DESIGN AND CONSTRUCTION OF A MICROCONTROLLER BASED AUTOMATIC SLIDE DOOR WITH METAL DETECTION.

BY

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DEDICATION

First of all, this work is dedicated to Allah (S W T), and then to my dad Mallam M.S . Umar, my mum Mallama Habibat Umar, to my siblings and all who have been of great support to me.

ACKNOWLEDGEMENT

First and foremost I am thankful to Allah the most Gracious and most Merciful for helping me finish this work. His blessing was with me throughout the work.

I am indebted to my father and my mother for teaching me the importance of hard work and perseverance and for instilling in me the confidence to succeed at whatever I chose to do.

I wish to express my deep sense of gratitude and indebtedness to Mr. Achonu Adejo Department of Telecommunication engineering F.U.T Minna for his inspiration, guidance, constructive criticism and valuable suggestions throughout the project, Mrs A. Asindi with her full support.

I am also thankful to all staff of Department of Electrical and Computer Engineering F.U.T Minna, special thanks to the LAB staff.

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CHAPTER ONE

1.0 INTRODUCTION

Man has always strived to achieve comfort, ease of life, convenience and security through civilization and modernization. Thus the microcontroller based automatic slide door with metal detection is one of the devices designed to bring comfort and convenience to our daily life.

It is a type of door which has been programmed to open when it detects a person about 0.5meters from it. It thus opens only when metals are not detected on a human when the push button is pressed, and if a metal is detected, the door remains closed. This type of door is different from ordinary doors in that only authorized people are allowed passage through the doors, providing security and ease of passage.

This door system is engineered to ensure safe entry to offices, shopping complexes, airports, banks and other buildings providing efficient performance, high degree of reliability, advanced safety and security.

1.1 OBJECTIVES

The objectives of this project are

1. To design a automatic secured slide door.
2. To provide convenience, time saving and energy saving in and out of a building.

1.2 SCOPE OF STUDY

This project will be limited to the programming of a microcontroller with metal detection to control the entrance and exit into a building. It will comprise of a programmed microcontroller, metal detector, dc motors, LCD and a motor drive. This will enhance secure and easy passage in and out of a building.

1.3 METHODOLOGY

The circuit design of this project involves a well programmed microcontroller, LCD, power source, dc motor, motor driver and a metal detector. The metal detector consist of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field which helps in detecting metals whenever a human is about 0.5meters near the door. It then sends output signals to the microcontroller which has been programmed to control the motor drive in a forward and backward direction. If metals are not detected after scanning, the LCD displays access granted. The microcontroller now sends an output signal to the motor drive telling it to move the motor in a forward direction which in turn opens the door for passage. In the other hand, if metals are detected, the LCD displays access denied, the microcontroller then sends an output signal to the motor drive telling it to keep the motor in a reverse position thus keeping the door closed.

The power source is from a 240volt step down transformer which steps it down to 12volts. The voltage regulator helps to reduce the 12volts to 5 and 6 volts. The 5volt is used for powering the microcontroller and the 6volts is used for powering the motor.

1.4 PROJECT OUTLINE

This project is divided into five chapters. Chapter One is introductory chapter, Chapter two deals with literature review, Chapter three presents the design procedure, Chapter four is concerned with the analysis and discussion of results. The last chapter which is Chapter five is the conclusion including limitation, recommendations and useful suggestion for further work.

The Block Diagram Of A Microcontroller Based Automatic Slide Door With Metal Detection Is Has Shown bellow.

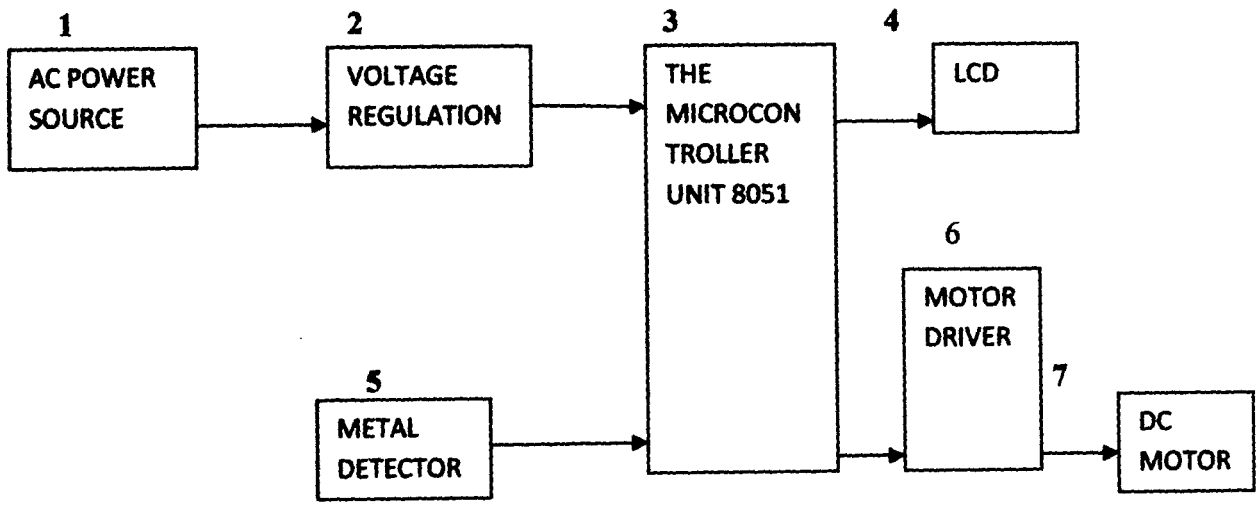

Fig 1.1 The block diagram of the project.

This holding containers acts as weights, which opens the doors through a series of ropes and pulleys. This is what Hero used in opening gates. [2]

Supermarkets were the first segment of retailers to use automatic doors. In 1930, George W Jenkins opened the first public market in winter Haven, Florida publishing the door, pulling

ABSTRACT

This project presents a simple model of an automatic sliding door system with metal detection, which uses a microcontroller, LCD, Dc motors and drivers. The metal detector senses metals and the LCD displays access granted or denied. The microcontroller controls the driver which moves the motor forward and backward to open and close the door at entrance. A modular approach was employed in the design, which was broken down into 7 units. It is intended that this device, which is portable and cost effective becomes useful in providing security for automatic doors.

coil, eddy current will be induced in the metal which produces an alternating magnetic field on its own thereby showing the presence of a metal.

The first industrial metal detection were developed in the 1960s and were used for mining and industrial applications. It was also used in detecting guns, knives, and land mines. Towards the end of the 19th century, many scientist and engineers used their growing knowledge of electrical theory in an attempt to device a machine that would pin point metals. The GERMAN Physicist Heinrich Wilhelm Dove invented the induction balance system which was incorporated into metal detectors a hundred of years later. Early machines were crude and uses a lot of power and worked only to a very limited degree. [5]

The modern development of metal detector began in the 1920s. Gerhard Fisher had developed a system of radio direction finding, which was to be used for accurate navigation and it worked well. But Fisher noticed that there were anomalies in areas where the terrain contained are bearing rocks. He reasoned that it should be possible to design a machine which would detect metals using search coils resonating at radio frequency and was successful in the year 1925 which was the first patent of a metal detector. However, it was one Lieutenant Jozef Stanislaw Kosacki, a Polish officer attached to a unit stationed in St Andrews, Fife, Scotland during the early years of world war 2, who refined the design into a practical Polish mine detector [6]. They were heavy, ran on vacuum tubes and needed separate battery packs.

