **AMAH OKPORIE, Reg. No: 880EE**, in the Department of Electrical and Computer Engineering, Federal University of hnology Minna under the supervision of **DR. Y. A. ADEDIRAN** The project has been pared in accordance with the specifications governing the award of a **B.ENG Degree in ctrical and Computer Engineering** by the Federal University of Technology, Minna.

______________________ 19/11/2004

Date

. Y.A. ADEDIRAN
(Supervisor)

______________________ 7/02/2005

Date

IGR. M.D. ABDULAHI
(Head of Department)

______________________ ______________

Date

xternal Examiner)

DEDICATION

This project is dedicated to God Almighty who has shown me love even in my wrongs.

AKNOWLEDGEMENT

I give thanks to the Almighty God for seeing me through the period of my first-degree program.

I am grateful to the lecturers of Electrical/Computer Engineering Department for the knowledge they have imparted into me in spite of the prevailing difficult circumstances. I am particularly grateful to Dr. Y. A. Adediran my project supervisor for his time and suggestions that made this project what it is today.

My sincere gratitude goes to Elder (Chief) & Mrs. I. U. Kama (who indeed have been parents to me) for their love and support and for insuring that I had a fulfilling period of training.

I wish to appreciate my brothers and sisters Austine, Nnanna, Agwu, IUK, Chinedu, Ugo, Ifeanyi, Chioma and Uchechi, for their love and care.

Finally, I thank Agu, Khalil, Afolabi, Seyi, Wange, Obi, Ayo, Olanma, Emily, Uche, Jalil, and all my friends for their love and support.

ABSTRACT

This project aims at developing an electronic security monitoring system for monitoring eight points (doors).

This security monitoring system consists of six units; these are the power supply unit, the clock unit, the counter unit, the multiplexer unit, the demultiplexer unit and the display unit. These units are designed using ICs such as 555 timer, counter (74293), multiplexer (74LS138), demultiplexer (74LS151) and light emitting diodes. A careful combination of all these units forms the electronic security monitoring system.

The aim of this project, which is to see that eight points or doors can be monitored instantaneously, was achieved at the end of this project.

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CHAPTER 1

1.0 INTRODUCTION

A quick warning of attack is much better than not knowing that an attack is taking place. This project is being undertaken at a time when governments, industries and of course the ordinary household need to pay more attention to security more than ever before because crime in its entirety is virtually out of control.

It is no longer an issue of argument that the advance in commerce and industry creates an ever-increasing risk to be combated, hence the need for technologically advanced security measures. This can only be achieved when all those concerned are directly involved in it and become well acquainted with the unparalled contributions of electronic security systems.

Wide variety of electronic security aids exist, examples are the burglary alarm system and the shadow activated alarm system. In this project however, I am considering an electronic security monitoring system, which uses light emitting diodes. Signals are run from each point (door) to an LED on the monitoring panel. The use of a multiplexer and a demultiplexer reduces the amount of wiring on the system. The overall aim of this security monitoring system is to enhance and facilitate security within its area of coverage.

Governments, industries, banks, telecommunication exchange, power control centers and indeed the ordinary household will find this security aid very useful especially now that crime is at its peak.

1.1 LITERATURE REVIEW

Electronic security systems have undergone tremendous improvements over the years with advancement in electrical/electronic innovations. Security measures took different forms in the early days. Man had to choose hideouts in caves and go through the strain of building mighty walls of stones round a village or home – just to ensure security of lives and properties. But today, electronic systems made up of electrical/electronic components and various integrated circuits (ICs) have taken over and the results are as never imagined by the early man.

The Adams Memorial Museum in Deadwood, south of Dakota in the USA, took advantage of this ever-improving world of electronics and was able to secure the lives of its staff and curtail thefts, which it suffered for about 66years.

Electronic security monitoring systems starts with a control panel usually located in a basement or closet. The control panel contains the brains of the security system and essentially operates as a central computer. Various sensors or hard wire connect to the control panel from locations throughout its area of coverage.

Electronic security systems are more important now than ever before. For homeowners and corporate offices alike, protecting assets and ensuring privacy have become of paramount importance. Whichever angle one chooses to look at it from, electronic security systems are always worth more than their initial expenses.

1.2 MOTIVATION

Over the years man has improved in all facets of life. This has resulted in better living standards and acquisition of more expensive properties – thus making life more costly as the years go by. There is therefore the need to secure these lives and properties to avoid loosing them as soon as they are acquired.

It is logical that as security measures continue to improve, the burglar also improves in his techniques of pilfering. There is therefore the need for security measures that can be at least one step ahead of the burglar.

Burglary alarms, fire alarms, intruder detectors and surveillance cameras are all electronic devices that have in no small measure contributed to the security of lives and properties, hence the motivation to choose the electronic security monitoring system for this project. Below is the block diagram of the electronic security monitoring system.

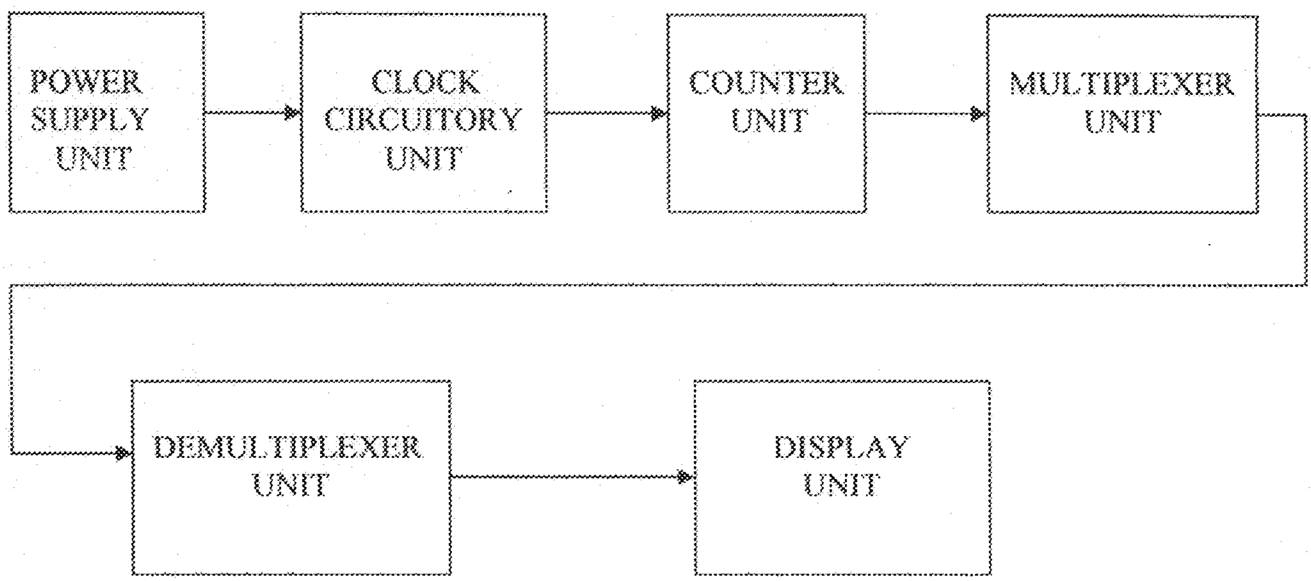


Fig. 1.1 Block diagram of the electronic security monitoring system.

1.3 OBJECTIVES

1. To design and build a simple low cost, low power device to ensure security of lives and properties.

2. To design and construct a device that can monitor 8 points of entrance/exit from a point of choice.

3. To ease the trauma of insecurity of homeowners and corporate offices.

1.4 PROJECT LAYOUT

CHAPTER ONE: This chapter introduces the project and reviews related developments and brief history related to security monitoring systems.

CHAPTER TWO: This chapter discusses the design principle that combines the various subunits that make up the security monitoring system.

CHAPTER THREE: This chapter discusses the procedure and construction of the device.

CHAPTER FOUR: This chapter deals with the testing of the device, discussion of results, cost, recommendations and conclusions drawn from this project.

CHAPTER 2

2.0 DESIGN PRINCIPLE

In this chapter, we will be looking at the design principle that combines all the individual components to achieve the desired aim of security monitoring.

This design principle will be considered under six major units that make up the security monitoring system. These units are the power supply unit, the clock circuit unit, the counter unit, the multiplexer unit, the demultiplexer unit and the display unit.

