DESIGN AND CONSTRUCTION OF A DIGITAL CODED ACCESS SECURITY SYSTEM

BY

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PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN THE ELECTRICAL/COMPUTER DEPARTMENT OF THE FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA-NIGER STATE, NIGERIA

NOVEMBER, 2004.

DECLARATION

I hereby declare that this project (electronic door lock) was constructed by me under the supervision of Engr. J. KOLO; a lecturer in the department of electrical/computer engineering, Federal university of technology, MINNA.

8/12/2004

IBRAHIM KHADIJAH OZIOHU
Student's signature

Date

8/12/04

ENGR J. KOLO
Supervisor signature

Date

CERTIFICATION

This is to certify that this project DIGITAL CODED ACCESS SECURITY SYSTEM was designed and constructed by Ibrahim Khadijah Oziohu for the partial fulfillment of the award of Bachelor degree in electrical/computer engineering.

ENGR. J. KOLO
Project supervisor

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ENGR. M.D ABDULLAHI .
Head of Department

8/12/2004
Date

EXTERNAL EXAMINER

Date

IBRAHIM KHADIJAH OZIOHU
Student

Date

DEDICATION

This project is dedicated to my parent Mr. and Mrs. Isiaka Ibrahim who saw me through my course of study and especially through this project work.

ACKNOLEDGEMENT

My profound gratitude goes to Almighty Allah, who in His infinite mercies protected, guided, directed and inspired me during this masterpiece and through out my entire stay in the University.

Special thanks to my parents, Mr. & Mrs.Isiaka for their love and care.

My sincere appreciation goes to my project supervisor, ENGR.J. KOLO, for making the whole task a lot easier, the head of department ENGR. M. D Abdullahi, all lecturers and other staffs of Electrical & Computer Engineering Department.

Thanks to my brother and cousins, Abdulwahab, Suleiman, Ismaila, Saratu, Kate, Salamat and abdulkadir for their immense support and encouragement.

I will also like to place on record the valuable help and encouragement of Miss Jummai Muhammad, not forgetting Maimuna, Amina, Hawa salami Mohammed and Adetunji

Finally, to all my very special friends who have been supportive in a way or the other. Thank you and God bless you all (Amin).

ABSTRACT

The purpose of this project work is to design a coded access security system for electronic equipment and doors focused on housing privacy and security.

This was achieved by the use of digital integrated circuit and combination of discrete components.

The device mentioned above consists of seven fundamental units; power supply unit, which supplies direct voltage to the system, input unit, which converts the decimal code to binary code, the memory unit; which is where the binary code are stored, the password unit is where the password of the device of set, the comparator compares the set code in the password unit to the code memory unit. The control unit controls the alarm circuit while the output unit gives access to the electronic device or door.

A digital coded access security system is used to gain access to any system where it is used. It open or lock a particular system depending on the electronic logic (code) applied to the relay terminal as described here. To gain access to a system, the three digit stored by the multislide switch must be entered on the correct sequence by pressing the number of the rectangular diode matrix and entering it using the push button switch. if a wrong code is entered in to the circuit thrice it triggers an alarm to show that the wrong code has been enter and the system lock will not open.

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CHAPTER ONE

1.0.0 GENERAL INTRODUCTION

1.1.0 INTRODUCTION.

The need for security and privacy is very essential to an individual and an organization. As such this project is focus on the design and construction of a digital coded access security system for electronic equipment.

The digital coded access security system by definition is an electronic device in which a particular code is programmed on the device and any user will have to enter that code via a keypad to gain access to particular equipment. The equipment might be electronic in nature, a door/lock or any electromechanical device that suits the objective of the project.

The objective of this project work is to safe guide equipment and information on electronic devices such as personal computer e.t.c.

Now are days, we have computer and programmer hackers everywhere with this security device. It will be difficult for this programmer hacker to have access to your system except they have your password, they cannot power the system talk less of operating the system.

This project is a humble contribution to the development of digital electronic and digital control system, particularly in electronics engineering. It seeks to see how common integrated circuit components can be cascaded together to grant access to power in electronic devices.

The security system will act as an electronic interface via a relay to the power supply unit of the end-user equipment. It will be designed to operate on 5V DC while it uses a diode matrix keyboard as the keypad. The keyboard is used to select the code that goes directly to a group of parallel latches. The latches hold the various digital codes and send them to the digital comparator. The comparator will compare the codes with that of the programmed code from the multi-slide switch and gives an output, which will switch a secondary element (e.g. a relay or solenoid) that will control an electrical or electromechanical device as depicted in the generalized block diagram of the project.

1.2.0 AIM AND OBJECTIVES

The digital coded access security system plays a major role in the area of security and privacy. The following are the possible areas of it applications;

1. Safeguarding the use of power electronic appliances hereby minimizing power consumption in the house or industry.
2. Gates and Doors: If the device is used to access door and gates a solenoid valve will be used to replace the 13A load which is used to supply power to the equipment whereby only the end user with the right code will gain entrance to the door or gate.
3. It can be used in places like ministries, offices, banks and companies can use this device after works hours, such that only authorized staff can gain access to the electronics equipment e.g. computers, printers networks switch e.t.c

1.3.0 LITERATURE REVIEW

Lock is a device that secures such things as a door of a house or cabinet, brief case or other luggage and the action of an ignition system by means of a bolt or a latch that can be released by a mechanical, hydraulic or electric/electronic actuator. It is a device widely used to protect property/information from thieves and intruders. A lock is operated by a key, in the case of the combination by the dealing the correct sequence of position, electronic lock responding to an electronic logic to open it, remote control lock by using its remote control unit and the card operated lock by using the right card.

The Egyptians developed mechanical locks about 2000 B.C. These locks were made of wood and contained pegs that fell by the gravity into the corresponding holes in the lock bolt. This is the first known lock found in the ruins of the near eastern palace of khorsabad near ancient ninevah. It is the forerunner of the modern pin tumbler lock. The Greek used a simple lock in which a notch was moved by a large-sickled shape key. The Romans developed warded locks, the first metal locks. In Europe skilled locksmiths devised ingenious variations of locks and adorned them with elaborate decorations.

The principle of combination lock probably originated in china, it appeared in southern Germany in the 16^{th} century and resurfaced in England in the following century. The familiar combination lock works without any physical key but with dealing the correct sequence. The combination lock mechanism consists of three or more slotted rings connected to a graduated dial. In order to open the combination lock, the correct series of position is dialed. This process aligns the slots, allowing the bolt to be released.

The security provided by the modern locks began in the 18^{th} century, when Linus Yale and Linus Yale Jnr invented the pin tumbler lock. The senior Yale patented (1851) a lock with a radial pin tumblers, his son patented improvement and began manufacturing the lock. Great modern advances made in lock security involve the use of multiple tumblers and this form the basis of most locks made.

The advancement in the technology made machine tools and manufacturing methods become more sophisticated, locks were produced with closer part tolerance resulting in better security. Locks were later combined with burglar alarm systems that automatically fires a steel relocking bolt into the door jam when a foreign key was inserted. In 1883 George Lush Pearson applied for a patent for his invention, which would alarm by means of electric communication. This was initially a revolving lamp in the exterior of the protected premises or the use of bells. It was not however until 1923 the intruder alarm became generally available, since that time lock equipment have been designed which uses the principles of ultrasonic, microwave, infrared light, television current monitored wiring, magnetic recorders, pressure pads, vibration sensors, capacity sensors, microphone, many type of switches and electronic security system.

Today new security technologies threaten the dominance of the metal lock and key. The key card developed in the early 1980's for use in the hostels, is a small credit card that holds coded information that is magnetically imprinted allowing a guest to enter the rented room. The code is changed when the person checks out. The keyless locks are the most recent of the modern locks. They include remote control lock, card operated lock and the electronic lock, which this project writes up, is all about.

1.4.0 **PROJECT OUTLINE**

This project report describes in details the design and construction of a digital coded access security system. The report comprises four chapters as outlined below.

Chapter one is a general introduction, resenting in brief insight into the main concept behind the project, its aims and objectives, a literature review and the project outline.

Chapter two gives a clear description of the step-by-step design of the electronic unit. The principle of operation is also discussed to give a vivid understanding on how the various unit of the digital coded access security system works.

Chapter three gives a profile of how the construction of the device was done and the testing procedures were also discussed.

Chapter four includes conclusion, recommendation and references consulted while working on the project.

CHAPTER TWO

2.0.0 SYSTEM ANALYSIS AND DESIGN

For the purpose of Analysis this project is described in details with the aid of block diagram as presented in fig 1.

The block diagram consists of basic units briefly presented below.

Power supply unit: This is the source of electrical energy of power to the entire system and its indispensability can be appreciated from the fact that, without it the system will not be able to perform any work. The unit provides a 12v (D.C) with a common ground.

Input Unit: This Unit comprises of the Encoder Unit, monostable 555 timer Multivibrator Unit, and 74C164 (IC2) shift register and other discrete components such as resistor which is connected with the diode (signal diode) to give a rectangular diode matrix keyboard which is the encoder unit.