His design was used extensively during the clearance of the German mine fields during the second battle of El Alamein when 500 units were shipped into field Marshal Montgomery to clear the mine field of the retreating Germans, and later used during the Allied invasion of sicily, the Allied invasion of Italy and Normandy.[7]. His knowledge created the first practical metal detector which was kept secret for 50 years.

There are different uses of metal detectors, some of the uses are as follows:

For security purpose for example at air ports, for detecting mines at battle fields. This two examples are shown below

Fig 2.0 metal detector for Airport searching

"

fig 2.1 metal detector for mine detection

2.3 MICROCONTROLLERS 8051 and History

A microcontroller (sometimes abbreviated as uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and a programmable input/output peripherals. Program memory, in the form of NOR FLASH or OTP ROM is also often included on chips, as well as typically small amount of RAM. Microcontrollers are designed for embedded applications in contrast with the microprocessors used in personal computers or other general purpose application.

The Intel MCS-51 is a Harvard architecture, single chip microcontroller,[uC] series which was developed by Intel in 1980 for use in embedded systems and early 1990s. [8]. Intel original MCS-51 family was developed using NMOS technology, but later versions, identified by a letter C in hungry than their NMOS predecessors. This made them more suitable for battery powered devices. The chip is as shown below:

The microcontroller chip is as shown below:

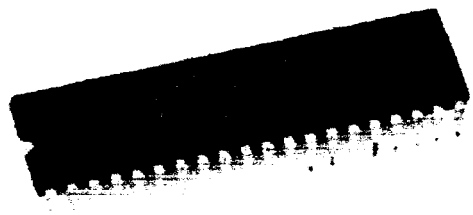

Fig 2.1.1 the microcontroller chip.

TABLE OF CONTENTS

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Supermarkets were the first segment of retailers to use automatic doors. In 1930, George W Jenkins opened the first public market in winter Haven, Florida publishing the door, pulling the door and parking the rolling basket carrier in front of the door frustrated shoppers at least momentarily. A shopper approaching the exit door had no choice but to bring the shopping cart to a halt, open the door with one hand and push the shopping cart with the other. Congestion of shoppers waiting for chance to use the exit door prevailed. To solve this problem, in 1940, Jerkins installed automatic doors. The first public supermarket came to be much more than a pretty building. [3]

Hero's mode of operating automatic doors were complex, therefore, in 1954 HORTON and LEW HEWITT came up with the first automatic slide door. Horton developed and sold the first automatic sliding door in America in 1960. The company co-founders DEE HORTON and LEW HEWITT invented the first automatic slide door in 1954. Their automatic door used a mat actuator. The idea came to them to build an automatic sliding door back in the mid-1950s when they saw that the existing swing doors had difficulty in operating in Corpus Christi's winds.

The two of them went to work and now came up with the idea of inventing an automatic slide door which would circumvent this problem of high winds and their damaging effect. Horton automatic Inc. was formed in 1960, there by placing the first commercial automatic slide door in the market and literally establishing a brand-new industry. Their first door in operation was donated to the city of Corpus Christ for it shoreline drive unit department. [4]

2.1.1 Types of Automatic Doors

There are three major types of automatic doors:- slide door, swinging and folding automatic doors.[2]

2.1.2 Automatic Slide Doors:-

This type of door provides effective two way traffic. Sliding doors are equipped with a feature that allows the sliding door to open when pushed out in emergencies. These doors require adequate amount of slide room in which the door can move.[2]

2.1.3 Automatic Swinging Doors:-

Two doors are typically used when a swing door is automated. One door swing inward and the other swing outward. This enables two way traffic. It is crucial that these types of doors are marked to indicate the direction of travel.[2]

2.1.4 Automatic Folding Doors:-

Folding doors have two or more separate panels. The first panel swings and the panel slides in a guide, enabling it to slide as both panels swing in v shape, which is the fold. These types of door may either include single folding door that swing in and out or a pair of door that simultaneously fold in and out. It requires a minimum space to install.[2]

2.2 HISTORY OF METAL DETECTION

A metal detector is a device which respond to metal that may not be readily apparent. The simplest form of metal detector consist of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of metal is close to the

1. 8-bit ALU, accumulator and 8 bit registers.
2. 8-bit DATA BUS it can access 8-bit of data in operation.
3. 16-bit ADDRESS BUS it can access 64kb memory location.
4. ON CHIP RAM 128 bytes (data memory).
5. ON CHIP ROM 4kBytes(program memory)
6. 4 byte bi-directional input/output port
7. UART (serial port)
8. Two 16-bit counter/timer
9. Two level interrupt priority
10. Power saving mode.

A new and particularly useful feature of the 8051 core was the inclusion of the Boolean processing engine which allow bit level Boolean logic operations to be carried out directly and efficiently on internal registers, and RAM. This critical feature helped cement the 8051's popularity in industrial control applications, because it reduced code size by as much as 30percent. It also have 4 register set which reduces interrupts latency. The MCS-51 UART make it simple to use the chip as a serial communications interface. External pins can be configured to connect to internal shift registers in a variety of ways, and the internal timers can also be used allowing serial communication in a number of modes both synchronous and asynchronous. Some modes allow communication with no external components. Once a UART and a timer if necessary have been configured, the programmer needs only to write a simple interrupt routine to refill the send shift register whenever the last bit is shifted at by the UART and/ or empty the RAM the receive shift register.

The MCS-51 has four distinct types of memory- internal RAM, special function registers, program memory and external data memory. The internal RAM (IRAM) is located from address 0 to address 0xFF. IRAM from 0x00 to 0x7F can be accessed directly and the byte from 0x20 to 0x2F are also bit –addressable. Special function registers (SFR) are located from address 0x80 to 0xFF and are accessed directly. Program memory (PMEM) is located starting at address 0. There are various high level programming language compliers for 8051. Several C compilers are available for the 8051. Most of which feature extension that allow the programmer to specify where each variable should be stored in it Six types of memory , and provide access to 8051 specific hardware features such as the multiple register banks and bit manipulation instructions. There are many commercial C compilers. SDCC is a popular open source C compiler, others are FORT, BASIC, PASCAL, but they are less widely used compared to the C and assembly language.

The 8051 has the following feature:

1. It is compatible with MCS -51 TM products.
2. 8k bytes of In-System Reprogrammable flash memory.
3. Endurance:1000 write/erase cycles.
4. Fully static operation: 0Hz to 24Mz.
5. 256x8-bit internal RAM.
6. Eight Interrupt sources.
7. Programmable serial channel.

