DESIGN AND CONSTRUCTION OF AN AUTOMATIC SLIDE DOOR WITH UNINTERRUPTED POWER SUPPLY

BY

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DEDICATION

I dedicate this project To the Glory of God who has been my helper and to everyone out there, who has a dream, please keep dreaming and work towards your dream.

DECLARATION

I, Esuola Oladipupo Oyinlola, hereby declare that this project work is wholly and solely written by me under the supervision of Engr. A.S Mohammed and submitted to the Department of Electrical and Computer Engineering of Federal University of Technology, Minna for the award of Bachelor of engineering (B.ENG) degree in Electrical and Computer Engineering.

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My profound gratitude also goes to my supervisor Engr. A.S. Mohammed for his support and advice in course of this project.

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ABSTRACT

In today's modern world of technological advancement, machine control has taken over 80% of the manual control systems. In light of this; this project utilizes the concept of infrared transmission which could form the basis for Automatic slide door (ASD), also the issue of power failure is considered hence the use of Uninterrupted Power Supply (UPS). To be able to appreciate the function of the design, the principle of operation o the ASD with UPS is being explained in this project. Each a person approaches the door his/her body causes reflection of the emitted rays by the transmitter, to the receiver, causing the door to slide open and subsequently closes back, after some seconds. Also when there is a power failure the backup battery continues to provide the power supply. This project (Automatic Slide Door with Uninterrupted) was successfully design, constructed, and was found to perform the expected result.

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CHAPTER ONE

1.0 INTRODUCTION

The dream of every developing nation, like our country Nigeria is to become one the most sort after in her socio-economic and technological development by the year 2020.

It is of no doubt, that technology is the tool that makes the preservation of the totality of the human socio-economic possible, but its luxury and reliability must be given the topmost priority it deserves. Automatic slide door (ASD) with Uninterrupted Power Supply (UPS), is an approach towards achieving this goal. It is targeted at making life easy for people in this 21st century in the use of door. When we think of doors, we think of open and close, ASD with UPS, which is an electronically operated door is not exceptional. The Automatic slide door with Uninterrupted power supply (UPS) finds it application in homes, banks, Hospitals, Hotels, Industries, Ministries and Government Parastatals amongst others.

Most doors are manually (mechanical operation) operated (open/close), with the use of hands or contact with door. Others are electronic based, using remote control or by pressing a button, the door comes open. Others are based on the use of light sensors, like the Light dependent resistor LDR, photodiode, phototransistor amongst others. Most of these devices have their lapses in the use of the doors. The manually opened door may be too heavy for an individual to open and this implies more power and consequently more people to open a single door, issue of low frequency response, some have hitches in terms of their time duration, for opened/ close operation. Most time there's need for high torque motor to drive the door, hence requiring more power. Most of

these models do not incorporate the need for an uninterrupted power supply (UPS)/proximity. Furthermore these devices are fairly expensive and also cannot be relied on.

It is therefore imperative to provide a door which is efficient and reliable and stress free accessibility using cheap components that are great reliability and far less expensive than its counterpart and bearing in mind the epileptic nature of the power supply in our country. This has led to the design and construction of Automatic slide door with UPS

This entail an individual working towards at a distance of 10-15cm and then the slides open granting the user an entry or exit as the case may be without any need of pressing a button or having a contact with the door, and the batteries are charged with the AC supply, once there is AC power outage, the device continues its operation with the DC supply from the back-up.

1.1 PROJECT MOTIVATION (AIMS /OBJECTIVES)

Technology is solving a problem in the different ways, the focal point of this project: Design and Construction of An Automatic sliding door with a UPS is aimed at developing a simple low cost device to ease the manual opening and closing of door and making provision for Uninterrupted power for the continuous operation of the device, using an Infra-Red motion detector, and a 12Vdc battery with other components.

1.2 OBEJECITVE OF THE PROJECT

The major objective of the project are listed

i) To design a door that is efficient and reliable, and cheaper compared to other doors, which require manual opening or touch activated.

ii) Making provision for continuous operation (power), when there is power failure for the operation of the Door.

iii) To prevent any transfer of any infection that could be transferred via hand contact.

iv) Creating a good impression of a company's image, complementing the old adage that says "first impression last long". For Co-operate bodies, individual or any establishment interested in the use of the automatic slide door, most especially for the business minded firms towards their clients.

v) Reducing stress and saving the energy of users irrespective of the kind of door in use (Material).

vi) To stimulate the interest of the upcoming engineering student to take up research topics, not only in electrical and computer engineering, but also in relevant fields.

1.3 METHODOLOGY

In the design of Automatic sliding door with uninterrupted power supply, the circuit operates in a way that any time an object or an individual approaches the door at a particular range, the sensor (Infra-Red) will receive the reflected ray that is being transmitted and the

door will slide open and then close after 5seconds, and when the AC source is out the DC source provides the power supply.

1.4 SCOPE OF PROJCT

This project covers technological development using simple and cheap devices in achieving luxury in the entry and exit of a place which was designed in four modules: the charging of the battery as well as serving as UPS, the transmitter, receiver/sensor the driver module. The project does not consider any form of security or lock, in the use of the door. It also assumes an already exiting sliding door with it mechanical module constructed and this is by the use of a CD-ROM drive. A 555 Timer which is a Monostable Multivibrator and sometimes called Astable Multivibrator is used to generates the pulse for the operation, [3] which was used for both receiver and transmitter signal operation BC547 transistor, Infra-red, the driver IC for the door BA6219A, voltage regulators LM7812, LM7809, LM7805[1] Simply working towards a door it opens and ease the stress of opening, with the use of the UPS there is no need of panicking that the door might remain closed or open, just as it is named Automatic slide door with UPS.