The Password or Switch unit: This unit is made of multi-slide switches; this is where we save our password.

The Memory Unit: This unit comprises of 74LS164 which is an 8 bit serial parallel-out-shift register and 74LS374 which are octal D flip flop with common enable.

The Comparator Unit: This unit is made up of a 74LS85 (IC7, IC8, IC9), which are all 4-bit magnitude comparator.

The Control Unit: this Unit comprises of a 74HC11 (IC10) which is a Triple 3-input AND gate, an astable 555 timer (IC12, IC13) multivibrator, Transistor (TR2) and 74C164 (IC3) which is also a shift register.

Output Unit: The output unit comprises of a transistor (TR1) and relay (RL1), a diode (D1) and a load unit.

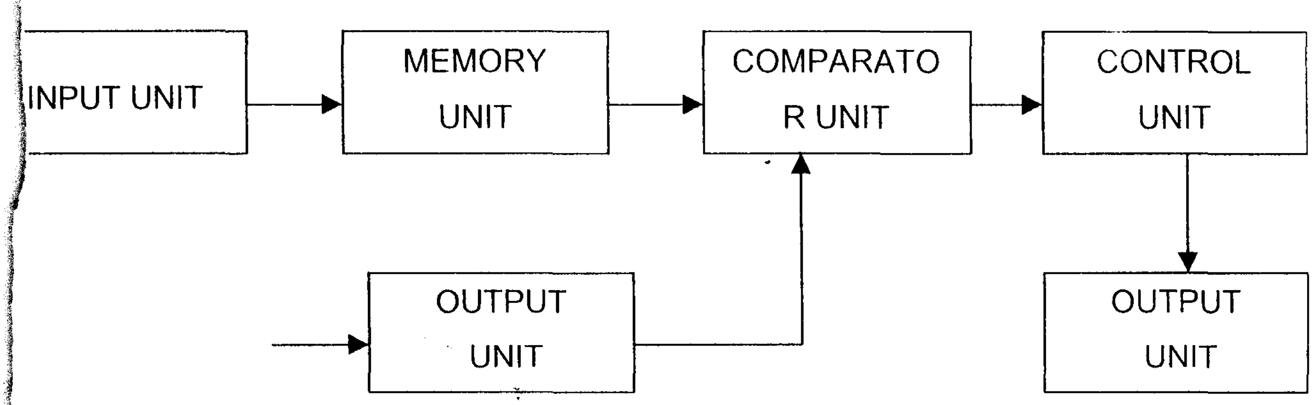


Fig 2.0 Generalized Block diagram

2.1.0 **POWER SUPPLY STAGE (+5 & +12V)**

All stages in the project uses +5V except the relay circuit, which uses +12V. The power supply stage is a linear power supply type and involves a step down transformer, filter capacitor, and voltage regulators, to give the various voltage levels. The power supply circuit diagram is shown in fig. 3.6

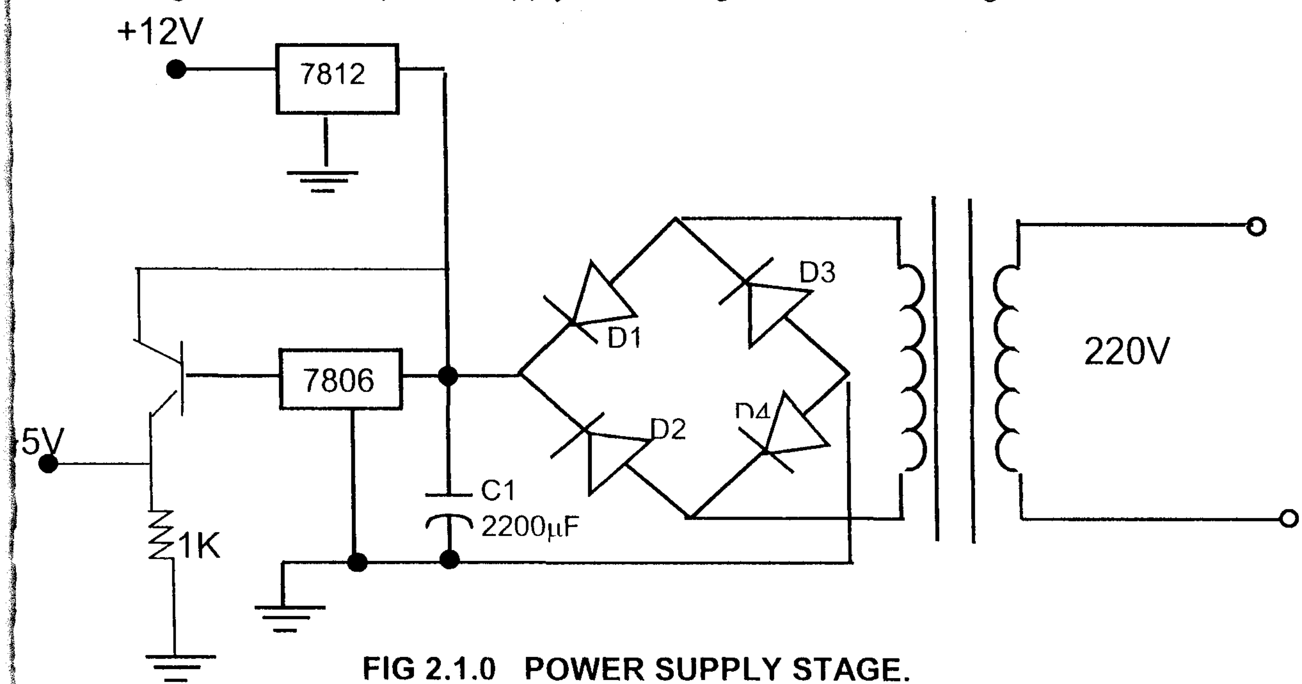


FIG 2.1.0 POWER SUPPLY STAGE.

The rectifier is designed with four diodes to form a full wave bridge network. C_1 is the filter capacitor and C_1 is inversely proportional to the ripple gradient of the power supply. Fig. 2.12 shows the ripple gradient

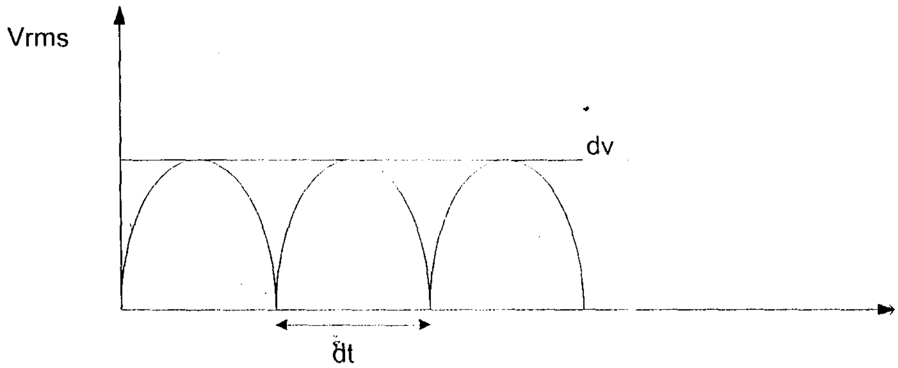


Fig.2.1.2

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

For an rms voltage of 12volts (from transformer)

Vpeak = 12 x √2 (i.e., rms x √2)

= 16.97V

Hence letting a ripple voltage of 25% makes dv = 4.24

But 1/C = dv / dt

C = dt / dv

= 10ms / 4.24V (where dt = 10ms for 50Hz)

= 2358.5μF

A preferred value of 2200μF was employed for the power supply

A 7806 Regulator was used. The transistor TIP41 that is used to buffer the output drops 0.7V (V_{BE}) to reduce the +6 to 5.3V, which is approx. +5V, and a 7812 regulator was used for the 12V supply generation.

2.2.0 **INPUT UNIT:**

The input unit comprises of the encoder unit, the monostable 555timer (IC1) multi-vibrator unit, 74C164 (IC2) shift register, 40106(IC1) hex Schmitt trigger and other discrete components such as resistor.

2.2.1. **Encoder unit:**

While computers and other digital electronic systems work in some form of binary code, humans prefer the decimal code. Code converters are therefore necessary to convert one code into another. An encoder (usually at the input of a system) makes conversions into binary, often from decimal.

Encoding circuits take many forms. The basic principle of one type of decimal to BCD encoder is shown in Fig. 2.2 The array, called a rectangular diode matrix which is used in this project contains switches numbered 0 to 9 (which may all be on the same keyboard) representing corresponding decimal numbers.

If for example, switch 3 is pressed, diodes D_4 and D_3 are connected to supply+ and conduct. Current flows through R_A and R_B, creating voltages across them which make outputs A and B go 'high'. The other two outputs and D stay 'LOW' since they are connected to ground via R_C and R_D respectively. The BCD output is then 0011 (binary equivalent of decimal 3).