The block diagram of a microcontroller is as shown below:

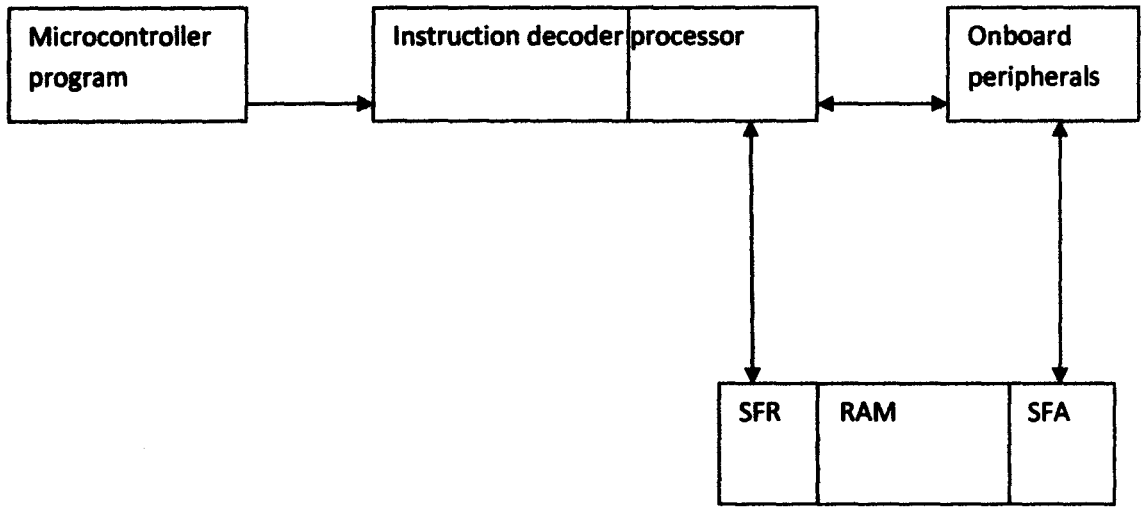
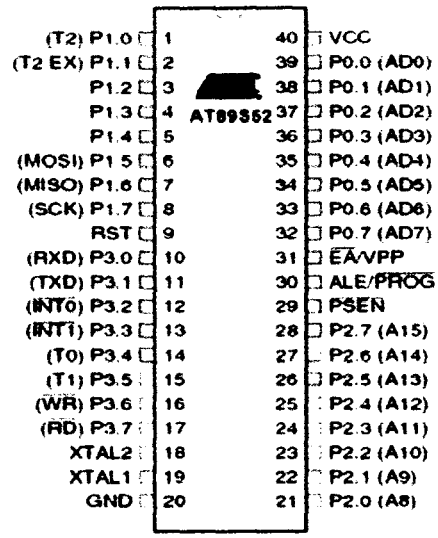


Fig 2.1.3 microcontroller block diagram

Microcontroller programming:

It comprises of set of instructions written by the designer. It usually comprises of four classes of instructions which are :

1. Arithmetic operation
2. Logic operation
3. Data transfer operations
4. Branch operations



PIN Configuration:

Fig 2.1.4 a 8051 MICROCONTROLLER.pin configuration

FUNCTIONS OF PINS:-

VCC

Supply voltage.

GND

Ground

Port 0

This is an 8-bit open drain bidirectional i/o port. Each pin can sink eight TTL inputs, and when 1s are written to port 0 pins, the pins can be used as high impedance inputs. it can also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory, also it receives the code during flash programming and output codes bytes during program verification. This comprises of pin 1-8.

RST: Reset Input: a high on this pin for two machine cycles while the oscillator is running reset the device. When held at 0 it runs normally. This is PIN 9.

PIN 10-17: This is the port 3 which is another bidirectional input port. Each pin on this port serves an additional function from those in port 1. Pin 10 and 11 receive and transmit respectively using RS232 product, 12 and 13 process the interrupts, 14 and 15 have alternative functions associated with timer 0 and timer 1, 16 and 17 are based on working with external memory.

PIN 18 and 19: they connect to external crystal, ceramic resonator or oscillator module to the microcontroller.

PIN 20: VSS: this is the ground pin.

PIN 21-28: this is just like the port 2 pins used in working with external memory.

PIN29: (PSEN) program store enable is the read strobe to external program memory.

PIN 30: (ALE) this is an output latch enable used for latching the low byte of the address during access to the external memory.

PIN 31:(EA) It is connected to the ground and used to execute code from internal memory.

PIN 32-39: port 0 except that it does not have internal pull up resistor like port 1, 2 and 3. It is also used when working with external memory.

PIN 40: Vcc this is the 5v pin (on 5v devices). [9]

2.4.1 REVIEW OF RELATED WORKS

A student of Federal University Of Technology Minna[Abio Florence] in 2009 designed a laser guided door controller. He used a laser diode and a transistor, this unit generates the signal. It works in the form that whenever the laser falls on an object, the door opens. This form of automatic slide doors are very expensive.[10]

A student of Federal University Of Technology Minna[LAWAL JIBRIN] in 2010 designed and constructed an automatic slide door. He uses an infrared as sensor. The infrared transmit with the aid of frequency generated using a 555 timer operating in an astable mode. This transmitter has an infrared beam, once the beam is broken by anybody entering through the door or as a result of any form of disturbance detected by the infrared, output signals are given to the microcontroller which has been programmed to drive the motor in a forward direction once the infrared sends the signal to the microcontroller. This opens the door. The drawback of this work was that there is no form of security because it opens to any form of disturbance, so unauthorized persons can go in and out of the building even with weapons without being identified [11]. This was why I came up with the idea of using a metal detector for security purposes.

This informed the motivation for incorporating a metal detector for security purposes in this project.

CHAPTER THREE

3.0 THE DESIGN PROCEDURE

The design procedure of a microcontroller base automatic slide door with metal detection involves the following stages:

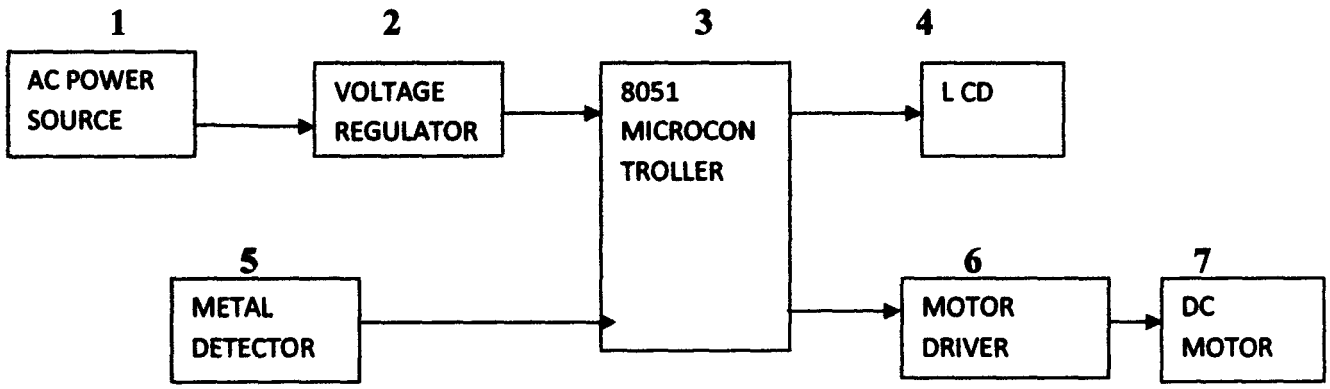


Fig 3.0 The block diagram showing the various stages in the design.

