Design and Construction of Automatic Door with "Welcome" Note

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2004/18789EE

A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE. IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG)
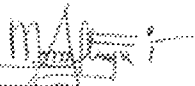
December, 2009

Dedication

I dedicate this project to my Dad, Late Alhaji Aliyu Goro (May his gentle soul rest in Jannatul Firdause) Amin. Dad, your effort to raise all of us right from childhood will not be in vein (Insha Allah).

Declaration

I Ma'aruf Aliyu Goro, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the federal university of technology, Minna.

Ma'aruf Aliyu Goro

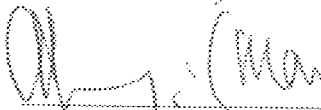*Name of student*

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Signature and date

Mrs C. O. Alenoghena

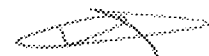*Name of Supervisor*

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Dr Y. A. Adediran

Name of H.O.D

(May 6 2010)

Signature and date

Name of External examiner

09/3/10

Signature and date

Acknowledgement

I begin by acknowledging almighty Allah for sparing my life and protecting me through out this work, and His Messenger, Prophet Muhammad (S.A.W), the best of men and guidance to mankind.

My sincere and humble appreciation goes to my Supervisor; Mrs C. O. Alenoghena for her tireless efforts in corrections, guidance and advise, my Technical Supervisor, Mallam I. Yahaya for the assistance and guidance, and not forgetting my able HOD, Dr Y. A. Adediran.

I will use this ample opportunity to express my special and wonderful appreciation to the most cherished being in my life, Hajiya Fatima Sulaiman. Mum, only Allah can reward you abundantly. And also my step mum, Hajiya Hassana Nasir. May you both remain blessed.

I extend my sincere gratitude to my brothers, Mal. I. A. Goro and Mr A. A. Goro for their financial and intellectual support.

I personally like to acknowledge the following people; Mallam A Sadiq, Mr S. Nuhu, my Friends, Abdulrahman, Raji, Musa, Adamu, Babangida, Abdulkadir and the rest not mentioned. My colleagues at home and School, Bello, Nasir, Ndastu, Adamu, Idris, Bima, Marwan and all the 2008/2009 electrical/computer engineering students.

I cannot complete this list without remembering the Gorosons and daughters, Abdulrahim, Isah, Umar, Dauda, Haruna, Hamza, Yakubu, Nasiru, Fatima, Maimuna, Hauwa, Salma, and the last dons Sadiq and Ahmad.

Abstract

Today, the prime objective of man is making things easier, faster, safer and more reliable. One such way man have achieved this objective is through automatic doors. This project is on the design and construction of automatic door with digital display. Automatic doors are doors powered opened and closed by power or spring or both. The door is activated by a photoelectric sensor (laser sensor) which controls the automation of the door. When a person/object cross the beam, a relay is switched and the door opens for nine seconds. The timing of the circuit is controlled by two 555 timers operating in their monostable modes. One of the timers gives a sound output through a buzzer to indicate activation of the door. The door becomes stationary opened in exactly two seconds and simultaneously, the 14-segment display a "WELCOME" address, for the person entering to see, for the next seven seconds out of the nine seconds that the door opens. After this time, the display light switch OFF as another relay close the door by moving the motor in opposite direction. The design circuit was constructed and found to work appropriately.

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Chapter One

Introduction

1.1 Overview

As the world moves from analogue systems to digital systems, the need for automation can hardly be over stressed. Man has always strive to make things easier, safer and more reliable in life; through adjustments (additions and subtractions) of previous works done by successors, many objectives have been realized. This project follows the same trend.

Automatic doors are doors that are powered open and close either by power, spring or both [1]. There are several methods by which an automatic door is activated. In this design, a laser ray will be used to activate the door, since automatic doors are not complete without photoelectric sensors controlling them [2].

The whole circuit design intends to open the door automatically and subsequently give a "welcome" display output.

1.2 Aim

The main aim of this project is to design and construct an automatic door with "WELCOME" display output.

1.3 Objectives

* Drawing and simulation of circuit using multism
* Testing of circuit on bread board
* Construction of power pack on Vero board
* Building of house model, construction of actuator stage and testing door operation.
* Construction of display and unit stage.

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❖ Connection of whole circuit together and testing

❖ Casing/external aesthetics.

1.4 Methodology

Analogue and digital circuits are both involved in the design. Laser beam would be employed as the activator that will switch a relay which opens the door. Another relay then closes the door after nine seconds. The timing would be controlled by two 555 timer ICs operating in their Monostable mode. The fourteen segment display is a common cathode of which all cathodes are connected together.

1.5 Advancement over Previous Designs

Most of the previous design used infra red sensor, few used light depended resistor LDR. Laser ray is chosen for this design because of some advantageous features it offers over other light beams. Such advantages are:

> Laser light is more parallel than any other light sources, so every part of the beam takes almost the exact same direction and the beam will therefore diverge very little [3].

> As it is so parallel, it can be focused to very small diameter. As such, line of sight for the sensor easy to locate.

> It also makes possible to examine tiny details and also triggers very fast within the range of Pico seconds or femto seconds in some cases.

> It can also be made monochromic so that one light wavelength will be present.

Most importantly as advancement, is the display of "welcome" as the door opens. The 14-segment display can write any letter, number and some symbols. Certainly, any name or

information about the area of application can be written with the display by just following the simple technique used in this prototype.

1.6 Scope

This work is limited to a prototype that demonstrates how automatic doors work. The power unit has an LED to indicate availability of power in the circuit. In addition, a sound indicator from the buzzer alerts the person/customer that the door is activated. The prototype also includes a display of WELCOME address from dual 14-segment display that makes the customer (or any other person pending on area of application) feels honored as he enters the building.

1.7 Outline

Following the requirement for final-year project implementation as stipulated by electrical/computer engineering department, this project is written in five chapters.

The first chapter introduces the whole work, giving an insight of the methodology, aim/objectives, scope and outline. The next chapter provides the literature review that shows the theoretical background of the project and previous works related to the project.

The third chapter analyses the circuit design. It explains how the circuit is constructed and implemented modules-by-module. Chapter four discloses testing and results obtained from construction. The last chapter then summarizes the whole work. It includes recommendations and possible improvements on the design.

Chapter Two

Literature Review

2.1. History of Automatic Doors.

The first automatic doors were invented by Heron of Alexandria aka Hero, who was a great mathematician and mechanics inventor from Alexandria, Egypt [4]. He was one of the greatest inventors in ancient times. His strange inventions, such as automation theater-puppet worked by strings, drums and weights-automatic doors, and coin operated machines, were famous throughout ancient world [5].

Hero described not one, but two different automatic door applications. The first application used heat from fire lit by city's temple priest. He used a similar application to open the gate to the city [6].

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 [7]. Pushing 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 through with the other hand. Congestion of shoppers waiting for chance to use the exit door prevailed.

To solve this problem, in 1940, Jerkins installed automatic doors. The first Publix supermarket came to be mush more than a pretty building. The magical device (automatic door) dazzled the public and convinced customer who lived far away to visit the store [8].

