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Design and Development of Sound Control Door Lock System

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ABSTRACT: *Security is very important, especially the security of lives and properties. This work involves the use of sound in controlling the opening and closing of doors using electromechanical application. In this work, sound is used to activate the mechanisms which opens and closes the door without any external effort. The system is made up of two main features, the Security Access system and Control Mechanism. The security access system was designed using circuit wizard software and then constructed on a veroboard and other materials while the control mechanism was constructed using a simple DC motor for the opening and closing of the door. In its operation, a specific sound pattern in form of a positive voltage is sent to pin 14 of* IC_1*, pin 14 of* IC_1 *is connected to a transistor(*Q_2*) which causes the 555timer to oscillate sending pulses to pin 14 of* IC_2*, during this, the output of* IC_2 *then operates in a sequential mode. The code switch then sets the number of beat that will set* IC_3 *into the desire sequential output set by the operator. The output signal energizes the relay which controls the DC motor to open the door and closes after a preset time.The testing showed quick and fast response in operation of the door lock system.*

KEYWORDS: *Sound, 555 Timer, Control, Door, Signal, Security*

I. INTRODUCTION

1.1 Background of Study

Sound control doors are doors that employ the used of sound in opening and closing, this work is unique in every aspect of operation in terms of accessibility and control. It may be confused with sound control switch.A sound control switch is an electronic switch that employs the use of sound to ON and OFF a device. This workdiffers from sound switch even though sound is used to activate their mechanisms and operation. In this work, the system comprises of two systems; Security Access system and Control Mechanism. The security access system is the system that grants the user or operator an access into any system while the control mechanism controls the operation of the security device. The increasing rate of crime, attacks by thieves, intruders and vandals despite all forms of security gadgets and locks still need the attention of researchers in finding a permanent solution for the well-being of lives and properties of individuals [Adamu, 2009]. This work will employ the use sound pattern of knock to grant access to only those who inputs the correct sound pattern (knock) on the door. It was designed to eliminate the problem of unwanted noise. One major problem of the sound control devices is environmental noise which triggersthe devices. In this work, an obstacle sensor (infrared) was introduced into the device to avoid false triggerring. Hence, the sound control system will only respond to whoever blocks the obstacle sensor to input the correct sound pattern set by the user or operator.

The control mechanism involves the use of a DC motor and gear system in opening and closing the door. Immediately the sound have been encoded by the user, the sound control system decodes it and sends a signal to the control mechanism which opens and closes the door depending on the signal sent by the sound control system. The major function of the DC motor is to provide the required turning torque when activated while the gear system is to increase or reduce the speed of the DC motor used.

The sound control door system was designed to serve well in different security applications, providing inexpensive inputting keys (sound) free from false triggering.

The design stages consists of the power supply unit, input sensor, sound decoding and oscillator. It also consists of special network components (infrared) to prevent false triggering and ensure desired performance objectives. A decade counter IC is used instead of flip-flop, special transistor and edge triggering network for low audio frequency.

The primary purpose of switch is to provide means of connecting two or more terminals in order to permit the flow of current across them, to allow for an interaction between electrical components, and to isolate circuits so as to terminate communication flow when need be. The motivating force behind this design is based on the desire to alleviate the problem faced by the aged, physically and insecurity challenges. It also takes into considerations the illiterates that may have problems operating some “complex” Hand-Held Sound Control Switch (VOX).

The device is activated by clapping or knocking twice within a set time period that is determined by an oscillator and sequential output of 4017 counter depending on the encoded preset signal.

1.2 Aim and Objective

The aim of this work is to design and develop a sound control door lock system, specifically this work will:
Determine the signal needed to activate the door lock system and the mechanical system in opening and closing of door system.

1.3 Scope of Study

The scope of this work is to design a device which can be switched ON and OFF using voice signals. Specifically:

i. The switching interface applied in this work is the general purpose type as it is not restricted to only one type of load.

ii. The type of control this work employs is the simple ON/OFF control switch.

1.4 Limitations

This work was carried out within the design consideration; as a result of this very few limitations were observed. They are:

- It can only be used in a light weight door (<25kg).
- It can only be applied to swing doors.
- The degree of opening angle is $(0 \leq \propto \geq 95^{O})$.