2.2.2 **THE MONOSTABLE MULTIVIBRATOR:**

The monostable multivibrators are used for timing operations in many electronic systems. The popular eight pin 555 timer IC (IC1) is used in this project and it act as a single pulse generator. The connections are given below. in this case only one external resistor R1,is required and threshold(pin6)is joined to discharge (pin7).one rectangular output pulse is produced when then circuit is triggered by the falling(negative going)edge of an external pulse applied (pin2).it then returns to its one stable state ('LOW' output) to await the next trigger pulse. For this project a ten seconds monostable stage was used to generate shots of clock pulse each time the codes are entered from the keyboard. The ten seconds monostable is triggered from the output of a comparator.

The time T of the output pulse can be shown to be given by:

T=1.1R1 X C1

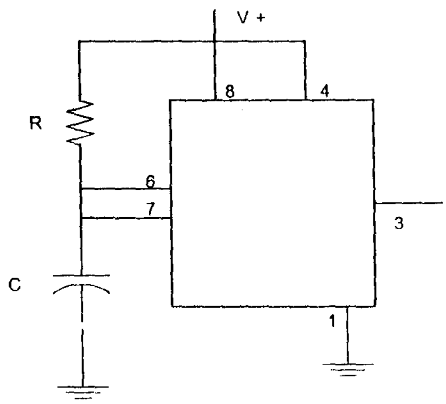


Fig.2.2.2 Ten seconds monostable.

Since T = 1.1RC, and the time duration of the monostable is 10s. (To allow for fast triggering of the counter).

Letting C_1=100uF,

Gives R_1 = 10/ 1.1x100uf

= 90.09K

= 100K .

2.2.3 **THE 74164 SHIFT REGISTER (IC2)**

This is an 8-bit parallel out shift register. it is a monolithic complementary MOS (CMOS)integrated circuit constructed with N and P enhancement transitors.These 8 bit shift registers have gated serial inputs and clear. Each register bit is a D-type master/slave flip-flop. The gated serial input permits control over incoming data because a low at either input inhibit entry of the new data and resets the first flip-flop to the low level at the next clock pulse. A high level input enables the other input determines the state to the first flip-flop. Data at the serial input can be changed with the clock is high or low, provided that the minimum setup time requirement are meet. Clocking occurs on the low-to-high level transition of the clock (CLK) input.

FUNCTION TABLE

Input				Output		
CLR	CLK	A	B	QA	QB.............	QH
L	X	X	X	L	L	L
H	L	X	X	Q_{AO}	Q_{BO}	Q_{HB}
H	↑	H	H	H	Q_{AN}	Q_{GN}
H	↑	X	L	L	Q_{AN}	Q_{GN}

QAo, QBo, QHo equals the level of QA,QB,QH respectively before the indicated steady state input condition were established.

H=high level(steady state)

L = Low level (steady state)

X =Irrelevant (any input, including transitions)

T =Transition from low to high level

QAn, QGn =the level of QA or QG before the most recent transition of the clock indicates a 1-bit shift.

2.2.4 40106(IC11) HEX SCHMITT TRIGGER:

This is a monolithic complementy Metal Oxide Semiconductor (CMOS) IC, constructed with N and P-channel enhancement transistor.

2.2.5 **MODE OF OPERATION OF THE INPUT UNIT**

The encoder is used in this project as a source of BCD mode to the octal register is stored in only one register at a time depending on the value at the clock input of the 555 timer (IC1). The output from IC1 is used on clocking the shift register 74164(IC2).a high input signal on the trigger pin (pin1) of the IC1, output a LOW signal while a LOW signal to the pin trigger it to a HIGH output.

The 555 timer (IC1) has a HIGH input signal applied to the pin2 to output a LOW unless the push button pin (P1) is depressed and released a LOW is applied to this pin and a high is required to trigger the 40106 to generate a source of regularly space use to clock the shift register.

When the encoder unit is depressed the data is stored on the memory latch by depressing the push button pin(P1),thus triggers the output of the 555 timer(IC2) to a HIGH, which is used to activate the Schmitt trigger (IC11) to clock the shift register IC2(74164) whose first output is used to enable the first octal d-flip-flop to store the data on the data line since it is the only one that its clock inputs is HIGH for this project we are using 3 code, so we are storing 3 data. To store the second data on the data line the push button P1 is depressed and released to send clock pulse to the shift register, this makes the second output HIGH and used to enable the second octal d flip-flop to store the data on the data line. The same procedure is applied to store the third data on the data line to the octal D flip-flop clock input. This allows only one octal d flip-flop to store data on the data line on each clock pulse transition.

2.3.0 **MEMORY UNIT**

The 74LS374 is a high speed, low power octal flip-flop and 3 state outputs for bus oriented applications. A buffered clock (CP) and output enable (OE) is common to all flip-flops. The 74LS374 is manufactured using advanced low power schottky technology.

2.3.1 MODE OF OPERATION

The eight edge-trigger flip-flop enter data into their register on the LOW to HIGH transition of clock (CP). The output enable (OE) controls the three state output and is independent of the register operation when output enable (OE) is HIGH the outputs will be in the HIGH impedance state.

Pin	Name
$D_1 - D_7$	Data Input
LE	Latch Enable (Active HIGH) Input
CP	Clock (Active High going edge) input
OE	Output Enable (Active low) Input
$Q_1 - Q_7$	Output

2.4.0 PASSWORD OR SWITCH UNIT

2.4.1 MULTI-SLIDE SWITCH

This is a set of miniature SPST ON-OFF switches. The package is the same size as a standard DIL (Dual In-Line) integrated circuit. This type of switch is used to set up circuits, e.g. setting the code of a remote control. The "single-pole-single-throw" switches. The "poles" are the numbers of separate circuits the switch makes or breaks at the same time. The throws are the number of positions to which each pole can be switched. The type of switch use for this project is called a multi slide switch. The password for the device is set here.

2.5.0 **COMPARATOR UNIT**

The 74C85 is a 4 bit magnitude comparator of high speed that uses a silicon-gate CMOS technology to achieve operating speeds similar to LSTTL with the low power consumption of standard CMOS integrated circuits. It is a four bit magnitude comparator which will perform comparism of straight binary or BCD codes. the circuit consist of either comparing input (Ao, A1 ,A2 ,A3 ,Bo, B1, B2, B3) three cascading input (A>B,A<B, and A=B)and three output(A>B,A<Band A=B).the device are expandable with external gathering in both serial and parallel fashion.

2.5.1 **MODE OF OPERATION**

This device compares two four bit words A and B, and determines whether they are equal for this project. One of the four bit word is coming from the octal D flip-flop 74374 (IC4, IC5, IC6) and the other from the multi-slide switch. if the input data from the 74374 ICs are all equal to the value set in the multi-slide switch the comparator will give a HIGH output and if the data are not equal it gives a LOW output through pin6 of the 7485.this is now applied to the input pin of an AND gate.

2.6.0 **CONTROL UNIT**

This unit comprises of a 74HC11 (IC10), which is a triple 3-input AND gate. An astable 555timer (IC12&IC13) multivibrator; which, is the alarm circuit, a transistor (Q2) and a 74C164 (IC3), which, is also a shift register.

2.6.1 **THE 74HC11:**

This is a triple 3 input AND gate. The AND gate utilize advanced silicon-gate CMOS technology to achieve operating speeds similar to LSTTL gates with the low power consumption of standard CMOS integrated circuits. All gates have buffered outputs, providing high noise immunity and the ability to drive 10LSTTL loads. The 74HC logic family is functionally as well as pin out compatible with the standard 74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to Vcc and ground.

MODE OF OPERATION

The 3 output coming from the 74374 comparator is inputted into the 7411 (IC10).it gives a HIGH if all the inputs are HIGH and a LOW if one of the inputs is LOW.

2.6.2 **ASTABLE 555 TIMER (IC12&IC13) MULTIVIBRATOR:**

The eight pin 555 timer IC acts as a square wave oscillator.R3, R4, R5, R6. C2&C3 are external resistor and capacitor. The 555 is used for the timing circuit in this project and also the alarm circuit. Timing circuits are those which provide an output change of state after a predetermined time interval. Timing circuits is modified here to function as Astables and Bistables. The emanation of IC timing devices. The most popular of the present IC timers is the 555 timer, which is available in an eight pin dual in line package, in both bipolar and cmos forms. The 555 timer comprises of 23 transistors, 2diodes and 16 resistors in its internal circuitry. Its functional block is shown in fig 2.6.2a

