DESIGN AND CONSTRUCTION OF AN AUTOMATIC DOOR COTROL

BY

DJIBRILLA MOUNKAILA
97/6446EE

THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING,
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY,

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NIGER STATE, NIGERIA.

IN PARTIAL FUFILLMENT OF THE REQUIRMENTS
FOR THE AWRAD OF BACHELOR OF ENGINEER DEGREE (B.ENG.)
IN ELECTRICAL AND COMPUTER ENGINEERING

FEBRUARY, 2002

CERTIFICATION:

I certify that this work was carried out by Djibrilla Mounkaila of the Department of Electrical and Computer Engineering, Federal University of Technology, MINNA.

Engr.P.O. Attah
(Supervisor)

25/02/2002
Date

Dr.Y.A Adediran
(H.O.D)

14/3/02
Date

(External Examiner)

Date

DECLARATION:

I hereby declare that the project work is an original concept wholly carried out by Djibrilla Mounkaila, under the supervision of Engineer ATTAH, P.O of the department of Electrical and Computer Engineering, Federal University of Technology Minna.

DEDICATION:

I dedicate this work to my country (Niger Republic),

My father (Mounkaila Seyni) and mother (Mintou Halidou), my

Stepmother (Aichatou Issa), my brothers and sisters, my fiancé and

Her family and also my Village (Kobe-Keina)-

ACKNOWLEDGMENT

My most profound thanks and gratitude goes to Almighty ALLAH for His mercy over me and who granted me the full heart during this study. My heart feet appreciation goes to my supervisor Engr.P.O. ATTAH whose effort has been to bring the best out of students. I appreciate the effort made by the Departmental lecturers in seeing that I arrive to this stage. I am sincerely indebted to Mounkaila Seyni whose tireless effort has brought me to this work. I also owe Illah Alhamalou, O.Friday and friends for their assistance in various ways. All my relations who have contributed in one-way or the other I appreciated you all.My appreciation also goes to Oumarou Seyni, Salcy Issifou, Tiemogo Daouda, Abdoulaye Seyni, Hamadou Marmoudou, Mariama Insa and Yaiouba Santy.

This acknowledgement will not be complete if I fail to appreciate the love and moral support of Mintou Hafidou Zeno who has taken it upon herself that this project is completed.

I will also wish to thank the following people with whom I have been during these studies: Abdourahmane N., Ousseini I. and Mahamadou M. I must not fail to thank all my classmates and particularly my country mates from NIGER-REPUBLIC and the entire people of NIGERIA who have shown me the legendary hospitality of Africans.

May GOD bless them all.

ABSTRACT:

The use of automatic door control can never be over emphasized.

The need for this project is as a result of increasing use of automation to improve people's standard of living. It deals with the detection of person's presence in a Determined area. In arching this aim, a flat surface under which a press-switch (button) is placed, are used. Their resultant is a current transmitted to a relay, which will activate the door controller (motor).

TABLE OF CONTENTS

CHAPTER ONE

(INTRODUCTION)

1.1 INTRODUCTION:

This project is based on the Design Construction and Testing of an automatic door control. Technically defined, Automatic control is the art of replacing human supervision by robot supervision. Robot can be any system performing mechanical sequences by mean of Electric power. In this case we are using a limit switch locate under a well-defined surface near the door. This surface is supported by some springs and insulated a pen micro-meters from the ground. Once any weighty object on this part, it will be pressed down whereby activating the micro-switch. This later will supply voltage in a relay coil that will automatically attract its iron armature by establishing a magnetic field and this, in turn, causes the contacts of the relay to be made of broken. That is the normally closed (NC) will be opened and the normally opened (NO) will be closed. Those changes of state are used to establish a motor power supply, which will drag our slide door making to be opened.The closing of the door is obtained by using the opposite rotation of the motor. This is done after a set-time provided by a delay relay that is switched by another limit-switch pressed by the door after opening. In this project for testing purpose the dragging motor used is a small d-c of g r controlling a small door designed to that effect.

1.2 LITERATURE REVIEW

The basic function of an Automatic door control system is to sense the coming near to the door by any weighty object or person then activate a motor to open the door and close it after some times. This has to be done with maximum assurance. Further more the idea control system should also be highly reliable and work only under the outside it was designed for. For example it should not be subject of false operation due to neighboring condition s (vibration and its similar)

Any automatic control has six essential features that are:

1- The material (electricity).

2- The process (Relays and their links).

3- The sensing device (Micro-contact or limit-switch).

4- The output device (door motion and LED's).

5- The general program (sequence of operation)

6- The robot brain (link between sensing device, output device and Relays)

And we have three distinct kinds of automation viz

-Command automation: In this kind of automation the sensing devices of the system have no effect on the command ability of the robot brain. They are generally used to relay data to instruments that are read by human operators who then may change the general instruction issued to the robot brain.

Feel back automation: This is the technique used to determine variations in output from a process and adapt the process to contract these changes.

Feel forward automation: These are the third important form of automation in which data are sensed from input materials and the subsequent process adjusted to take changes in their data into account.

In this present project the most vital element is the sensing device.

There are numerous instances in automated system where an object must be detected.