2.1 THE POWER SUPPLY UNIT

Power supply is a basic necessity in any electrical or electronic design. Not only is the power supply needed, it is to be of the required magnitude to effectively operate the system in question. The power supply must also be stable. The power supply unit comprises a step down transformer, a rectifier, a filter capacitor and a regulator. The values of these components have to be worked out.

To get the component values required for this project, we would start from the output where we require a constant $5V_{DC}$ supply to operate the security monitoring system. To obtain $5V_{DC}$, a 5V regulator (7805) is required. The values of the rectifier, the filter capacitor and the transformer are calculated as shown in the design formulae below:

Regulator output = $5V_{DC}$

$V_{DC} = 9V = 0.63V_{max}$ (for a 7805 voltage regulator)

$V_{max} = 9/0.636$

= 14.15V

$V_{rms} = 0.707V_{max}$

$= 0.707 \times 14.15 = 10V$

But there is no 220/10V rated transformer. The obtainable standard rating is 220/12V. We therefore standardize the transformer to the latter.

The diodes required for rectification,

Diode PIV = V_{max} (for bridge rectifier). PIV is 50V so we require 50V (PIV) diodes.

The rectified output waveform is purely smooth as may be obtained from a DC battery. To achieve that, a filter capacitor is used to smooth the output waveform from the rectifier as shown in figure 2.1 (a) and (b) below.

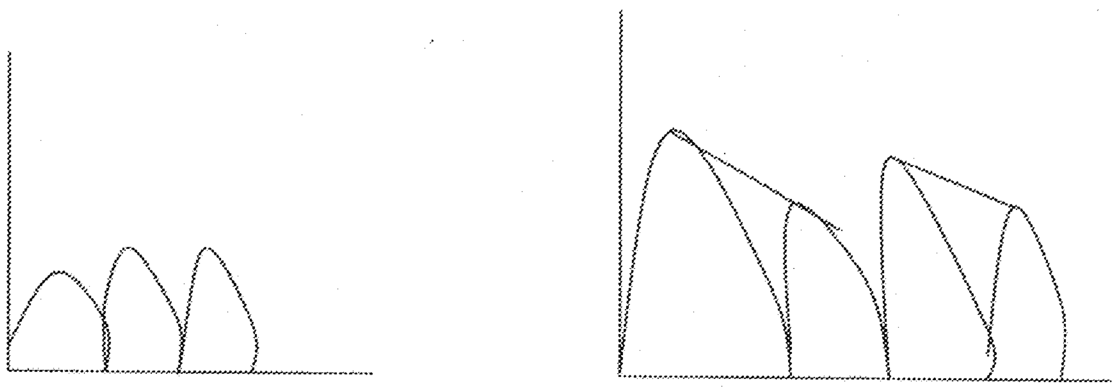


Fig.2.1 (a) output waveform without filter (b) output waveform with filter

So for the power supply unit, we need the following components and values as calculated in section 2.1:

- 220/12V transformer
- Diodes (for bridge rectifier) 50V (PIV)
- $5V_{DC}$ regulator
- 100uF filter capacitor

Figure 2.2 below shows how these components are combined to build the power supply unit.

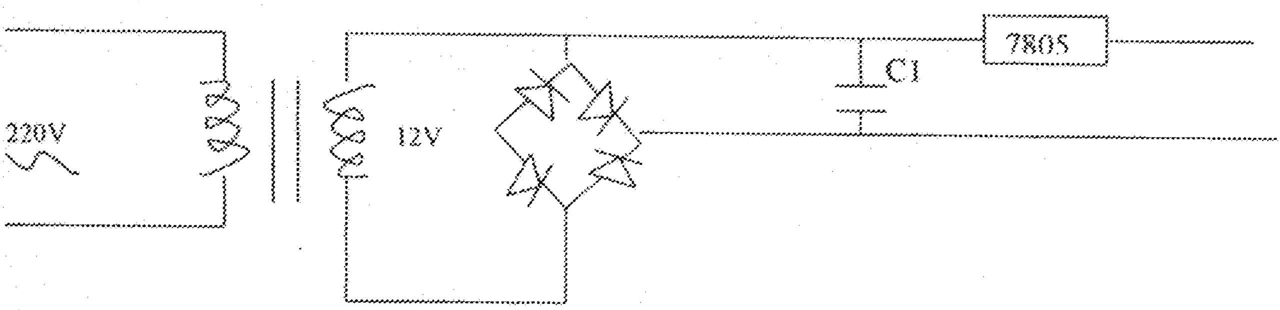


Fig 2.2 the power supply unit.

2.2 THE CLOCK CIRCUIT UNIT

The clock circuit unit is required to generate pulses at regular intervals and frequency to operate the counter unit. The clock unit consists of the 555 timer, a resistor and a capacitor. Appropriate value combination of the resistor and capacitor determines the ON and OFF time of the clock pulses. To calculate the ON time and OFF time we use the formula below.

For time ON (T_{ON})

$T_{ON} = 0.693\ (R_A + R_B)C = 0.29sec.$

For time OFF (T_{OFF})

$T_{OFF} = 0.693(R_B)C = 0.14$sec.

Total time for a complete cycle (period)

$T = T_{ON} + T_{OFF} = 0.29 + 0.14 = 0.43$ cycles per second

Frequency, $F = 1/T = 2.33$Hz.

Where C = capacitance

R_A = resistance of resistor A and

R_B = resistance of resistor B

To calculate the value of C, R_A and R_B from the above formula, T_{OFF} is first chosen, then the value of a capacitor is chosen, from there the value of R_B is known. The next step is to choose the T_{ON} and the value of C and R_B is substituted in the formula and then the value of R_A is calculated.

For this project, the T_{OFF} is 0.14seconds and C is 100uFso that the value of R_B is calculated from:

$T_{OFF} = 0.693(R_B)C = 0.14$secs.

$R_B = 0.14/0.693 \times 100uF = 2.02K$

$T_{ON} = 0.693(R_A + R_B)C = 0.29$secs.

$R_A = 4.18 - 2 = 2.2K$

$C = 100uF$, $R_A = 2.2K$, $R_B = 2.0K$

These are now connected as shown in fig.2.3 to give the clock circuit

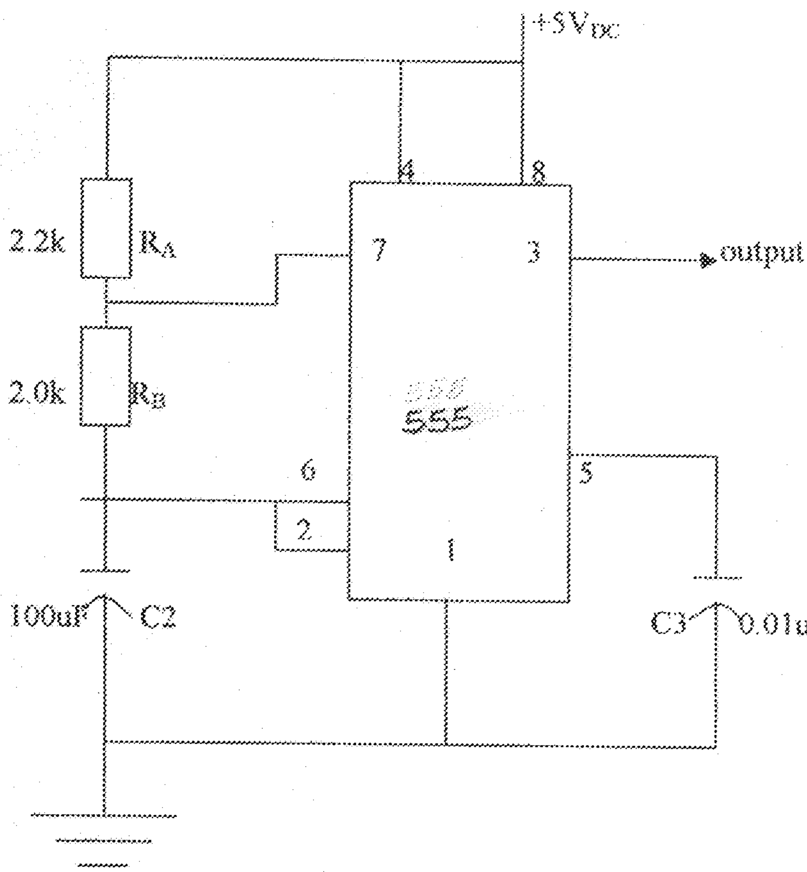


Fig.2.3 clock circuit diagram.