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In 1960, Horton's Automatic Incorporation places the first commercial automatic sliding door on the market [9].

The idea came to Lew Hewitt and Horton to build an automatic sliding door in mid. 1950's, when they saw that the existing swing doors had difficulty operating in high winds.

2.2 Laser Ray

LASER is an acronym that represents Light Amplification by Stimulated Emission of Radiation. It is a device that emits light (electromagnetic radiation). The word light in this phrase is used in a broader sense referring to electromagnetic ray of any frequency not just that in the visible spectrum [10]. Hence, there is IR laser, X-ray lasers and UV-lasers to mention but few.

A laser consists of a gain medium inside a highly reflective optical cavity, as well as means to supply energy to the gain medium. The gain medium is a material with properties that allow it to amplify light by stimulated emission. In its simplest form, a cavity consist of two mirrors arranged such that light bounces back and forth each time passing the through the gain medium. Typically, one of the mirrors, the output coupler, is partially transparent. The output laser beam is emitted through this mirror.

The process of supplying energy required for amplification is called pumping. The energy is supplied by electric current or as light at different wavelength. Such light may be provided by flash lamp perhaps another laser.

2.2.1 History Foundation of Laser

Albert Einstein in 1971, in his paper on Quantum Theory of Radiation, laid the foundation for the invention of laser and its predecessor maser. In 1928, Rudolf .W. Ladenburg confirmed the existence of stimulated emission of negative absorption [11].

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In 1939, Valentine .A. Fabrikant predicted emission to amplify "short waves" [12]. In 1950, Alfred Kastler proposed the method of optical pumping [13].

The first working laser was demonstrated on 16 May 1960, by Theodore Maiman at Hughs research laboratory [14]. Today, optical storage devices such as compact disc and DVD players in which the semiconductor laser less than mm wide scans the surface of the disc. The second largest application is fiber optic communication. Other applications are barcode readers, laser printers and laser printers.

2.2.2 Modes of Operation of Laser

Two main modes can be indentified:

A. continues wave mode (CW): here, the output of laser is relatively constant with respect to time. The population inversion required for lasing is continually maintained by a steady pump source.

B. pulse mode: in this case, the output of laser varies with respect to time typically taking the form of alternating ON and OFF periods. Pulse mode is achieved using some technique such as Q-switching, mode locking or gain switching. In this operation much higher power can be achieved.

2.3 Types of Automatic Doors.

There are three major types of automatic doors; namely swinging, sliding and folding automatic doors [15].

2.3.1 Automatic Sliding Doors;

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

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2.3.2 Automatic Swinging Doors;

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

2.3.3 Automatic Folding Doors;

Automatic 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 to "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. A folding door requires a minimum space to install, yet provides plenty of door space.

2.3.4 Factors Considered in Choosing Type of Automatic Door

The nature of the application is most important factor in determining the type of Automatic door that will be installed. Not all types of automatic are suitable for every application.

Traffic flow, typical types of users, available space and aesthetic requirement or preferences are some factors to be considered.

Folding doors are preferred where space is at premium (small space), while sliding doors are good for emergency applications. Sliding and swinging doors are commonly used in health care settings, while folding doors are less prevalent [16].

2.4 Activators Used in Automatic Doors

Three main types of activators are used to trigger automatic doors;

i) Photoelectric sensors

ii) Switches

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iii) Remote controls

2.4.1 Photoelectric Sensors

Photoelectric sensors provide a non contact method to detect people or objects passing through the door and may be used in conjunction with a controller to open the door [17]. The widely used sensor is the IR sensor because it is easy to construct and manage.

Today, there are mainly three different technologies of sensors used in the market;

* Active IR

* Passive IR and

* Microwave sensors [18]

Active IR sensors are static. They only detect person or object if their bean a broken by the person/object. An active IR detector consists of one transmitter and at least two receiver chips with high quality optical system.

Passive IR sensors are sensitive to small temperature difference. They function in similar way to IR cameras used to detect heat losses in buildings. Their system is ideal for detecting people only there is always a difference of at least +1.8 between the surface temperature of a clothed person and surrounding environment.

Microwave technology sensors are used as motion detector/sensors. Motion sensors activates the door when it detect a moving object such as pedestrian or a shopping cart, but they can not detect still objects such as person stopped in the opening or closing path of the door [18]. If there is no movement in the monitored zone, the transmitter and receiver frequency remain the same and the zone is clear. If otherwise, movement occurs in the zone, the sensors become active since the emitted and received frequencies are no more identical.

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2.4.2 Switches.

Automatic doors can be activated by simply touching a button usually placed beside the door. This has gain application in commercial centers like banks, though IR sensors are incorporated together with the switches to ensure efficient operation. A switch is operated manually, perhaps after security checks. It can be a push button or swipe card. [19]

2.4.3. Remote Controls.

This provide control operation of the door from a distance, usually by touching a pad [20] Remote controls are not normally used in commercial centers like supermarkets, but can be used in restricted places like homes.
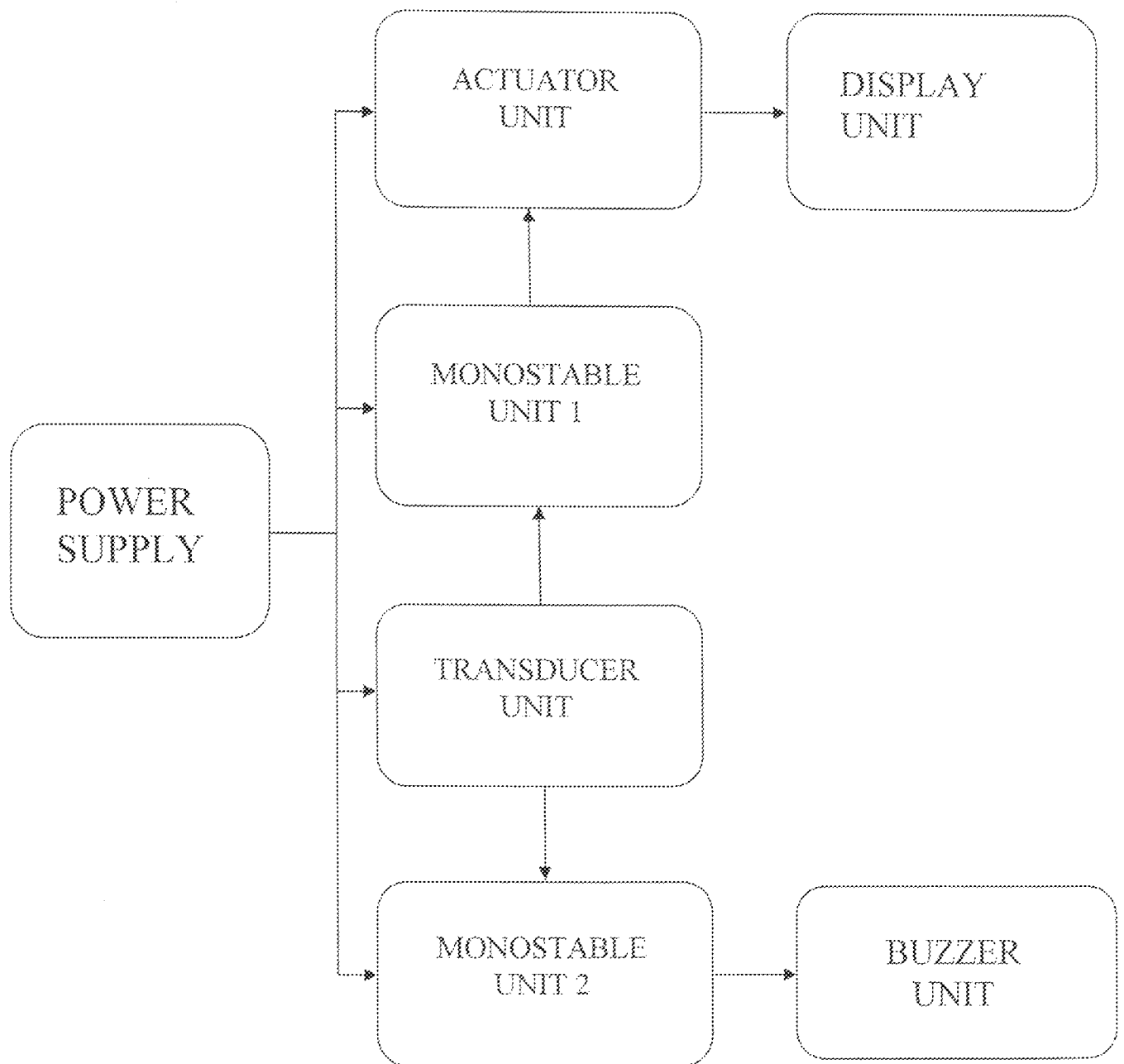
2.5 Block diagram