Several methods have been developed and refined in order to achieve this task, including (1) electromegnet inductive (radio frequency) devices and other magnetically actuated dry reed switches, Hall effect switches, winged switches and limit switches; (2) Ultra sonic detectors, (3) Photo electric sensors and capacitive sensors; (4) Now are days we can find the video detection depending in their field of detection, we can distinguish pediatric detectors, volumetric detectors, line presence detector (infrared emitter and receiver or photocell filling a light beam and surface detector)

For the later in which this project is more concerned, we have twelve main types of all operating accordingly to the target size, weigh and approach we have:

(a) The side mounted roller

(b)The top mounted roller

(c)The rod lever

(d)The adjustable-radius roller lever

(e) The standard roller lever

(f)The yoke roller lever

(g) The offset roller lever

(h) The spring rod lever

(i)The flexible top lever

(j)The top plunger

(k) The side roller plunger

(l)The woober switch (micro-switch)

1.3 PROJECT OBJECTIVE

The main objective of this project is to design and construct a multi purpose movement detector, which will form the basis of the automatic controllers in this project. It will work by detecting a direct moving objects or persons by appraising the weigh. It intended that the system will be insensitive to vibration and certain small masses.

1.4 PROJECT LAYOUT

This project is divided into four chapters.

Chapter one discusses general introduction of the project, the literature review, the objective and motivation of the project and its layout-

Chapter two was on system design: There calculations leading to the choice of component used where shown after introducing the chapter and other technical report will be stated.

Chapter three was assigned with construction, testing, result and discussion of result.Chapter four is left for recommendations and concusion; we also give suggestions, appendix and references.

CHAPTER TWO

(SYSTEM DESIGN)

2.1 INTRODUCTION

In electrical and computer engineering, we deal with block diagram for better illustrations and analysis of circuits .

That why this work will be represented in block diagram form shown in fig.2.1.1

We can distinguish two main blocks: Electrical circuit and Mechanical devices with their various sub units. (The Power Supply Unit) The sensing devices, the processing module and output module followed by the mechanical devices further more we can consider the block form by the sensing devices processing device and output devices, as functional unit

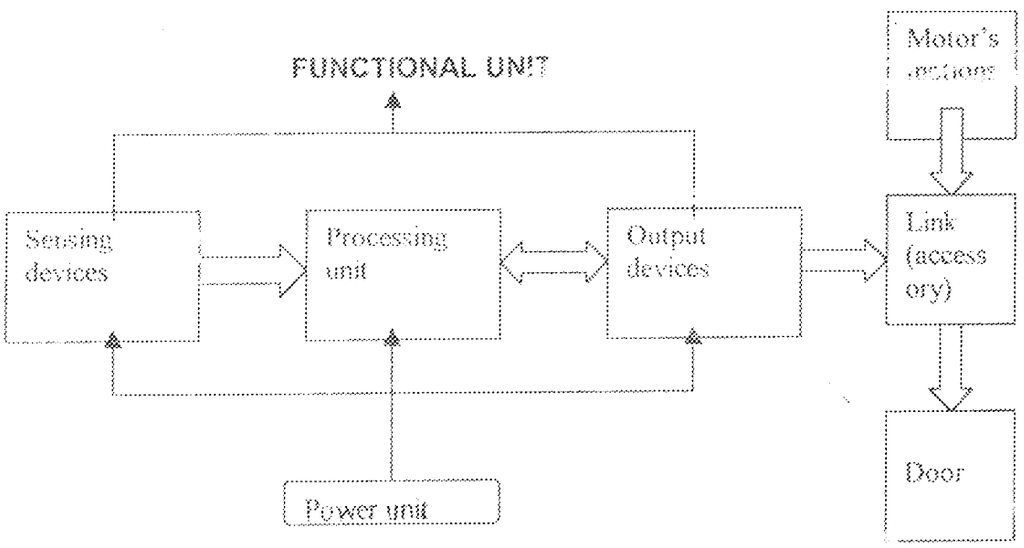


Fig.2.1.1 Block diagram of an automatic door control.