1.5 Review of Related Work

Ogri, et al, 1996,designed a prototype security door that can be remotely controlled by a GSM phone acting as the transmitter and another GSM phone with dual tone multi-frequency (DTMF) connected to the door motor through a DTMF decoder interfaced with microcontroller unit and a stepper motor.
The design was composed of four main functional modules, namely; the GSM module, the decoding module, controlling module and the switching module. The GSM module acted as both transmitting and receiving unit, employing the use of a mobile phone serving as the communication device between the user at one end and the object of access (i.e. the door) at the other receiving end. The decoding module and the controlling module were made using modern integrated circuit chips ensuring proper conversion of signal to binary codes, enabling the microcontroller to communicate properly with the switching device responsible for opening and closing the door. The codes were written in assembly language with Visual basic software and compiled with M-IDE studio for MC-51compiler which worked perfectly with Window XP environment, the program was ran without error before it was burned onto the microcontroller using a device called the programmer by placing the microcontroller on it socket equal to the pin number.

Adewale, et al, 1996, designed and developed a Microcontroller Based Wireless Security Door Access System. The system used a PIC 16F84 microcontroller for the transmitter design and PIC16F84 for the receiver module. The PIN for the person to be granted access was stored in selected general purpose registers in the controller. The microcontroller scans the data entry, and compares it with the stored PIN to grant or deny access to the person. The interfaces, equipment and also the components used in each stage of the prototype assembly and construction.
Input Type: Telephone Keypad, Pin: 3 Digits; Password: 464; Transmitter Frequency: 415MHZ; Supply Voltage: 5vdc, 12vdc (For Model Gate Dc Motors) Maximum Current: 500ma Access Mechanism: Model Sliding Door Microcontroller: PIC16F84 Sliding Door Interconnect: Small Computer System Interconnect (SCSI); DB-9 connector. The starting point of the project began with the remote control (transmitter). On this remote, is placed a keypad possessing a 12Key 3x4 matrix keypad connected to the PORTB of the microcontroller, which has been configured as the input.

The microcontroller scans the PORTB using a special subroutine program (SCAN), decodes any of the depressed keypads and sends the decoded binary number to the register where it is compared with the stored numbers. If all the entered numbers is the same as the saved numbers programmed in the special register, the microcontroller then sends a signal to modulate the transmitter. The signal modulates a 415MHz transmitter module capable of about 50meters. Supposing the numbers which are keyed on the keypad are not programmed in the special register or not keyed in the particular order as that saved in the special register, the access is denied. A LED is set off which has been configured on PORTA3. When the correct code has been keyed in the correct order; the access granted LED is set off which is configured on PORTA2 and in turn; an electric pulse is sent to the Relay (RL1) via PORTA1. PORTA has been configured as an output port. After the pulse has been sent to the RELAY (RL1), the magnetic field created by the armature coil attracts the armature to connect the contact thereby connecting the circuit and the signal being sent to the receiver. On the receiver end, the signal is demodulated by the receiver module which sends the pulse to the PORTA1 of the microcontroller which has been configured as the input, and the output is now sent to the relays (RL1 AND RL2) via the transistors Q1 and Q2 that controls the opening and closing of the model door via PORTB6 and PORTB7. The system is also coded such that the output of PORTA2 on the transmitter module indicates ACCESS DENIED when the wrong code is sent, while the LCD indicates ACCESS GRANTED via PORTBO to PORTB5.

1.6Types of Security Access System

There are different types of electric security devices, they are; switch activated lock system, sound activated system, shadow access lock system, light detector security system, pressure pad, sensitive security system and smartcard security access system etc. these systems are designed to serve different purpose as their names implies, their operation are related because some of them give access while some deny access.

- **Physical Security Devices**: A physical device such as • \speed passes. Key chains by gas station are used to identify a person. Sometimes a password or personal identification number (pin) is also required to ensure that it is the right person.
- **Biometric Identification**: Biometrics is the science of identifying someone from physical characteristics. This includes technologies such as voice verification, a retinal scan, palm identification and thumbprint.
- **Sound Activated Lock System:** The principle behind the sound activated lock system is that, it uses sound. The system locks permanently when there is a noise in the environment. This system uses sequential IC's like 555 timer which is made to operate with high frequencies and microphones will trigger alarm if there is a change in its frequency. These systems are ideal in bank vaults.
- **Shadow Detector Access System:** Another security access system is the shadow detector access system. This is mainly designed to be used at doors and places that need to be secured, the system works with alarm, but this device is highly inefficient because at the change in the intensity of light in bad weather and its function is restricted to only day hours.
- **Pressure and Sensitive Security System:** Pad with sensitive layers are hidden under the floor, when the system is activated alarm is triggered as pressure is applied on the pads. These pads are made of slightly suspended switch which closes the circuit and triggers alarm only when pressure is applied on it [Wikipaedia.org].
- **Smartcard Access System:** The card access control system secures an area using an electronic door locking mechanism that requires a card reader and valid card to access the area. Only persons who are permitted to access the area and who have been issued valid cards may gain entry. And the card is embedded with either a microprocessor or a memory chip, only a memory chip with non-programmable logic. The microprocessor can add, delete and manipulate information on the card, while a memory chip card (for example pre-paid phone cards) can only undertake a pre-defined operation [wikipaedia.org].

