DESIGN AND CONSTRUCTION OF AN AUTOMATED DOOR WITH COUNTING SYSTEM

BY

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2003/17177EE

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DEDICATION

This project work is dedicated to God almighty for His mercy towards me and my family, and to all good people who have assisted me during the course of my study.

DECLARATION

I Adesanya Olusesan Ekinne declared that this project 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.

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for Name of H.O.D

(May 6, 2010)

Sign & Date

Name of External Examiner

07/03/10

Sign & Date

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ABSTRACT

This project is design and construction of an automated door with counting system, it is used to open and close a door as the first person approaches the door and last person leaves respectively. The system also display the number of people entering and the number of people leaving as well as the number of people remaining in the building.

It has also both logistic and security application. For logistics, it can be used to know the number of people in a conference, seminar or other formal gathering so that the number of conference materials (brochures, speeches, programmes of events, refreshments etc.) to be produced can be known. For the security aspect, it can be used in banks, supermarkets, museums, park and resort center to ensure that no one is locked in (either by mistake or intentionally) at closing time.

The door has LDR(light dependence resistor), such that a light beam is broken each time a person passes through the door and the signal is sent to a digital control circuit which aids the counting and the automating of the door.

CHAPTER ONE

1.1 INTRODUCTION

The world is changing. Technology is limitless, only imagination can govern its potential. Once the idea is conceived by mind technology will achieve it. Labors are becoming less and less, automation are everywhere not only in the manufacturing and processing industry but with peripheral that we interact directly with on daily basis.

The research shows that an able-bodies man interacts with doors averagely 20 times daily. For women it is 35 times while it is 40 times for children averagely. No wonder sensors, proximity detectors, and voice recognition access is everywhere to control this wanted barrier.

When security personnel are placed at the entrance or exit of a complex, an office or a store, they are to monitor who goes in and who comes out. But human memory is shallow, it cannot accurately figure how many have gone out and how many are still there within.

This requirement can be perfectly achieved only through electronics means which is an automated door with counting system.

This project is the design and construction of AUTOMATED DOOR WITH COUNTING SYSTEM (ADWCS).The prototype door is being constructed to open automatically as the first person approaches and to close as the last person leaves.

The system is also designed to count and also to display the number of people entering a particular entrance and the number of those going out through the exit. The system also displays the number of the people remaining in the building. The project involves the use of LDR break beam sensors, placed at the entrance and the exit of the two doors. A person entering through the door breaks the beam, and a signal is sent to digital control circuits, which count and also display the count. Likewise, those going out of the building are also counted and displayed.

The application of the systems cannot be over emphasized. Apart from the counting of people entering and coming out of a place, the project also is used to control an automatic slide doors commonly used in banks, hotels, offices and conference halls supermarket, museum etc, or interface with a gate and trigger the opening when someone or a vehicle approaches. In this case, people would think there is a security man even if there is nobody there opening the gate.

1.2 GENERALISED BLOCK DIAGRAM.

The operation of the circuit is summarized in the generalized block diagram of fig 1.1

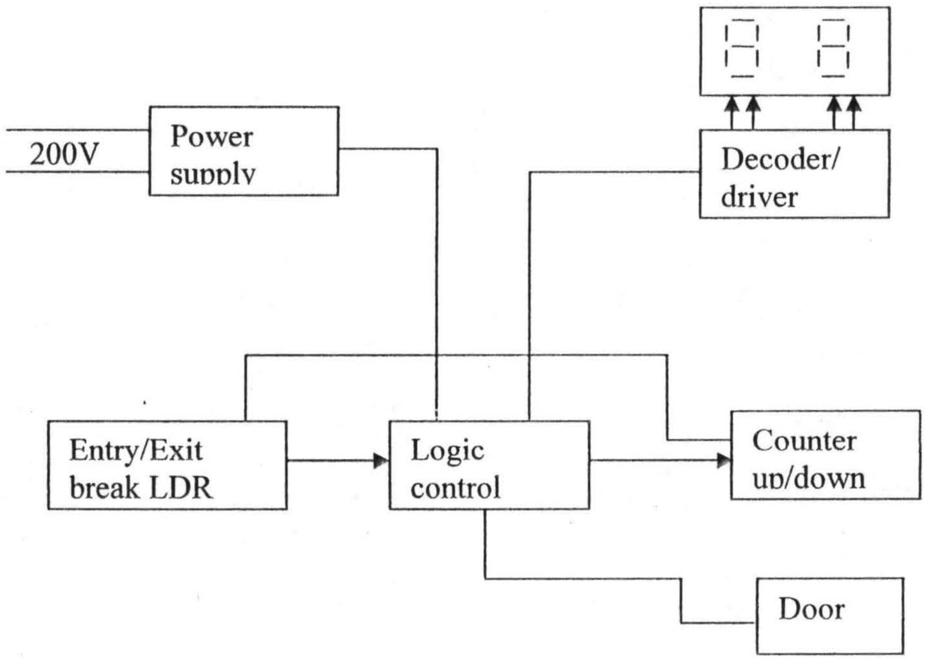

Fig 1.1 Block diagram of the system

1.3 OBJECTIVES.

The objective of this project work will include;

— To design and construct a simple low cost automated door device that will also aid the counting of people entering into a particular room, and people leaving through the exit, also the total number of people remaining in the room are displayed.

— To ease up opening and closing of a door through electronics means.

— To ease up digital counting devices through the aid of LDR (Light dependent resistor).

— To create awareness in electrical and electronic devices and automated-doors.

— To stimulate students interest in the growing field of automated doors.

— To improve organization security into and out some restricted entrances, like the strong room of banks, museum, supermarket etc.

1.4 METHODOLOGY.

The method used in carrying out the project is as follows.

The project uses a power source, which is the regulated 12V from the main source (PHCN). This arrangement provides a steady power supply to the digital control circuit. The door opens automatically as the first person approaches the door. The seven-segment displays used are common anode and they start counting up for entry when the output of the LDR receiver stage triggers a monostable multivibrator; and, when a person leaves the room an exit counter is triggered from an LDR sensor stage for exit. An independent counter is also configured to display the net count. (The total number of people left in the building) and when everybody have gone out of the building, the display reads zero, and the door closes automatically.

1.5 SCOPE OF THE PROJECT

The ADWCS is based on sensors and a digital circuit: it also has a counter that counts the number of people entering into a building, the people going out through the exit door and the total number of people remaining in the building.

The major limitation of this project is that two people backing themselves will be sensed at once; an error will be shown if it occurs, due to the fact that an LDR sensor will only sense one movement at that time.

1.6 PROJECT LAYOUT.

Chapter one

This chapter introduces the design and construction of an automated door with counting system, objectives, scope of the project and methodology.

Chapter two

This chapter begins with the historical and theoretical background of the project work.

Chapter three

This chapter contains the design, analysis and the calculations involved in the design of the project work, as well as the construction

Chapter four

The testing of the entire work is reported in this chapter

Chapter five

The final conclusion based on findings in the course of the work and the recommendations are included in this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORY AND DEVELOPMENT OF DOOR AND COUNTING

Door has long been with us, in the primitive age as wedge, in the stone age as barrier, in the iron age and industrial revolution under locks and keys now in computer age electromechanical and automation. Door use is a critical aspect of safe egress from buildings in access, security and emergency situations. The term automated doors includes full powered automated doors such as those that are commonly used at supermarkets and transportation terminals and "low energy" and "power assist" doors that are used in less demanding situations.

Automated doors offer an effective way to reduce the stress of door use. Automated doors are specifically designed to reduce congestion and increase access, but they also can be helpful to control access and improve security. Building safety codes and standards reflect this fact through many detailed design criteria. Automated doors must address these emergency concerns if they are part of designated exits. [1][2][3][4]

For people with disabilities, difficulties with door use are more pronounced and often a stressful aspect of everyday experience. Automated doors can make the door use task easier

Force to Operate Controls. Automated doors are activated either through detection systems or manual controls. There is enough research on the use of controls by people with disabilities to make recommendations on size, location and operating forces for these devices.

Force to Open Doors. The accessibility of automated doors is related to the force required to open manual doors. Establishing maximum thresholds for these operating forces essentially determines when automated doors will be required. Much research has been completed on the subject of opening doors against the resistive forces of mechanical closers and air pressure differentials. Although some of the findings are divergent, they can be explained by differences in research methods and sample selection. Given the purpose and intent of an application, it is possible to use the existing data base to make appropriate recommendations for maximum resistance forces (minimum opening forces) at manual doors. [1][2][3][4]

Research indicates that the abilities of the more severely disabled population to overcome resistance of door closers are very limited. Closers are not currently designed with a level of efficiency that would allow all doors to close properly if the opening force were set at the limit that people with severe disabilities could manage on an everyday basis. Furthermore, people with severe disabilities have limited use of their hands and arms. Therefore, there is a rationale for requiring automated doors. [2][3][4]

Passing Through Doorways. Research has demonstrated that passing through doors against the resistance of a closer is quite difficult for many people including those who use wheelchairs, and particularly children. The main problem seems to be that door users have to exert force to keep the door from closing while they are moving through the opening. Safety issues for people who walk or wheel slowly while using automated revolving doors are a special case of this problem. These doors do not really "close", but, the user can be bumped by the leaf behind them. Manufacturers have developed several different approaches to this problem but none has been evaluated in depth.