2.3 THE COUNTER UNIT

The counting of the number of clock pulses coming from the clock circuit and the output in binary coded decimal mode (BCD) is done by the counter unit. The counter counts from 0, the first clock pulse to a predetermined number (7 in this case) and then restarts the cycle (i.e. from 0).

A mode 8 counter is used for the purpose of this project. It counts from the first clock pulse input to the eighth point; then starts the cycle again as shown in the table below:

Table 2.4 truth table of a mode 8 counter

Decimal Clock Pulses	BCD output		
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1
8	0	0	0
9	0	0	1

The BCD output of the counter is used as the select input for both the multiplexer and the demultiplexer.

The logic circuit diagram shown in fig.3.4 is that of a 74LS293 IC counter which is used for this project.

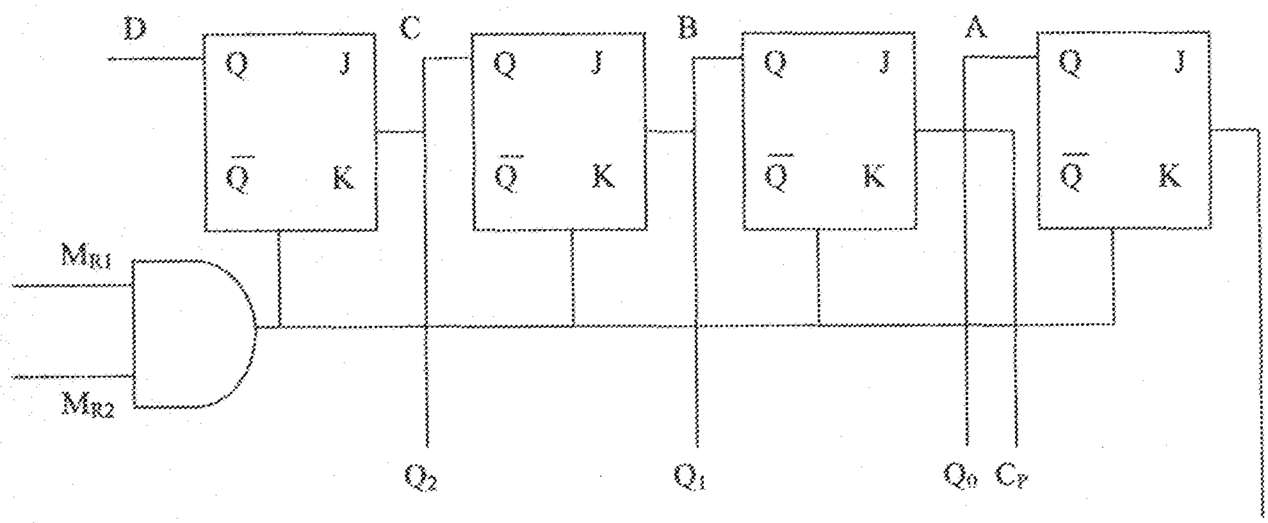


Fig.2.5 logic diagram of 74LS293 IC counter.

The 74LS293 IC is an asynchronous counter and it can be used as mode 8 or mode 16 counter. For this project it is used as a mode 8 counter, the pin configuration is shown below:

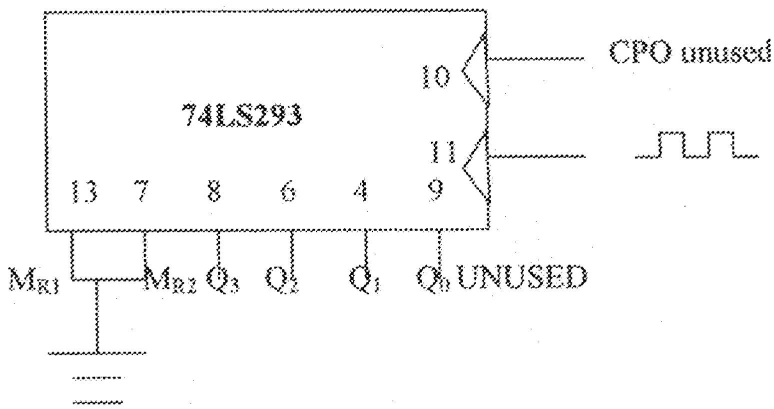


Fig.2.6 pin configuration of the 74LS293 counter.

2.4 THE MULTIPLEXER UNIT

The multiplexer has several inputs but only one of these inputs is routed to the output at a line. The input to be routed to the output is determined by the select input of the multiplexer. The multiplexer used here has eight inputs which corresponds to the eight points to be monitored. The select inputs are supplied by the BCD output of the counter. So as the counter counts from 0 to 8, it will cause the multiplexer to be routing the cognition of it's input in sequence with the counter position.

The block diagram, logic diagram and truth table for the multiplexer is as shown in fig. 2.7, 2.8, and table 2.9 respectively.