The other part which forms the power aspect is the use of LM317 for the charging of the battery and the use of relay to close up the circuit for the supply of uninterrupted power.

1.5 PROJECT LAYOUT

The general introduction, aims/objective and methodology are contained in the Chapter One, Chapter two contains the literature review, power unit, (AC source and DC source) transmitter unit, receiver unit and the driver unit.

Chapter three, deals extensively with the circuit design and analysis, the block diagram and the circuit diagrams of the automatic slide door system and the function units of the system.

A review of how the construction was achieved is given in chapter four, while chapter five the last chapter, concludes the project report. Past projects related to project where consulted in course of this work [1], [2] References are provided at the last page of the report.

CHAPTER TWO

2.0 LITERATURE REVIEW/THEORETICAL BACKGOUND

William Herschel, an amateur astronomer famous for the discovery of Uranus in 1781, made an important discovery in 1800. Herschel was familiar with Newton's discovery that sunlight could be separated into that separate chromatic components via refraction through a glass prism. Herschel thought that the colors themselves might contain different levels of heat, so he devised a clever experiment to investigate this. Herschel passed sunlight through a glass prism to create a spectrum (the rainbow created when light is divided into its color components) and measured the temperatures of the different colors. He used three thermometers with blackened bulbs and placed one bulb in each color while the other two were placed outside the spectrum as controls.

As he measured the temperature of the violet, blue, and green, yellow, orange and red light, he noticed that all the colors had temperatures higher than the controls and that the temperature increased from the violet to the red part of the spectrum. After understanding this pattern, Herschel measured the temperature just beyond the red portion of the spectrum and found this area had the highest temperature of all and thus contained the most heat. What Herschel discovered was a form of light beyond red light. Herschel's experiment was important not only because it lead to the discovery of infrared light, but because it was the first experiment that showed there were forms of light not visible to the human eye.[1]

Automatic devices are meant to work based on condition(s) in which they are designed to respond to. The response has to also do with timing; the design has a form of a time for its duration [2]. This project has its major operation based on 555 timer and other components

connected to it, which are resistors, capacitors, voltage regulators, Transistors, diodes, motor driver IC, connectors, just to mention few. This chapter gives the complete description of the various elements or modules used in the design and construction "Automatic slide doors with UPS".

The theoretical background of each element is extensively dealt with. The 8-pin is one of the most useful ICs ever made and it is used in many projects. With just a few external components it can be used to build many circuits and not all involving timing. The 555 can be used with a supply range of 4.5 to 15V (18V absolute maximum). The standard 555 ICs create a significant 'glitch' on the supply when their output changes state. In most cases a 100μf capacitor is connected across Vs and Ground, to avoid any possible oscillation. [3]

2.1 555 TIMER INPUTS

Trigger input: 1/3 Vs ('active low') this makes the output high (+Vs). it monitors the discharging of the timing capacitor in an astable circuit, such as the use in this project, it impedance is greater than 2MΩ

Threshold input: when 2/3Vs ('active high') this makes the output low (0V)it monitors the charging of the timing capacitor in astable and monostable circuits, it has a high impedance greater than 10MΩ.[3]

Reset input: when less than about 0.7V ('active low') this makes the output low (0V), overriding other inputs. When not required it should be connected to +Vs. It has an input impedance of about 10kΩ. [3]

Control input: this can be used to adjust the threshold voltage which is set internally to be $^2/_3$ Vs. Usually this function is not required and the control input is connected to 0V with a 0.01μF capacitor to eliminate electrical noise. It can be left unconnected if noise is not a problem.[3]

The discharge pin is not an input, but it is listed here for convenience. It is connected to 0V when the timer output is low and is used to discharge the timing capacitor in astable and monostablecircuit

2.2 THE BATTERY/CHARGER

A battery is an important source of power in modern electronic equipment. With the advancement of semiconductor technology, the power needed to operate electronic equipment is becoming less and less and many of them which operate on mains earlier are now being operated on batteries. Several types of batteries have been developed to meet the varied requirement.

Batteries are made up of cells. Each cell, depending on its types, provided 1-2, 2-1 volts. The number of cells in a battery is related to the voltage and to the required current. Inexpensive primary battery suffices for much small electronic equipment such as portable radios, clocks, cassette players and calculators. However, at higher prices rechargeable batteries eliminate the inconvenience of charging the battery charging and provide reliable stand-by during mains failure. There are various types of storage batteries, among which are: lead acid battery, Nickel cadmium battery, silver zinc battery e.t.c. this project is based on Lead acid batteries, specifically rechargeable lead acid. [5]

The past works done on automatic slide door, are either by the use of LDRs, Photo-transistors, which may have a limited range, to which it cannot exceed in order to communicate the object. Besides this most them were not putting to consideration the issue of power failure, as well as the situations where there may be need to reset the operation of the door, should there be any need for that. The UPS is a back-up in case of power supply, which is also been charged by the A.C power supply, which means that the system can still continue to function should there be a A.C power supply at any point in time.

In the design of Automatic Slide door with UPS, the battery is one of the components to be used. The battery is the second major source for power supply, by this virtue, the battery used is a lead core accumulator battery of 12V (combination of two-6V battery in series). The battery can work for 6-10hrs when fully charged and depending on the usage of the door. The charging circuit charges the battery, when the A.C source is up. [5]

CHAPTER THREE

3.0 DESIGN AND IMPLEMENTATION

3.1 THE COMPONENT CHOICE AND DESCRIPTION

The circuit design and construction of the project uses NE555 timers, C9014 transistor, voltage regulator LM7805, LM7812, 1N5392 diode, 380F infrared sensor, BA6219 IC, Lead Acid Batteries, Resistors and Capacitors, and a 9V battery.