Detection Zone: Sensors and control mats at the pull side of hinged doors should detect people approaching doors early enough to ensure that the door will open before the user reaches the sweep area. The automated door is activated by an automatic sensing device e.g. LDR that is located at each approach to the door. LDR is a detector that can be activated by body movement.

Closing Doors. Automated doors always close by themselves. Thus, this subtask is not an issue in design.

If a door meets opening force requirements, why would a building owner want to pay extra to automate it? Only facilities that seek ultimate convenience would install such systems.

The market for automated doors is becoming more defined. The type of product that fits best with a particular application is determined by frequency of operation, speed of operation required, new versus existing construction, traffic flow and cost. Products are available to address the full range of applications based on these factors. [1][3][4]

New technology entering the market is making use of microprocessors to provide more sophisticated control of door function. Computer control allows the door speed and direction to be adjusted automatically in response to conditions encountered during the door's movement. Such control can include distinguishing between a force applied to the door by an inanimate object or a force applied by a person. It also provides new ways to convey information to door users, providing feedback that can help them negotiate the door with less stress and increased safety. For example, a presence sensor can detect a person that has stopped in the middle of the passage and send a signal to the microprocessor control.

The microprocessor could evaluate the data and then activate a gentle pre-recorded announcement to encourage the individual to proceed. This level of technology promises to make the use of automated doors a highly interactive process with many options for controlling use of the door in response to different conditions and patterns of use. It presents many advantages for energy conservation, security and accessibility.

Manufacturers believe that automated doors are the preferred means of access for all users, not only people with disabilities.

In general, the cost of operating automated doors themselves is low. The principal operating cost associated with automated doors is due to increased energy costs. Costs increases result not only directly from heat loss or heat gain but also indirectly from additional space, such as vestibules, or equipment, such as air curtains, used to conserve energy at doors with high levels of traffic. However, the energy costs are primarily due to the traffic flow, not the automated doors themselves. [1][2][3][4]

Supermarket chains use large vestibules between two sets of doors to help reduce energy costs. One organization said that it had made a decision to utilize only revolving doors in an attempt to cut energy costs. It should be noted that such systems can cost as much as $100,000 each. This commitment indicates the extent of the problem for that particular organization. Low energy door installations do not cause as severe an energy conservation problem because they have less traffic. Although these doors may remain open a long time, several people can pass through before they start closing. This reduces the traffic at adjoining doors. [1][2][3][4]

In summary, the selection of a particular automated door system is based on reliability and durability issues rather than cost concerns. Once the level of reliability and durability is established, cost then becomes an issue for competing systems of the same type.

Similarly, improvements in digital counting technology are centered on and around electrical and electronics innovations. In early days counting was done in different ways, mostly manually. Man was the first counting machine that ever existed on the earth, which involves counting with his fingers. Then as larger quantities emerged, various items such as twigs, pebbles, Napier's bones and abacus were used.[1][2][3]

The first counting equipment that existed was the abacus; this system is simply based on a radix of five. It has a set of beads moving on parallel strings, the first set contains five beads on each string which allows counting from 1 to 5, while the second set has 2 beads representing 5 to 10. The abacus emerged from the need for merchants to count and calculate prices and similar functions. The original counting boards were made of stone or wood, it has a groove between which beads or pebbles were moved. An example of a counting board is the salami's tablet which was discovered in 1846 on Salami's island by the Babylonians. The salami's tablet is a white marble of length 149cm in length, 75cm in width and 4.5cm thick.

Napier's bone was another wonderful multiplication tool invented by John Napier of Scotland in1550. The bones are a set of vertical rectangular rods, divided in 10 squares. The top square contains a digit and the remaining squares contain the first 9 multiples of the digit. When a number is constructed by arranging side by side the rods with the corresponding digit on the top, then its multiple can be obtained by reading the corresponding row of multiples from left to right while adding the digits found in the parallelograms formed by the diagonal lines.[2] [3] [6]

Finally, the punched card which was invented by Herman Hollerith was used for vital statistics tabulation and was also adopted for use in 1890 census. The punched card can be chosen as a basis for storing and processing information. The design of Herman Hollerith ruled the computing world for almost 100 years.

In our modern world today, counting is something of necessity from human history after the development of language. Using a digital electronic counter in the area of monitoring people hasn't been greater use. But in several ways a digital electronic counter can be used.

A bank monitoring system is design to give information on the number of persons entering and going out of the bank hall and also the total number of people remaining in the bank hall. It employs the use of up/ down counter, which increases/ decreases when a signal is sent to a pulse sensor.

Another application is in a hall having 2 doors, one for entry and the other for exit, in this case, a light dependent resistor sensor placed both at the entry and exit and thereby number of persons that passes through the entry and exit door will be known.

Cinema Hall: design to give information on the number of persons within the hall during a film section, thereby number of persons that entered the hall will be known.

Also an automation room light controller, here once a person enters the room and the circuit registers a count. This enables the light while if that person leaves the room and the counters data is decreased, this causes the light to switch off.

Counting applications allows digital monitoring, numbering, recording and control of things, even people in the aspect of this project, more logic units are designed for counting operations with the invention and development of digital electronics that work on binary designation.

2.2. THEORETICAL BACKGROUND

For a good understanding of the circuit to be discussed in the next chapter, there is the need to know the theory behind the various components used.

2.3 SLIDING DOOR

Clear Width

Several studies have examined the minimum clear width required to pass through a doorway with a wheelchair. The clear width of the door is measured as in Fig. 2.1. In the only American study with adults, demonstrated that a 30 in. (760 mm) clear width was satisfactory for all, including wheelchair users in their sample. They recommended a clear width of 32 in. (815 mm.) to provide tolerances for fast movement.[1][3][4]

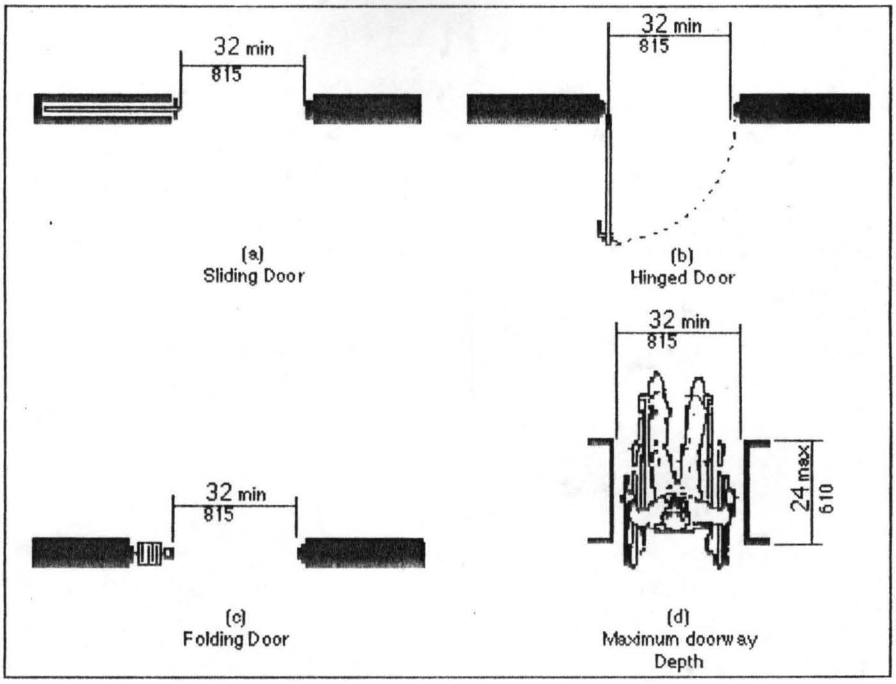

Figure 2.1 Door width clearances (as in ANSI 117.1, UFAS, MGRAD, ADAAG)

There are two important manoeuvring clearances (see Fig. 2.1). The first is the front clearance, the distance from the face of a closed door to the closest obstruction opposite the door. The second is the latch clearance. This is the distance measured parallel to the closed door from the edge of the door at its latch to the closest obstruction. There are also six different approaches to a swinging door based on whether the user is coming from the side or directly in front and, if from the side, whether from the latch- or hinge-side of the doorway. Research has demonstrated that the direction of approach affects the minimum clearance required [2][4]