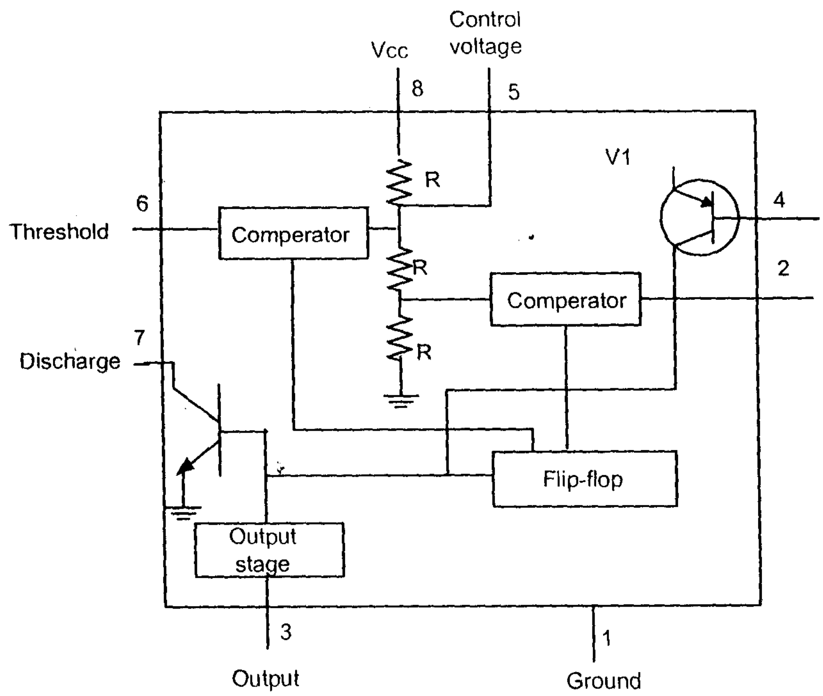
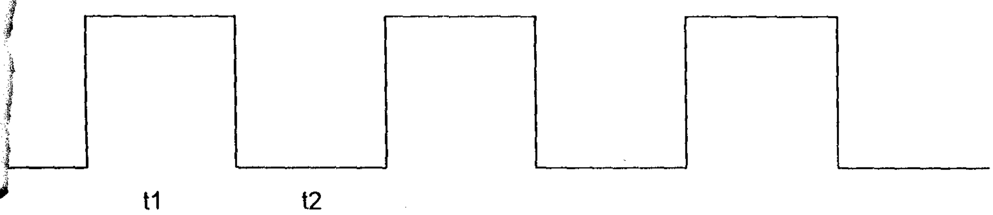


Fig 2.6.2a   555 Timer (internal) block diagram

The functional block diagram consists of two comparators, a flip - flop, two control transistors and a high current output stage.

The two comparators are actually operational amplifiers that compare input voltage to internal reference voltages which are generated by an internal voltage divider chain of three 3kΩ resistors. The reference voltages provided, are 1/3 Vcc and 2/3 Vcc. When the input voltage to either of the comparators is higher than the reference voltage for that comparator, the amplifier goes into saturation and produces an out put signal to trigger the flip - flop. The output of the flip- flop controls the output stage of the timer.

The 555 timer chip works from a D.C supply of 3 - 15v and can source or sink up to 200mA at its output. The astable operation produces free running pulses which could be used as an oscillator and can give frequency output in the range of a fraction of 1Hz to 1MHz. The oscillator output give square wave pulses as shown in fig 2.6.2b



g 2.6.2b Square wave pulses of the 555 timer.

ere t_1 is the ON time and t_2 is the OFF time.

$$\frac{1}{T}$$

here period $T = t_1 + t_2$).

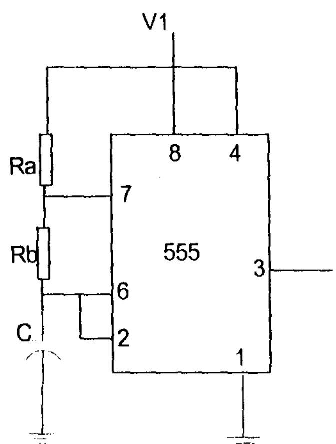
,

$0.7 (R_A + R_B) C$,

$0.7 R_B C$

ce,

$T = 1.44 (R_A + 2R_B) C$.



2.3d typical astable 555 timer configuration.

Given that
$$R_A = R_9 = 10K = 10000$$
$$R_C = R_{10} = 10K = 10000$$
$$C_3 = 4.7\mu F$$

Substituting this in the above

$$F = \frac{1}{1.44(10K + 2\times 10K)4.7\times 10^{-6}}$$
$$= 4.925HZ$$

2.6.3 **TRANSISTOR:**

Transistors are active components used basically as amplifiers and switches. The two main types of transistors are:

The bipolar transistors whose operation depends on the flow of both minority and majority carriers, and the unipolar or field effect transistors (called FETs) in which current is due to majority carriers only (either electrons or holes). The transistor as a switch operates in class A mode. In this mode of bias the circuit is designed such that current flows without any signal present. The value of bias current is either increased or decreased about its mean value by the input signal (if operated as an amplifier),or ON and OFF by the input signal if operated as a switch.

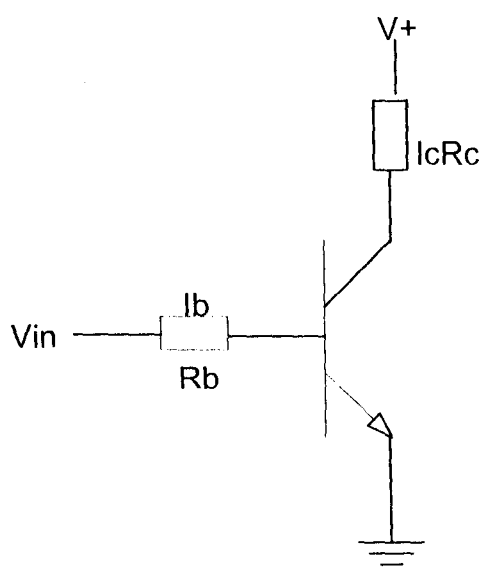


Fig.2.4a TRANSISTOR AS A SWITCH.

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

V_{CE} =O, when the transistor is ON.

Which implies that,

$V_+ = I_c R_c + V_{CE}$ ------------------------1

$V_{IN} = I_B R_B + V_{BE}$ ---------------2

$\frac{I_c}{I_b} = h_f$ ------------------------3

$R_B = \frac{V_R - V_{BE}}{I_B}$ -----------------4

Where,

I_c = collector current

I_b = base current

Vin = input voltage

V+ = supply voltage

V_{CE} = collector-emitter voltage

Hfe = current gain.

The transistor TR1 act as a polarity inversion.

74C164 (IC3): this is also a shift register like IC2.

2.6.4 **MODE OF OPERATION OF THE CONTROL UNIT**

The input of the 74164 is gotten also from the output of the monostable 555 timer (IC1) and it is applied to the two-shift register 74164(IC2andIC3) simultaneously; this is being shifted simultaneously. So that when the first three digit to open the device is applied to the comparator, if the binary code input are the same with the code access required to open the device the output of the comparator are all HIGH this is applied to the triple AND gate to give a HIGH which is applied to the transistor (TR1) which does polarity inversion of the output at the base of the transistor and a LOW is outputted. If one of the comparator is LOW, the AND gate gives a LOW at the output, which is applied to reset pin (pin9) of the shift register (IC3) and this clear the shift register.

But if the first three digit to open the device is wrong, that is if one of the comparator output is a LOW, the output of the triple AND gate is a LOW and this applied to the polarity inversion transistor Q1.which output is a HIGH and is applied to the reset pin (pin9) of the shift register, if another three wrong digit is applied it does not affect the shift register. The third wrong set of three- digit trigger the alarm circuit since the seventh output of this shift register is applied to the supply pin of the astable multivibrator to trigger the alarm circuit.

2.7.0 **THE OUTPUT UNIT**

The output unit comprises of a transistor (Q1) and relay (R1), a diode (D1) and a load unit.

The transistor here is used to switch the relay, which powers the alarm circuit. The transistor here acts as a switch, which operates in class A mode. The relay is switch on when the monostable unit gives a HIGH output, the transistors used in the common emitter mode for polarity inversion. This output is applied to the relay making the relay contact to be open when a HIGH is applied to it. A base resistor is required to ensure perfect switching of the transistor in saturation. Diode D5 protects the transistor from back emf that might be generated since the relay coil presents an inductive load.

In this case Rc, which is the collector resistance, is the resistance of the relay coil, which is 400Ω for the relay type used in this project.

Hence, given that Rc = 400Ω (Relay coil resistance)

V^+ = 12V (regulated voltage from the power supply stage or battery)

Vbe = 0.6V (silicon)

Vce = 0V (when transistor is switched)

Vin = 10.3V (from the timer output)

Hfe = 300 (from data sheet for BC337)

Since,

$$V_+ = I_c R_c + V_{CE} \quad \text{----------} (1.0)$$

$$V_{in} = I_B R_B + V_{BE} \quad \text{----------} (2.0)$$

$$\frac{I_C}{I_B} = h_{fe} \quad \text{----------} (3.0)$$

$$R_b = \frac{V_{in} - V_{BE}}{I_B} \quad \text{----------} (4.0)$$

Where,

I_C = collector current

I_B = base current

V_{in} = input voltage

V_t = supply voltage

V_{CE} = collector-emitter voltage

H_{fe} = current gain.

From 1.0, 12 = IcRc + Vce

12 = Ic (400) + 0

And, Ic = 30mA

From 3.0 , I_B = 30mA/300

= 100uA

From 2.0, $10.3 = 100uAR_B + 0.6$

$R_B = 9.7/100uA$

$= 97K\Omega$

$R_B = R_5 = 100K\Omega$ (Preferred value)

2.7.1 **MODE OPERATION**

When the three codes inputted are the same as the stored value (password) the output of the AND gate is a HIGH which is inverted to a LOW by the transistor Q2 and makes the relay contact close here by causing the circuit not to work.