These includes:

1. Power supply
2. Metal detector
3. 8051 (microcontroller)
4. LCD display
5. Voltage regulator
6. BA6209 (DRIVER STAGE)
7. Dc motor

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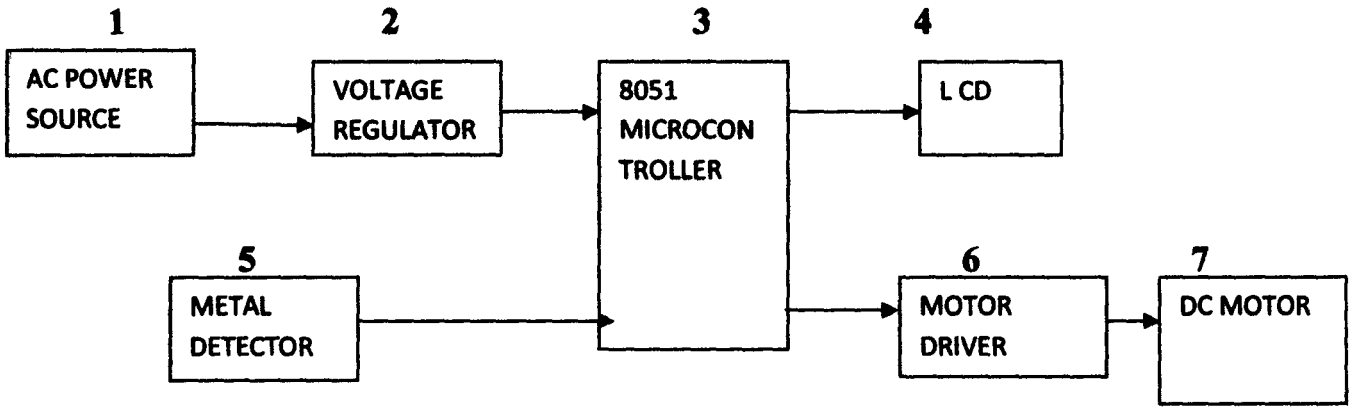

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These includes:

1. Power supply
2. Metal detector
3. 8051 (microcontroller)
4. LCD display
5. Voltage regulator
6. BA6209 (DRIVER STAGE)
7. Dc motor

3.1 Design of power supply unit

The power pack mainly consists of a 240/12v ac transformer, a full bridge rectifier, filtering capacitors and regulators.

The diagram bellow shows the circuit diagram of the power supply unit:-

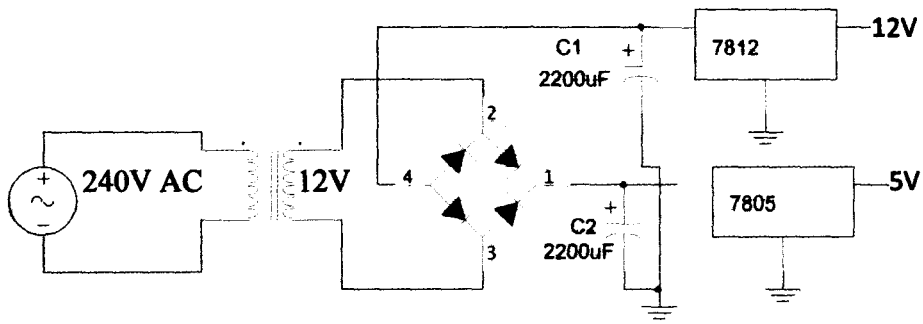

Fig 3.1 power supply unit

The power supply unit supplies ac voltage of 220VA, which was stepped down to a 12VA. This 12VA was now rectified using a full wave rectifier to a 12v dc. The 2200uF capacitor helps in filtering off the ripples after rectification. The 7812ic and 7805ic helps in regulating the voltage to 12 and 5 volts respectively. The transformer rating is 220VAC/12VAC, 500Ma for a voltage of 12volts.

Calculation of the voltage is shown bellow:

The peak voltage Vpeak=V x 1.414. Since v = 12v then

Vpeak=12 x 1.414= 16.971v. [12]

The chosen capacitor was 2200uF which helps in filtering the ripples after rectification

3.1.1 RECTIFICTION DESIGN

A full wave bridge rectifier was used to convert the 240v AC 12v AC.

Calculation of the maximum the voltage.

Vpeak= peak voltage.

Vrms= root mean square voltage

Vmax = maximum voltage

Given that Vmax=1.414 x Vrms. And Vrms=12v

Vmax = 1.414 x 12 = 16.971v. Hence the peak inverse voltage is equal to Vmax

Vmax=Vpeak which is equal to 16.971v.

The diode with peak inverse voltage rating of 110v was chosen in the design of the full wave rectifier. The diode type is IN4001 100v. The circuit diagram and wave form of the rectification process is as shown below:[13]

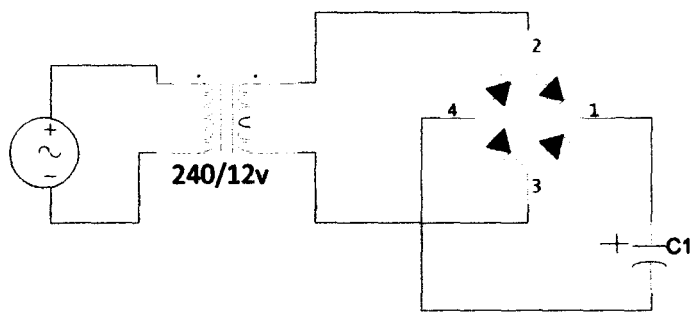

Fig 3.1.1 a full wave bridge rectifier

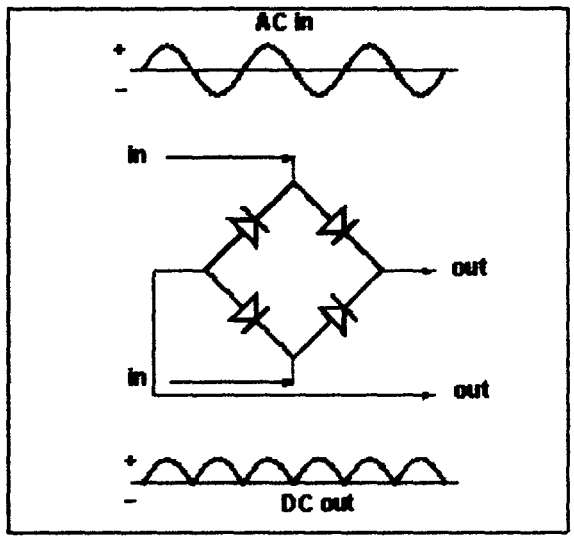

Figure 3.1.1 the rectifier wave form

3.2 METAL DETECTION UNIT

This is the security unit. It is made up of an operational amplifier [LM358] , two 10k resistors, one 100k resistor, 2.2mH inductor, a buzzer and a transistor.