2.2 ELECRICAL DEVICES

2.2.1 Power Unit:

(1) The Transformation Stage

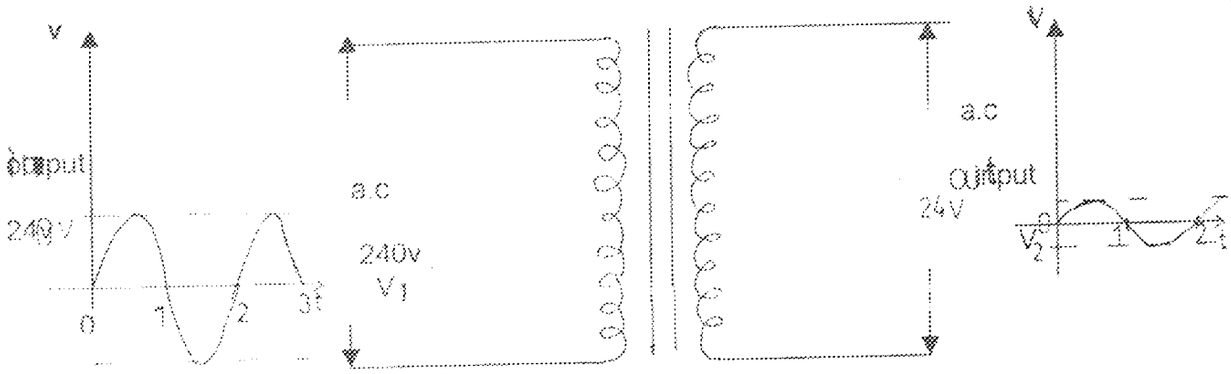


Fig 2.2.1 A transformer and its in put/output voltages representation

from the Fig2.2we can see that V_2 =1/10 V_1 =V_2 /V_1 = 1/10

But f_1 =f_2 =50hz with f_1 = primary frequency

f_2 = secondary frequency

Let I_1 be the primary current and $I_2$the secondary current applying transformer effect relationship V_1 /V_2 =n_1 /n_2 =I_2 /I_1 =1/10 and for a value of I_2 =2 (A)

We can deduce from I_2 /I_1 =10 that I_2 /10=I_1

Thus I_1 =0.2(A)

We can now calculate the power consumed in the circuit with the formula P=IV

Thus P_2 = I_2 V_2 =24(v) x 0.2 (A)=4.8 (w)

(ii) RECTIFICATION STAGE

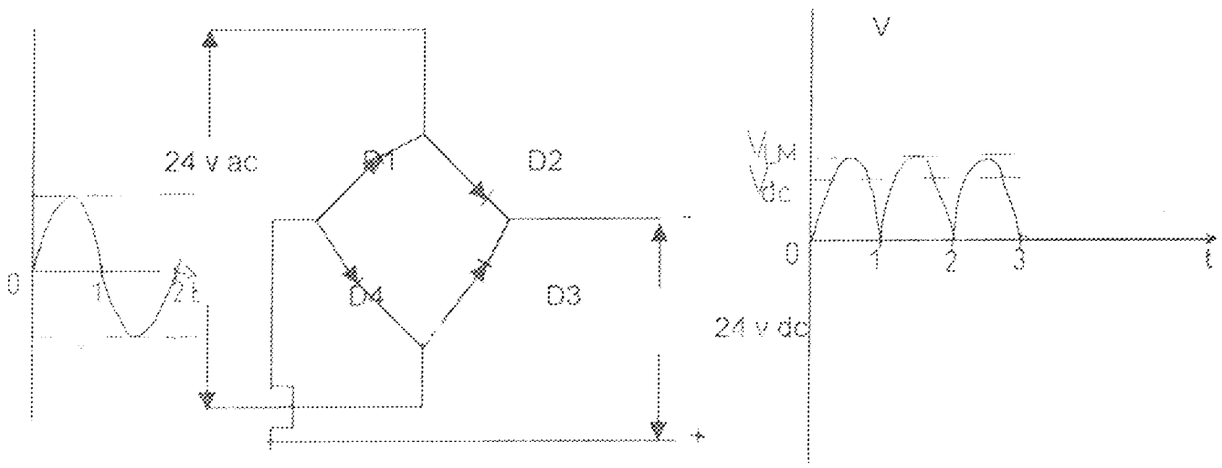


Fig. 2.2.2 Bridge rectifier

The average and RMS values of the voltage are given by the equation

$V_L = V_M / \sqrt{2} = (1/\sqrt{2})\, V_M = 0.707V$

Where V_L is the RMS voltage value

V_M is the average voltage value

(iii) THE FITTRING STAGE

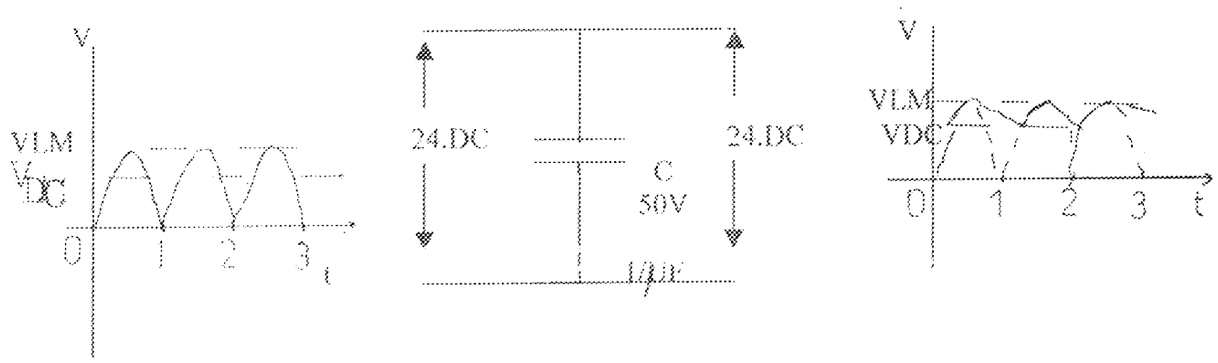


Fig. 2.2.3 The Filter

LET Vr (p-p) be the amount by which capacitor voltage fall during discharge period tr.