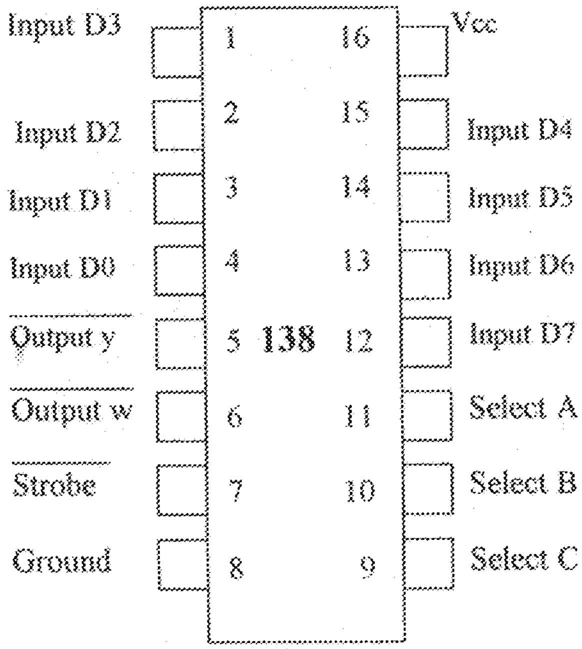


Fig.2.7 block diagram of an 8 input multiplexer

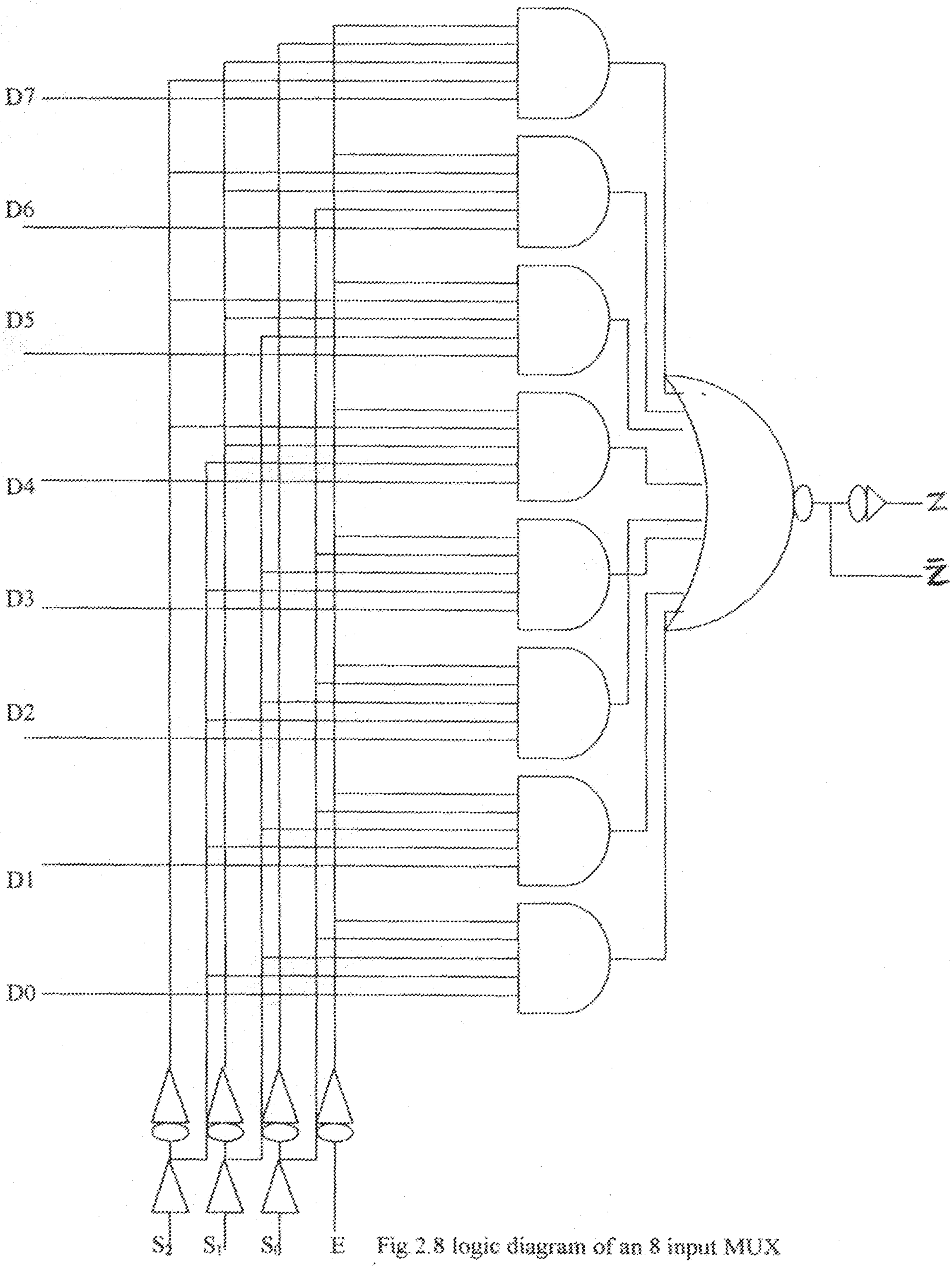


Fig 2.8 logic diagram of an 8 input MUX

Table 2.9 truth table for an 8 input multiplexer

INPUT				OUTPUT	
E	S_2	S_1	S_0	$\bar{Z}$	Z
H	X	X	X	H	L
L	L	L	L	I_0	D_0
L	L	L	H	I_1	D_1
L	L	H	L	I_2	D_2
L	L	H	H	I_3	D_3
L	H	L	L	I_4	D_4
L	H	L	H	I_5	D_5
L	H	H	L	I_6	D_6
L	H	H	H	I_7	D_7

The following definitions are worthy of note:

E = Enable input

D_0-D_7 = Signal input

Z = Non-inverting

$\bar{Z}$ = Inverting Output

2.5 THE DEMULTIPLEXER UNIT

The demultiplexer has only one input and eight outputs, which also corresponds to the eight points (door) to be monitored. This input is routed to one of these outputs at a time determined by the select input. This input is supplied from the output of the multiplexer and the select inputs are supplied by the counter output. That is to say that the same counter output is supplied to both the multiplexer and the demultiplexer select inputs. This is done to make sure that the number, which the multiplexer routed to the output, will synchronize with the number, which the demultiplexer is to output it's input.

The block diagram, logic diagram and table of truth for the demultiplexer is as shown below.

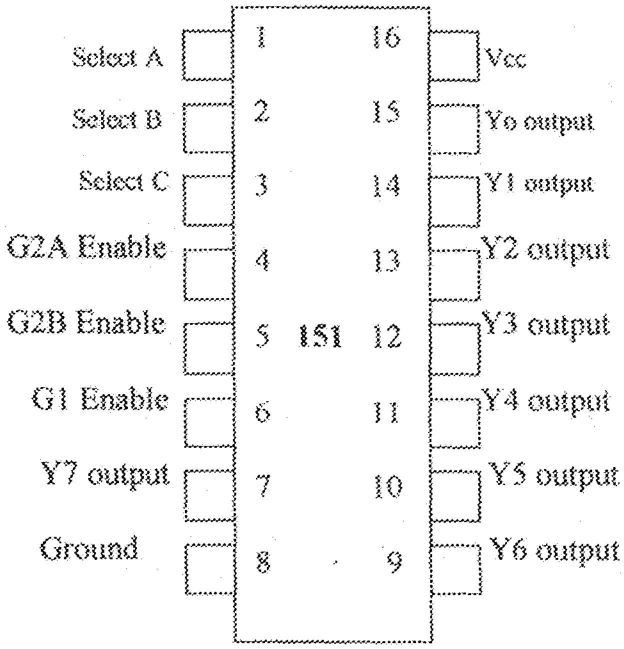


Fig.2.10 Block diagram of an 8-bit demultiplexer

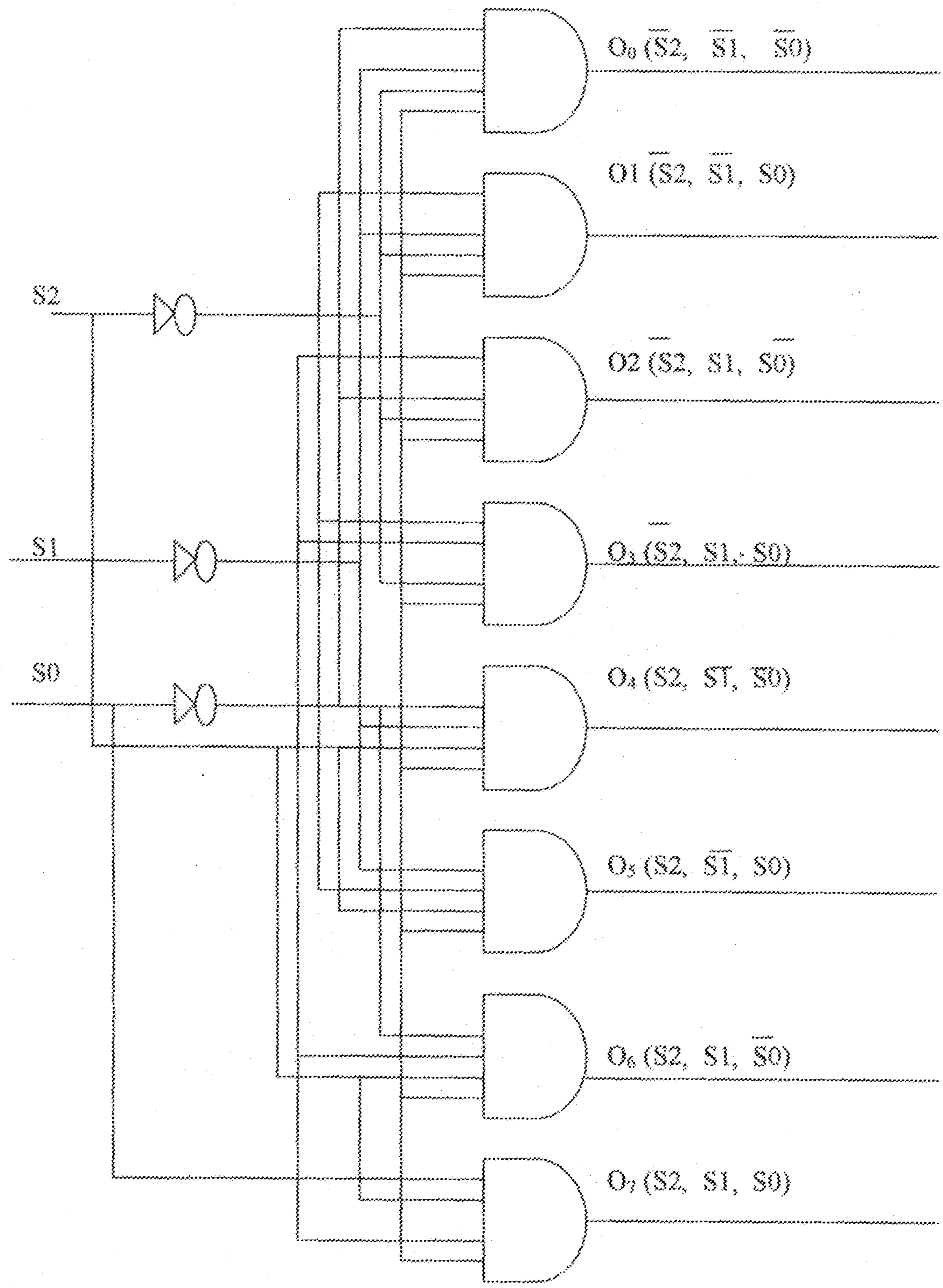


Fig.2.11 Logic diagram of an 8-bit demultiplexer

Table 2.12 Truth table for an 8-bit demultiplexer

SELECT CODE			OUTPUT							
			07 0	06	05	04	03	02	01	00
S_2	S_1	S_0								
0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	1	0	0	0	0	0	0	1	0	0
0	1	1	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0	0	0
1	0	1	0	0	1	0	0	0	0	0
1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0

2.6 THE DISPLAY UNIT

The display unit is where the actual thing that is happening in the system is interpreted. It is the display unit that indicates the status of each point (door) whether it is open or closed as communicated to it by the demultiplexer output.