1.7 Improved 555 Oscillator Duty Cycle

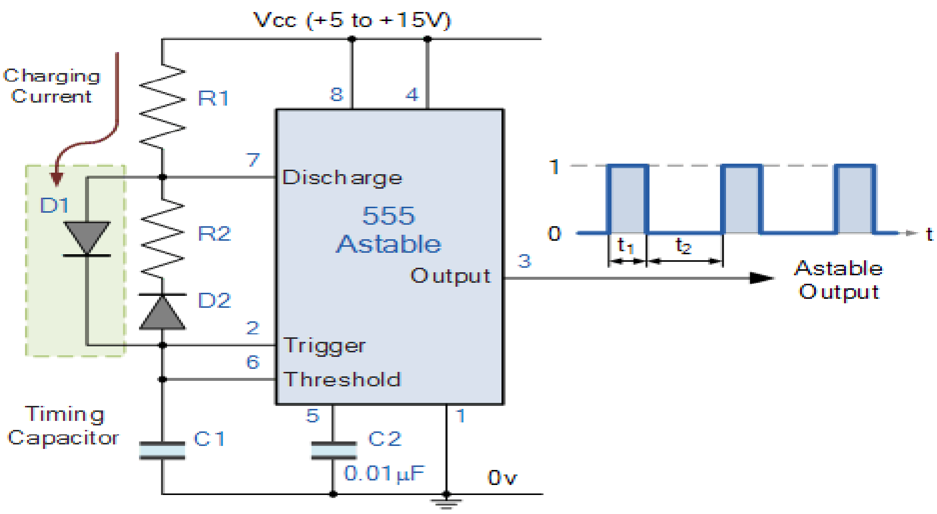

Figure 1: Astable Vibrator with 50 Percent Duty Cycle [www.google.com]

Figure 1 is an astablemultivibrator, by connecting this diode, D_1 between the trigger input and the discharge input, the timing capacitor will now charge up directly through resistor R_1 only, as resistor R_2 is effectively shorted out by the diode. The capacitor discharges as normal through resistor, R_2. An additional diode, D_2 can be connected in series with the discharge resistor, R_2 if required to ensure that the capacitor will only charge up through D_1 and not through the parallel path of R_2 as during the charging process it is connected in reverse bias.

The charging time of $t_1 = 0.693(R_1 + R_2)C$ is modified to take account of this new charging circuit and is given as: $0.693(R_1 \times C)$. The duty cycle is therefore given as $D = R_1/(R_1 + R_2)$. Then to generate a duty cycle of less than 50%, resistor R_1 needs to be less than resistor R_2.

Although the previous circuit improves the duty cycle of the output waveform by charging the timing capacitor, C_1 through the bypass diode, D_1, we can also produce a fixed square wave output waveform with an exact 50% duty cycle simply be moving the position of resistor, R_2 to the output pin as shown.

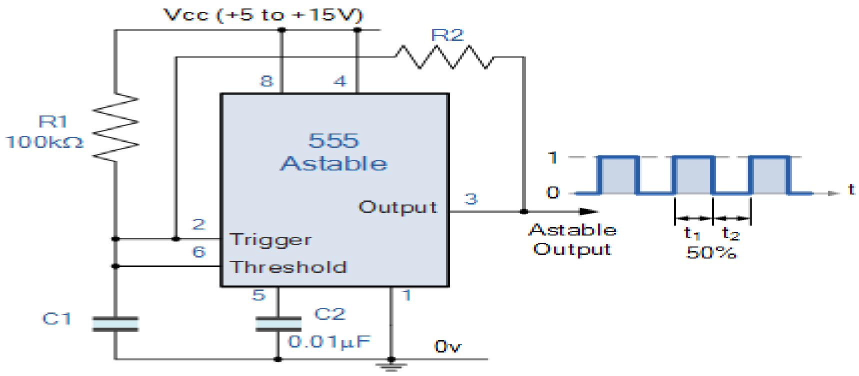

Figure 2: 50% Duty Cycle Astable Oscillator [www.google.com]

The reason for this 50% duty cycle is that capacitor; C_1 is now charging and discharging through the same resistor, R_2. When the output from the 555 oscillator is HIGH, the capacitor charges up throughR_2 and when the output is LOW, it discharges through R_2. Resistor R_1 ensures than the capacitor charges up fully to the same value as the supply voltage.