Fig 2.1 block diagram of automatic door with "welcome" display

2.5.1　Power Unit

This is the most vital unit of the circuit because without which all other parts will not work.

AC voltage (230/240v) is stepped down and converted in to DC voltage (12v). Two transformers are used. The first transformer (T1) steps-down 230/240v to 12v and supply the Vcc for the main circuit. Transformer T1 is isolated from transformer T2. The second transformer T2 has two 7805 (5v) regulators (RG1and RG2). These regulators supply laser transmitter, motor and display circuit.

2.5.2　Transducer/Sensors Unit

The transducer is a laser sensor that converts light signal into electric signal. It has a transmitter and receiver. The transmitter transfer parallel laser beam focused on line of sight to the receiver. The receiver detects the transmitted signal and gives it electrical output to the two Monostable stages.

2.5.2　Monostable Unit

These are 555 timer circuits that obtain inputs from the same sensor, but are configured to have different output duration.

The first Monostable gives output for nine seconds. It controls both the display and the motor. The second Monostable timer gives output for 1.1 second to the buzzer.

2.5.3　Actuator Unit.

The actuator is an electric motor that opens and closes the door. The motor receives an electrical current from a control relay and delivers a mechanical output that pushes the door open or close

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2.5.4 Display Unit

This is a four-dual 14-segment that displays "WELCOME" as the door opens. It uses the same regulator but operates at different time with the motor. In order words, the motor uses the 5v of regulator RG1 when it is opening. It then gives the 5v to the display when it reaches its opened position. Then, it draws back the 5v and cutout the display when it wants to close. This load sharing technique will be explained further in chapter three.

2.5.5 Buzzer Unit.

The buzzer gives a sound to indicate the beam of laser sensor is crossed. The buzzer is controlled by Monostable stage 2.

Chapter Three

Design and Implementation

3.1 Analysis of Block Diagram

The design of the circuit was done module-by –module in respect to the layout of the block diagram; beginning from power unit, to the sensor (including Monostable units), to the actuator unit, the buzzer unit and finally the display unit.

3.1.1 Design of Power Unit

The power pack mainly consists of two transformers, two bridge rectifiers' circuit, filtering capacitors and regulators. The two centre tapped transformers step-down 230/240v AC to 12v AC. The 12v AC is converted to DC with the aid of bridge circuits; D1-D4 for transformer T1 and D5-D8 for the second transformer T2. CT1 and CT2 are the filter capacitors for T1 and T2 respectively. Embedded to T2 circuit only is two regulators 7805. The circuit below explains the representation of power unit better:
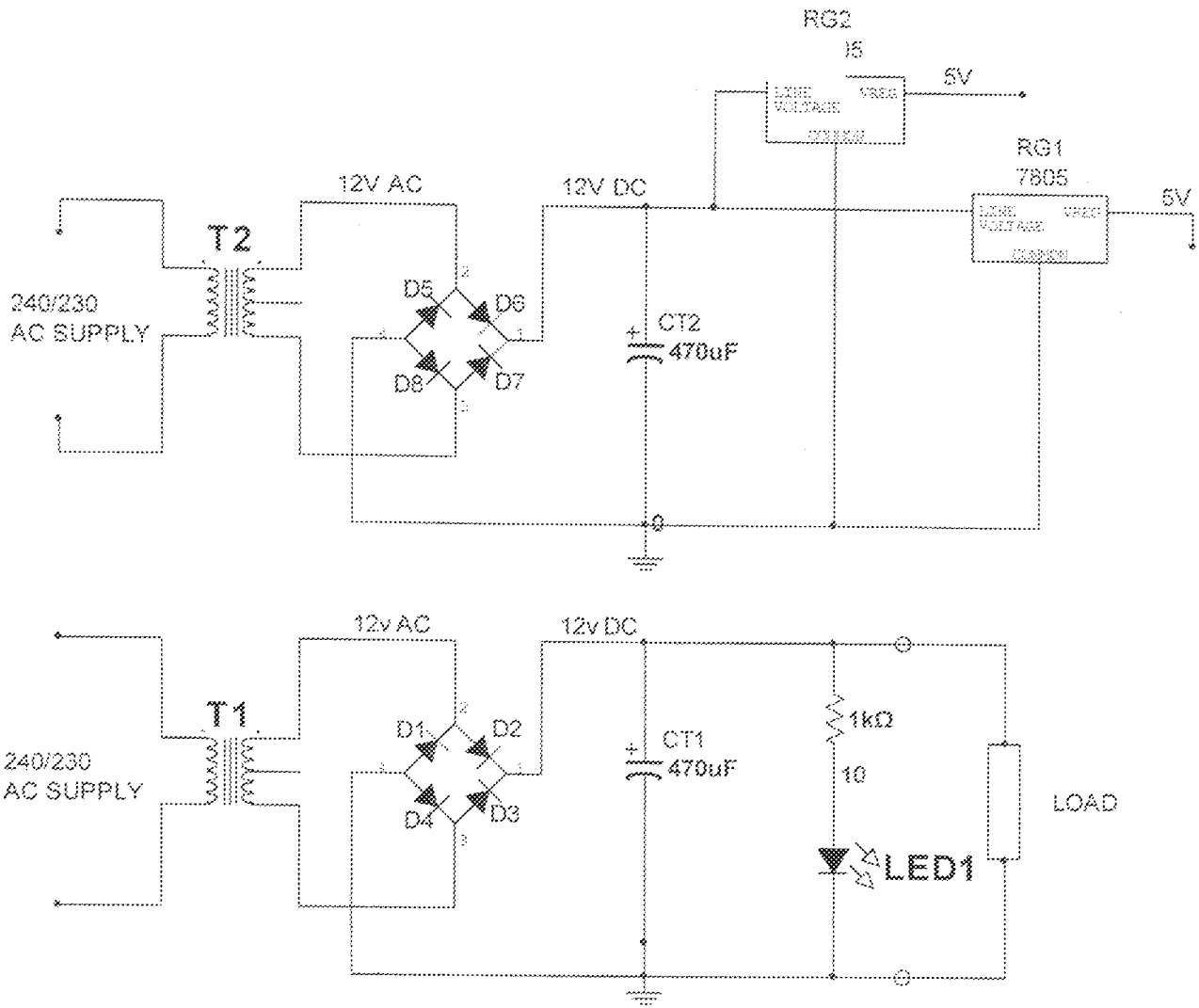
Fig 3.1 circuit diagram of power unit