The display unit is constructed with LEDs. There are eight pieces of this LED each denoting the door number from 1 to 8 respectively. The anodes of al the LEDs are connected to a common power source through a limiting resistor while their cathodes are connected to each of the eight outputs of the demultiplexer. Then it is arranged in that order, that is, LED connected to the first output of the demultiplexer will be number 1 while the LED connected to the last output of the demultiplexer will be number 8.

The red LED has been chosen because of its low power consumption. Also it tallies with the general notion that red colour denotes danger because when an intruder enters a place, he is a source of danger to the place. The arrangement of the display unit is as shown in figure 2.13

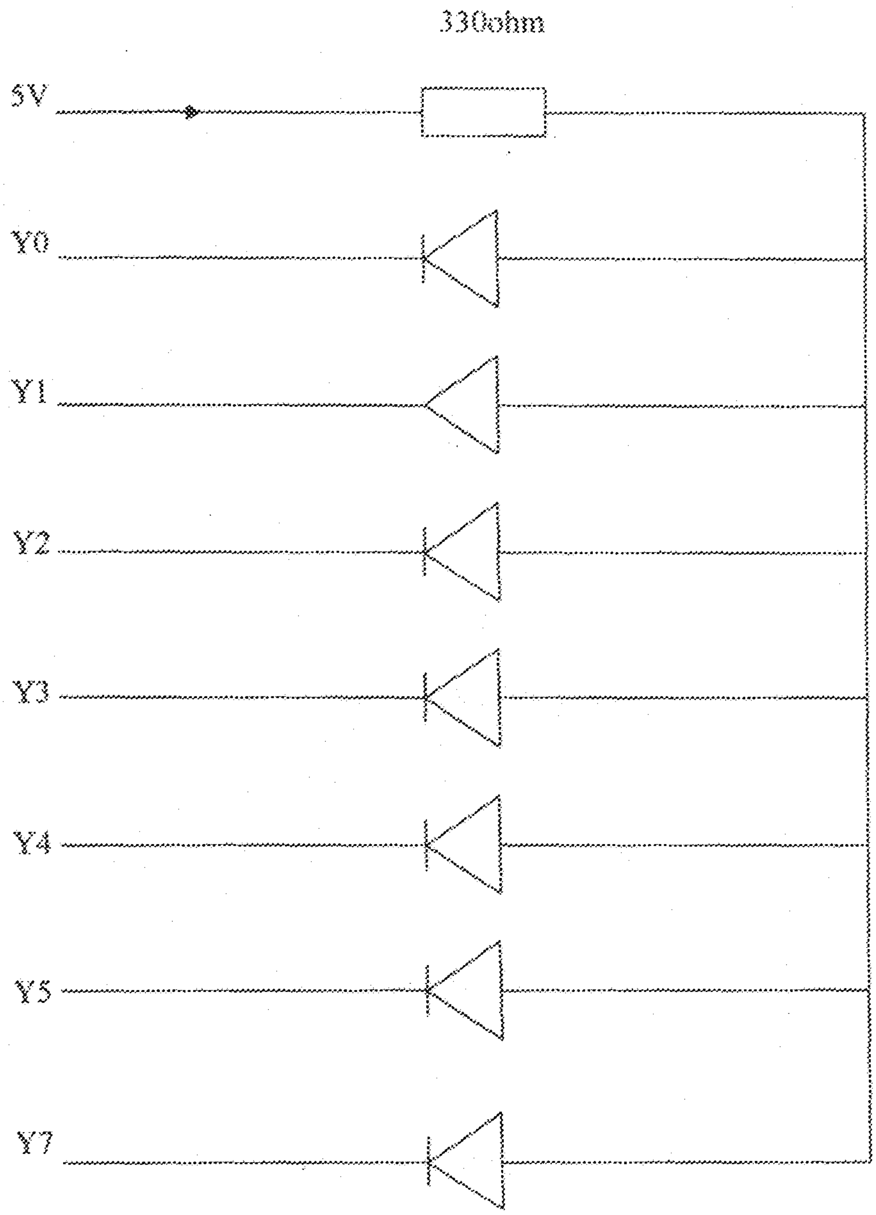


Fig.2.13 display unit arrangement.

CHAPTER 3

3.0 CONSTRUCTION

The principles of operation of the individual components used in this project and of course the design principle required to achieve the security monitoring system have been well discussed in the previous chapters of this work. Incorporating these designs and principles into each other to construct the security monitoring system is our target in this chapter. Here, the components used, tools used and the procedure for the construction will be treated.

3.1 PROCEDURE

The procedure in constructing this security monitoring system followed the discrete units that make up the system viz; the power supply unit, the clock unit, the counter unit, the multiplexer unit, the demultiplexer unit and the display unit, then the casing of the system.

The power supply unit comes first as shown in figure 4.1. After the construction, it was tested with a multimeter to confirm the expected voltage of $5V_{DC}$.