The automatic slide door with UPS comprises of the following subsystem:

i. AC power supply

ii. 5V volt regulator

iii. 12V Battery Charger

iv. Infrared Detector/Timing circuit

v. Reversible Motor driver

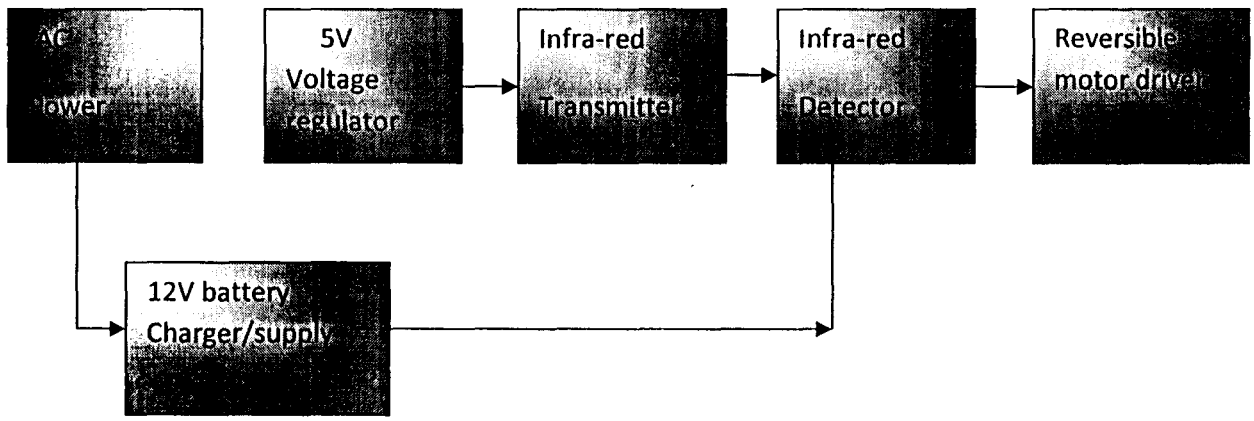

Fig 3.0 Block diagram of Automatic slide door with UPS.

3.2 THE POWER SUPPLY

Majority of electronic circuit uses direct current supply obtain by rectifying the A.C Voltage supply from PHCN/ GENERATOR. This is achieved through the following laid down procedures. The block diagram to illustrate this is shown below in fig 3.1

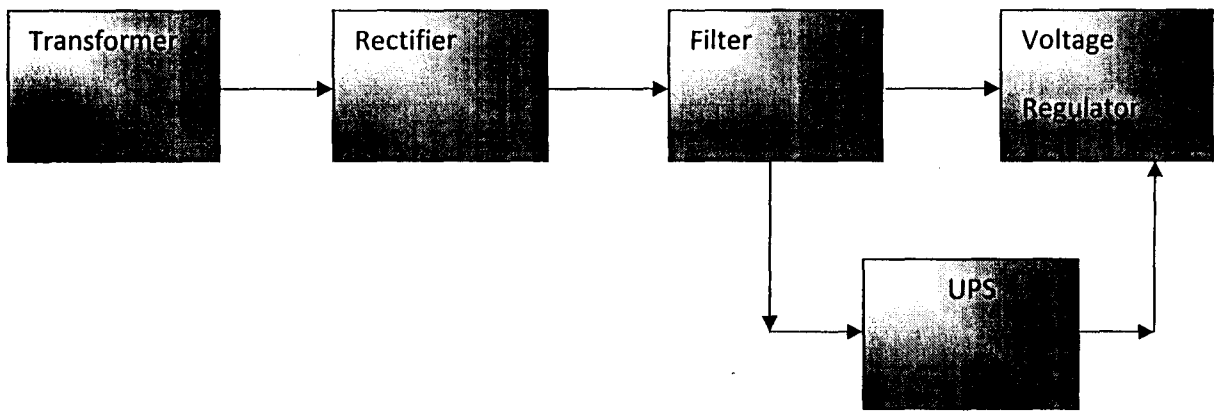

Fig 3.1 Block diagram showing the stages of the regulated power supply.

3.2.1 TRANSFORMER

A 220V (R.m.s)/12V step down transformer was used to reduce the 220 A.C from the main supply to 12V which is rectified to give the required DC voltage.

3.2.2 RECTIFICATION

The term rectification is defined as the process of changing or converting a pulsating A.C voltage into D.C voltage by eliminating the negative half cycle of the alternating voltage. [3]. This project adopts the use of the full wave bridge rectifier because of its ability to produce the

approximate varying and reference voltage. The maximum instantaneous voltage between terminals.