However, as the capacitor charges and discharges through the same resistor, the above equation for the output frequency of oscillations has to be modified a little to reflect this circuit change. Then the new equation for the 50% Astable 555 Oscillator is given as [Boylestad, & Nashelsky]:

50% Duty Cycle Frequency Equation

$$f = \frac{1}{0.693\,(2R_2).C}\ Hz \qquad (1)$$

Note that resistor R_1 needs to be sufficiently high enough to ensure it does not interfere with the charging of the capacitor to produce the required 50% duty cycle. Also changing the value of the timing capacitor, C_1 changes the oscillation frequency of the astable circuit.

II. MATERIALS AND METHOD

2.1 Design of Power Supply Unit

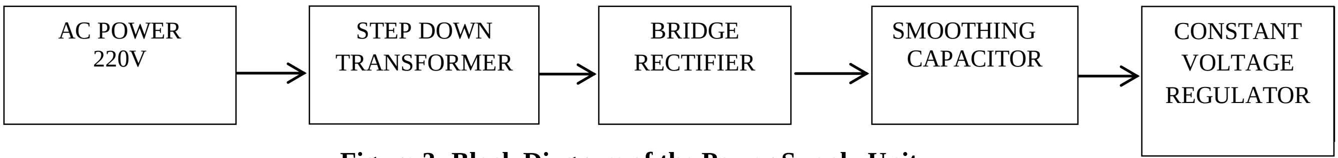

Figure 3: Block Diagram of the Power Supply Unit

The entire circuit is powered by a standard +5Volts DC power supply since most of the components are digital logic components. Before the power supply unity was designed, the total power requirement of the circuit was analyzed as follows:

- The CMOS IC for 555, CD4017 datasheet specified that the maximum voltage to be 15Volts and the minimum voltage to be 3Volts.
- The DC motor required 6 Volts.

Therefore, the circuit can adequately run on a 6Volts DC supply. However, in order to obtain the 6Volts DC supply from the public mains, the following circuit configuration was used. The transformer is a step down transformer rated 240V/9Vac at 500mA: since the expected output voltage is 5volts, any value above this is suitable. So a 9V transformer is chosen to step down the alternating current voltage from 240Vac to 9Vac at 500mA.

And $D_{Current} = 1.5 \times 500mA = 0.75A$ (2)

When $D_{current}$ is the Diode forward current. Therefore the required device must have a: $D_{piv} \geq 25V$ and $D_{current} \geq 0.75A$. From diode catalogue (datasheet), the IN4001 has the following characteristics; $D_{piv} = 50V$ and $D_{current} = 1A$, this makes it more than suitable. Hence the four diodes of the bridge rectifier are IN4001.

- **Filtering Stage:**

The filtering stage consists of two capacitors. The function of the capacitor is to remove the fluctuations or pulsation (called ripples) present in the output voltage supplied by the rectifier. Capacitor C_1 and C_2 are filter capacitor and improvement capacitor respectively **[Rashi, 1986] and [Richard, 2001].** The voltage rating of the capacitors is chosen such that it is at least 1.5times the Vp from the rectifier output.

The Vp from the rectifier output is

$V_{P(in)} - V_d = V_{p(out)}$ (3)

Where $V_{p(in)}$ is the Vp from the transformer; V_d is the voltage drop across the rectifier diodes; and $V_{p(out)}$ is the Vp from the rectifier output.

Thus, $V_{p(in)} = 21.21$; $V_d = 1.4V$ (voltage drop across each diode arm is 0.7V).