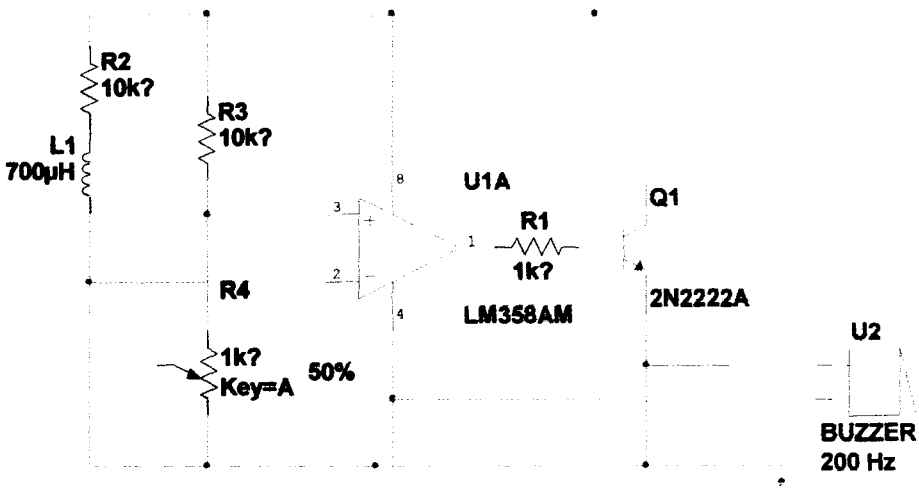

Fig 3.2.1 metal detector circuit

3.2.1 The Amplifier

An operational amplifier is a DC coupled high gain electronic voltage amplifier with a differential input and usually a single ended output. It produces an output voltage that I typically hundreds of thousands times larger than the voltage difference between its input terminals. They are important building block for wide range of electronic circuits.

The LM358 is a low power dual operational amplifiers. It consist of two independent, high gain, internally frequency compensated operational amplifiers which were design specially to operate from a single power supply over a wide range of voltages. The main voltage I + 5volt.

Specification

1. Amplifier type: low power
2. Band width: 1MHz
3. Base Number: 358
4. Gain Bandwidth: 1MHz
5. IC Generic Number: 358
6. Input off set voltage Maximum:9v
7. Operating temperature range: commercial
8. Supply voltage + nom : 5v
9. Supply voltage range: 3v to 32v.

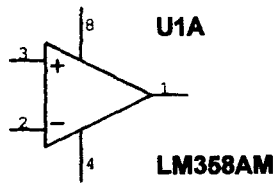

Fig 3.2.2 OP-AM

1. 1 is the Vout: output voltage.
2. 2 is the V+ : non inverting input
3. 3 is the V- : inverting input
4. 4 is the Vs- negative terminal supply
5. 8 is the Vs+ positive terminal supply

The power supply pins are Vs+ and Vs- from Vout= (V+ - V-)Aol where Vs+ is the non inverting terminal voltage and Vs- is the inverting terminal voltage and Aol is the open loop gain. [14]

3.2.2 TRANSISTORS AS A SWITCH.

The basic function of a switch is to connect and disconnect some supply voltage to load. A transistor is an electronically controlled switch that will close the connection between the collector and the emitter when the difference between the base voltage and the emitter voltage exceeds about 0.7V.Below are the characteristics of an ideal switch:

1. No leakage current when its open.
2. It is perfectly short circuited when closed.

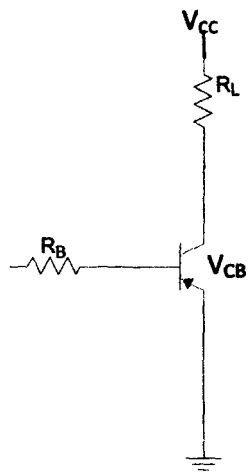

Figure 3.2 .3Transistor As A Voltage Switch.

From the figure 2.5, the transistor is used to switch the supply voltage to and from the load resistance R_L. If the transistor is switch between cut off and saturation by a supply in the base circuit, the voltage across the load resistance is switched between Vcc and ground. The base current condition is given by:

$\beta I_B = I_C = (Vcc - Vce(sat)) / R_L = Vcc / R_L$

Since Vce (sat) << Vcc

$V_{BB} = V_{BE} + I_B R_B = V_{BE} + V_{CC} R_B / \beta R_L$

To drive the transistor into full conduction the lowest possible value of V_{BE} (at IC= V_{CC}/R_L) must be considered. To drive the transistor into the cutoff condition, V_{BB} is made slightly positive relative to the emitter. The positive feedback value should exceed $I_{CO}R_B$ (I_{CO} reversed biased the collector current) so that the emitter junction is reversed-biased, the collector current is approximately I_{CO}. The maximum value of V_{BB} is determined by the breakdown voltage of the reverse baised junction. Although the collector junction voltage exceeds the emitter junction voltage by V_{CC}, both junction must be considered because in some transistor the emitter junction breaks down at a much lower voltage than the collector junction. If R_L is varied, the same voltage V_{CC} is switch across it as long as the base is sufficient for saturation at the value of R_L. Hence, the transistor acts as a switch. [15]

All this components put together make up a simple metal detector. When current passes through the inductor coil, a magnetic field is produced, this field attracts any metal that comes in contact with it. The transistor is then switched on and input signals are sent to the microcontroller, which has being programmed to control the LCD and motor driver. The LCD

displays access denied and the motor drive is in the reverse biased state and the door remain closed.

3.3 AT89C52 (MICRO-CONTROLLER)

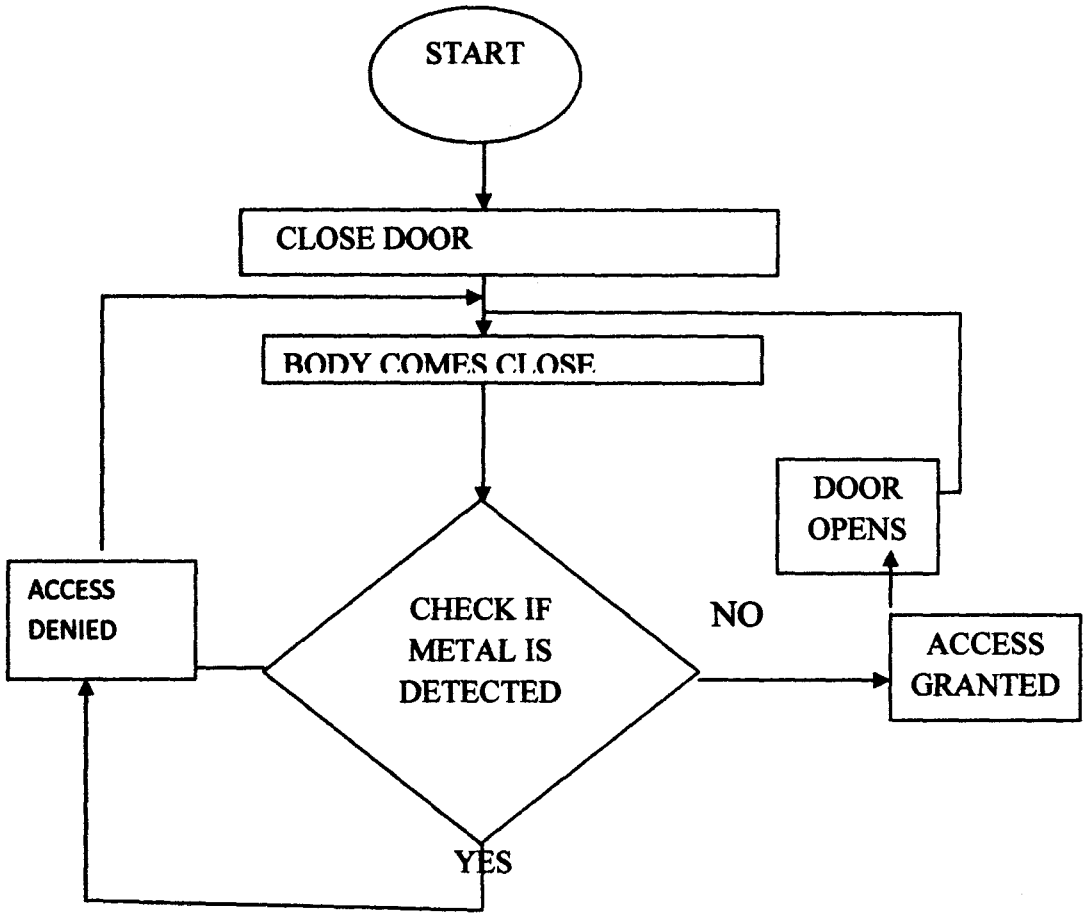

Fig 3.2.4 the flow chat of the Program

The programming section of the project

AT89C52 (micro-controller) is a programmable chip. The pin function and features of this IC have been discussed in the previous chapter (i.e. chapter two).Its operation in the circuit is programmed using C++ which was converted into assembly language using a compiler. The signal obtained is fed into the interrupt pin which notifies the processor that an event has taken