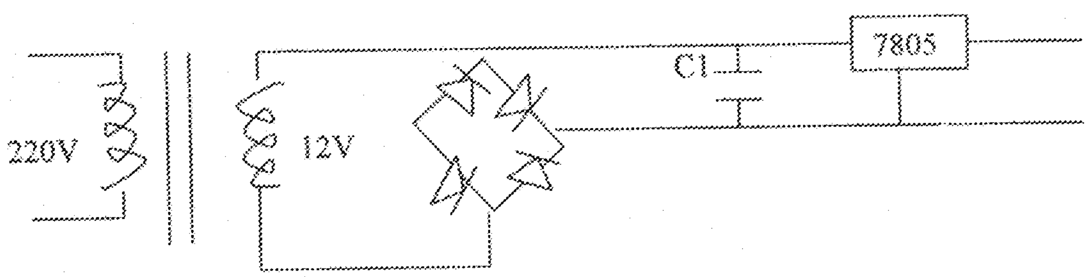


Fig.3.1 construction of the power supply unit

The next stage is the clock unit shown in figure 3.2

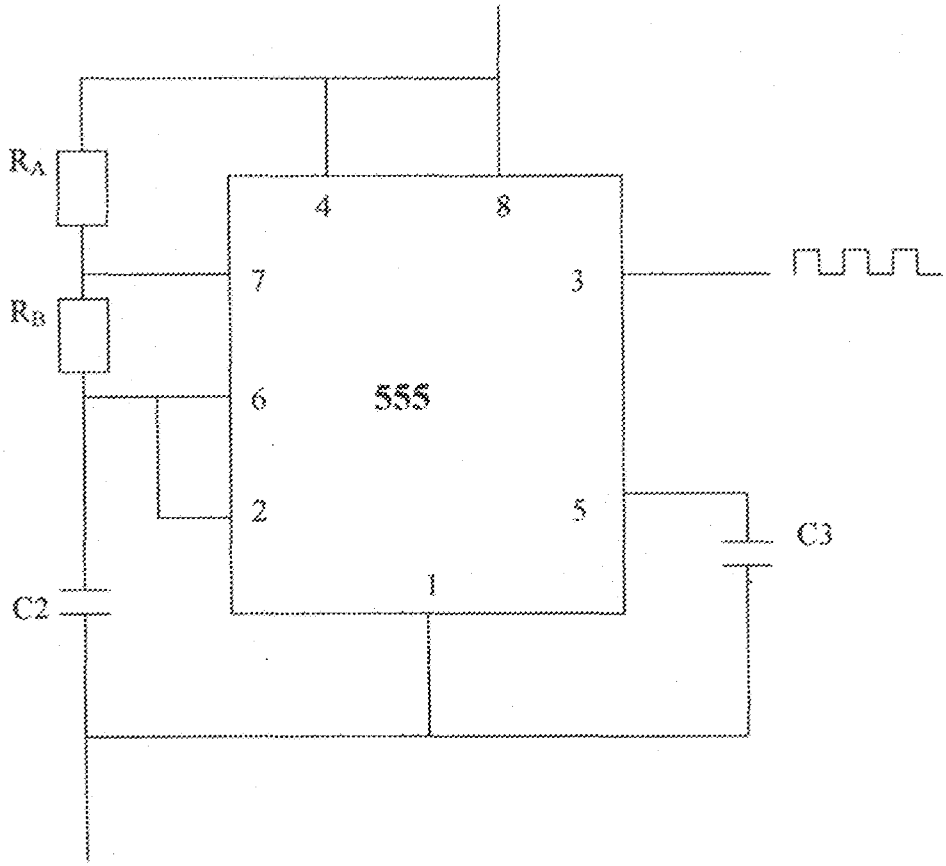


Fig.3.2 construction of the clock unit

When the circuit has been supplied with 5V, the output is monitored with oscilloscope to see the waveform of the clock pulses.

The next stage is the counter unit that is an IC. When the necessary connections have been made as shown in figure 3.3, the clock circuit output is used to serve as the Counter input

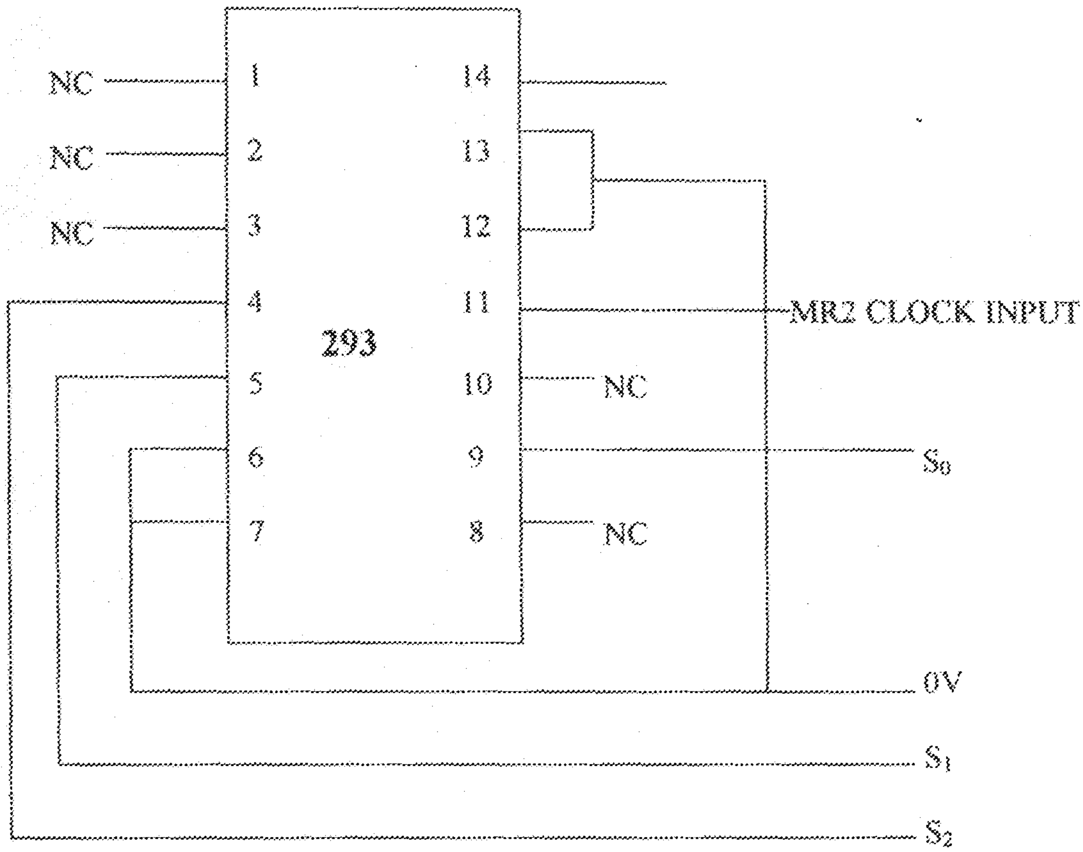


Fig.3.3 connection of the counter

A multimeter is used to test the three outputs of the counter $S_0 - S_2$. It is these three outputs that serve as the input for the multiplexer and demultiplexer.

The connection of the multiplexer is done as shown in figure 3.4

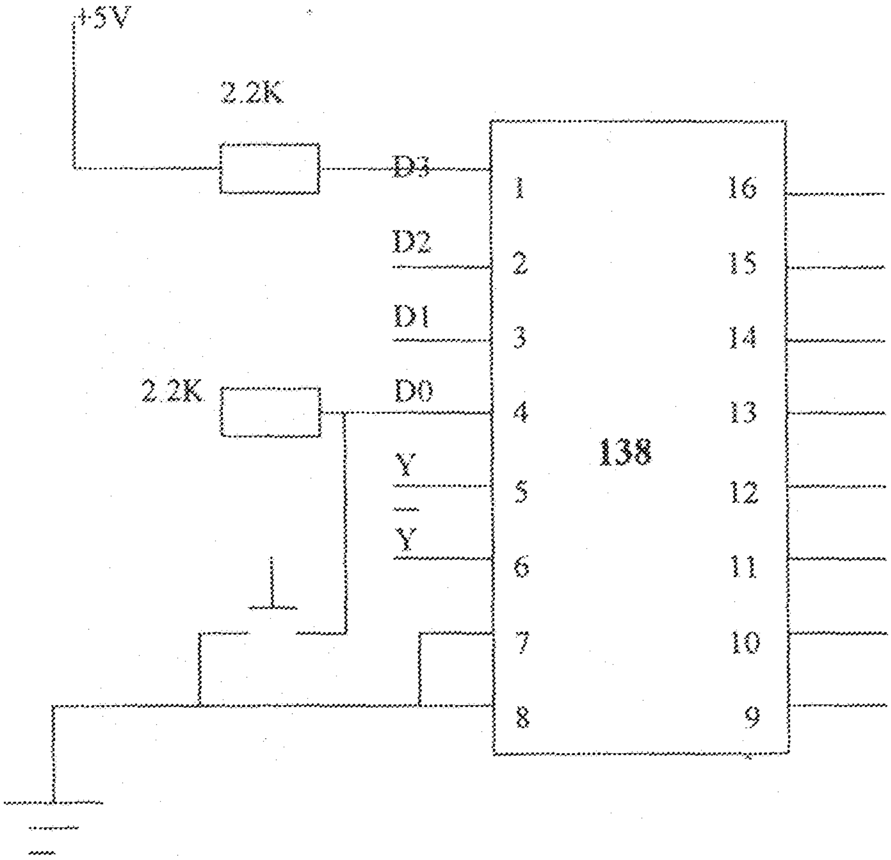


Fig.3.4 construction of the multiplexer unit

All the inputs, ($D_0 - D_7$) are connected as in D_0. The switches are hidden in each of the eight doors. When the door is closed, the power source is diverted to ground causing the multiplexer input to be low. But when the door is open, making that particular multiplexer input HIGH, pin 6 is the inverting output that serves as the input for signal or data for the multiplexer.