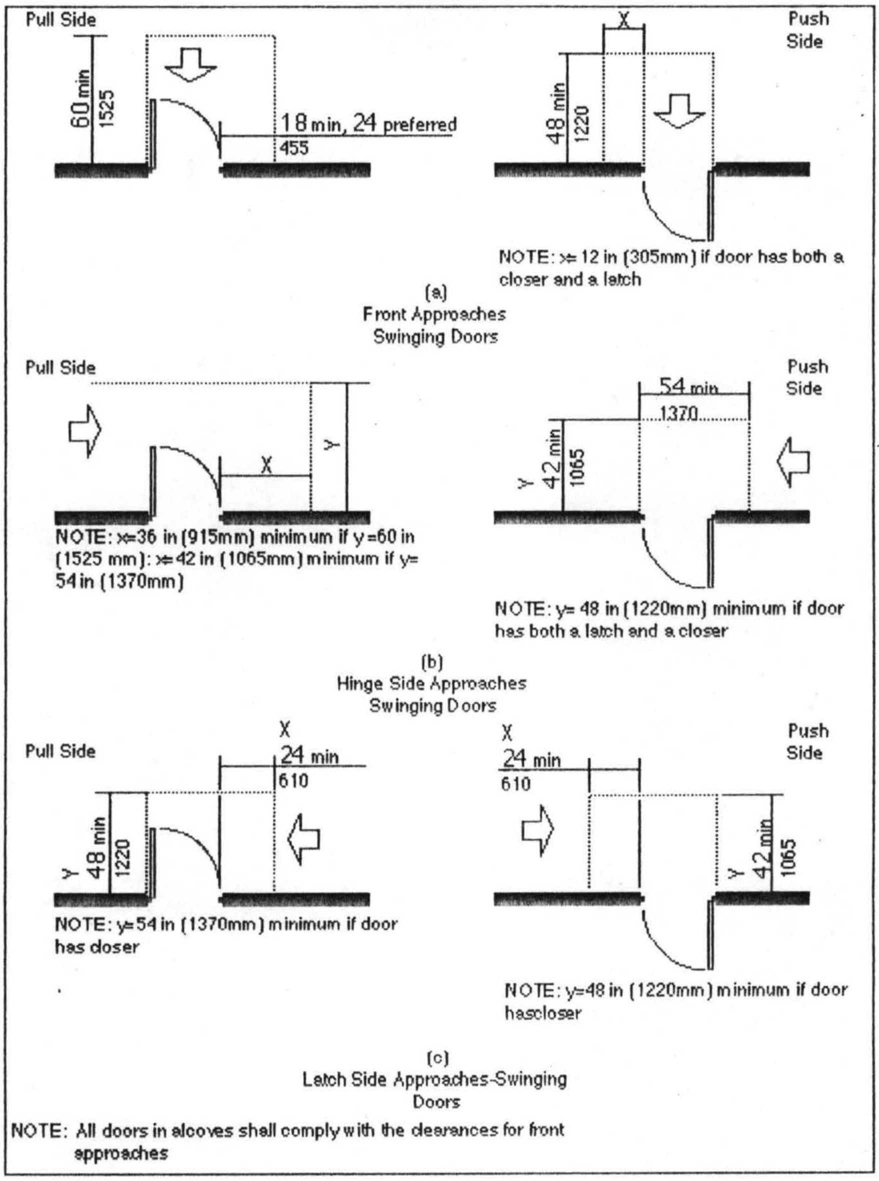

Figure 2.2 Manoeuvring clearances (as in ANSI 117.1,UFAS, MGRAD, ADAAG)

2.4. COUNTERS

Counters generally are categorized as Asynchronous (ripple) and synchronous. They are made up of flip – flop, which are triggered sequentially (as in the case of Asynchronous triggering of the ripple counter is useful in cases, which the propagation delay associated with ripple – through counter may be problem.

Grouping of flip – flops together so that they act as a data store produces a register. Certain type of register can be used to count pulses and are known as counters. Flip – flops generally may be used to form counters but the JK flip – flop is the most popular and most flexible to use.

2.4.1 ASYNCHRONOUS COUNTERS

Consider the three – stage counter using JK flip – flops connected in toggle mode shown in Fig. 2.3 below.

If all outputs and initially reset to zero by an input going low in the clear line prior to the input signal arriving and the JK flip – flops are master – slave then the input pulse to flip – flop A (FFA) will have no effect on the QA output until the pulse changes from logic 1 to logic 0 level.

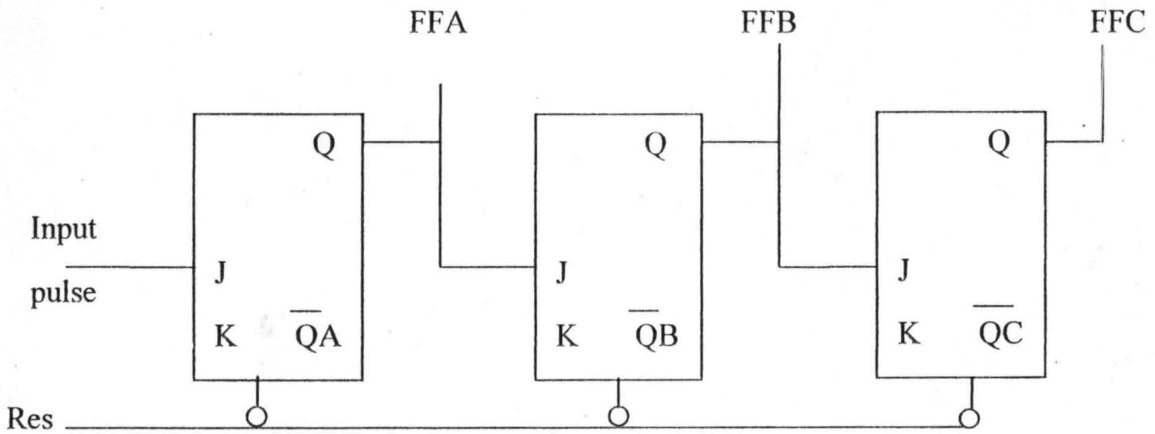

Fig 2.3 Three stage counter

However the output QB reset at 0 since the input pulse to flip – flop B (FFB) has gone from 0 to 1. Similarly, QC will remain 0.

When the second input pulse has arrived and gone from logic 1 to logic 0. However, if this is a negative transition and as such will cause the output of (FFB) to toggle so that QB goes to 1. Since this is a positive transition QC will be unaffected and remains at 0

At the end of the third input pulse, QA again toggles; this time to logic1 QB and QC retain their value of 1 and 0 respectively. At the end of the forth input pulse,

QA toggles and falls to 0. The transition from 1 to 0 at the input to FFB causes QB

to fall to 0 and this transition in turn causes FFC to toggle so that QC goes to 1. [1] [2][3]

One of the commercially available counters is the 74LS192.

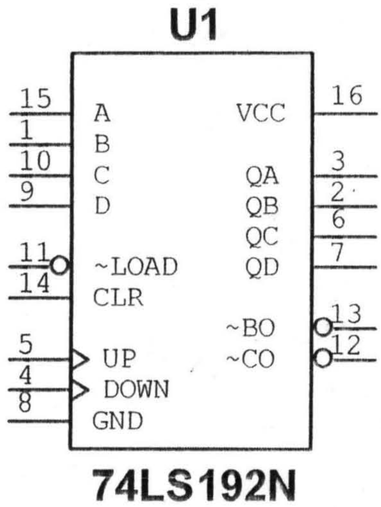

Fig 2.4 74LS192 Decade counter

The 74LS192 counter, when used as BCD counter or an equivalent decade counter, could be cascaded to give larger decimal counts. Suppose it is required to build a counter to count from 00 to 99 being used to clock the next count which represents tents. The QD output of the tents counter would likewise be used to trigger the 74LS192 to be used to count tens.[2] [3]

2.5. IC TIMERS.

The emanation of IC timers eliminated a wide range of mechanical and electromechanical timing devices. It also helps in the generation of clock and oscillator circuits.

Timing circuits are those, which will provide an output change after a predetermined time interval. This is of course, the action of the monostable multi – vibrator, which will give time delay after a fraction of a second to several minutes quite accurately. The most popular of the present IC, which is available in an eight, pin line package in both bipolar and CMOS form. The 555 timers is a relatively stable IC capable of being operated as an accurate bistable, monostable or astable multivibrators. The timer comprises of 23 transistors, 2 diodes and 16 resistors in it internal circuitry. [1][5]

The 555 timer used in this project was configured as a monostable multivibrator. Once the cicuit is triggered by a negative going pulse, the output will go high and remain high until the set time (determine by the capacitor connected to pin 5 and pin 6) has elapsed. Also, the output timing pulse can be terminated at any time by bringing pin 4 (reset) low. Thus resets the 555 timer.

Its functional diagram is shown below in Fig 2.4.