place. The program is written to give an output which is used to operate the driver (BA6209A) used to move the motor both in a forward direction and in reverse direction. R6, R7 are pull up resistors used to make the output of the micro-controller high and they were chosen to be 2.2kΩ. The flow chat of the program is shown in chart 3.1. See appendix 1 for the program code.

3.4 LCD DISPLAY

This a liquid crystal display in short form (LCD), it is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCDs are more energy efficient and offers safer disposal than CRTs. It low electrical power consumption enable it to be used in a battery powered electronic devices. It is an electrically modulated optical device made up of any number of pixels filled with liquid crystals and arrayed in front of light source (backlight) or reflector to produce images in color or monochrome.

In this project, a 16x2 LCD display was used and it diagram is as shown bellow:

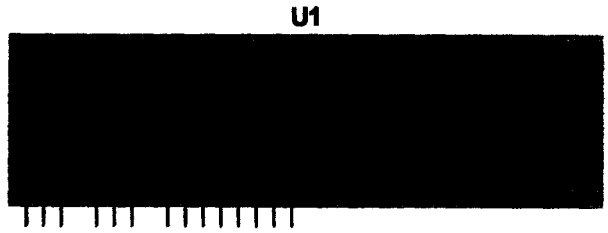

Figure 3.3 LCD 16x2 diagram

The pin configuration is shown below:

Pin no.1 D7 Data bus line 7 (MSB)

Pin no.5	D3	Data bus line 3
Pin no.6	D2	Data bus line 2
Pin no.7	D1	Data bus line 1
Pin no.8	D0	Data bus line 0 (LSB)
Pin no.9	EN1	Enable signal for row 0 and 1 (1st controller)
Pin no.10	R/W	0=write to LCD module and 1=read from LCD module
Pin no.11	RS	0= instruction input and 1= Data input
Pin no.12	VEE	contrast adjustment
Pin no.13	VSS	Power supply (ground)
Pin no.14	VCC	Power supply (+ 5v)
Pin no.15	EN2	Enable signal for row 2 and 3 (2nd controller)
Pin no.16	NC	not connected.

2.5 VOLTAGE REGULATOR

The voltage regulator is an electrical device designed to automatically maintain a constant voltage level. It may be a simple "feed-forward" design or may include negative feed back control loops. This may use an electromechanical mechanism or electronic component.

2.5.1 Measure of regulator quality

The output voltage can only be held roughly constant, the regulation is specified by two measurements:

1. Load regulation is the change in output voltage for a given change in load current (for example typically 15mV, maximum 100Mv for load currents between 5Ma and 1.4A at some specified temperature and input voltage).

2. Line regulation or input regulation is the degree to which output voltage changes as a ratio of output to input change for example (typically 13m V/V) or the output voltage change over the entire specified input voltage range(for example 2% for input voltages between 90V and 260V, 50Hz-60Hz).

The voltage regulator was used to regulate the from a 12V to a steady 5V used in the design.

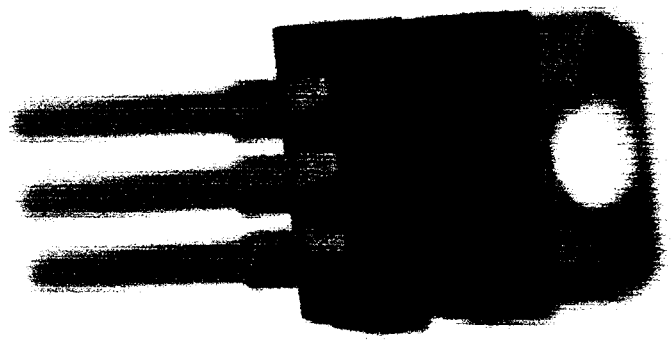

Fig 3.4 The voltage regulator chip

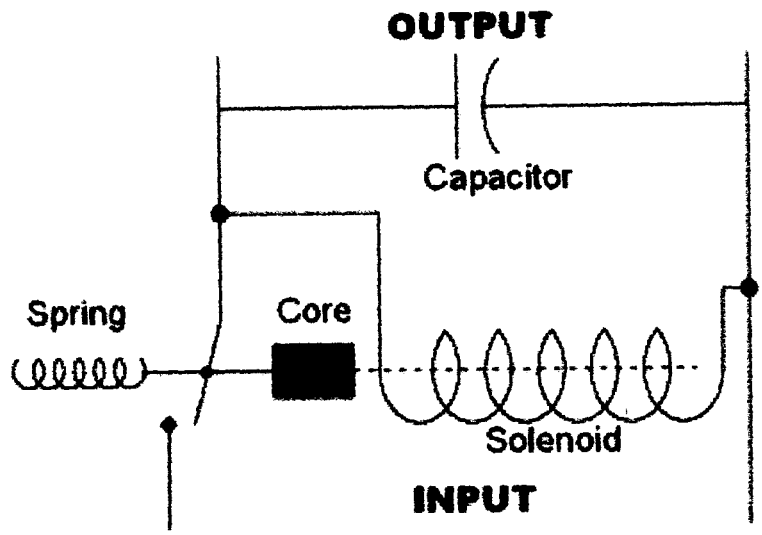

Fig 3.5 Circuit diagram for a simple electromechanical voltage regulator

3.6 DRIVER STAGE (BA6209A)

A Zener diode was used to regulate the 12V dc source to the pin 8 of the driver (BA6209A). Current limiter for the pins 4, 5 and 6 of the driver are taken to be 2.2kΩ, 1kΩ and 2.2kΩ respectively as shown in figure 3.4 (comprehensive circuit diagram). The truth table of BA6209A driver is given in table 3.1.

Table 3.1The truth table

PINS	2	3	4	5	6	10	OPERATION
	LOW	LOW	LOW	X	LOW	LOW	10→2
	LOW	OPEN	LOW	LOW	HIGH	HIGH	2→10
	HIGH	OPEN	LOW	HIGH	HIGH	LOW	10→3
	OPEN	LOW	HIGH	LOW	LOW	HIGH	3→10
	OPEN	LOW	HIGH	HIGH	LOW	LOW	BREAK
	LOW	LOW	HIGH	X	HIGH	LOW	BREAK

X:Don't care

The output from P 2.2, P2.3 (port 2) of the micro controller is fed to pin 6 and pin 4 of the driver (BA6209A).The states of these pins 4 and 6 of the driver are used to determine the operation of the motor taking pin 3 and pin 10 as the driver's output. When the driver's input at pin 6 and pin 4 are at different states the motor operates considering pin 3 and pin 10 as the output which will also be in different states. In table 3.1, an arrow is used to indicate the movement of the motor within pin 3 and pin 10 output of BA6209A.That is, from pin 10 to pin 3 the motor move in forward direction while from pin 3 to pin 10, it moves in reverse direction. This therefore, performs the closing and opening of the door. The picture which will give a clear explanation about this stage is attached in figure 3.4 (comprehensive circuit diagram).