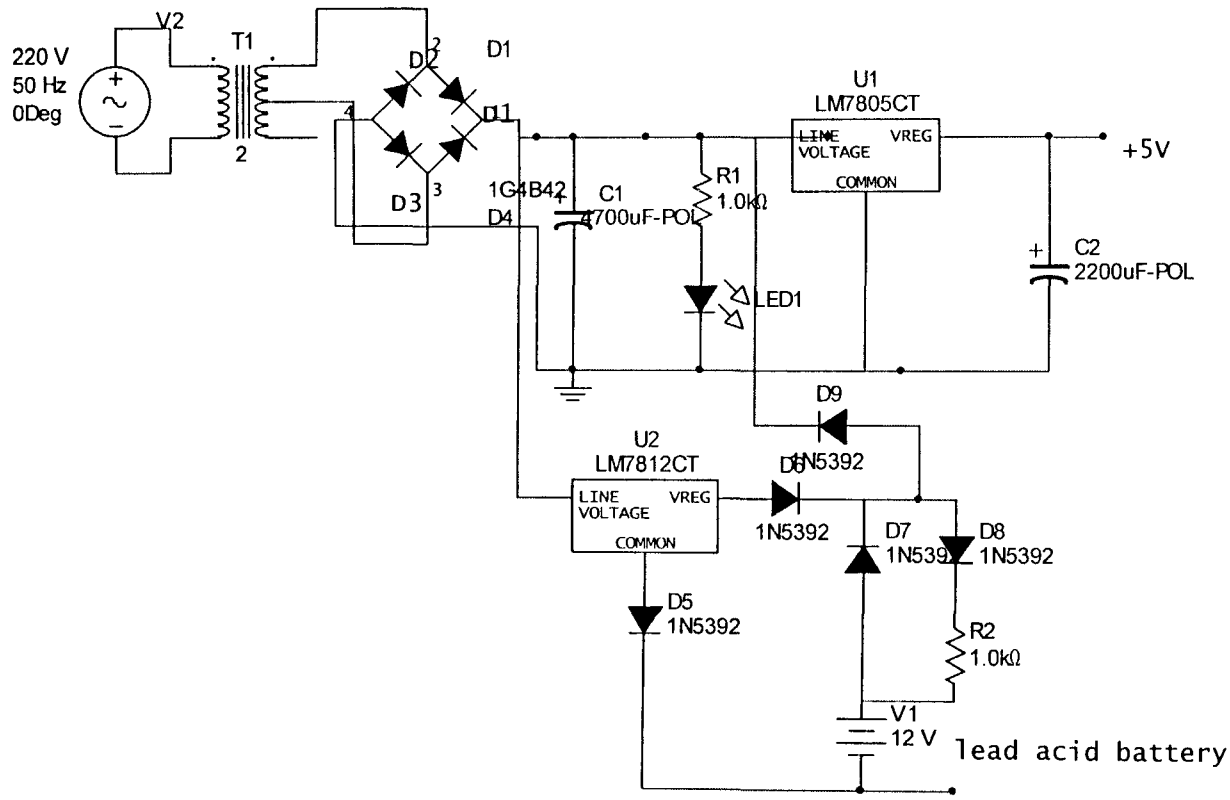

Fig 3.2 System Supply Circuit.

D1-D4 forms a full-wave bridge rectifier connecting the 12V RMS AC input voltage of a pulsating DC voltage [Vrms√2-1.4] V:

For a 12V supply voltage, the DC voltage has a maximum amplitude of 12√2- 1.4 = 15.5V

This voltage was smoothened by 25V/4700μf capacitance deduced as shown in the expression:

Q = CV= It ---------- Eqn 3.0

C = It/V I= maximum load current

T= 1/2f = 1/2x 50

V= maximum AC ripple voltage on the DC supply

The maximum load current was deduced from the duration of the current shown by the subsystem.

Battery charger: 0.4A

Monostable: 10mA

Motor driver/motor: 0.1A [3]

$\sum$ = 0.51A ---------- Motor driver current

For the 7805 regulator used for the 5Volt regulator, the minimum input voltage required is 5+2 = 7V. On a 15.5V DC voltage, this is translated into a maximum AC ripple voltage of 8.5V.

C = 0.51x 1/(2x50)x /8.5 = 0.0057/8.5= 0.00064.

A value of 4700µf was used as the capacitance, which was deduced from the previous calculation, this is only the minimum capacitance required to keep the system specification from falling below the projected value. The smoothened DC voltage was fed into a 7805 5V, 1Amp regulator to produce a steady ripple free 5volt DC input voltage.

A power on led indicator was connected across the rectifier for a visual indication of the system status.

To keep power consumption low in the design, a low-voltage operational system supply was selected. The sensor was rated specifically for 5V, hence the choice of the low voltage supply.

The supply was realised from the circuit shown below;

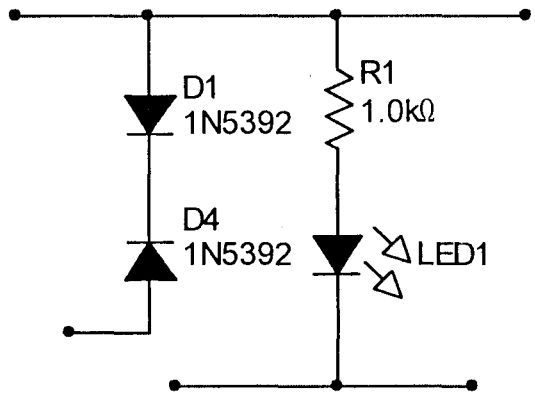

Fig 3.3 Power on Indicator

The current timing resistor was deduced from:

$$R_s = \frac{V_s - V_{led}}{V_{led}} \quad \text{---------- Eqn 3.6}$$

V_s=15.5V peak

V_{led} = 1.7V

I_{led} =5-20mA = 18mA

$$R_s = \frac{15.5 - 1.7}{0.15} = \frac{13.8}{0.15} = 920\Omega$$

A 100Ω resistance was used instead.

3.3 BATTERY CHARGER

Provision was made for charging a 12volt lead acid secondary cell on the unit. The battery charger subsystem comprises of 7812 12V regulator D5-D8 and a 100Ω trickle charging resistor. [1]

D5 lift the 12V regulator above the ground to counter the voltage drop across D6 which is used to prevent the back discharge of the cell by the 7812 with the mains removed.

Trickle-charging is perfected by D8 and a 100Ω resistance which limits the charging current to the cell. D9 provides a connect/disconnect on the 12volt Dc supply to the 7805 regulator.