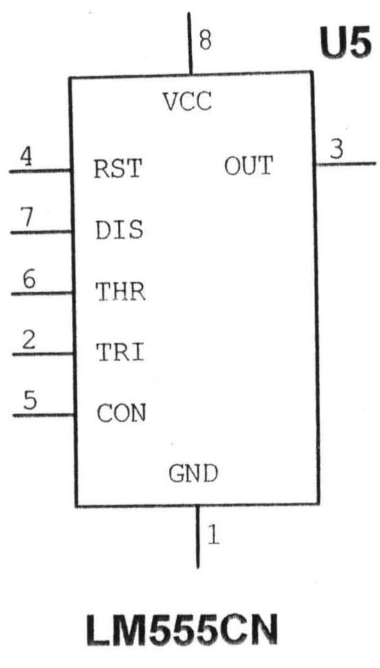

Fig 2.5 555 timer pin orientation

The output of the flip – flop controls the output stage of the timer. The 555 timer chip works from a d.c. supply between 3 – 15v and can source or sink up to 200mA at its output. The operation of the 55 timers is further defining the functions of all the pins. The details regarding connection to be made to pins are as follows.

Pin 1: this is the ground pin and should be connected to the negative side of the supply voltage.

Pin 2: this is the trigger input. A negative going voltage pulse applied to this pin when falling below 1/3Vcc causes the comparator output to change state. The output level then switches from LOW to HIGH. The trigger pulse must be of shorter duration than interval set by the external CR network otherwise the output remains high until trigger input is driven high again.

Pin 3: this is the output pin and is capable of sinking or sourcing a load requiring up to 200mv and can drive TTL circuits. The output voltage available is approximately – 1.7V.

Pin 4: this is the reset pin and is used to reset the flip – flop that controls the state of output pin3. Reset is activated with a voltage level of between 0V and 0.4V and forces the output low regardless of the state of the other flip – flop input. If reset is not required, then pin 4 should be connected to same point as pin 8 to prevent accidental resetting.

Pin 5: this is the control voltage input. A voltage applied to this pin allows the timing variations independently of the external timing network. Control voltage may be varied from between 45 to 90 of the Vcc value in monostable mode. In astable mode the variation is from 1.7 to the full value of supply voltage.

Pin 6: this is the threshold input. It reset the flip – flop and hence drives the output low if the applied rises above two – third of the voltage applied to pin 8.

Pin 7: this is the discharge pin. It connected to the collector of an npn transistor while the emitter is grounded. Thus the transistor is turned on, pin 7 is effectively grounded.

Pin 8: this is the power supply pin and is connected to the positive of the supply. The voltage applied may vary from 4.5V to 16V although devices, which operate up to 18V, are available.

[1] [3] [6]

2.6. LIGHT DEPENDENT RISISTOR (LDR)

Light energy falling on a semiconductor such as a candmium sulphide, causes a change in its resistance. The LDR which is a photocell has resistance as high as 10MΩ in total darkness and in bright sunlight about 100Ω. The LDR, with a surface which is exposed to light, can carry several milliampres, an amount which is sufficient to operate ICs and even relays.

The symbol of a light dependent resistor is shown in fig 2.6

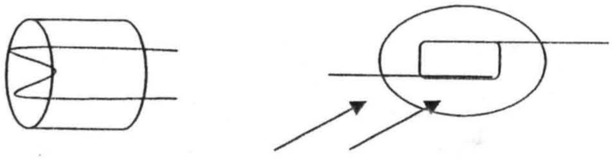

Fig 2.6 Light sensitive surface Symbol of LDR

CHAPTER THREE

DESIGN ANALYSIS AND CONSTRUCTION

3.1. CIRCUIT DESIGN

The automated door and the counting system comprises of the following sub – system.

Power supply unit

LDR sensor

Pulse detector

2 – Digital Up – Down counter

2 – 74LS47 BCD – 7 Segment Decoder

Display unit

Door unit

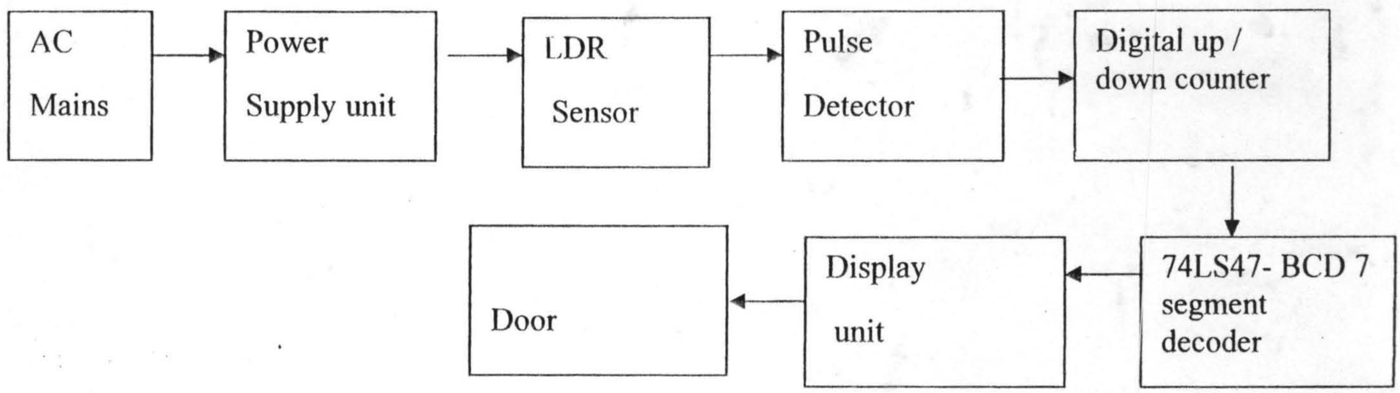

Fig 3.1 Circuit Block Diagram

3.2. PRINCIPLE OF OPERATION

The LDR sense the people entering or leaving and trigger the door open or closed as the case may be. Two displayed are used for the monitoring of IN and OUT. The doors have LDR sensors such that a light beam is broken each time a person passes through the door. The output of the sensor receiver stage triggers a monostable multivibrator , which clocks the counter to count – up for IN. if somebody leaves the building, the EXIT counter is triggered from a light sensor for EXIT and the counter updates the EXIT count. The two counters are cascaded to count UP/DOWN to monitor both the entry and EXIT. This counter will display the NET count, which is the number of people still left inside a particular building or house.

The two displays are assumed to be monitored independently so that a consonance of results can tell that there is no cheating in any way, especially for a security system or in occasions where gate takings are made and tickets are sold.

3.3 LIGHT SENSOR STAGE

The sensor stage is shown in Fig 3.2. The circuit employs the use of a LDR receiver and amplifiers to enable its output drive other stages. The LDR was used as the main optic – sensor due to its ability to give low resistance in day light better than the other optical devices mentioned. The LDR is fed to the input of the comparator IC1. The resistance measured from the photoresistor in no transmission of light is 1MΩ and during transmission drop to approximately 5kΩ. fig 3.2 shows the light transceiver circuit and the monostable stage IC2 is a Schmitt trigger stage to remove ripple noise from triggering the counter falsely.