VC=discharge voltage= $V_{ip}.e^{-t/CR_L}$

C=capacitance of the capacitor

R_L =load resistance

idc=dc current and dq the charge lost $Vr(p\ p)=dq/c=ID.Tr/C = V/FrCR_L$

The rms voltage value is V_r (rms)=Vr (p-p)/$2\sqrt{3}$

(iv) REGULATION STAGE

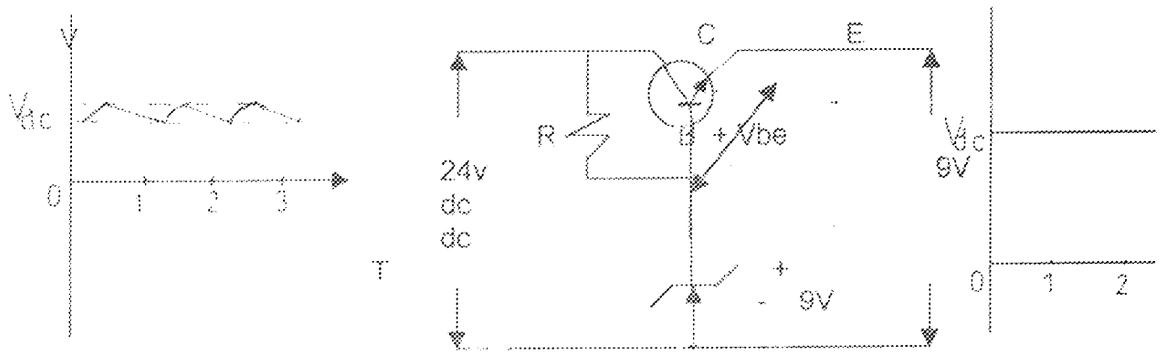


Fig.2.2.4 The regulator (7809)

Let V_z =Voltage across the Zener diode

Vbe=Voltage across the junction Base-Emitter of the transition

V_L =The load voltage.

$V_L + Vbe - V_z = 0$

Thus $Vbe = V_z - V_L$
(Fixed)

2.2.2 FUNCTIONAL UNIT:

(1) SENSING DEVICES:

Actuator

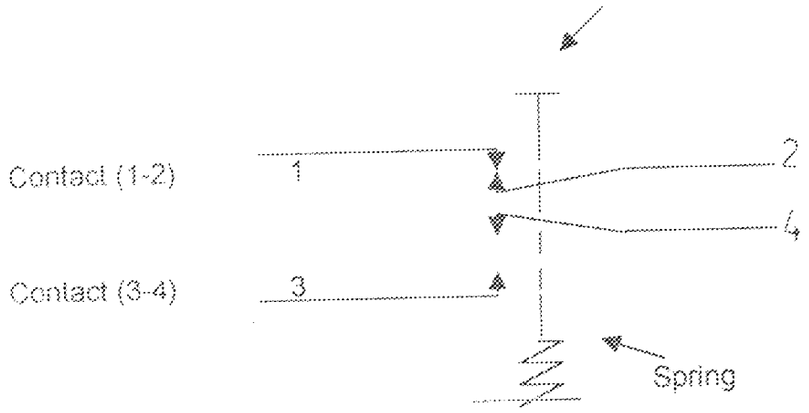


Fig.2-2-5 limit switch

They are all electromechanical limit switches and needs a simple pressure on their actuators to establish or interrupt their contacts

These will automatically go back to their initial position after releasing the actuator.

(ii) PROCESSING

(A) Relay - 1

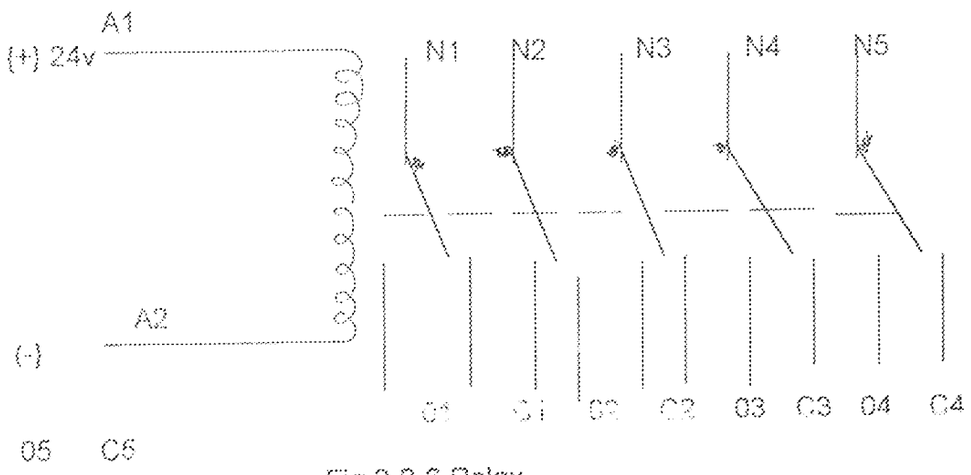


Fig.2-2-6 Relay

Is a normal relay with five input pins and 5 pairs of output pins (5xNo and NC). The coil has its supply through A1 and A2 and will be energized when a 24v dc is applied to its terminals. Thus attract its moving blades. It need a very small amount of current with is given by: I=V/R=24/ 10=>I=2.4(A)

Where V=Applied voltage

R=Coil Resistance

And Power consumption is =p =RI^2 = 57.6 (W)