Two transformers were used instead of one in order to supply efficient power to terminals of each load.

Considering T1, it takes the capacitor Ct1 to charge period "t" which is half the total period. Thus, for 50Hz frequency, the time t is:

$$t = \frac{1}{2f}$$

$$t = \frac{1}{2 \times 50}$$

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=0.01second

The capacitance is a function of voltage dv as in the relationship;

$$Q = It$$
$$Q = Cdv$$
$$Cdv = It$$
$$C = \frac{It}{dv}$$ -- (1)

Where Q is charge in coulombs

I= current the transformer handles =300mA = 0.3A

The rms voltage value is 12v, and then the peak value will be;

$$Vpk = Vrms\sqrt{2}$$

$$Vpk = 12\sqrt{2}$$

Assuming dv occurs in a period 25% of peak value,

$$dv = \frac{25}{100} \times 16.97$$

$$dv = 4.232v$$

Hence, from equation (1)

$$C_{T1} = 0.01 \times 0.3/4.243$$

$$= 707.05 \times 10^{-6}F$$

$$= 707.05\mu F$$

Same calculation applies for transformer T2 since the rating of T1 and T2 is equal.

$$C_{T2} = 707.05\mu F$$

470µF was used in the circuit. The ripple output commensurate with the 25% deviation dv assumed in the calculation. The capacitor rating is 16v, considerably greater than 12v of the circuit as required.

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An LED was used as indicator to show if power is available. The LED also eases the determination of faulty components. For example, if the light output of LED is flickering, it is most probable that the filtering capacitor is bad, or if LED, it means power is not reaching the components circuitry. The LED circuit is shown below;
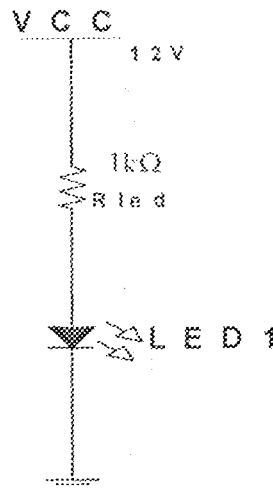

Fig 3.2 circuit of the power indicator

Maximum forward voltage for LED $=V_f= 2.4v$ and the corresponding current $I_f =10mA$

The limiting resistor $Rled$ is given by;

$$= \frac{Vcc - Vf}{If}$$

$$= \frac{Vcc - Vf}{If}$$

$$= \frac{12 - 2.4}{10e^{-3}}$$

$Rled=960\Omega$

The value used for $Rled$ in the design was 1000Ω or $1k\Omega$.

3.1.2 Design of Sensor Unit

This unit has three sections;

a. The transmitter (laser diode)

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b. The receiver (sensor) and

c. The mono stable units (555 timers)

a. The Transmitter

The transmitting unit uses laser diode that transmit parallel beam to the sensor, and is coupled by connecting the anode of the laser to 5v from regulator RG2 and the cathode grounded through a 57Ω resistor. This 57Ω is specified by manufacturers.
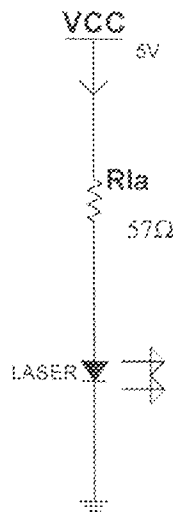

Fig 3.3 laser diode circuit (transmitter)

The current flowing through the laser diode, since $V_f = 0v$ is;

$$Ila = \frac{Vla}{Rla} =$$

$$Ila = \frac{5}{57}$$

$$= 87.7mA$$

b. The Receiver

One of the sensor pin is connected to base of a PNP transistor, whose collector connects to a relay RL1. The voltage generated by the sensor can't in any way be used to generate power from it because it can barely be detected [21]. That is why the PNP transistor

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was used to amplify current for the relay RL1 which switches fast and therefore can correctly detect small voltage changes.
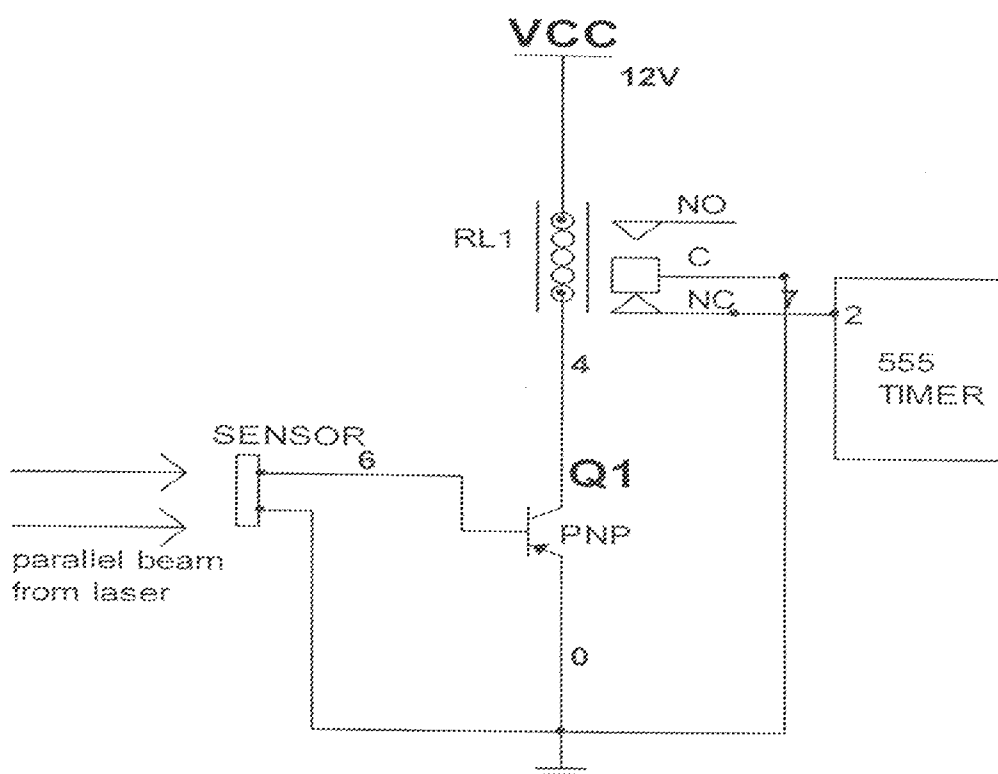

Fig 3.4 the receiver of sensor circuit

The relay will not switch until the base of the transistor goes negative when the beam is blocked.