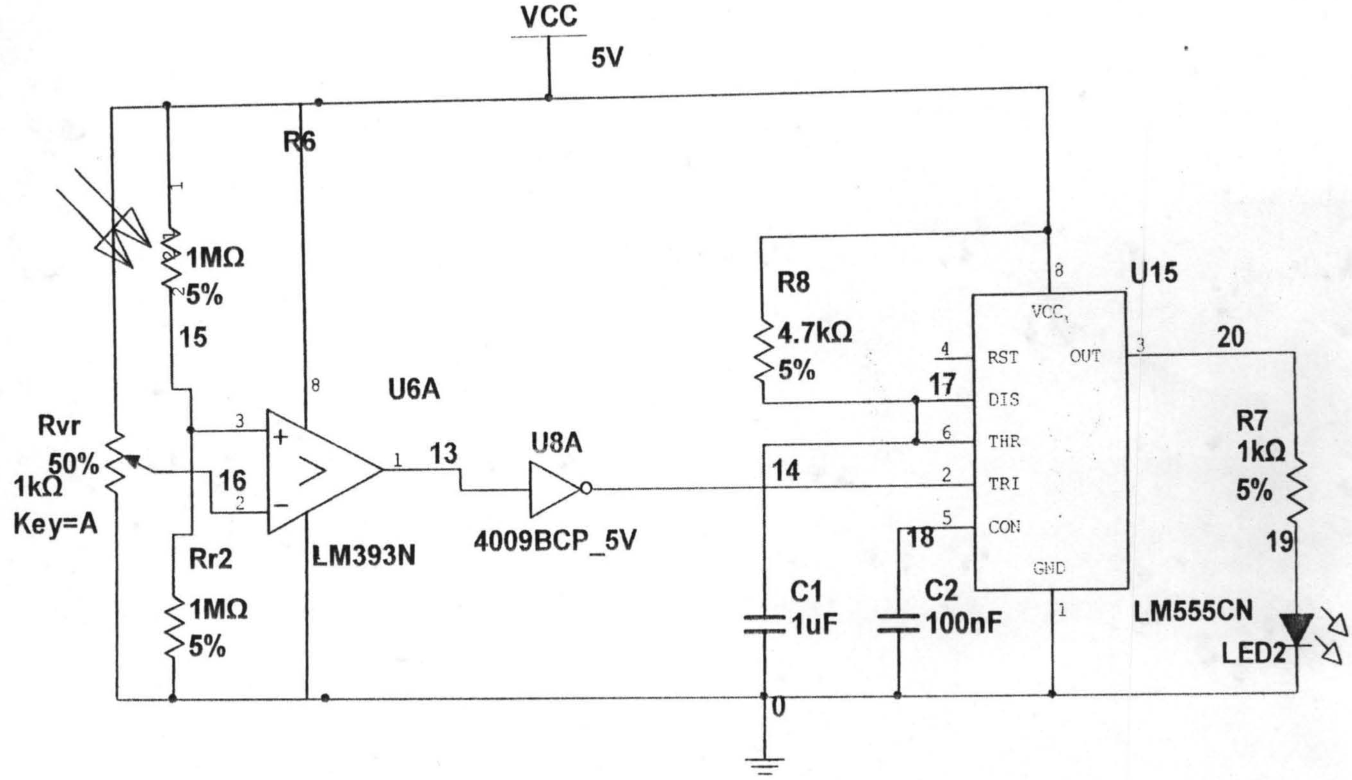

Fig 3.2 Light sensor stage

The photo cell (LDR) gives different resistances for light (i.e. reception of incident light) and darkness (i.e. when there is no reception of light). This change in resistance will show as voltage change when connected with a resistor which form a potential divided with it. The resistance of the Photo – cell (R_D) was found to be as follow.

Darkness (i.e. no transmission) --------------------------- (≈ 1 MΩ)

Light (i.e. transmission) ------------------------------------ (≈ 5 kΩ)

Considering that for these two situations there would be a drop (V_{RD}), across the photo cell

Since $$V_{RD} = \frac{R_D}{R_D + R_2} \times V$$ ------------------------------- ---------------------------(1)

Where R_D = drop across LDR

V_{R2} = Voltage drop across R2

V + = 5V supply

Now setting the voltage across R_2 to be 2.5V in darkness (i.e. without any Light rays)

Then $2.5V = \frac{R_2}{1M\Omega + R_2} \times V +$ --(2)

$$0.5 = \frac{R_2}{1M\Omega + R_2}$$

$$0.5M\Omega + 0.5R_2 = R_2$$

$$R_2 = \frac{0.5M\Omega}{0.5}$$

$$= 1M\Omega$$

This implies that upon transmission, the drop across will be

$V_{R_2} = \frac{R_2}{5K\Omega + R_2} \times 5$ --(3)

$$= \frac{1M\Omega}{1.005M\Omega} \times 5$$

$$= 4.9V$$

R_D= 1MΩ R_2 and R_D form a potential divider to set the reference voltage for the comparator.

R_2 = 1MΩ and Rvr=0.5kΩ preset.

Connecting this to comparator with a reference in between the two voltage levels of darkness and light will give two distinct outputs (i.e "HIGH" or "LOW") for transmission and NO transmission respectively.

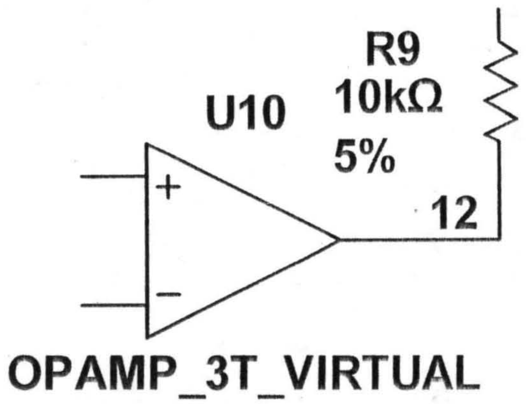

Fig 3.3 Comparator

$V_{out} = V_{in} \times A_0$

Where $V_{in} = V^+ - V^-$

And A_0 = open loop gain

3.4 POWER SUPPLY UNIT

A regulated D.C output is one terminal whose voltage remains almost constant regardless of the amount of current drawn from it.

A regulated 5 – 9 volt DC supply was required for the system. This was derived from a 12V /1A step down transformer and a full ware rectifier as shown below.

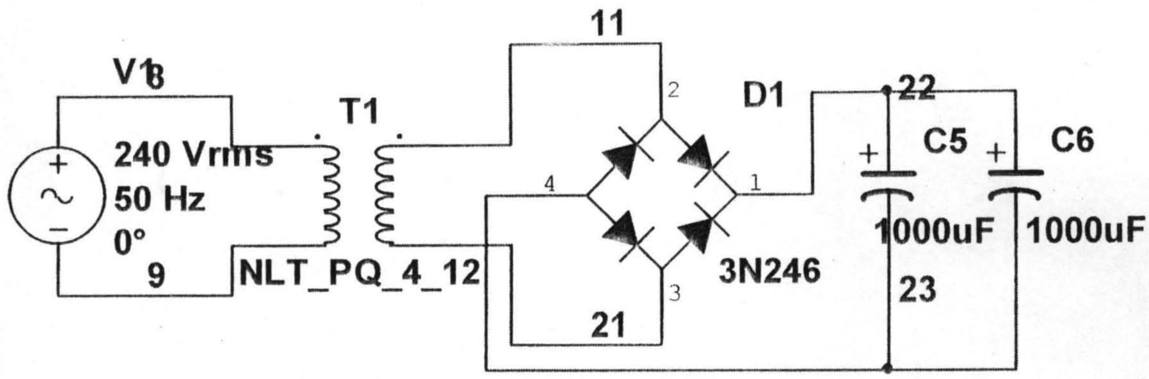

Fig 3.4 Power Supply Unit

The 12VAC input voltage was converted to a pulsating DC of amplitude given by the expression:

$$V\,(\text{peak}) = 12\sqrt{2} - 1.42 \equiv 15.5\text{V}$$

This DC voltage was smoothened by a capacitance deduced from the

Formula: $C = \frac{It}{V}$

Where I = Maximum load current

$$T = \frac{1}{2f} = \frac{1}{2 \times 50}$$

V = peak – peak AC ripple voltage

The load current was computed from the total summation of the current drawn by the different sub – systems.

Pulse Generators - 50mA

Light sensor - 50mA

Counter_______5mA

$$Display \rightarrow \frac{\approx 400mA}{\Sigma I \approx 500mA}$$

For a regulated 5–9 volt output, the minimum input voltage in the regulator was 7v (taken from manufacturer Spec sheet)

On a 15.5 pulsating Dc voltage, the peak – peak Ac ripple voltage is thus:

$15.5 - 7 = 8.5V$

Introducing the above parameters into the expression for the calculation of C yields:

$$C = 0.5 \times (\frac{1}{2 \times 50}) \div 8.5$$

$$C = \frac{0.005}{8.5}$$

$$C = 600 \mu F$$

This value is the minimum required to meet the worst – case system requirement. It was increased to 1000uF for improved system performance.

The 5 – 7 volt output was filtered by two 1000uF capacitors and fed into the circuit.

3.5. PULSE GENERATOR

To generate the required pulse needed for detecting entrance and exit motion, a source of 38KHZ light energy was required. This was realized using an LM555CN device configured as a 50% only cycle monostable oscillator as illustrated below

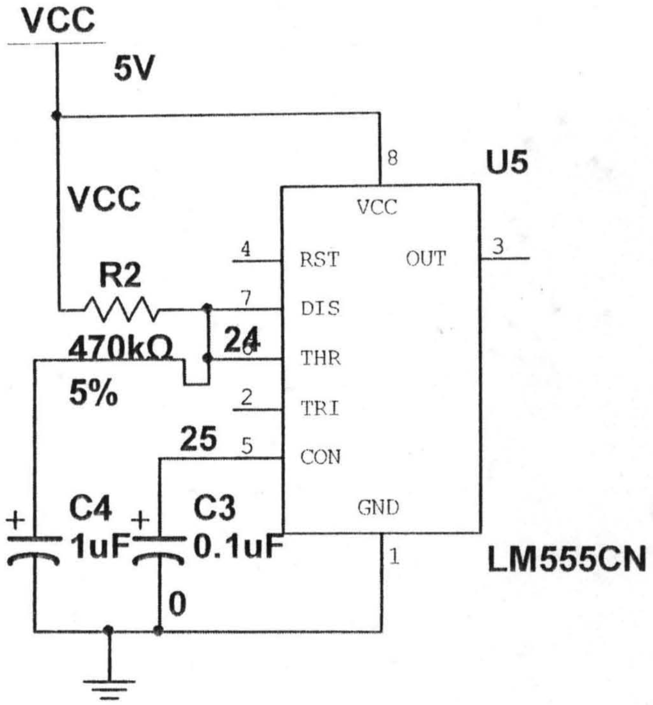

Fig 3.5 Pulse Generator

The output frequency of the oscillator is approximately given by the expression.

$$F = \frac{1}{2\pi R_T C_T}$$

R_T is the resistance between the output and pin 7,

C_T is the capacitance from pins 6, R to ground.