The demultiplexer unit is constructed as shown in figure 3.5

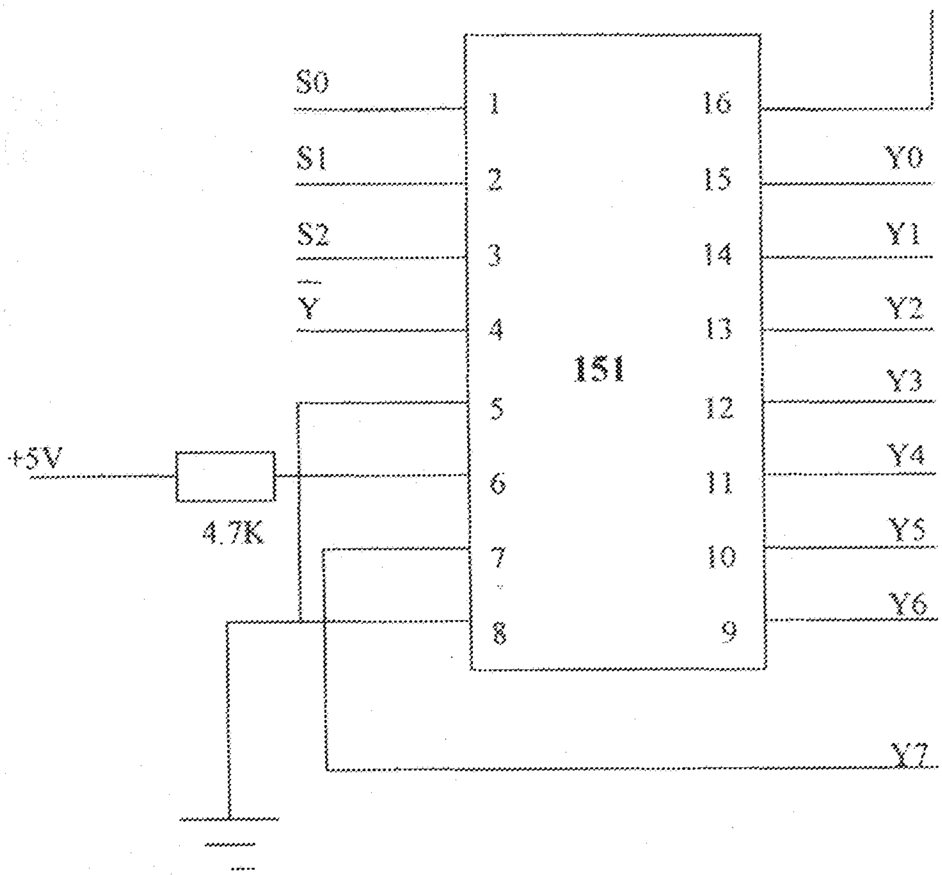


Fig.3.5 construction of the demultiplexer unit.

Following the demultiplexer unit is the construction of the display unit. It is as shown in figure 3.6

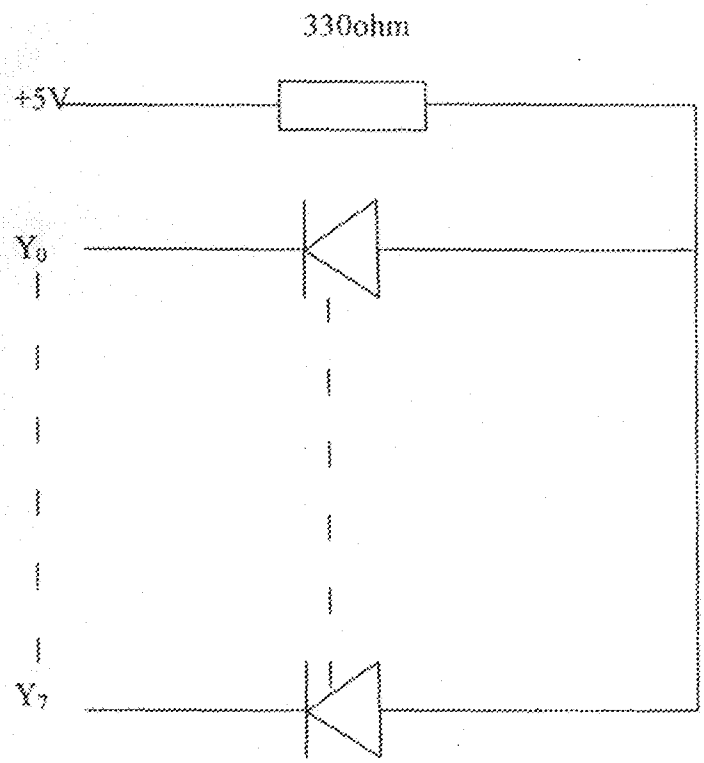


Fig.3.6 construction of the display unit

The anodes of the LEDs are connected to a common power source but their cathodes are connected to each of the outputs of the demultiplexer ($Y_0 - Y_7$). These units are connected together to form the complete security monitoring system as shown below:

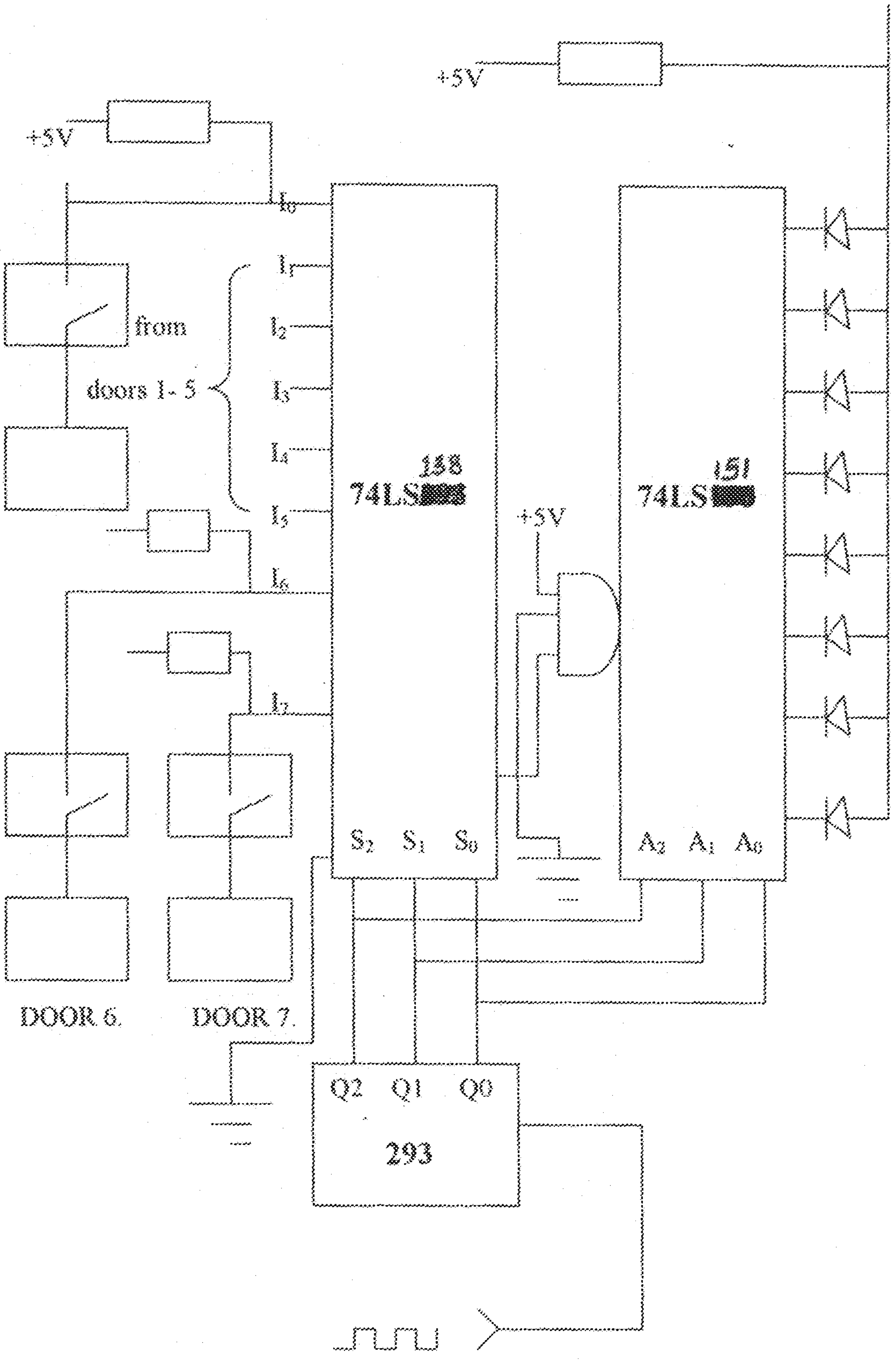
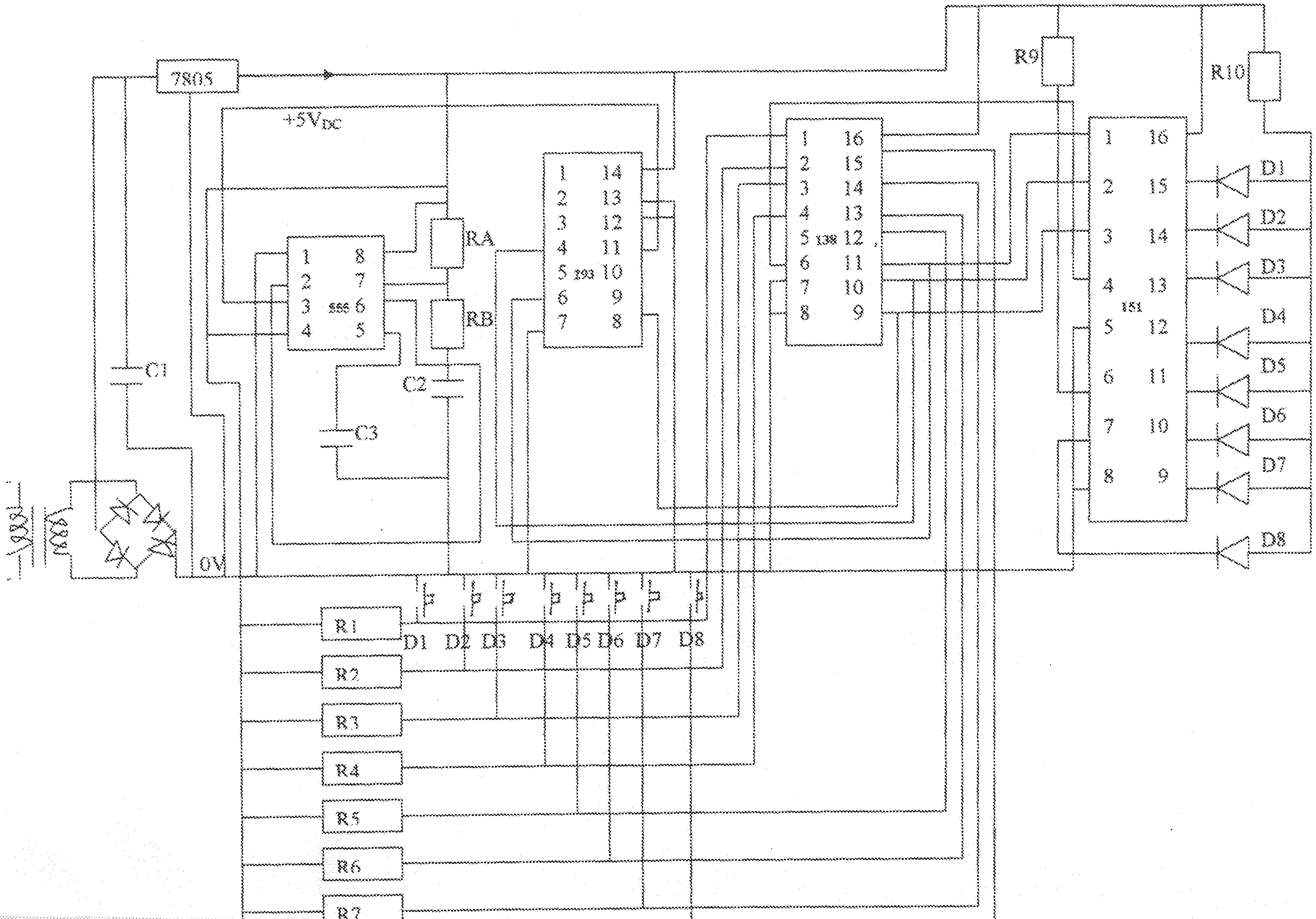