The diode D1 is connected to prevent eddy current in the relay circuit; it protects the transistor from back emf that might be generated since the relay coil resents an inductive load.

The load unit is a 13A switch who's live is connected to the relay contact. The line is powered from a 220V from the ac mains so that when the contact is closed the power output from the switch is 220V and 0V when the contact is open.

2.8.0 **HOW THE DEVICE'S OPERATES**

The device starts working when it is powered ON by connecting the plug to the ac mains.

To enter the first number of the code required to open the switch the push button equivalent to this number on the encoder unit is depressed and released, this number enters into the fist memory latch (IC4) whose clock input is the only one that has change transition from LOW to HIGH. This occur by depressing the push button (P1) connected to the monostable 555timer (IC1), which output a HIGH and this is used to trigger the (IC10) to clock the shift register (IC2) to output a HIGH on its first output only. This output is connected to the first memory latch (IC4), which stores this number.

To enter the second number of the code into the memory latch (IC5) stores the data, since the second pulse applied to the shift register (IC2)make only the second output connected to memory latch IC5)to go from LOW to HIGH.

The third number of the code is entered into the memory latch (IC6) following the process done for storing the first number.

These numbers that from the code are applied to one set of the input (pin 4) of each comparator unit (IC7,IC8, IC9)and the other set of input pin of the comparator has the code access applied to them from a multi-slide switch.

The output of each comparator is a HIGH if the numbers applied to it are the same and a LOW if the number are different from the numbers enter into the memory latches (IC4 -IC6) are the same as those of the multi-slide switch, each comparator (IC7-IC9) outputs a HIGH which is applied to the three input AND gate which, is applied to two different transistor (Q1andQ2) simultaneously.

The transistor TR1 is a switching transistor required to open the system, when the HIGH input from the AND gate is applied to the base of this transistor (TR1), it is inverted by the transistor working as a polarity inversion in the common emitted mode. This inverted output (i.e. a LOW) is applied to the relay, which closes the contact and opens the system, which is a 13A switch.

The other transistor TR is used to activate the alarm syetem.when the HIGH is applied to its base, it is inverted to a LOW, which is applied to the reset pin of the shift register (IC3) and clear the shift register (IC3) and disable the alarm circuit from working since this is connected to the seventh output of the shift register and requires this output to be HIGH to trigger the alarm.

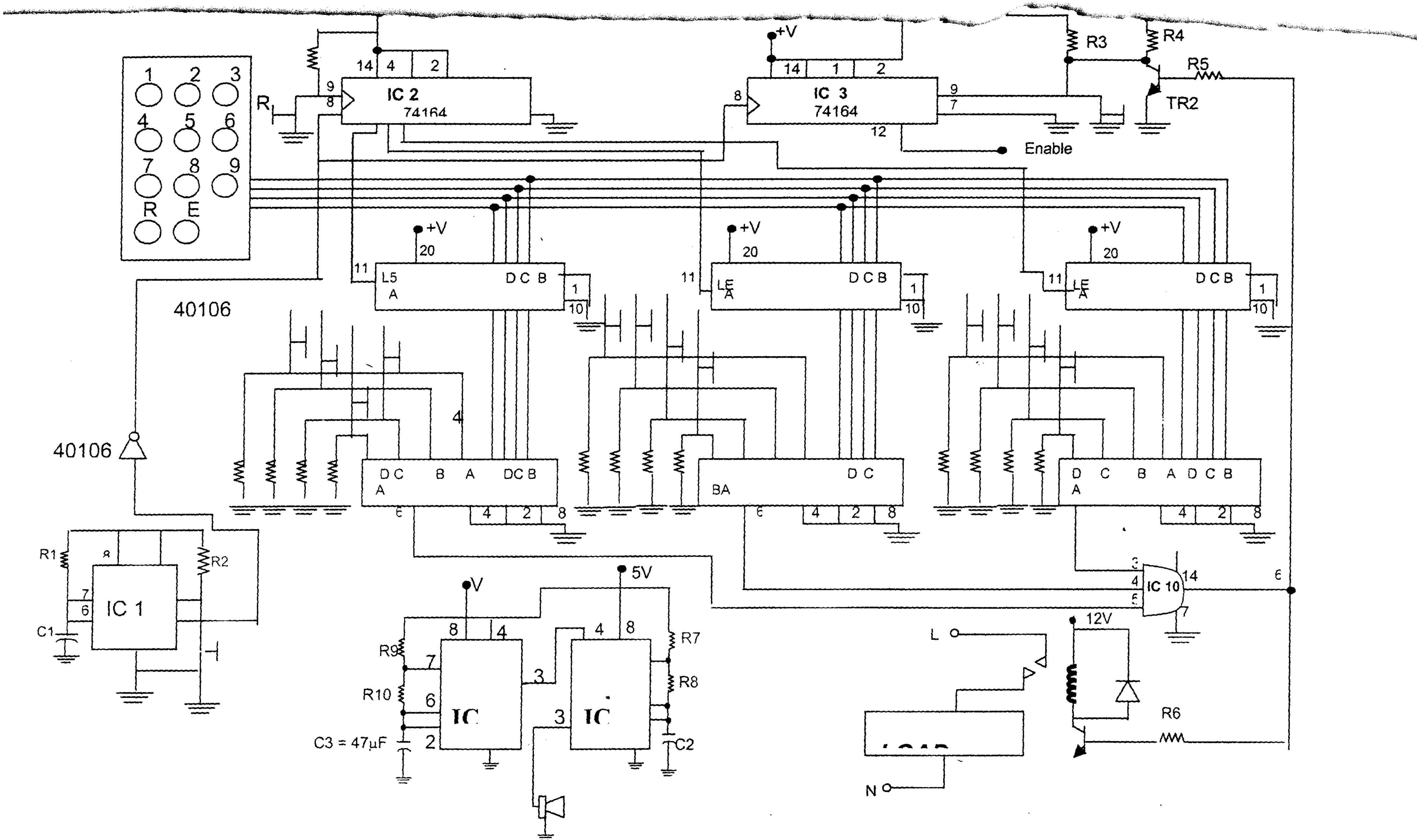
If at least one of the number of the code required to open the lock is different from that stored in the multi-slide switch, there will be at least a LOW applied to the input pin of the AND gate (IC) and its output will be LOW. This

LOW is applied to the transistor TR1 whose output is HIGH and this is applied to the relay, which leaves the relay contact open so the system remains closed and cannot be used. also the LOW at the output of the AND gate (IC) is applied to the transistor TR2 whose output is HIGH, this output is applied to the reset pin of the shift register (IC3) which does not clear this shift register.

The alarm circuit is connected to the shift register (IC3) in such a way that it is trigger when the third set of incorrect code is entered using the push button on the encoder unit .the seventh output of the this shift register is connected to the astable multivibrator which trigger the alarm circuit at the seventh clock pulse applied to the shift register (IC) of an incorrect code. To stop the alarm and make the circuit work in the correct sequence the reset button is depressed and released which clears the two shift registers (IC2 and IC3) and the correct code to open the system is applied in the correct sequence to open the system.

)MPONENTS LIST

1	100K
1	100μF
R2	1K
3	1K
4	2.2K
5	100KΩ
6	47K
7	3.3K
8	220Ω
9, R10	10K
3	47μF
C 1	555 Timer
C2-IC3	74164
C4-IC6	74347
C7-1C9	7485
C10	7411
C11	40106
IC12-IC13	555timer
IC14	7806
IC15	7812


IC 2
74164
IC 3
74164
R3
R4
R5
TR2
Enable
+V
1 2 3
4 5 6
7 8 9
R E
40106
40106
IC 1
R1
R2
C1
IC 10
12V
R6
L
N
5V
R7
R8
C2
R9
R10
C3 = 47μF
IC
IC

CHAPTER THREE

3.0.0 TESTING AND CONSTRUCTION

3.1.0 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 its working ability, and was finally constructed to meet desired specifications.

The device (door lock) was tested after construction to check if the circuit was working to design. The devices was tested as follows

1) When the device was connected to the power supply the wrong password was entered.

2) With the device still powered and the push button switch (P2) depressed and released, the right password was entered.

3) With the device still connected to the power supply, the wrong password was entered and then the right password was entered without depressing the push button switch (P2).

4) The push button switch (P2) was depressed and released, the right password was entered.

3.2.0 **THE RESULT**

The following results were obtained for the steps being tested for, as stated in the above section

1) When the system was powered and the wrong password was entered, the electronic appliances connected to the device will not be power.

2) With the second step, the electronic appliances will be power.

3) With the third step, the electronic appliance was not power even with the right password entered immediately after the wrong password.

4) With the fourth step, the electronic appliances will be power to enable operation

3.3.0 **IMPLEMENTATION**

The implementation of this project was done on the breadboard. The power supply was first derived from a bench power supply. (To confirm the workability of the circuits before the power supply stage was soldered).