$V_{p(out)} = 21.21 - 1.4 = 19.81V$, (4)

The voltage of the capacitor should be

$V_{p(out)} \times 1.5 = 19.81 \times 1.5 = 29.715V$ (5)

A capacitor that has a voltage of 35V was chosen. For effective filtering off of the ripple from the pulsating DC, the capacitance value chosen should be high enough to eliminate the ripple voltage (Vr) to about 20% of the peak voltage (Vp). The ripple voltage is given by;

$V_r = I_o \div (2FC)$ (6)

20% of Vp = 0.2 × 21.21 = 4.242V

Where I_0 is maximum current from supply = 500mA; F is frequency of supply = 50Hz; C is the expected capacitance of the capacitor, hence

$C = I_0 \div (2FV_r)$ (7)

$C = 500mA \div (2 \times 50 \times 4.242) = 1.178 \times 10^{-3}F$.

However, the manufacturer specified that if the distance between the capacitor and the regulator is up to 6 inches, the inductance of the connecting cable may interfere with regulation [www.aldata sheet.com 2012], therefore a capacitor of capacitance value of 2200µF is recommended for C_1. Therefore C_1 is rated 2200µF at 35V. C_2 is mostly specified in rectifier circuits and its value is 0.01µF.

- **Voltage Regulator Stage:**

The fixed voltage regulator is the 78xx series. 78 indicate that it is a positive voltage output regulator while xx signifies that value of the voltage; 09 for 9V, 12 for 12V. 7805 was used in this work to ensure that a 5V output voltage is obtained. To carry out effective voltage regulation, the minimum input voltage to the regulator is gotten from the manufacturer formula;

$V_{out} = V_{min} - V_{ref}$ (8)

Where V_{out} is the output voltage = 6volts;

V_{ref} is the reference voltage given by the manufacturer = 2 or 3volts;

$V_{in} = V_{out} + V_{ref} = 5 + 3 = 8V$

The minimum required input voltage for effective regulation is 8 to 7V. Since we are getting a V_{rms} of:

$V_{rms} = 0.707\ V_p = 0.707 \times 21.21 = 14.995V$

The power supply is adequate for proper regulation; hence the voltage regulator required is 7805.

- **Current Limiting Resistor and Power ON Light Emitting Diode:**

The series connected components are to indicate that there is power on to the circuit. The resistors protect the LED from damage and it value is given as:

$$R_1 = \frac{V_S - V_d}{I_d} \qquad (9)$$

Where Vs is supply voltage = 5V; Vd is voltage of diode = 1.25V; and I_o is current of the diode = 10mA.

$$R_1 = \frac{5-1.25}{10} = 375\Omega$$

2.2 Design of Sound Decoding Units

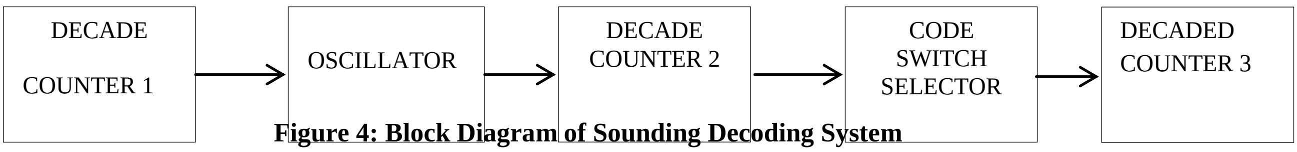

Figure 4: Block Diagram of Sounding Decoding System

This comprise of an oscillator (555) decade counter (hef 4017), diode(1n4001) and a transistor(bc547).

The figure below show the configuration of 555 Timer as a an Astable Vibrator, but in every design to achieve the desirable goal. They must be some assumption;

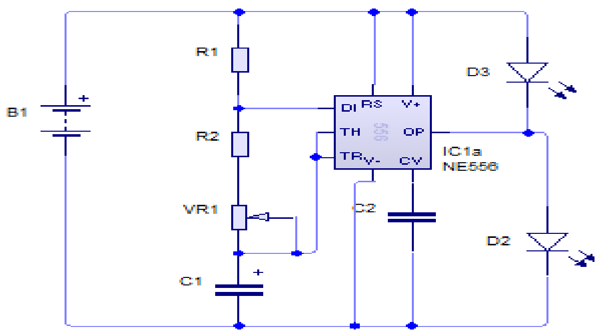

Figure 5: 555 Timer Configuration of the Circuit

- **Assumption**

- Assuming there must be a variation in frequency, in other words the frequency can be varied from low frequency to high frequency.
- Let C = 10μF
  $R_1 = 4.7k\Omega$, $R_2 = 100k\Omega$

Note: The voltage range for 555 Timer IC is 3 – 15V.

∴ **Calculation**

Note that the 3 parameter mentioned earlier (R_1 R_2 and C) will assist us in achieving two frequency if one parameters is being varied or alter.