The output wave form is a 38kH$_z$ 50% duty cycle rectangular wave. The output frequency was fed into the And gate 74L304 and to the pin4 of second 555 timer.

A current limiting resistor of the value deduced from the expression below was connected in series with each LED to limit the current to a safe level.

$$R_S = \frac{V_S - V_{LED}}{I_{LED}}$$

$V_s = +5V,$

$V_1 D_R = 1V$

$I_{LED} = 4mA$

$$R_S = \frac{5-1}{0.004}$$

$R_S = 1k\Omega$

3.6 2 – DECADE UP/ DOWN COUNTER

To keep track of entrance / exit motion, a two – digit system was realized using 74LS192 synchronous up/ down counter.

The LSD (units) counter was driven directly from the monostables. The terms counter was driven from the units counter via the terminal layup / terminal lay down output.

The counters were cascaded as shown in fig 3.6

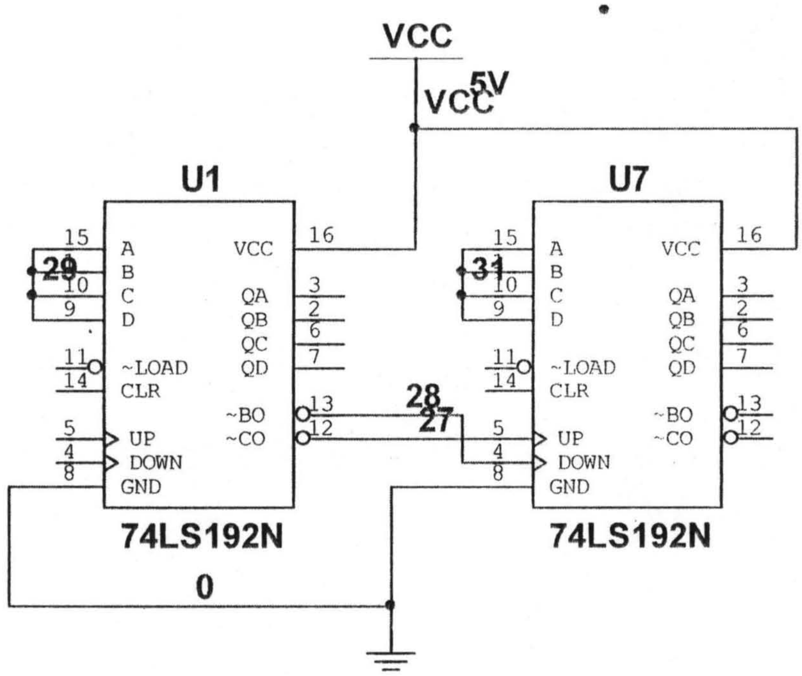

Fig 3.6 Cascaded UP / DOWN Counter

The 4 – bit BCD output from each counter was fed into a 74LS47 BCD – 7 segment decoder where they were subsequently converted to 7 – segment code before displaying the corresponding to the occupancy level by the counters.

3.7 74LS47 BCD – 7 -SEGMENT DECODER

To generate the required segments illumination from the 4 – bit BCD outputs from the counters, a 7447 BCD – 7– segment decoder was used. The 74LS47 was designed for common – anode 7 – segment displays.

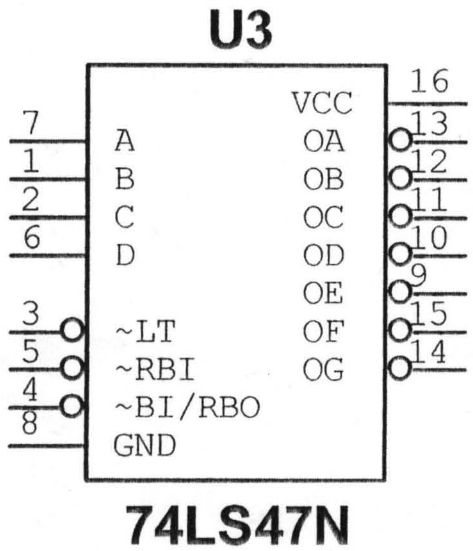

Fig 3.7 Seven Segment Decoder/Driver

Their input circuit was wired to the counters and its output circuit connected to the 7 – segment display.

The truth table of the 74LS47 is given in table 3.1

BCD Codes	Character displayed
0000	0
0001	1
0010	2

0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9

Table 3.1BCD coders to corresponding displayed character

3.8 DISPLAY UNIT

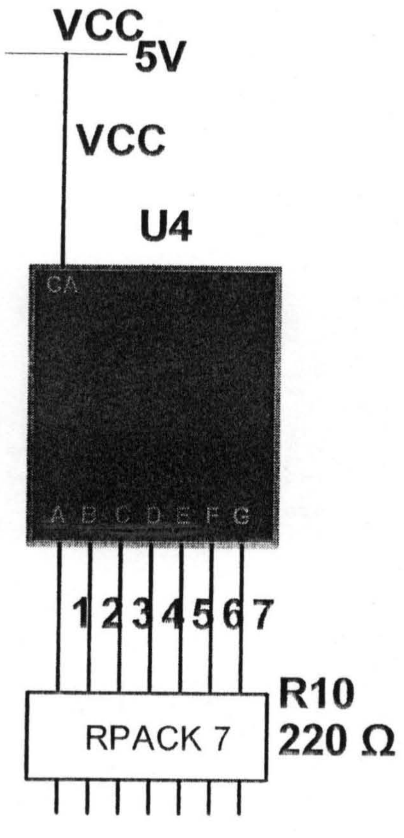

Fig 3.8 Layout of Seven Segment Display

The display unit is made up of two common anode 7 – segment display. Each leg is being connected to a limiting resistor to limit the current flowing through the LEDs before they are connected to the decoder.

3.9 OUTPUT LOAD CONTROL

Automatic detection and safety systems were provided for the self powered sliding automated doors. A relay was used to provide control for the bidirectional motor. The relay was placed in the collector emitter circuit of an NPN transistor as shown

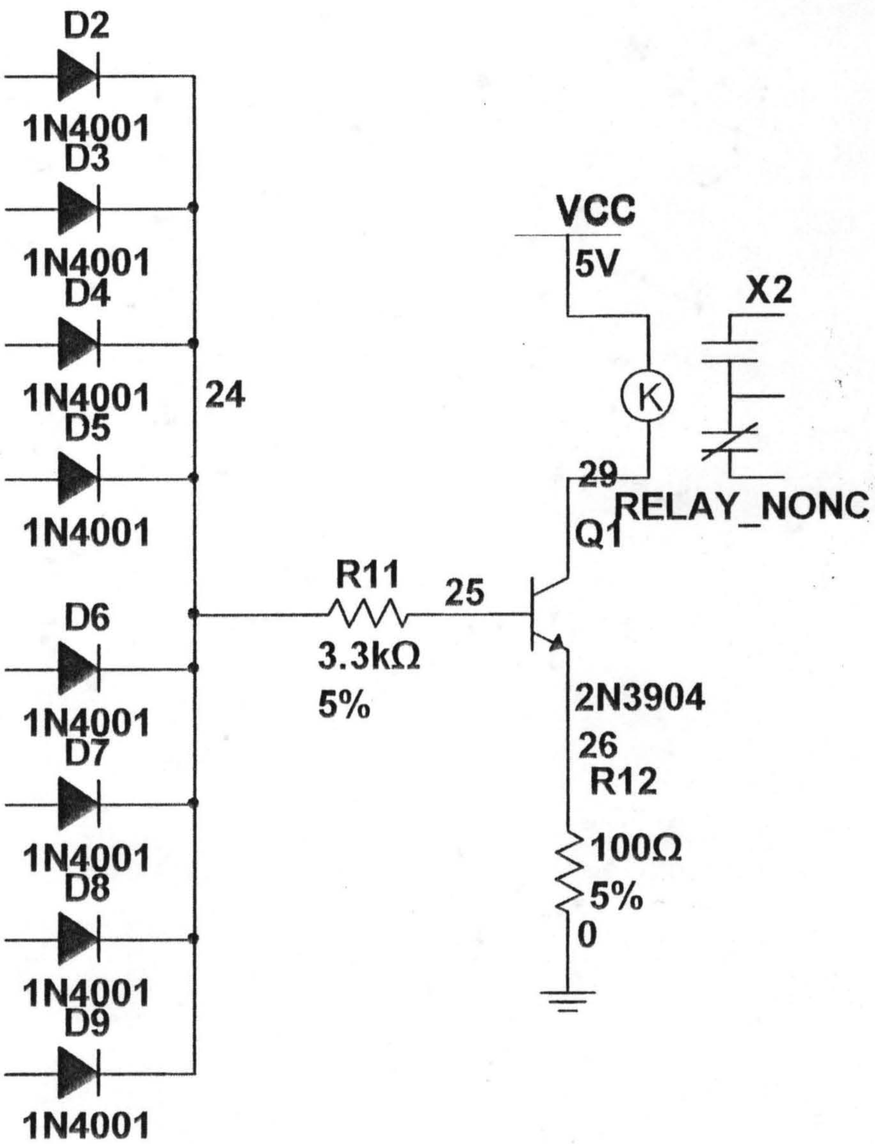

Fig 3.9 Logic Control for the Load.