(b) RELAY (ii)

Delaying device

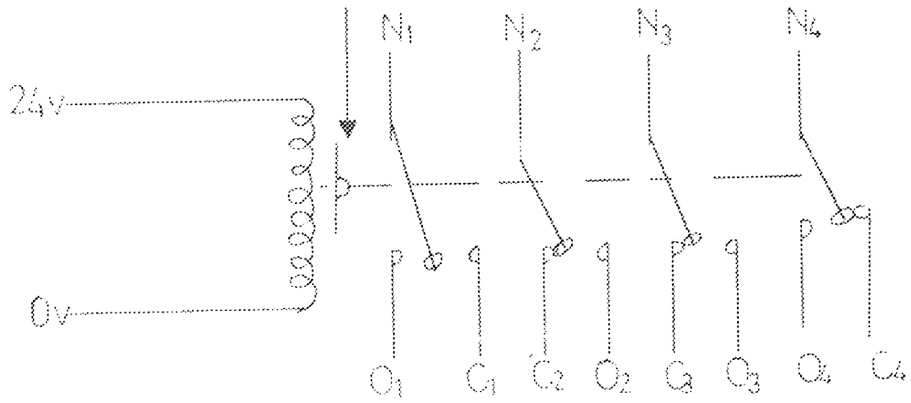


Fig 2-2-7 Delay relay

is a time relay of about 5 seconds delaying time with pins and 4pins of output pin 4 (NO and NC).Its current consumption is given by I=V/R=24/10=thusI=2.4 (A)

And power $P=RI^2$-57.6 (W)

(C) RELAY (iii)

Has the same principle with relay (I) if not that its contacts are four (4)

~~of~~ five(5)

The current consumption is given by I= V/R = 24/15 =>I =1.6A, P =RI

=38.4(W)

(iii) OUT PUT DEVICES

(a) Light emitting diodes

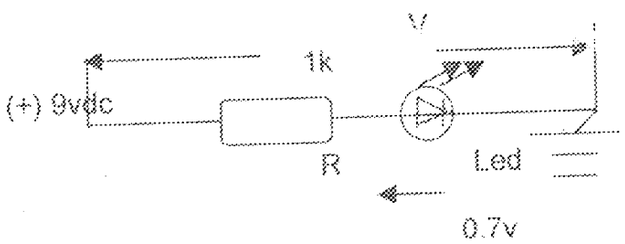


Fig.2-2-8 Led's circuit

Let= R_{Led} be the LED'S resistance

R be the resistor resistance

V the voltage across the line

V_{Led} the voltage drop across the LED=0.7v

from LED'S Theory I the line current

$V=(R+R_{Led})\ I= IR+IR_{Led}$

$V=IR+V_{Led}$ ⇨ $IR=V-V_{Led}$ $IR=9-0.7=8.3(v)$

From with I=83/R=8.3/1000=(8.3) 10^{-3} the power consumed by the line is P = VI= (9) (8.3) 10^{-3} =0.074 (W)

(b)The d.c motor

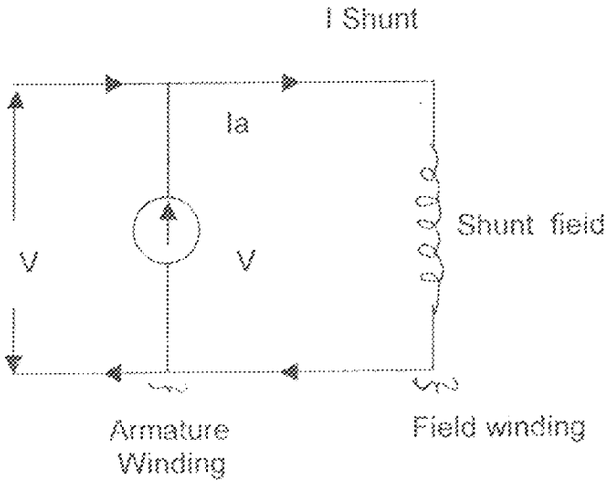


Fig. 2-2-9 d.c motor shunt field

Let V be the applied voltage across the armature

Eb the back em.f

Ia Ra Armature ohmic drop

The voltage equation of the motor is given as: V=Eb+IaRa

And the power consumed is P=VI=30(W)

When calculating for the motor efficiency we should take in account the power lose since out of armature input, some is nested in Ia R loss and the rest is converted into mechanical power within the armature.

Thus efficiency =EbIa/VIa=Eb/V

It can be seen that the higher Eb compare to V; the higher the efficiency.

2_3 MECHANICAL DEVICE:

The motor is fixed in one place and provided with a gear at is shaft.

Along the door's motion line was placed a Rock-straight which is attached to the door.

When the motor is running it will be dragging the Rock thus the door.