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. For proper understanding of how the system operates and allow for troubleshooting, the pin configuration of the ICs and other active components used are shown below. The 555timer was used in the astable and monostables stage.

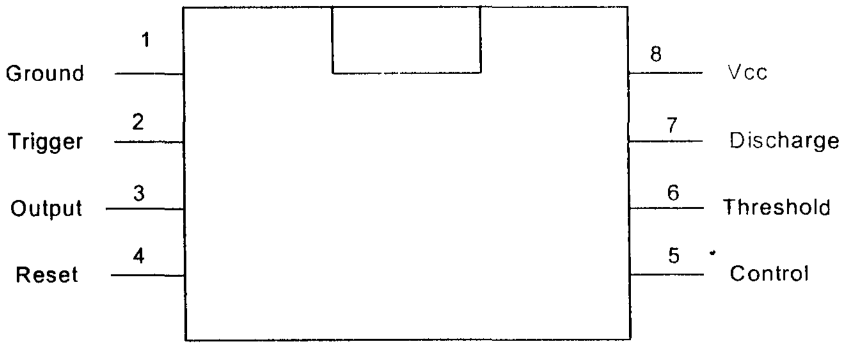
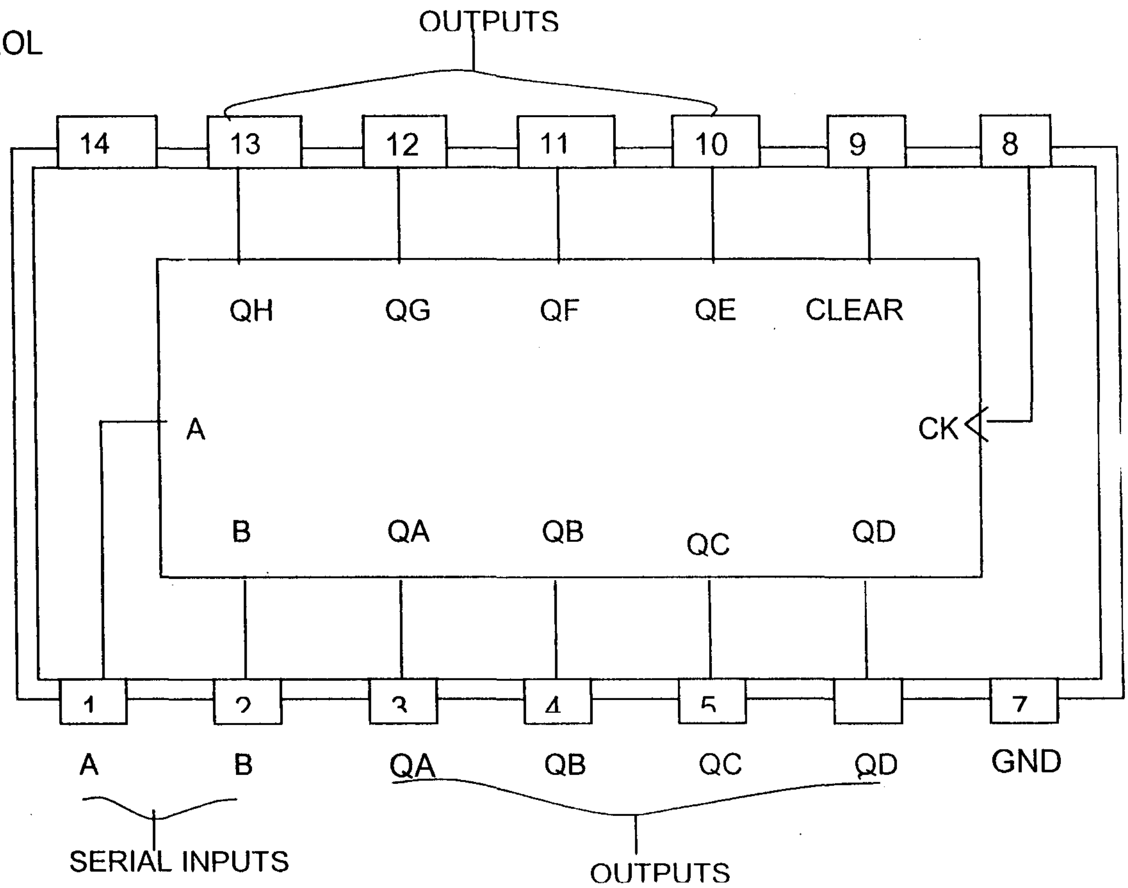


Fig 3.3.1 shows the pin configuration of the NE555 TIMER

The 74164 was used in the input and control unit. The in configuration is shown below.

NTROL



The 7411(triple 3-input) AND Gate is used in the control unit. the fig is shown below