If Vcc is applied, the common C of relay RL1makes contact with normally open NO and remains there, not until the beam is broken, C makes contact with normally closed NC and returns to NO position. This happens within few milliseconds and draws pin2 of 555 timers to lower than 1/3Vcc and subsequently triggers the timers.

c. Monostable Units

555 timers were used in this stage. The timers have 8-pins of which pin2 is the trigger and the out put at pin3. Considering the inner circuitry of the 555 timer IC, pin2 is the input

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to the lower comparator and is used to set the latch. Triggering is accomplished by taking the pin2 from above to below 1/3Vcc and causes the output to go high (1.7 less than Vcc) [22].

However, the output last for time "T" determined by RC network at pin7 and 6(discharge and the threshold).the relationship to determine T is:

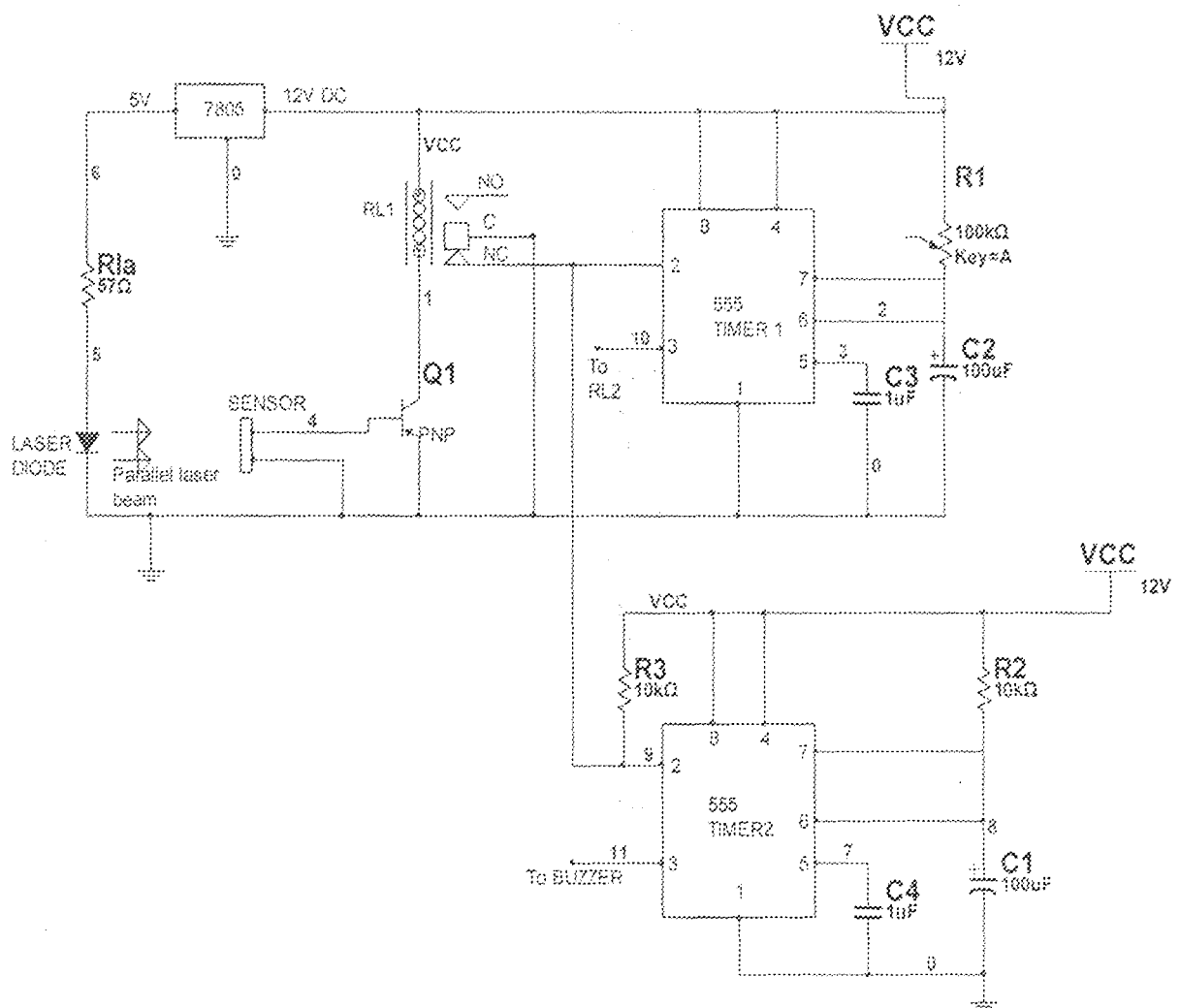$$T = 1.1RC \text{ --- (2)}$$

Fig 3.5 complete circuit of sensor unit

From circuit in fig 3.5, for mono stable1, the time of output was set at 9s.

i.e. $T_1 = 9s$

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C_1 was fixed at 100µF.

From equation----- (2)

$T_1 = 1.1R_1C_1$

$$R1 = \frac{T1}{1.1C}$$

$$= \frac{8}{1.1 \times 100e^{-6}}$$

$$= 81.82k\Omega$$

100kΩ variable resistor was used in this design and its value adjusted to give the 9s required.

For mono stable2, the output time T2 was set at 1.1s.

From equation 2

$T_2 = 1.1R_2C_2$

$$R2 = \frac{T2}{1.1C}$$

$$= \frac{1.1}{1.1 \times 100e^{-6}}$$

$$= 10k\Omega$$

The output voltage of pin3 is 1.7 less than Vcc.

Therefore, voltage output at pin3=12-1.7

$$= 10.3v.$$

The trigger pin2 of the multi vibrators were connected to Vcc via 10kΩ resistor according to specification of the IC. Pin4 was tied to Vcc to avoid any false resetting, though the times are short to expect any false resetting. Pin5 was also grounded through 1µF capacitor to serve as noise immunity.