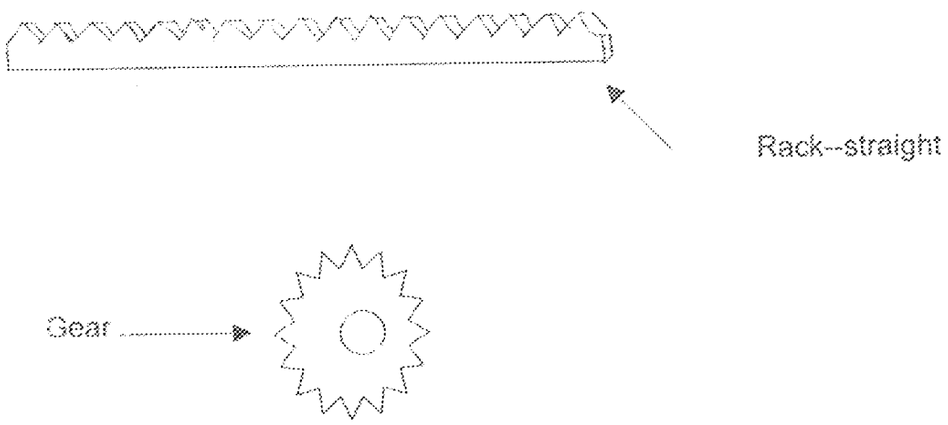


Fig 2-3-1 Mechanical devices

CHAPTER THREE

(CONSTRUCTION, TESTING AND RESULTS)

3.1 CONSTRUCTION:

This sub-chapter will highlight how the different parts of the system were brought together. It will also give an explicit detail of each block represented in the chapter 2 -Fig. 2-1-1.

It is the final stage of the work and shows the real life setting of the system.