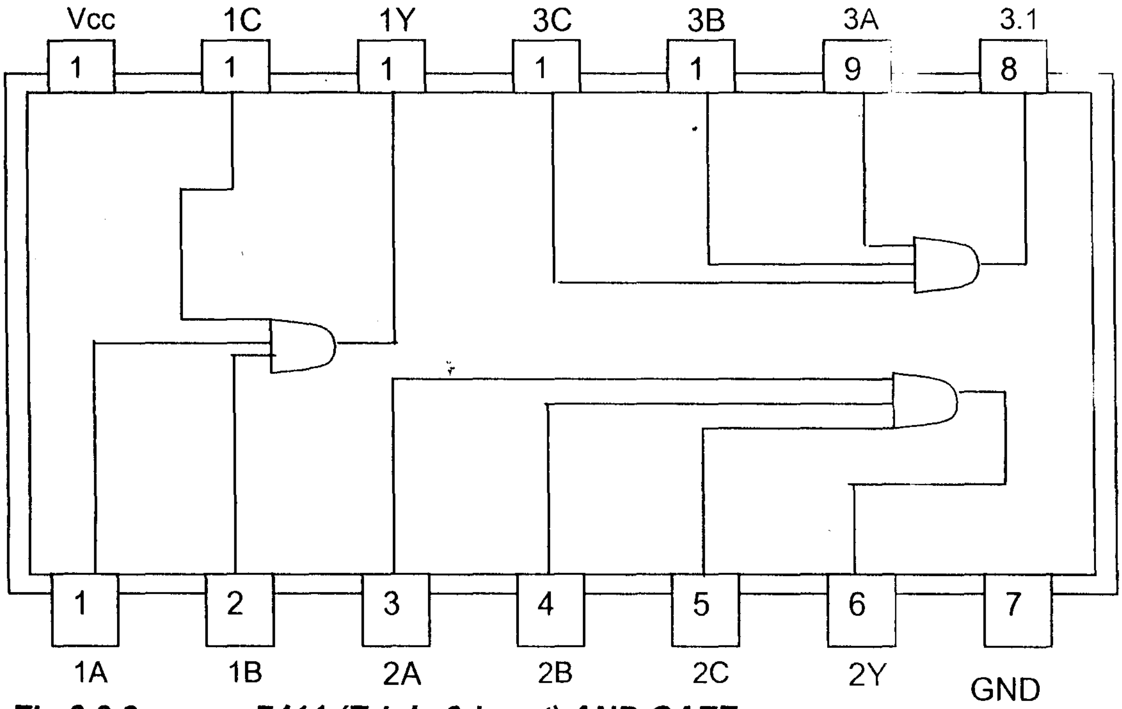


Fig 3.3.2 ***7411 (Triple 3-input) AND GATE***

The 7485 (4 bit magnitude comparator was used in the comparator unit

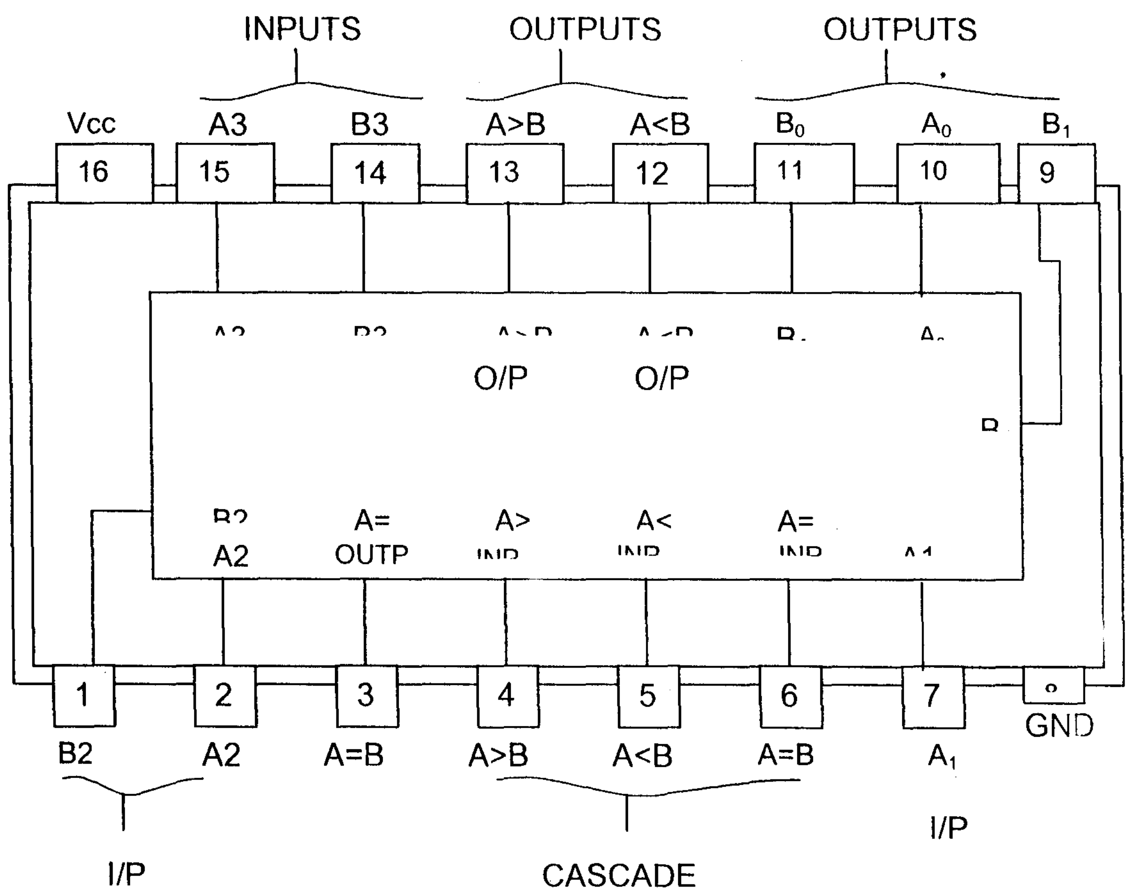


Fig 3.3.3 7845 (4-BIT MAGNTUDE COMARATOR)

The 40106 Hex Schmitt Trigger was used in the input unit

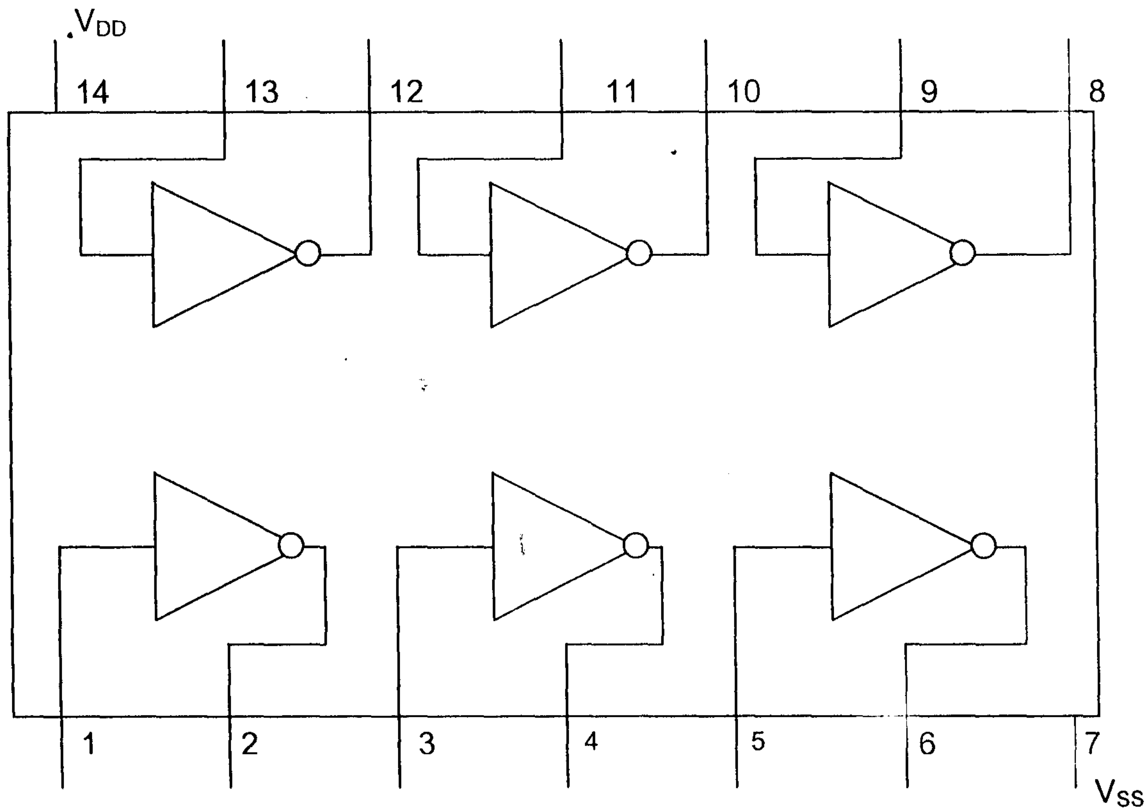


Fig 3.3.4 40106 HEX SCHMITT TRIGGER pin configuration

The 74374 was used as a latch in the memory unit.

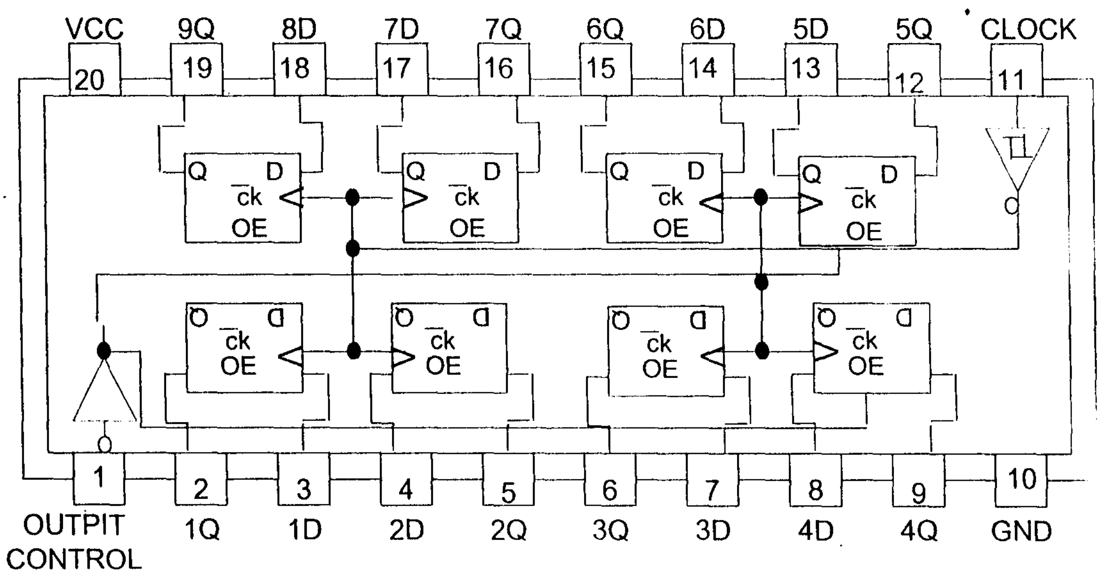


Fig 3.3.5 74374 pin configuration

the rectangular Diode is used in the encoder stage of the input unit.