3.1.3 Actuator Unit

This unit gives a mechanical motion of the door. It has two main parts; the relays and a dc motor. The circuit below shows how both were connected.
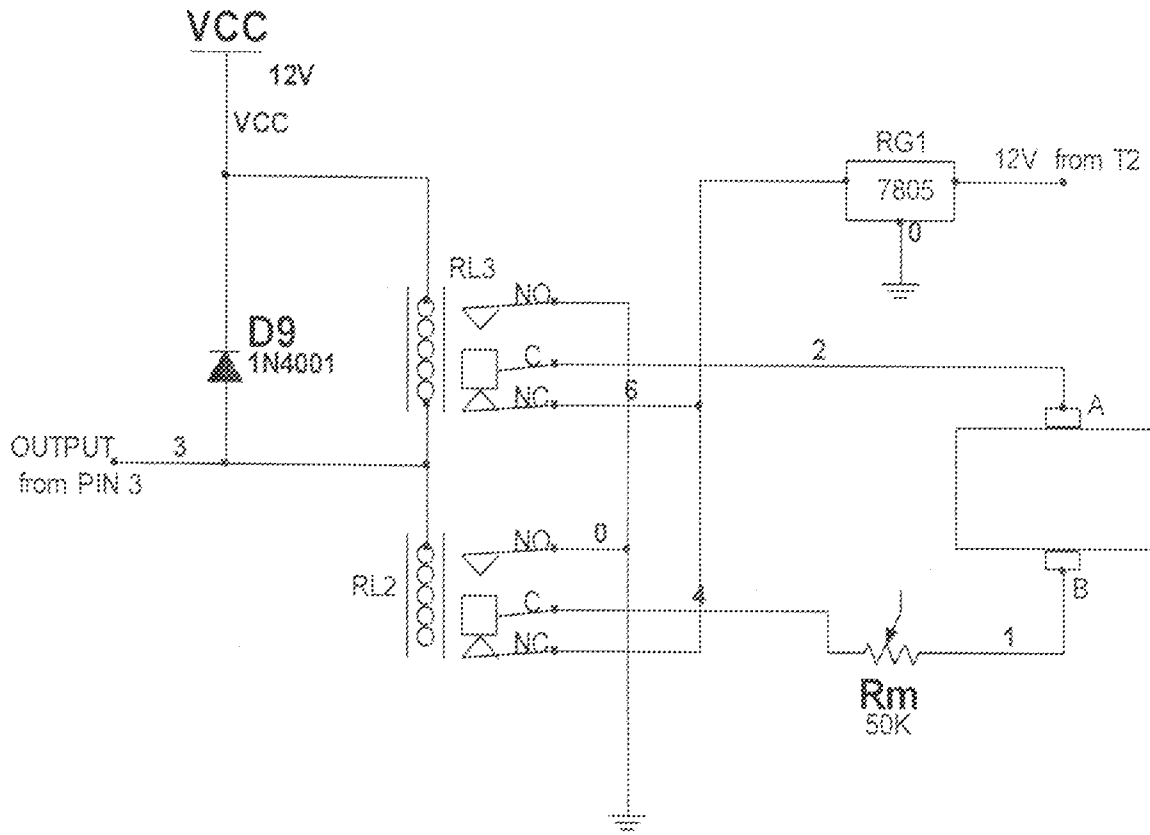

Fig 3.6 circuit diagram for actuator unit

The relays were used primarily as switching devices in the circuit. Depending upon the design, relays generally are not to control power consuming devices except for small motors and solenoids that draw less than 2Amps [23].

The relays used have ratings of 400Ωcoil resistance. Then the current flowing through the relay coils I_L is:

$$I_L = \frac{V_{cc}}{Rl}$$

$$I1 = \frac{20}{400}$$

$I1$ =30mA which is much less than 2Amps.

The speed of the motor is regulated by a variable resistor Rm, which was adjusted to 50kΩ. The current flowing through the motor I_m to give the required speed is;

$$= \frac{V}{Rm}$$

V=voltage from regulator RG1=5v.

$$Im = \frac{5}{50\omega^3}$$

=100μA

Diode D9 is a protection diode to prevent back emf from the relays. This is essential in order to avoid current flowing back into pin3 of the 555 timer which can cause malfunctioning of the circuit.

3.1.4 Design of Buzzer Unit

This unit consists mainly of a buzzer. The positive terminal of the buzzer is connected to output of pin3 from 555 timer2. The timing was configured to output for 1.1s. This means that the buzzer sounds for 1.1s.

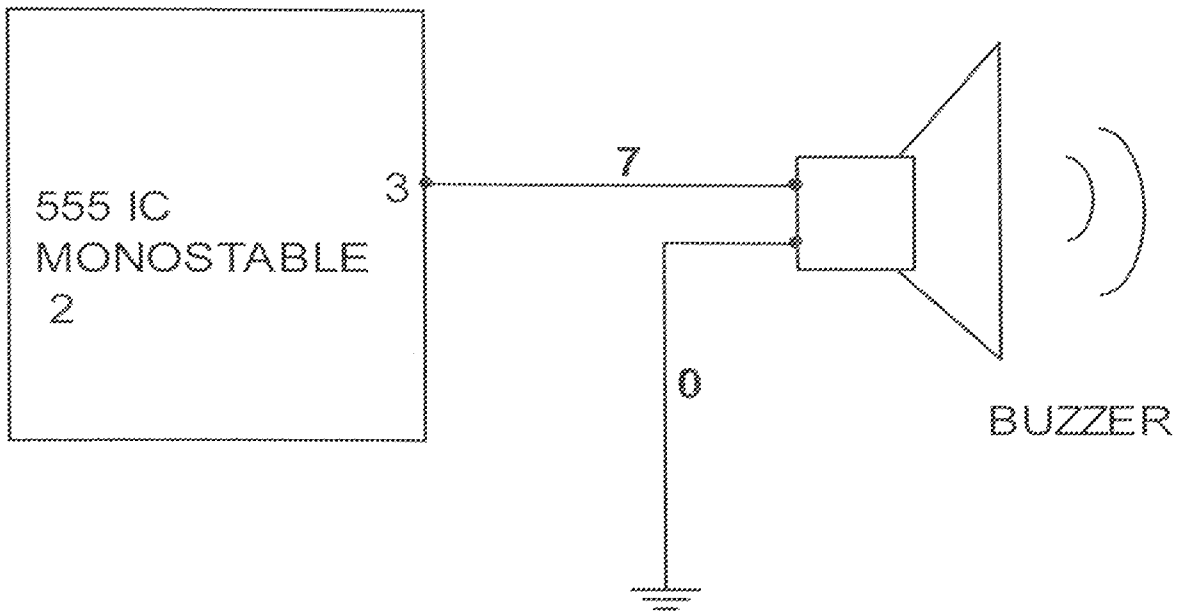Fig 3.7 circuit of the buzzer unit

3.1.5 Design of Display Unit

This unit was designed using a dual 14-segment display. The displays write "WELCOME" when the door has opened.