If the A.C is present, D9 is reverse-biased and the battery charger system is isolated from the system. However, with mains absent, D9 is forward biased and passes the 12volt DC to the 7805 regulator to continue providing power to the motor driver and the 5volt subsystems.

3.4 INFRA-RED DETECTOR / EMITTER

An IR emitter / detector pair was used to sense motion. This was based on an interruptive "through – beam" detection in which the system responds to a breakage in the beam continuity between the emitter and the sensor. The emitter is a 38 kHz IR pulse transmitter configured as shown below [5]:

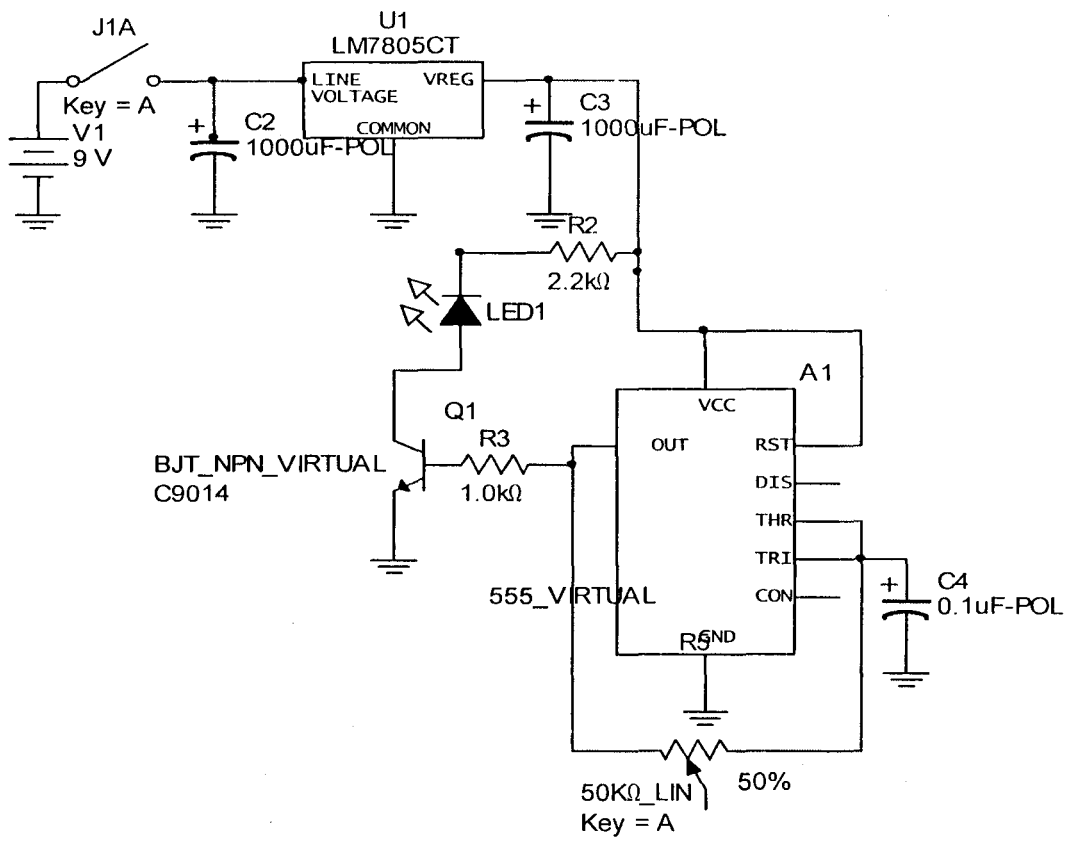

Fig 3.4 IR Generator

A 9V DC source was used to power the subsystem. C2 buffer the 9v input voltage source, while C3 stabilizes the 5V regulated voltage. U1 and NE555device, was configured for 50% duty cycle operation by the convection of pin 6 and 2 together. The output on pin 3 is thus a perfect square wave form with equal $T_{ON}.T_{OFF}$. R1 and C1 form the frequency determining components according to the equation

$F = (1/RC)$ Hz ----------Eqn 3.7

C1 was made 0.001uF capacitance. R1= 26kΩ was made variable for fine tuning the generated frequency. The 38 kHz output turned on, a C9014 transistor on/off to pulse current through the IR diode on its collector [6].

Design Calculation:

The current through the LED was chosen as 0.015A, the DC gain, H_{fe}, of the C9014 device is typically 300. The forward-- voltage of the LED is approximately 1.1V.

$$R = \frac{5 - 1.1}{0.1} = \frac{3.9}{0.015} = 260\Omega$$

A 220 Ω resistance was used instead as the diode could handle a pulsed current up to 1A.