3.1.1 ELECTRICAL UNIT:

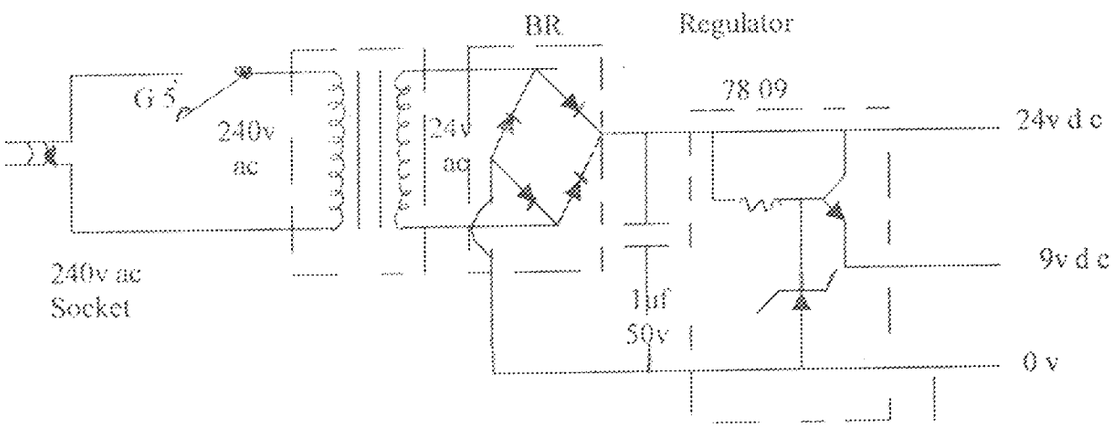


Fig.3-1-1 Power supply

3.1.2 Function unit

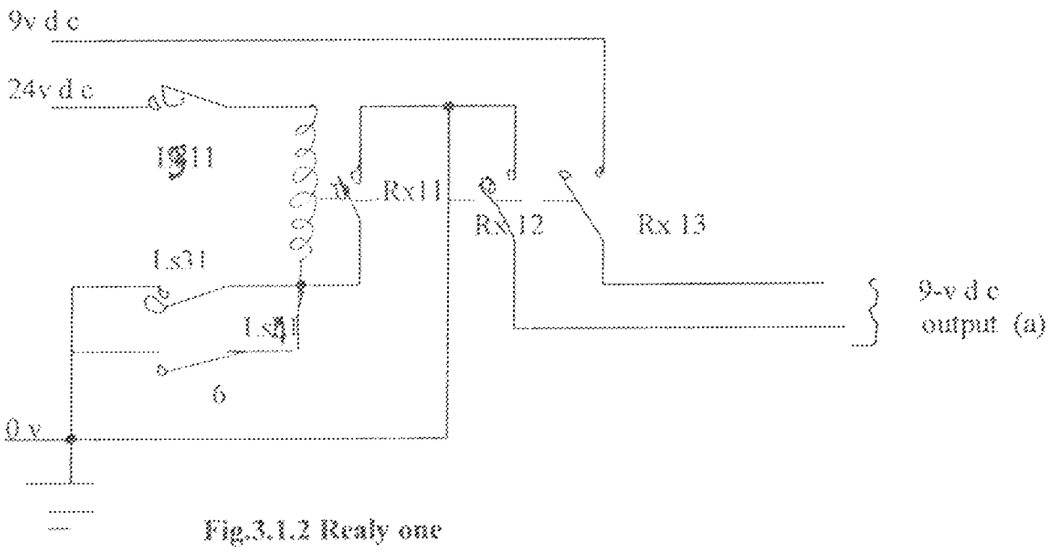


Fig.3.1.2 Realy one

RELAY II

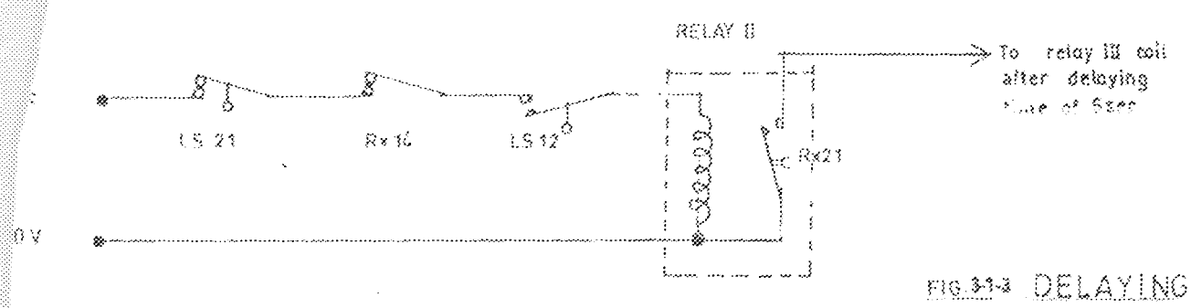


FIG 3.3-3 DELAYING

RELAY III

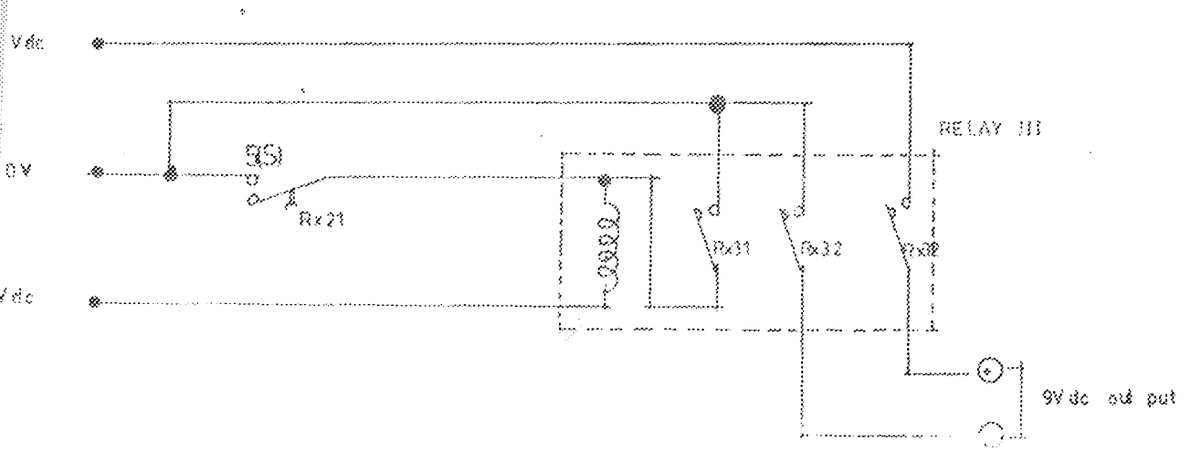


FIG 3.3-4 CLOSING

OUTPUT DEVICES

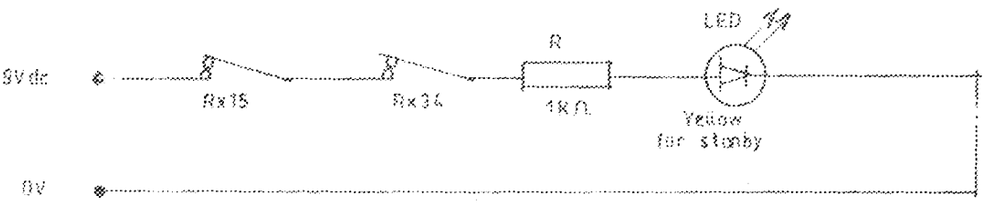


FIG 3.3-5 STANDBY INDICATOR

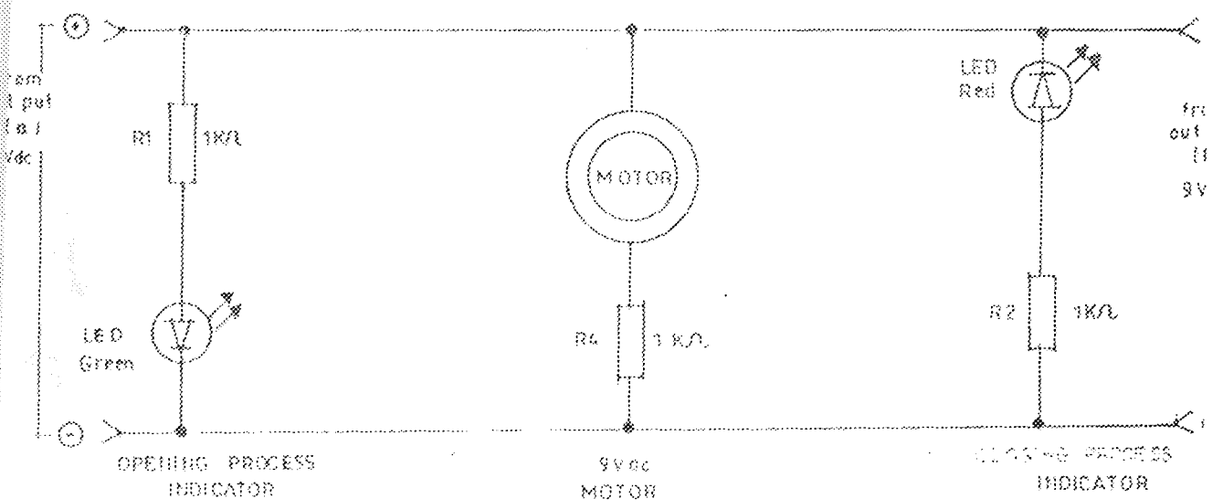


FIG 3.3-6 OUTPUT DEVICES

3.2 TESTING

3.2.1 THE STAGES TESTING

This is done stage-by-stage following the block diagram 2 of the system represented in fig.2.1.1 in chap 2.

When the 240v is supplied to the transformer, it first makes sure that I have my required output voltage (24v) from it. Then the 24 dc after the bridge rectifier. Next is to measure the value of the voltage after the regulator. When all these are done I then test the relay effect when the sensor is activated and the required timing for the delay relay-I measured the voltage across the dc motor for the two directions. All these are done before the system is mounted together with the mechanical accessories.

3.2.2 THE OVER ALL SYSTEM TESTING

Here one will first have to switch on the general switch and a yellow light emitting diode showing the standby position will on. Next stage is to try walking towards the door either internally or externally and it will automatically opened by about 5 seconds before closing itself again.

While opening a green light diode will on to show it and a red light emitting diode will show the closing process.

3.3 RESULTS:

During the testing, once a person or object climbs the platform, the door will open, then will close after a giving time (5 seconds). But when many people are crossing, the door will remain opened because of the continuous trigging of the system given by weight of each person. It is then only five second after the last person passes that the door will start the closing process. Again when the door is in closing state and platform is pressed it will automatically change direction that is the opening process will take over.

3.4 DISCUSSION OF RESULTS:

In this design the target was achieved even though it is after many corrections and so many problems enumerated among which:

1-The setting of the platform with the sensor under.

2-To have a reasonable speed (not more not less) for the motor dragging the door.

3-To establish a good compromise between the motor, door and their mechanical link.

Now what we should ask our selves is that, is the technology used in this project more efficient than the modern one using electronic components?

From my investigations, I find out that this method used consist of three relays, this more Power consumption compare to a system using modern sensing and processing devices. For instance an infrared emitter-receiver or a light depending resistor and light Source, combined with electronic processing system, will need at most one relay for Powering the motor.