Four-dual 14-segment has 18pins each. Two of the 18 pins are the cathode "Cd"; the others correspond to powering a line stroke on the display. One extra pin is not connected "Nc". The pin connections are represents as shown below:
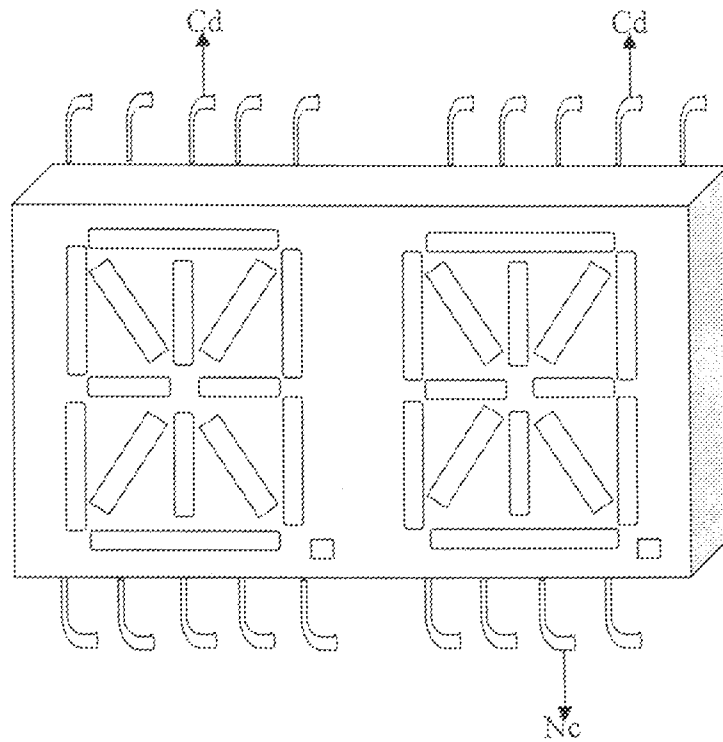
Fig 3.8 pin configuration for (dual common cathode) 14-segment display

The display is a dual common cathode, hence all the cathodes were connected together and then connected to point, the negative of the motor in its opened position. The others pins were connected to point A, positive terminal of motor.

Between the display and the motor is a switch SW, this switch is particularly important in load sharing technique between motor and display. The motor was timed to reach its opened position in two seconds, and remain stationary opened for 7seconds. There fore it is not using any power from the circuit in this state. At this instance, the switch SW automatically closes and the 5v will be utilized by the display for 7seconds that the door remains stationary, the motor changes polarity when it closes. As such, the anode of the display will be drawn to negative and vice versa. The switch SW now opens and automatically switches the display from the circuit.
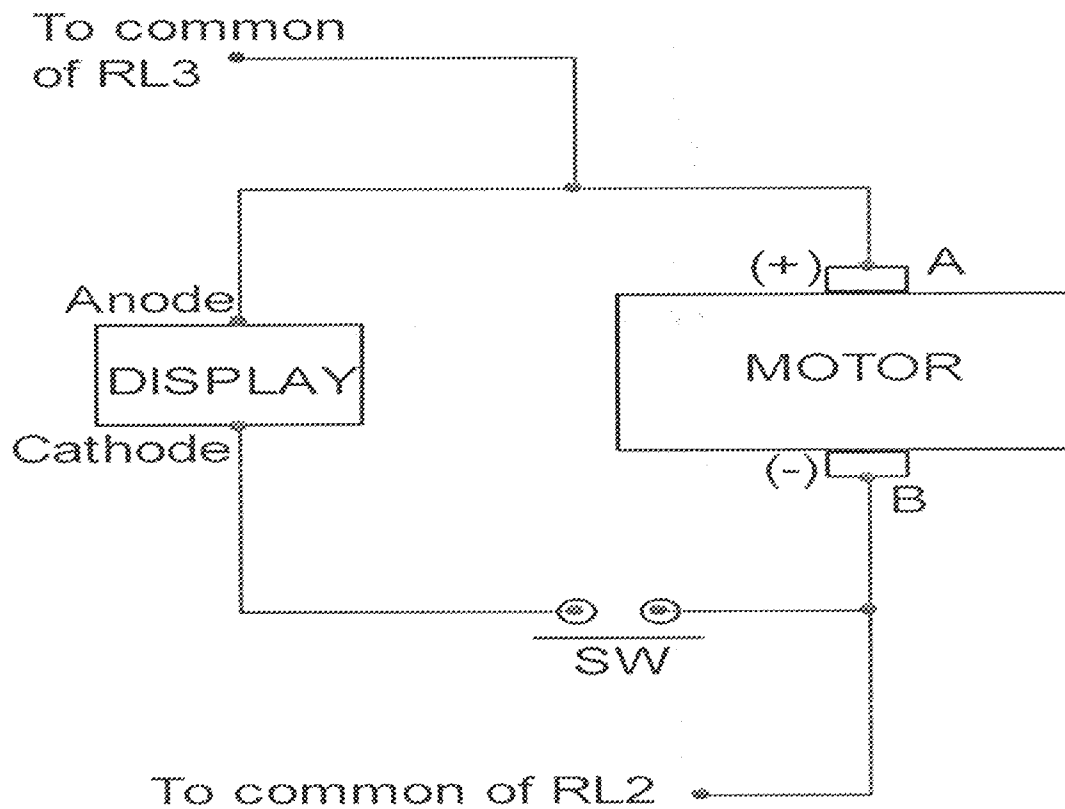
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Fig 3.9 schematic diagram of dual 14-segment display interfacing with motor terminals

3.2 Circuit Operation

The circuit will automatically open the door and simultaneously give an output display "WELCOME" note when the door opens backward. A simple dc motor drives the sliding door. The operation of the dc motor is based on the principle that when a current carrying conductor is placed in a magnetic field, a force acts on the conductor which tends to rotate it [24]. The mechanical force is produced by electric motor (as it converts electric energy to mechanical energy) as it moves the sliding door.

The dc motor is switched by relays. However, automatic door operation of the door is controlled by photoelectric sensor.

Considering the whole circuit diagram in fig 3.10, when laser sensor is seeing the beam, the base of the PNP transistor is pulled to the ground and switches the relay RL1. The relay magnetizes and moves the common terminal C to normally open NO which is not connected. Then pin2 of 555 timers will not trigger because it just was disconnected from ground.

If a person/object blocks the beam, the sensor is blocked and the base of the transistor switches off the PNP transistor. The transistor switches the relay off and the common makes contact with NC. Pin2 of the timers now become low (less than 1/3Vcc) and outputs through pin3.

The second mono stable timer now output and activates the buzzer to sound for just 1.1s. This sound is to indicate that beam is broken and door will is opening. The output of 555 timer1 is connected to RL2. When the circuit is powered initially, the C of RL3 moves to NO position and make point A of motor to go negative in polarity. The terminal B will remain positive.

Now when 555 timer1 gives its output to RL2, the C move to NO and point B becomes negative in polarity, where as the C of RL3 moves to NC and contact A terminal becomes positive. This makes the motor move in one direction (open).