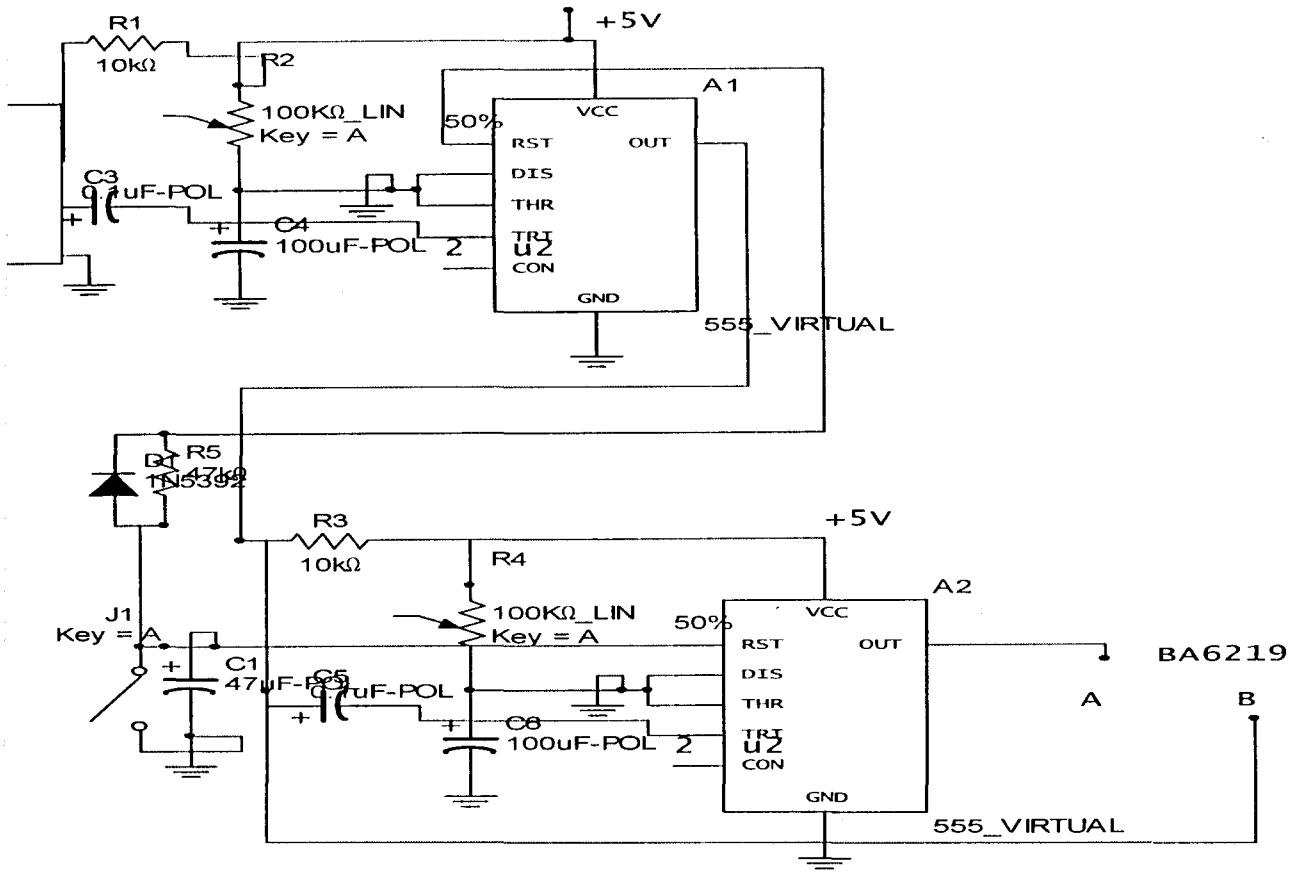

Fig 3.5 IR Detector

The detectors / wave form generators were configured as shown in fig. 3.6. The two mono stables were configured for equal output pulse width set by the 100kΩ preset resistance and the 100uF capacitances on their pin 6, 7 with the sensor output high, both mono stables have their pin 3 (output) on generating. The control signal 00 to the BA6219 6 motor control IC. When a

beam discontinuity is detected, U2 is triggered by the falling edge on its pin2 input as shown below:

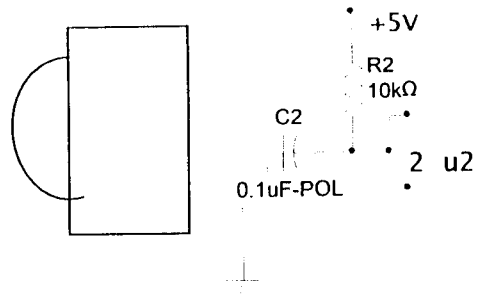

Fig 3.6 Monostable Trigger Circuit.

The 10μf output pulse on the TSOP 1738 is differentiated by the 0.1μF, 10kΩ network on pin 2. The falling edge pulse is coupled into pin2 of the U2 and its output goes high for a time given by

T = 1.1RC. ---------- Eqn 3.8

C = 100uF, R = 100KΩ adjustable. This provides the control logic 01 to the BA6219. When U2 gives out (after 4/5 seconds) its falling edge on pin 3 trigger U3, forcing pin 3 of U3 high for an equal time period, providing the control logic 10 to the BA6219. When U3 times out, the logic present on the BA6219 input pins returns to 00. Thus, the necessary motor control logic necessary to open/close an attached door (motion) this generated as tabled below:

B.	A.	State (motion)
0	0	Idling
0	1	Forward
1	0	Reverse
0	0	Idling.

Pin 4 was connected for power up reset connection, for both devices to ensure output turn off at power point the device were reset by a 47kΩ/ 47uF RC network as indicated below.

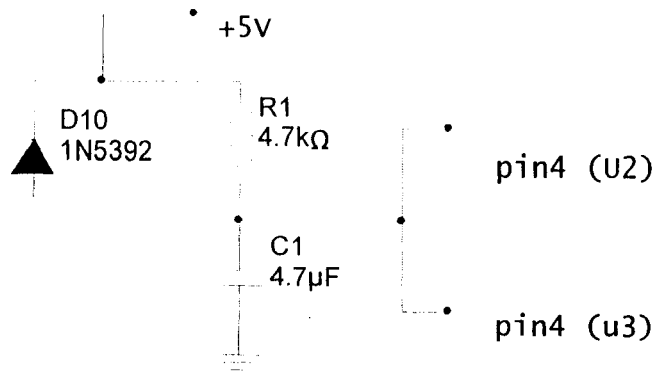

Fig 3.7 Monostable reset circuit.