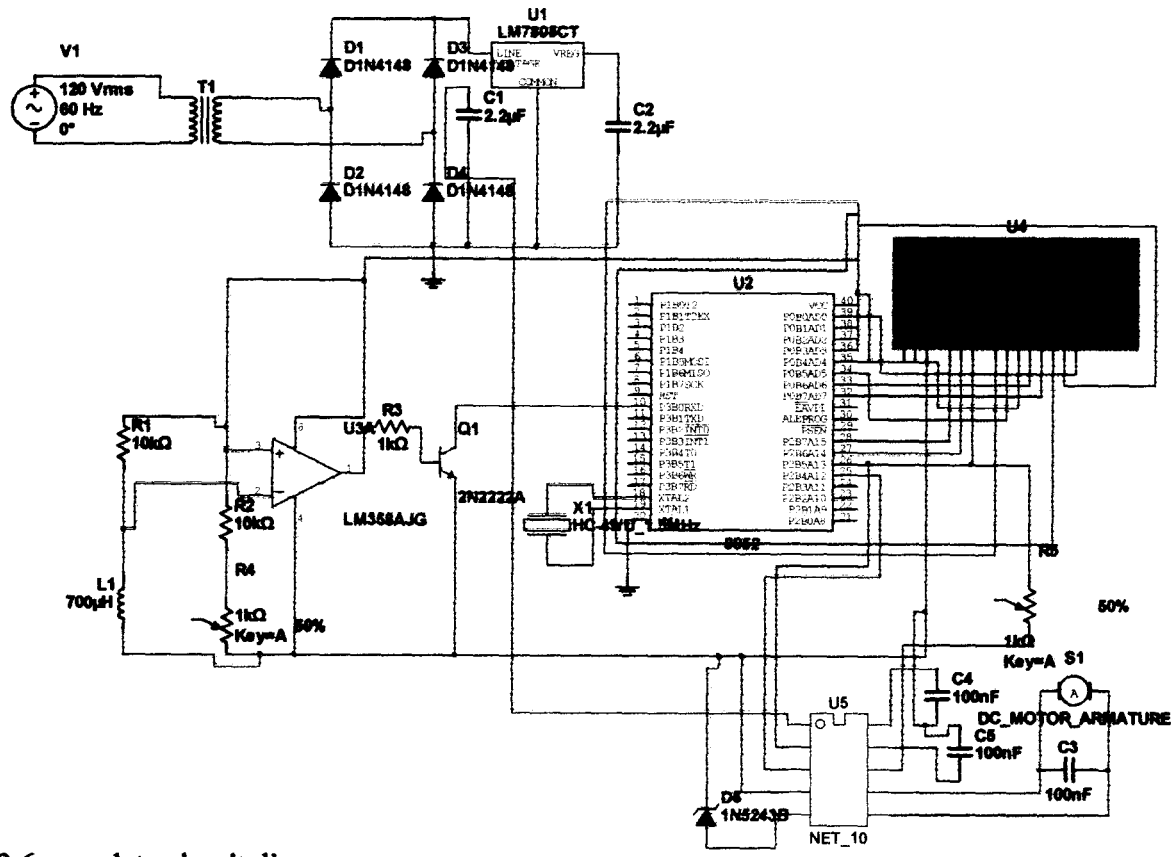

Fig 3.6 complete circuit diagram

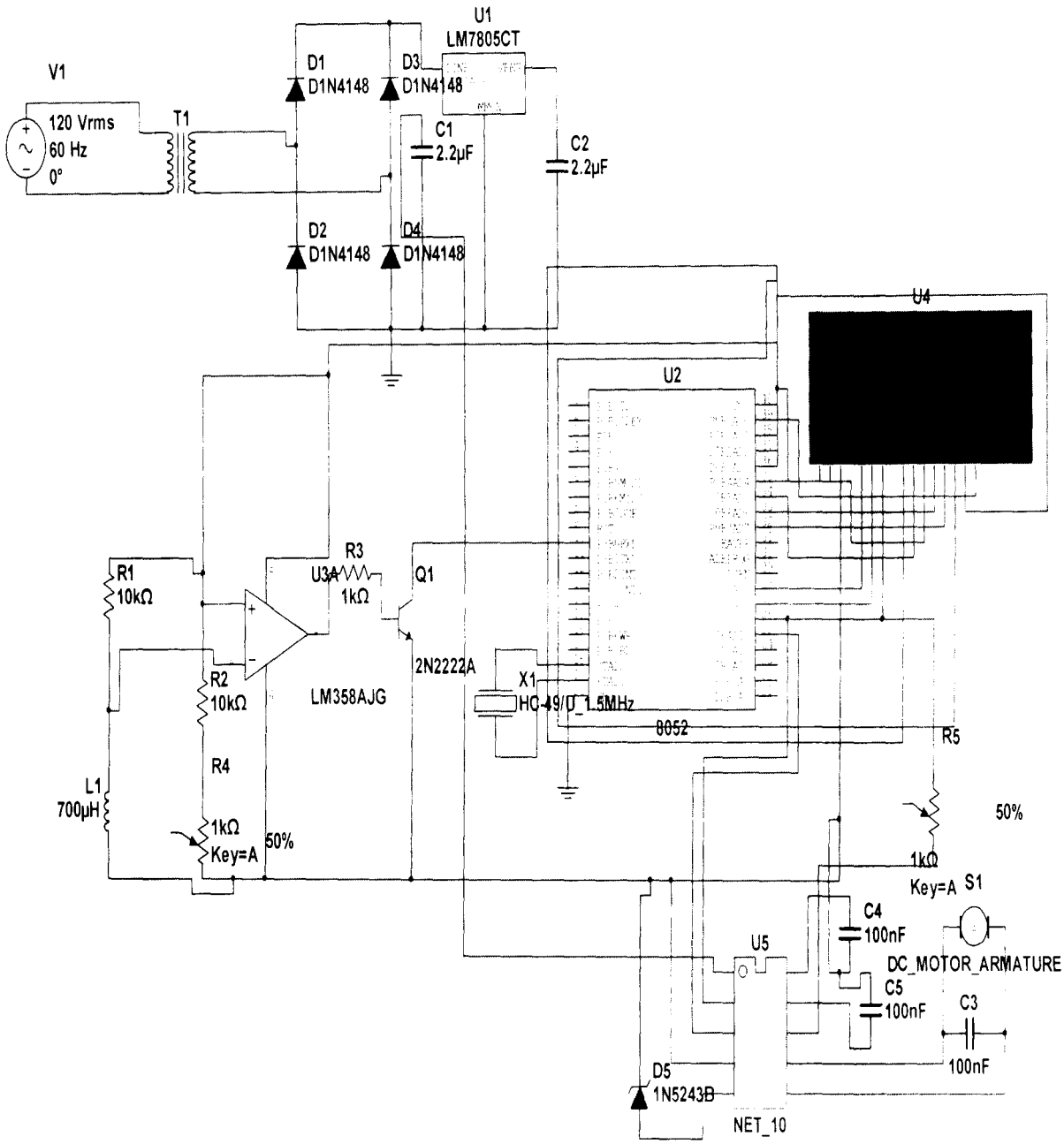

Fig 3.6 Complete Circuit Diagram

CHAPTER 4

4.0 CONSTRUCTION

During the construction, a number of decisions were made on the choice of components. Purchasing of the various components was done, placing all the components on bread board, testing was done and the results was positive. The construction of the project was done in two stages: soldering of the components on the Vero board and coupling of the entire project into casing. The circuit in chapter 3 was implemented and stimulated and was positive.