But for this work what I have taken in account is, the cost, the availability of materials used, and relays are more robust than electronic components.

CHAPTER FOUR

(RECCOMMENDATION AND CONCLUSION)

4.1 RECCOMMENDATION

The output of this design can be used as an alarm system or announcing. It can also operate automatically devices such as tape recorders, video camera's or tele-surveyor.

For this reasons, I recommend that this project should be developed to enhance greater efficiency mainly in the detecting process and the mechanical settings.

4.2 CONCLUSION

As stated earlier, this project forms the basis of the design of an automatic door control system. In the design any action that will make the limit-switch to be pressed will trigger on the door opening and closing process.

The appropriate setting of the sensing devices has prevented the system to be having false operations. And the use of common devices has made to reach the target with relatively low-cost therefore iam here calling the attention of all engineers in our under-equipped countries to make us of available materials in achieving the most sophisticated modern design instead of new products that we will still buy from Abroad-meanwhile we should keep on following the technological evolution.

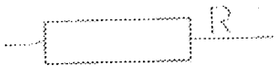
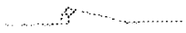
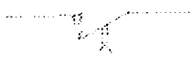
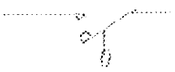
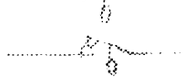
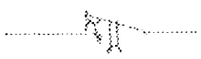
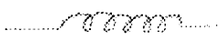
4.3 SUGGESTION

Since an electrical service becomes indispensable for any house in our days, I suggest the use of door opener in mostly of our houses. And I believe that this when completely insert in our day-to-day life, will be find very useful.

Also I am suggesting that this work should be developed to make the same circuit to be as well an automatic door control as an alarm system after working hours with a provision of an electric gash to key the door.

For a real life test of this circuit, I am proposing the 9v d.c supply to be replaced by a 240v a.c or 415v a.c supply with their corresponding motors.

APPENDIX:

240	Power supply
F:	General Switch
(+)	Positive polarity of d.c voltage
(-)	Negative polarity of d.c voltage
	Resistor
LSW	Limit Switch
RX 11:	relay contact (1^{st} –1 is the relay number and 2^{nd} –1 is the Contact number)
LED:	Light emitting diode
	D.c Motor
	Relay contact Representation (normally closed)
	Relay contact Representation (normally opened)
	Delay Relay contact Representation NO
	Limit Switch contact Representation NO
	Limit Switch contact Representation NC
	Delay Relay contact Representation NC
Ls 11:	Limit Switch contact 1^{st} –1 is Switch Number and 2^{nd} 1-is the contact Number
	Relay coil Representation
BR:	Bridge Rectifier

C: Capacitor

D: Diode

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