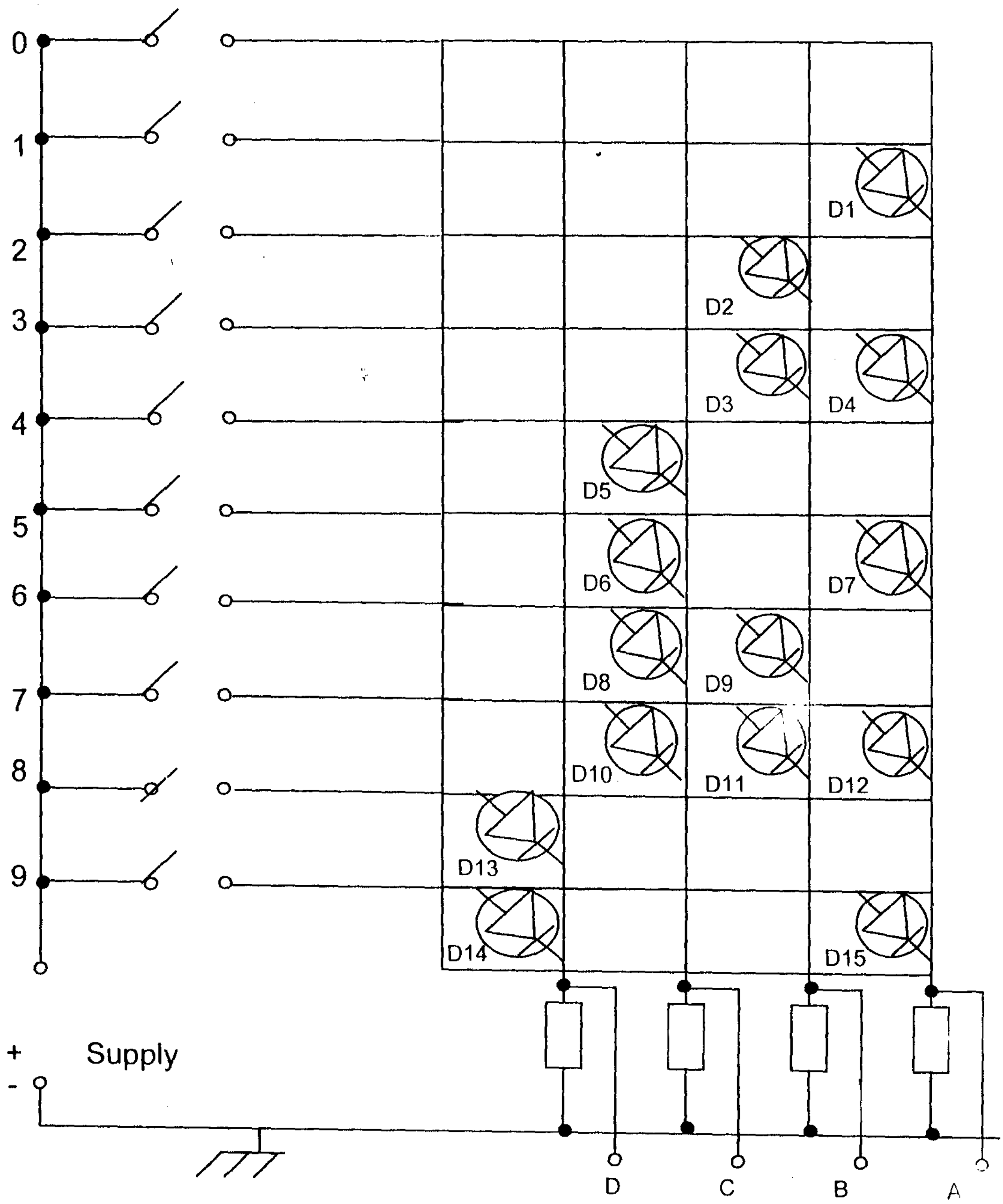


Fig 3.3.6 Rectangular diode matrix

3.4.0 **CONSTRUCTION**

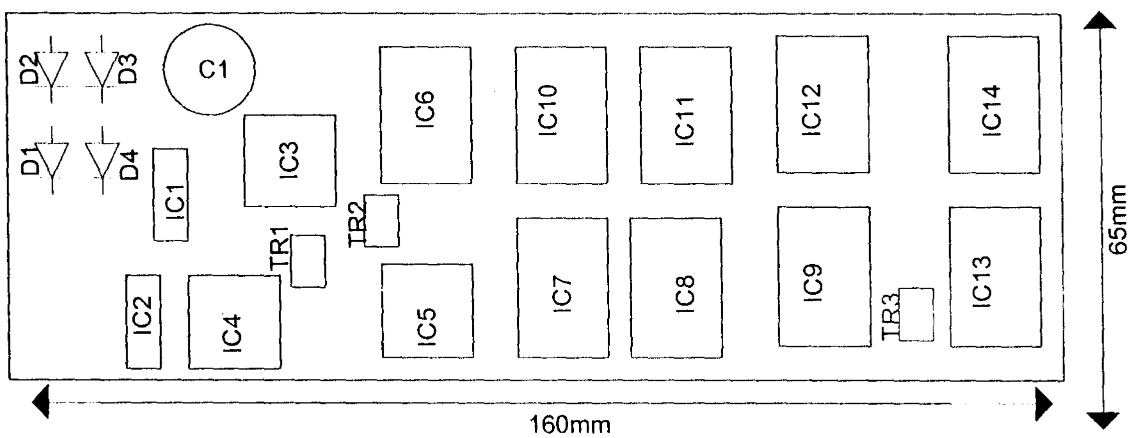
The construction of this project was done in two different stages, the soldering of the circuits, and the coupling of the entire project to the casing.

The power supply was first constructed before the encoder and latches stage was done.

The soldering of the project was done on a Vero board; two different Vero boards were used in the project for the entire construction.

The first Vero board contains the power supply comparator stage, timing circuits and shift register, digital comparators and latches, the second Vero board contains the alarm circuit and relay circuit.

Fig 3.4.1 shows the Vero board connection.



COMPONENTS LIST

IC1	7812
IC2	7805
IC3-I_5	555
IC6	7411
IC7 -IC9	7411
IC10-IC12	74LS374
TR1-TR3	BC546
IC13-IC14	74LS164

Fig.3.4.2 components layout on Vero-board 1.

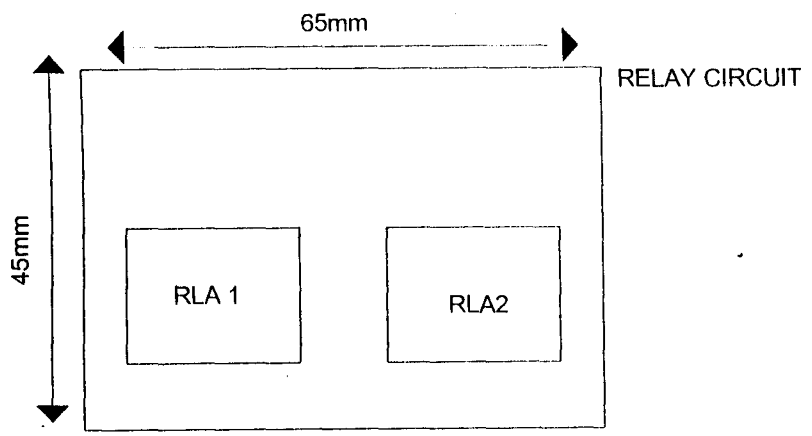


Fig 3.4.3 Components layout on Vero board 2

The second phase of the project construction is the casing of the project.

This project was coupled to a plastic casing. The casing material being plastic designed with special perforation and vents to allow for proper conventional air flow and cooling. The casing was made to be portable to allow for easy use and to make it user friendly.

Fig3.4.3 below shows the picture of the completely cased job.

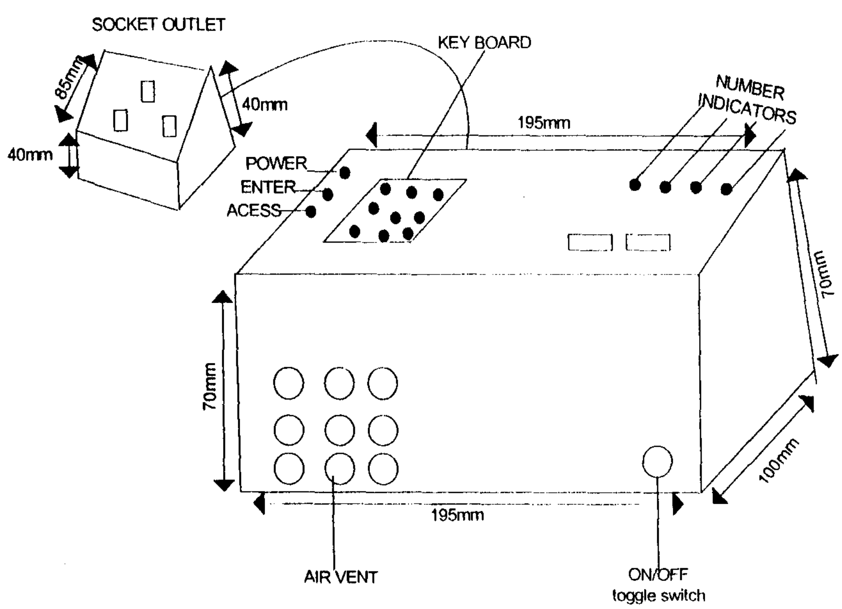


Fig 3.4.4 Isometric view of the casing with dimensions.

CHAPTER FOUR

4.0.0 CONCLUSION AND RECOMMENDATION

4.1.0 CONCLUSION

The project which is the construction of a digital coded access security system was designed considering some factors such as economy, availability of components and research materials, efficiency, compatibility and portability and also durability. The performance of the project after test met design specifications. The general operation of the project and performance is dependent on the user's ability to enter specific codes at a given time into the system.

The coding process is such that it would be very difficult for someone else to fiddle with the unit in an attempt to guess the code.

Also the performance and durability is dependent on how well the soldering is done, and the positioning of the components on the Vero-board. The soldering was such that ICs were not soldered near the power supply stages to avoid heat radiation, which might affect system performance.

The construction was done in such a way that all the modules were soldered separately, which 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 digital electronics and practical electronics generally which is one of the major challenges I shall meet in my field now and in future. The design of the digital coded access security system involved research in both, multivibrators and comparator circuits. Intensive work was done on counters, latches and registers.

I wish to thank the entire department, my supervisor and project co-coordinator 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.

4.2.0 RECOMMENDATIONS

1) I would recommend that further work be done on the system especially on the coding, to make the coding a remote controlled system.
2) A microprocessor or microcontroller should be used for the control circuit to reduce the component count.
3) A software version of this project should be designed to enable interfacing with the PC and to increase the variables of the coding system and help reduce the design stress.
4) The department should acquire more research-oriented books in the departmental library, to make enough materials availab... for students' use, especially data books.

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