4.1 TESTING

The testing and implementation process involved the use of some equipment such as:

1. Multimeter
2. Oscilloscope

Digital multimeter was used to test the design on the Vero board, the required measurement was taken such as the voltages, current, resistors and continuity of the circuit and the frequency measurement was taken.

Oscilloscope was used to observe the ripples in the power supply wave form and to ensure that all the waves forms are correct and the frequency are accurate.

4.2 PROBLEMS ENCOUNTERED

Several problems was encountered during the project. These include: design, implementation and construction problems. The major ones are as follows:

1. Problem of getting the actual sensitivity of the detector which was solved.

2. Problem encountered in driving the dc motor it was solved using a motor driver BA6209.
3. Burning of the LCD display due to some errors which was corrected.
4. Errors during soldering and measurement, these was solved by proper troubleshooting and serious care in the construction of the project.

4.4 BILL OF COMPONENTS

Table 4.1. Bill of Components.

S/N	ITEM	QUANTITY	UNIT PRICE	TOTAL AMOUNT
1	TRANSFORMER 240VAC/12VAC	1	₦250.00	₦250.00
2	DIODE IN4001	4	₦ 30.00	₦ 120.00
3	CAPACITOR	6	₦ 20.00	₦ 120.00
4	RESISTOR	6	₦ 20.00	₦ 120.00
5	DC MOTOR	1	₦ 250.00	₦ 250.00
6	BA6209	1	₦ 350.00	₦ 350.00
7	AT89C51	1	₦ 500.00	₦ 500.00
8	LCD		₦ 1500.00	₦ 1500.00
9	Inductor	1	₦ 20.00	₦ 20.00
10	Coil	1 yard	₦ 150.00	₦ 150.00
11	Crystal oscillator	1	₦ 100.00	₦ 100.00
12	TRANSISTORC945	1	₦ 150.00	₦ 150.00
13	12V ZENER DIODE	1	₦ 100.00	₦ 100.00
	TOTAL			₦ 3180.00

CHAPTER 5

5.1 CONCLUSION

A microcontroller based slide door using metal detector has been designed and constructed. The performance of this project depend on metals around the door close enough to be sensed or a person trying to enter through the door. During the construction of this project which is a micro-controller based slide door using metal detector, some factors were been considered. Factors such as cost, availability, reliability of components and their durability. The operation of the project was realized after test. The components were soldered well on the Vero-board in such a way that fault will be detected easily which will make maintenance and repairs an easy task and affordable for the user whenever the need arises

5.2.1 RECOMMENDATION

A standby power supply should be provided since the circuit won't operate when there is a power failure. This helps prevent damage of the door when it is forced to operate in a case where there is power supply problem.

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APPENDIX A: MICROCONTROLLER PROGRAME

```
#include<reg51.h>

sbit motor_a=P3^7;
sbit motor_b=P3^6;
sbit a_key  =P2^0;
sbit metal  =P2^1;
sbit en=P2^5;
sbit rw=P2^7;
sbit rs=P2^6;
sbit alarm=P2^2;
#define lcd_port P0
void lcd_cmd(unsigned char);
void dly(unsigned int k)
{
unsigned int x,y;
for(x=0;x<k;x++){
for(y=0;y<1000;y++);
                        }
}
void clr_lcd (void)
{
  lcd_cmd(0x01);
}

void write(unsigned char c,unsigned char reg_select)
{
en=0;
rw=0;
rs=reg_select;
```

```
lcd_port=c;
en=1;
en=0;
}
void lcd_data(unsigned char c)
{
write(c,1);
dly(1);
}
void lcd_cmd(unsigned char c)
{
write(c,0);
dly(2);
}

void init_lcd(void)
{
lcd_cmd(0x38);
lcd_cmd(0x0c);
dly(1);
lcd_cmd(0x01);
dly(1);
lcd_cmd(0x06);
dly(1);
}
void lcd_pos(unsigned char row,unsigned char pos)
   {
while(*p)lcd_data(*p++);
}
 void motor_clr (void)
 {
```

```
if(!a_key)
      {
  clr_lcd();
        lcd_pos(1,0);
        lcd_string ("PLEASE WAIT !!");
        lcd_pos(2,0);
        lcd_string("DOOR SLIDING!!!");
    motor_a=0;
          motor_b=0;
          dly(400);
          motor_a=0;
    motor_b=1;
    dly(1000);
          motor_a=1;
          motor_b=1;
          dly(400);
          motor_a=0;
    motor_b=1;
                        }
else
 motor_a=0;
 motor_b=1;
}
 void show(void)
{
 clr_lcd();
 {
 lcd_pos(1,0);
 lcd_string("   SCANING !.....");
 dly(200);
 clr_lcd();
```

```
lcd_pos(1,0);
lcd_string("   ACCESS DENY..");
dly(1);
lcd_pos(2,0);
lcd_string(" METAL DICTECTED ");
dly(1);
                }
        }
void alow(void)
{
clr_lcd();
lcd_pos(1,0);
lcd_string("    SCANING.... ! ");
dly(200);
clr_lcd();
lcd_pos(1,0);
lcd_string("   WELLCOME ");
dly(1);
lcd_pos(2,0);
lcd_string("ACCESS GRANTED..");
//dly(1);
}
void permit(void)
        {
 if(metal==0)
 {
 alarm=0;
 dly(200);
 alarm=~alarm;
 dly(80) ;
  show();
```

```
        dly(200);
//      clr_lcd();
        }
else if(metal==1){
    alow();
        dly(200);
        } }
void logo(void)
{
motor_a=0;
motor_b=1;
        clr_lcd();
        lcd_pos(1,0);
        lcd_string("AUTO SLIDE DOOR/");
        lcd_pos(2,0);
        lcd_string("METAL DICTATOR");
        dly(600);
        clr_lcd();
        lcd_pos(1,0);
        lcd_string("BY UMAR");
        lcd_pos(2,0);
        lcd_string("2006/24430EE ");
        dly(600);
        clr_lcd();
        lcd_pos(1,0);
        lcd_string("ELECT/COMPT.ENGR");
        dly(600);
        clr_lcd();
        lcd_pos(1,0);
        lcd_string("SUPERVISED BY...");
        lcd_pos(2,0);
```

```
        lcd_string("MR ACHONU ADEJO.");
        dly(600);
        clr_lcd();
        lcd_pos(1,0);
        lcd_string("MCTRLLER. BASED");
         }

void main(void)
{
init_lcd();
logo();//show();
while(1)
{
alarm=0;
dly(50);
alarm=1;
dly(50);
   motor_clr();
         permit();
```