When power is applied, the capacitor voltage, Vc, is 0V providing the required preset logic to both monostables, keeping their outputs low. The Vc increases exponentially which is by the RC constant.

After T= 1.1RC, reset is deserted and the Monostables are low primed for operation. A manual reset input R3 was computed using Ic and H_{fe}

$I_B = Iz / Hfe; = 0.015/300 = 5x10^{-4}$

$Rb = \frac{Vp - Vbc}{} =$ ---------- Eqn 3.9

$\frac{5 - 0.7}{}$

$5x10^{-4} = 8.6 \times 10^{-4}A$

The value was reduced to 1kΩ for over drive, permitting a longer separation distance between the IR source and detector.

3.5 INFRARED DETECTOR

The conveniently produced 3-pin IR sensor was used for detecting the IR produced by the transmitter. The IR sensor was wired to a Monostable device as shown below. The sensor output is high when it continuously receives the unmodulated 38 KHz IR pulses. However when a discontinuity is detected, it switches its output low momentarily and have high. This high-low-high pulse triggers mono stable U2 which in turn switches its pin3 high. Mono stable U3 at this time remains inactive when pin3 of U2 goes low, U3 is triggered, switches its pin3 high.

U3 pin3 stays high for a drive determined by the timing components covet) to pins 7,6.

The two outputs were used to generate the logic input needed by the BA6219 motor driver according to the truth table shown below [4]:

BA6219

B	A	mode
0	0	- idle
0	1	- forward
1	0	- reverse
1	1	-braking

A reset was also provided for external motor reset, BA6219 Motor Driver.

An integrated circuit BA6219 motor driver device was used for controlling motor direction. This device has the specifications stated below;

- BA6219 datasheet level

The device was operated with the 12V system unregulated DC Source and configured according to the meteoric shown below.

Table 3.0 INPUT/OUTPUT TRUTH TABLE

Input		Output		Mode
IN1	IN2	OUT1	OUT2	
L	L	OPEN	OPEN	IDLING
H	L	H	L	FORWARD
L	H	L	H	REVERSE
H	H	L	L	BRAKING

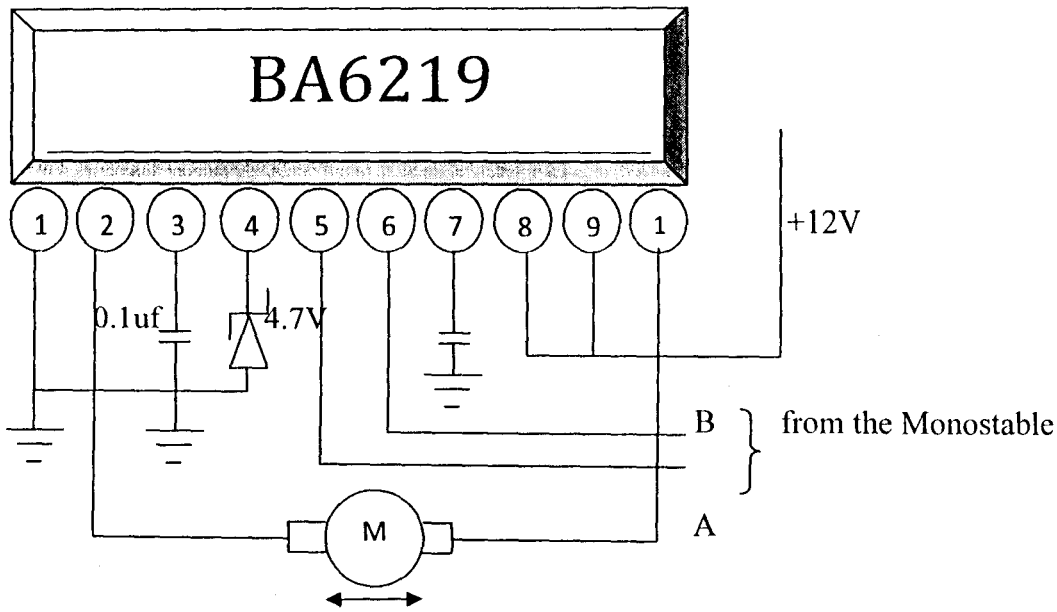

Fig 3 .8 diagram showing BA6219 connection

The motor voltage was set by a 4.7V Zener connected to pin4 by other circuit components were as specified in the manufacturer data sheet. [4]

CHAPTER FOUR

4.0 CONSTRUCTION AND TESTING

4.1 CONSTRUCTION

This is the process of putting together all various component of the various subsystem of the Automatic Slide door with UPS discussed in the previous chapter on bread board and tested. The ideal slide door is reliable, effective and inexpensive. The circuit was constructed in four sections: the transmitter/emitter, the receiver the driver as well as the power supply/UPS.

4.2 COMPONENT TESTING

Each of the components used was tested for functionality, this involves using MULTIMETER, so as to ensure good exact component are used in conformity with design circuit. This is necessary because the use of faulty component could result in malfunctioning of the design.

4.3 EXPERIMENTAL SETUP

The block of the circuit below illustrate the experimental set-up of the Automatic Slide Door with UPS system. The supply is a 12V AC or 12V DC supply source. This is used to supply the circuit with 9V and 5V as regard the component in which they are used for.