With the two counters registering Zero, the 8 – in or gate formed by the 8 diodes has an output logic level of Zero. This cuts the 2N3904 transistor off, thereby de-energizing the relay However, when any of the outputs switches high, the transistor is forward – biased and the relay is energized.Then the motor is powered to operate the door open

The current through the relay was limited by a resistance of value deduced from the expressions.

$$R_S = \frac{V_S - V_{RLA}}{I_{RLA}}$$

Vs $= +9V$, $V_{RLA} = 6V$, $I_{RLA} = 1mA$

$$R_S = \frac{9-6}{0.3}$$

Rs $= 100\Omega$.

3.10 DOOR UNIT

The Door Timing, which is the hold open period, is as long as there are people inside the building. The door closes when the last person leaves.

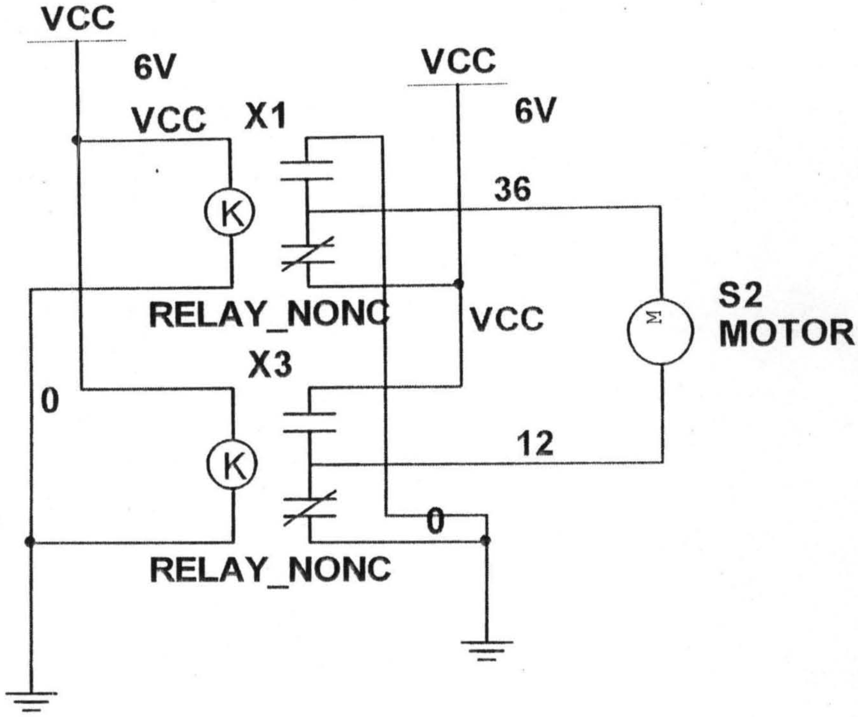

Fig 3.10 Connection of relays and motor that control the door.

3.11 CIRCUIT CONSTRUCTION

The construction part of the project followed the design step. It involved practical exercise in connecting the involved electronics components and parts in accordance with the circuit diagram. The constructions was achieved by dividing the total circuit into unit, and were soldered one after the other to fero board in tandem to meet the desire workability of the project after which the unit were joined together as a single working construction.

The power supply unit was of great importance during the construction and it was made with great care. After the complete construction, the power unit was properly checked for short circuit and unwanted bridges. Afterwards, the other parts of the circuit were connected to it.

3.12 CASE CONSTRUCTION

The casing of the constructed circuit was done through the use of transparent plastic glass and wooding materials. The materials were carefully selected for different parts of the circuit. The set up was quite flexible to allow for easy mobility and to make the displayed digit more visible.

CHAPTER FOUR

TESTING AND DISCUSSION OF RESULTS

4.1 TESTING

The physical realization of the project is very vital. This is where the fantasy of the whole idea meets reality. The designer will see his or her work not just on paper but as a finished hardware.

After carrying out all the paper design and analysis, the project was implemented and tests were performed on the completed construction so as to check its response and indicators. This was performed numerous times before a conclusion was made about the project performance with the aims of the project. The testing basically involved the complete setting up of the circuit and providing input into the sensors by walking across them.

The testing procedure are to trigger open, and close door, and to display increment and decrement and the directional indicators and this was performed numerous times before a conclusion was made about the project.

4.2 RESULTS DISCUSSION

The result was in accordance to the project objectives. The main feature of device movement detection worked properly. The door was opened by the approach of the first person and display counter was incremented when someone crossed the IN sensor. The count was decremented with the OUT sensor crossed.

Whenever pressed, the display reset button was able to put the count to zero and shut the door. Also, the display did not register a half crossing and did not decrement when the display was '00'.

The only setback occurred when the light beams from the light source were not properly focused on the input sensor. In this situation, the counter may give an erroneous count. This can be corrected, however by using a stiff, inflexible stand for both the display and the light source and by measuring the distance between the lights more precisely so that they focus directly on the input sensor.

Also, the project has the limitation that it can only be used in entrance with proper illumination both on entry and exit point. Also, the project has the limitation of detecting two people backing each other as they will be counted as one. However, it may not be a problem as there would be an independent observer that monitors such fraudulent act.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The project shows the importance of digital electronics in automating applications. Modern electronic component or sensor to be particular, have extreme flexible feature and attachment for numerous purposes that can relate a device with the status and control it environment.

The attributed simplicity in construction of the circuit corresponds to the reasonable level of acquired information for the project. In terms of acquisition of information, the internet was a very useful tool for the project.

Moreover, the project provides a real practical experience in electronics and automation, and highlight the significance of what was taught in the class.

5.2 RECOMMENDATION

i. Wider counting ranges could be achieved by incorporating more counters, decoders and seven-segment display into design.

ii. The project could be modified with micro-controllers for better feature.

iii. Talking alarms could be incorporated into the design.

iv. The display could be made of Liquid Cristal display (LCD) to reduced power consumption.

v. More powerful sensor could be used for real life applications

vi. The prototype door should be replaced with real door that meet the required applications.

vii. A rotating unidirectional crossbar should be placed at the point of crossing the sensors.