If the door reaches its opened position, the 14-segment display its "WELCOME" output. After the time of mono stable1 has elapse, pin3 output goes low and C of RL2 moves back to its NC position whereas C of RL3 goes to NO. these changes the polarity of the motor, the switch SW opens and display cutoff and motor moves in opposite direction (close).
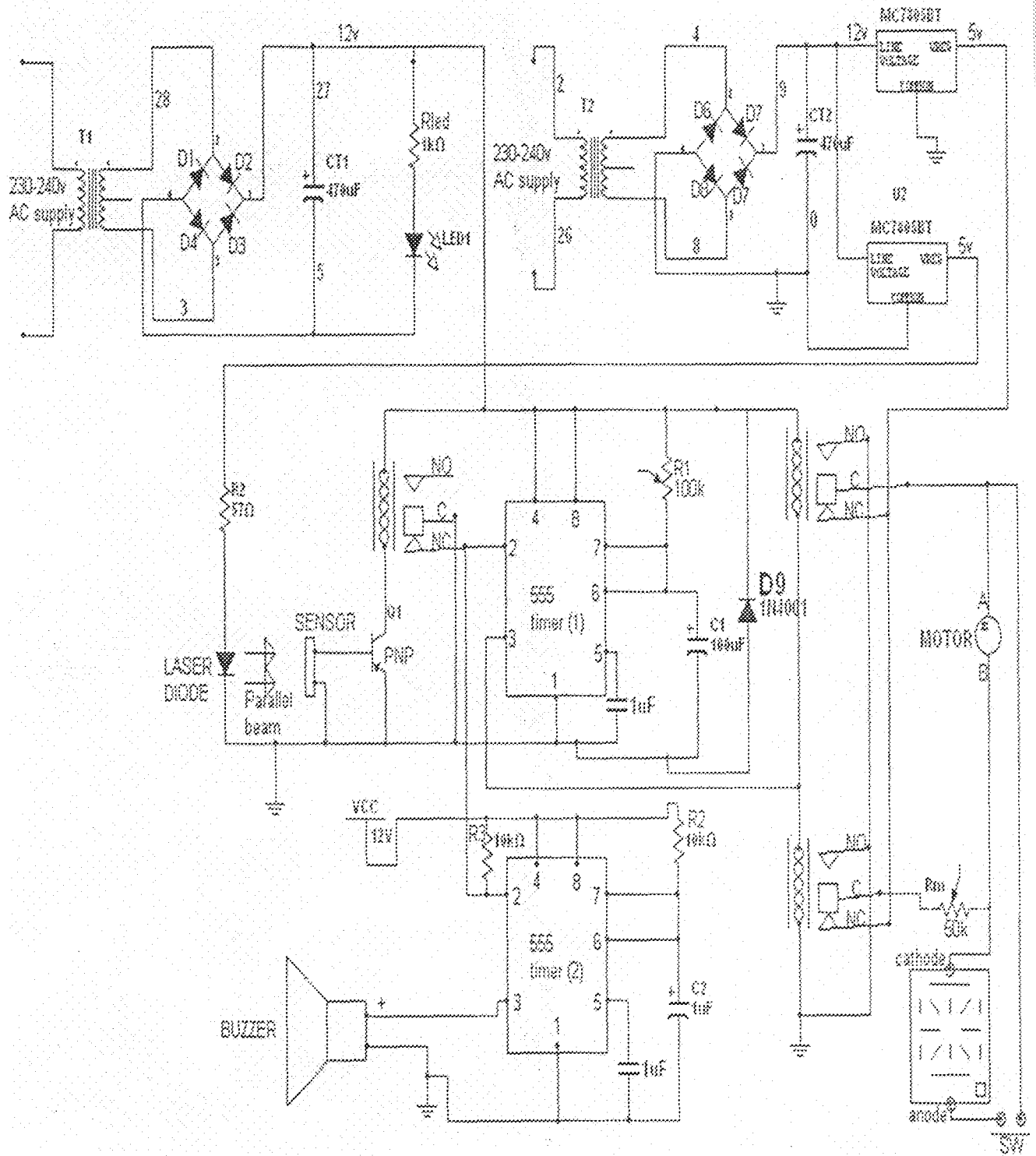
Fig 3.10 circuit diagram of automatic door with WELCOME display

Chapter Four

Construction and testing

4.1 Construction

The construction was implemented in consecutive modules pending on the relevance of one unit to the other.

The first unit constructed was the power pack, to give life to the circuit. Next was a house model. It measures 275mm long, 255mm wide and 120mm high. The door is 100mm long and 60mm high.

The actuator unit was then constructed, connected to power and the door operation tested. The door slides inward 40mm from its closed position. A smooth copper wire was placed between the floor and the door to reduce friction between the two surfaces.

Sensor units were then constructed, starting with 555 timers, to transmitter and receiver of sensor. The timing operation of door was then tested. The burser was then connected, after which the display configured. The whole circuit was then connected and the relevant tests carried out. Finally, the external aesthetics such as polishing and painting were done.

4.2 Tests and Results

Almost all the tests were done using multimeter. Only the timing tests were done by stop clock.

The test was carried out ensuring AC main to be 230-240v by using a stabilizer. If the AC falls below 210v, the circuit may not function properly; in fact some component like motor might not work. If on the other hand, the voltage level becomes very high, the motor

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speed will increase and virtually affect the gears. Under this condition, some components could be damaged.

The tests and results that was done can is summarized in the table below.

Table 4.1 tests conducted and results

S/N	Test	Instrument	Result obtained	Result expected
1	Voltage from transformers secondary output	Multi meter	12.3v	12v
2	Voltage from bridge/filter capacitor	Multi meter	9.9-10.2v	12v
3	Regulators output voltage	Multimeter	4.9-5v	5v
4	Voltage from pin3 of 555 timer	Multimeter	8.27v	10.3v
5	Output time of 555 timer1	Stop clock	9s	9s
6	Output time of 555 timer2	Stop clock	1.3s	1.1s
7	Display ON time	Stop clock	7s	7s

✓ For test 2, the filter capacitance value that was 470µF instead of about 700µF calculated account for the fall in the dc voltage, i.e. more ripples were present. Internal resistance of diodes in the bridge rectifier also accent for some lose.

✓ For the fourth test, the voltage output from pin3 of 555 timers was measured 8.27 instead of 10.3 expected. This is because the voltage input to pin8 (as seen in test 2) was 9.9-10.3v instead of 12v.

To prove this, pin3 output is Vcc-1.7

Then Vcc=output +1.7

$$=8.27+1.7$$

$$=9.97v$$

This means that the actual Vcc to 555 timer was about 9.97v not 12v.

4.3 Limitations

❖ Initial trigering effect: when power is applied to the circuit initially, the circuit activates (the door opens, the LED display lights, and the door closes after 9 seconds) because it senses the initial negetivity of the base. This could not be stopped using the circuit design. But it has no any negetive implication because after the initial trigering, the only means of activation is by breaking of laser beam.

❖ The circuit requires enough voltage level to operate normally. Once the voltage level falls below 210v, the circuit operation becomes abnormal.

Chapter Five

Conclusion

5.1 Summary

Laser sensor, dc motor and displays were used to design automatic doors with display output. The aim of this project "design and construction of automatic door with WELCOME display" was achieved. The door was automatically powered by a photoelectric laser sensor and simultaneous display for the time postulated is perfect.

5.2 Recommendations

Though the project aim and objectives were achieved, the stage is however, open for project students, hobby circuit designers and research tinkerers for improvement on this work. Some suggested areas are:

* A sound recordable circuit can be added to the design, so that instead of displaying alone, it can also voice out; say for example "welcome to FUT Minna". Suggested ICs that can handle such task are ISD25xx series and ISD1000A series.

* The tune of this design was focused on commercial centers. Focus can be made to other areas like security which will change the implementation of some parts in the design.

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