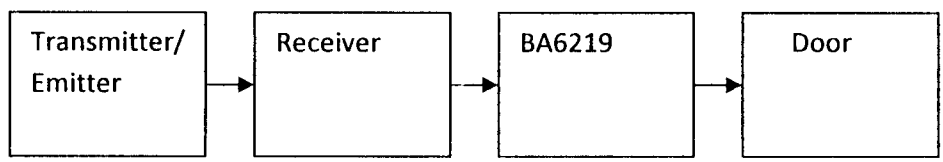

Fig 4.1Block diagram of ASD with UPS

4.4 SYSTEM OPERATION

During operation, the motor driver was connected to a CD-ROM which was used as a door, with the AC supply of 12V 0.5A turned on, two sections of the system is powered the; the operation Automatic slide door and the charging of the backup up section (Battery). The receivers part the system is powered on ready to receive a continuous beam of light from the transmitter. The transmitter was powered with a 9V dc battery, with the threshold voltage below 1/3Vcc which is a falling edge a trigger is through the pin 3 resulting to driver motor sending a signal operation to the CD-ROM which opens and closes within 6sec. The door has proximity of 7-10m for this reason the transmitter was powered separately. The back-up has a diode which connected reversed biased to avoid the flow of current when the AC supply is ON, once the supply fails the diode becomes forward biased which results to the functioning of the system.

4.5 SYSTEM TESTING

During testing the terminal of the motor driver was connected to the mechanical part of the door. With the supply on, and an object walking toward the door, it slides open and closes after some seconds. Also the back-up functions when the AC supply fails.

4.6 CASING CONSTRUCTION

A perforated PVC carpet was use to house the designed circuit after completion. It perforated to give ventilation (because of the working temperature of the components) and heat dissipation from the transformer and other electronic components. The diagram is shown below:

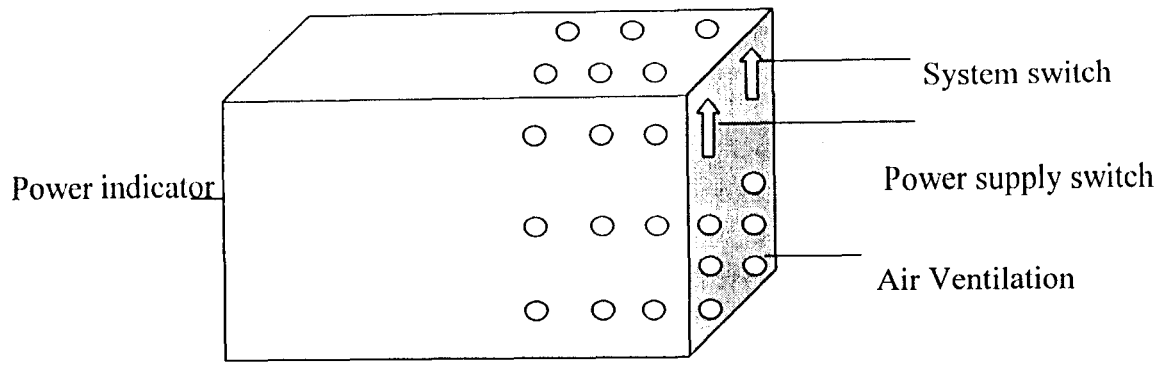

Fig 4.2 Case Design

4.7 DISCUSSION OF RESULT

The result carried out after the construction shows that the system (Automatic Slide door with UPS), operates based on the proximity of the infra-red detector that forms the basis of the slide door, and un-interrupted power supply function as it was suppose to. When the system is powered with A.C source the circuit will automatically switch on anytime a person / object comes across the specified area (that is the person/ object causes reflection of the infra-red ray to the receiver), the door slides open and then closes (in clockwise and anticlockwise direction)after some seconds. Also during operation if there is an AC power failure the UPS continues the provision of D.C supply.

4.8 COST ANALYSIS

Cost plays a vital role in any engineering design and construction. The cost of any project determines how prosperous that particular project is going to be used. In view of this, the cost estimation of Automatic Slide door with UPS is shown in the table below:

Table 4.7 Cost Estimation of the System

S/No	ITEMS	QUANTITY	COST (₦)
1	240/12V Transformer	1	250
2	Rectifier diode	10	150
3	Capacitor	6	100
4	Regulator	3	120
5	Resistors	10	50
6	Transistor	3	120
7	Flexible wire	1	150
8	6V battery	2	600
9	Vero board	1	150
10	Lead	1	300
11	Transmitter	1	180
12	Receiver	1	100
13	Connector	1	100
14	PVC casing	1	150
15	Ba6219	1	200
16	555 timer	3	120
17	Led indicator	1	20
18	Miscellaneous expenses		100
	Total		**₦2810.00**

CHAPTER FIVE

5.0 APPLICATION AND LIMITATION

The Automatic Slide door with UPS has many applications on the use of the system; it could be used in offices, as security door, hospitals and many other control systems.

5.1 PROBLEMS ENCOUNTERED

The various problems encountered are:

i) Finance

ii) Non-availability of some components

iii) Components setting in bread board and Vero

iv) Soldering

5.2 RECOMMENDATION

The design has been achieved by using discrete component such as resistors, transistor, diode and simple regulating IC etc. Where the exact value of a component could not be found equivalent value is used.

Due to sensitivity of this work, further work is necessary to improve on the performance and high efficiency.

5.3 CONCLUSION

The aim this project is to design, construct and test an automatic slide door with UPS, which have been achieved. The system was tested and the desired result was obtained, the system can be easily maintained and not so expensive to construct in terms of purchasing components.

A lot of experience has been acquired in this project within the time available. I apply most of the knowledge acquired in the class room to practical life problem.

In conclusion, this project in addition to its motive has exposed me to some problem encountered in electronic/ electrical design work and behaviour of instruments, the general precaution needed in design, construction and testing was observed. Lastly I was to some challenges expected of a university graduate.

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