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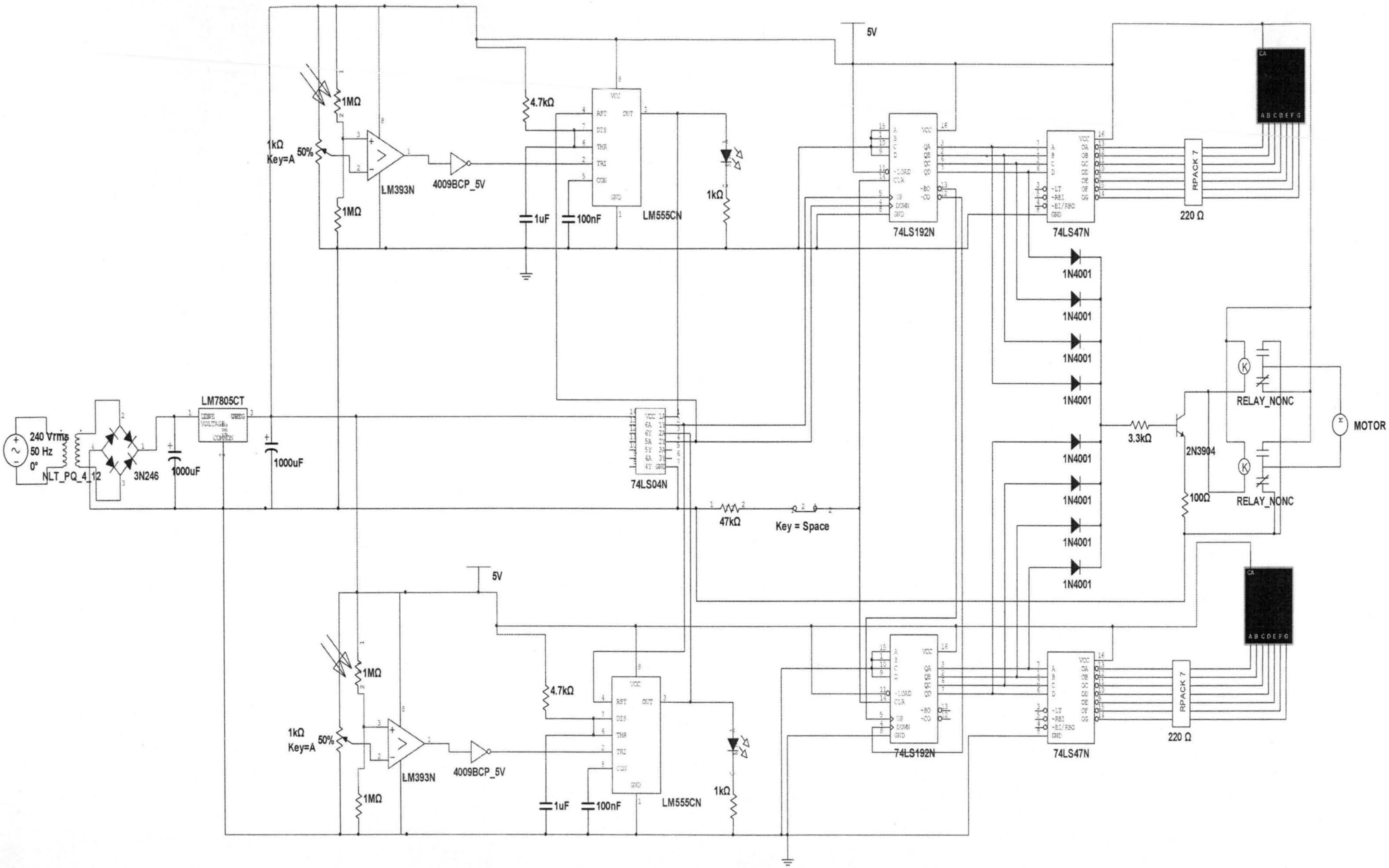
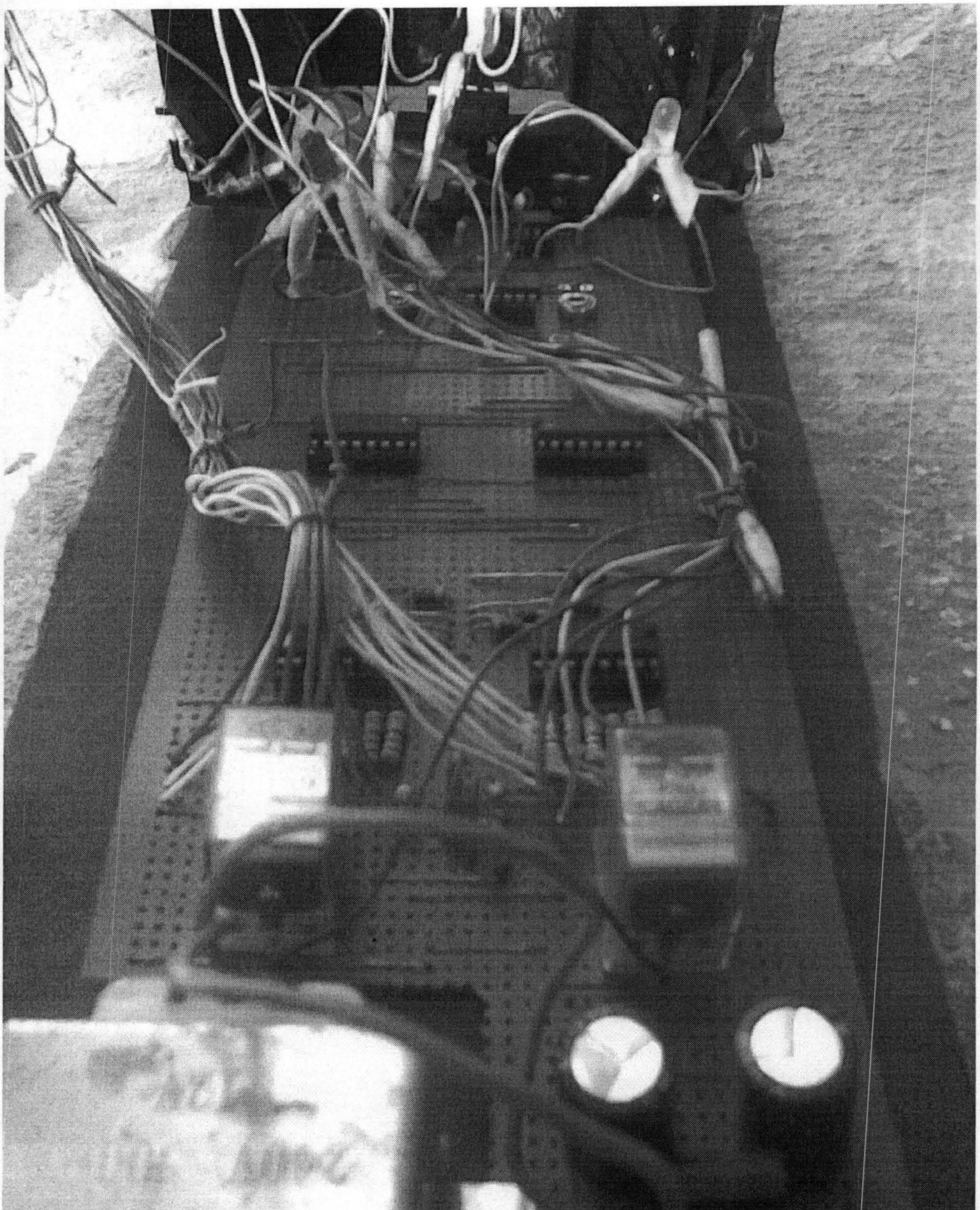
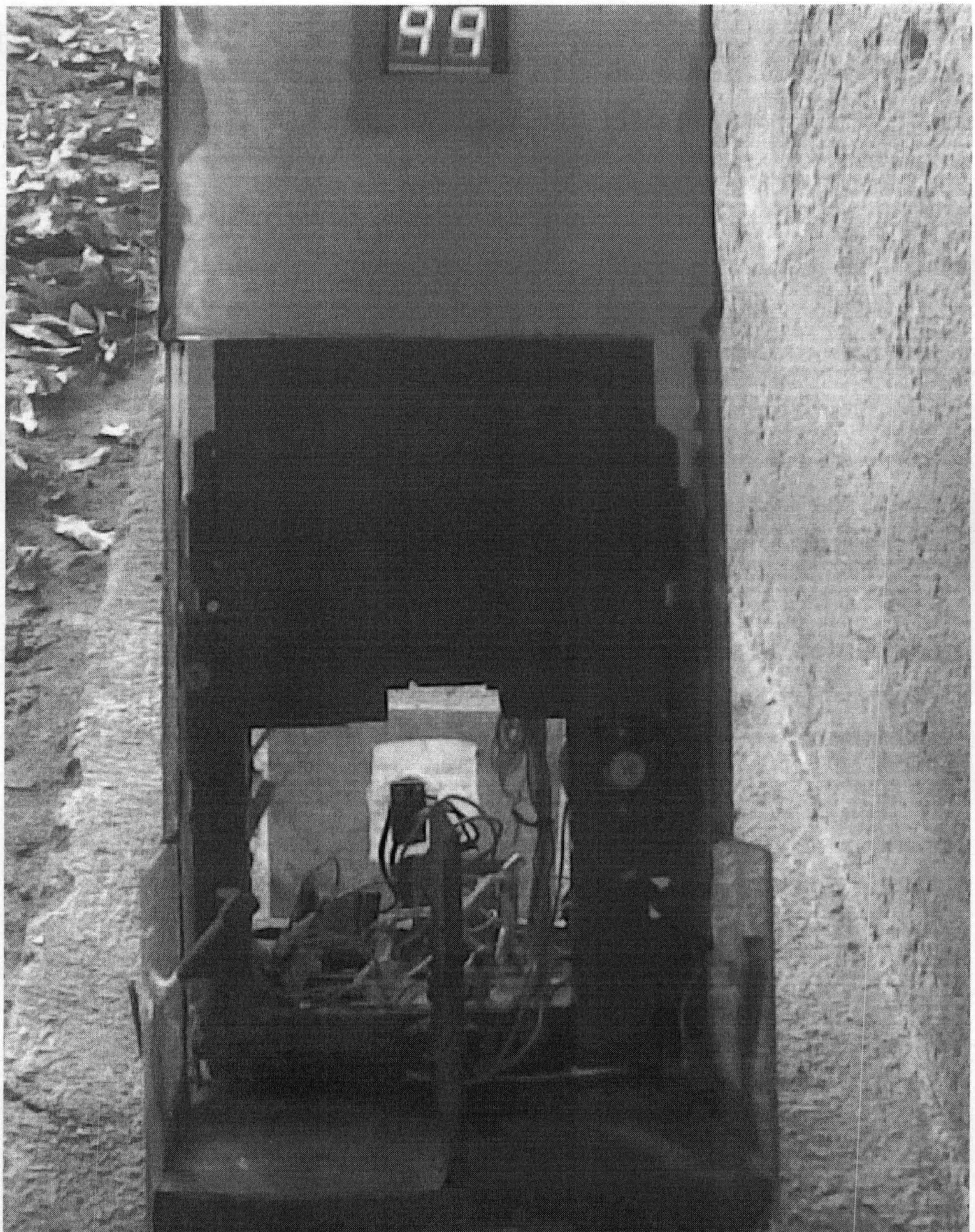
APENDIX 1 COMPREHENSIVE CIRCUIT DIAGRAM



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