Fig.3.7 connection of the sub-units

The last stage is the casing of the system. It is enclosed in a wooden box. A cardboard paper is used to form the numerical figures 1 – 8. It is then used to cover the eight LEDs.


7805
+5VDC
0V
C1
C2
C3
RA
RB
555
293
138
151
R1
R2
R3
R4
R5
R6
R7
R9
R10
D1
D2
D3
D4
D5
D6
D7
D8

CHAPTER 4

4.0 TESTING

The IEE Regulations 13 – 20 states that "on completion of an installation, appropriate inspection and tests shall be made to verify so far as reasonably practicable that the fundamental requirements of safety have been met." This persuaded me to ensure that this device does not only work when installed but also safe for use especially in the household environment.

Besides the careful physical observations of the internal circuitory of this device, continuity of all the links were tested with a multimeter. The inputs and outputs were verified to be of the required limits before connecting the device to a power source.

For maintenance purposes, this device needs to be tested at regular intervals to ensure that it is working properly. Maintenance procedure for this device is simple, just as mentioned before; this system has 6 distinct units. So with a multimeter, the system is tested following these units. It is a matter of testing the input and output of each unit, which will definitely localize the fault to a unit. Then the components in that unit are tested one by one to identify the exact faulty one. The faulty component is then repaired or replaced as may be deemed fit.

It is worthy of note that before any maintenance work or testing can be done, the device must be unplugged from its source of power. This is to avoid electric shocks and prevent short-circuiting any parts, which may damage the internal circuitory of the device.

4.1 RESULTS

The design and construction of any system must incorporate some means of protection. This is to ensure that most of the components (if not all) are protected against unusual changes so as to prolong the operating life span of these components. Also there must be some measure of control to ensure that the system maintains its design target during its operation.

The 2.2K resistors that are placed between the 5VDC supply and the switch/inputs of the multiplexer provide the protections in this system. These resistors serve as load during the closing of the switch to avoid open circuit. The resistors also serve to limit the current that enters the outputs of the multiplexer. This was achieved at the end of this project. Another protection is the 330ohm resistor that limits the current that passes through the LEDs to prevent it from burning out. This was also achieved.

One control device is the voltage regulator IC that controls the power supply. It keeps the voltage supply to the components approximately constant. It also ensures effective synchronization between the multiplexer and the demultiplexer. This makes it possible for the multiplexer to be at the same count with the demultiplexer. This control measure was also achieved at the end of this project.

4.2 COSTING

This project is a relatively cheap one considering its usefulness. The components are readily available in the market, though the multiplexer and the demultiplexer are scarce.

However due to varying nature of market prices, it will not be possible to give an accurate estimate of the cost of this project. But a sum total of seven thousand and fifty five naira was spent to complete this project.

4.3 RECOMMENDATION

Due to increasing complexity of crime epidemic, which is at the moment getting, out of control, and because a well secured environment gives a relaxed mind and freedom. I recommend this project for use in government, commerce, industry, banks and households where security is of great importance. And because a quick warning of attack is better than not knowing that an attack is taking place, this project couldn't have come in a better time than now.

Also for future work on this project, I recommend that an alarm system be incorporated into this device to alert the security guard in case he falls asleep or looses concentration. However the alarm system should be just loud enough to wake a sleeping guard since one of the basic ideas in this project work is to alert only the guard or house owner without the awareness of the intruder.

4.4 CONCLUSION

The design and construction of this electronic security monitoring system was a success. The sub-units functioned as required. 5VDC was obtained from the power supply unit by means of rectification and regulation. This was supplied to the proceeding units and together with the protections in the system, ensured that no component was burnt as a result of over voltage.

The design target of monitoring 8 points from any area of choice was achieved at the end of this project.

REFERENCE:

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APPENDIX:

COMPONENTS USED

The components used in this project are as listed below:

- Step down transformer (220/12V)
- Diodes (LEDs (8), 50V PIV (4))
- Capacitors (C1=100uF 25V, C2=100uF 16V, C3=0.01uF 16V)
- Voltage regulator (IC 7805)
- Timer (IC 555)
- Resistors (RA, R1 - R8=2.2K, R9=4.7K, R10=330, RB=2.0K)
- Counter (IC 293)
- Multiplexer (IC 398)
- Demultiplexer (IC 151)
- Push buttons (8)
- Connecting cables
- Vero board
- Wood (for casing)

TOOLS USED

The tools used include:

- Pliers (long-nose)
- Cutter
- Digital multimeter
- Oscilloscope

- Soldering iron
- Lead sucker
- Tester
- Screw drivers