$f = \frac{1}{ln2 \times C \times (R_1 + 2R_2)}$ (10)

$$f = \frac{1}{ln2 \times 10 \times 10^{-6} \times (4.7 + 200) \times 10^3}$$

$$f = \frac{1}{1.4186}$$

$f = 0.7$ Hz

$\therefore \quad Total\ Time = \frac{1}{f} = \frac{1}{0.7} = 1.43\ secs$

Time to on

$T_{ON1} = ln2 \times (R_1 + R_2) \times C$ (11)

$$= 0.693 \times 104.7 \times 10^3 \times 10 \times 10^{-6}$$

$$T_{ON1} = 0.73\ secs$$

Time to off

$T_{OFF1} = ln2 \times R_2 \times C$ (12)

$$= 0.693 \times 100 \times 10^3 \times 10 \times 10^{-6}$$

$$T_{OFF1} = 0.693\ secs$$

Note: I calculated the value for frequency when the parameter is at maximum capacity, and assuming that R_2 is being varied at 50% interval the frequency and Time even the duty cycle will change. I choose to vary R_2 because R_2 take part in the on and off equation.

1. When 100k is adjusted at 50%

$\frac{50}{100} \times 100k\Omega = 50k\Omega$ (13)

$f = \frac{1}{ln2 \times C \times (R_1 + 2R_2)}$ (14)

$$f = \frac{1}{ln2 \times 10 \times 10^{-6} \times (4.7 + 100) \times 10^3}$$

$f_2 = 1.37$ Hz

$f_2 \approx 1.4$ Hz

$$Total\ Time = \frac{1}{f_2} = \frac{1}{1.4} = 0.71\ secs$$

Time to ON

$T_{ON2} = ln2 \times (R_1 + R_2) \times C$ (15)

= 0.693x (54.7) x1000 x10x10^{-6}

= 0.38secs

Time to off.

$T_{OFF2} = ln2 \times R_2 \times C$ (16)

=0.693x50x1000x10x10^{-6}

=0.35secs

Duty Cycle $= \frac{T_{ON} \times 100}{T_{OFF\,2} + T_{ON\,2}} = \frac{0.38}{0.38+0.35} \times 100\% = 53\%$

ii. Taking 0% of 100k, $R_2 = 0$

$$f_3 = \frac{1}{ln2 \times C \times (R_1 + R_2)} \quad (17)$$

Note: $R_2 = 0$

Therefore; $f_3 = \frac{1}{ln2 \times C \times R_1} = \frac{1}{0.693 \times 4.7 \times 10^3 \times 10 \times 10^{-6}} = 30Hz$

$T_{Total} = \frac{1}{f} = \frac{1}{30} = 0.30\ secs$

Time to on

$$T = ln2 \times C \times (R_1 + R_2) \quad (18)$$

When R_2 = O

$T_{ON3} = 0.693 \times 4.7 \times 10^3 \times 10 \times 10^{-6}$ = 0.03secs

Time to off.

$$T_{OFF3} = ln2 \times C \times R_2 \quad (19)$$

When $R_2 = 0$

$$T_{OFF3} = 0$$

$$\text{Duty Cycle} = \frac{T_{ON\,3} \times 100}{T_{ON\,3} + T_{OFF\,3}} \quad (20)$$

$$= \frac{0.03}{0.03+0} \times 100\% = 3\% \quad (21)$$

Table 1: Values of Electronic Components Used

C	R_1	R_2	T_{on}	T_{off}	Total	Frequency
$10\mu F$	4.7kΩ	100kΩ	0.73s	0.69s	1.43s	$0.7H_z$
$10\ \mu F$	4.7kΩ	50kΩ	0.38s	0.35s	0.71s	$1.4H_z$
$10\mu F$	4.7kΩ	0kΩ	0.3s	0s	0.03s	$30H_z$

From the calculations, as R_2 increases the frequency of the circuit decrease and vice versa. The figure below show the circuit of 555 in an Astable mode used for oscillation application. Note that every resistor as a tolerance limit that is why 1kΩ was added to R_2 because when measured with an ohm meter the reading was closed:

$$R_2 = (100 \pm 1)$$

This circuit received signal from the input sensor twice to activate the astable oscillator which the output is fed into the decade counter for an output which depended on the number of oscillation received from the oscillator, at this point the code is set with the desired dip switch according to the number of chosen sound beat.

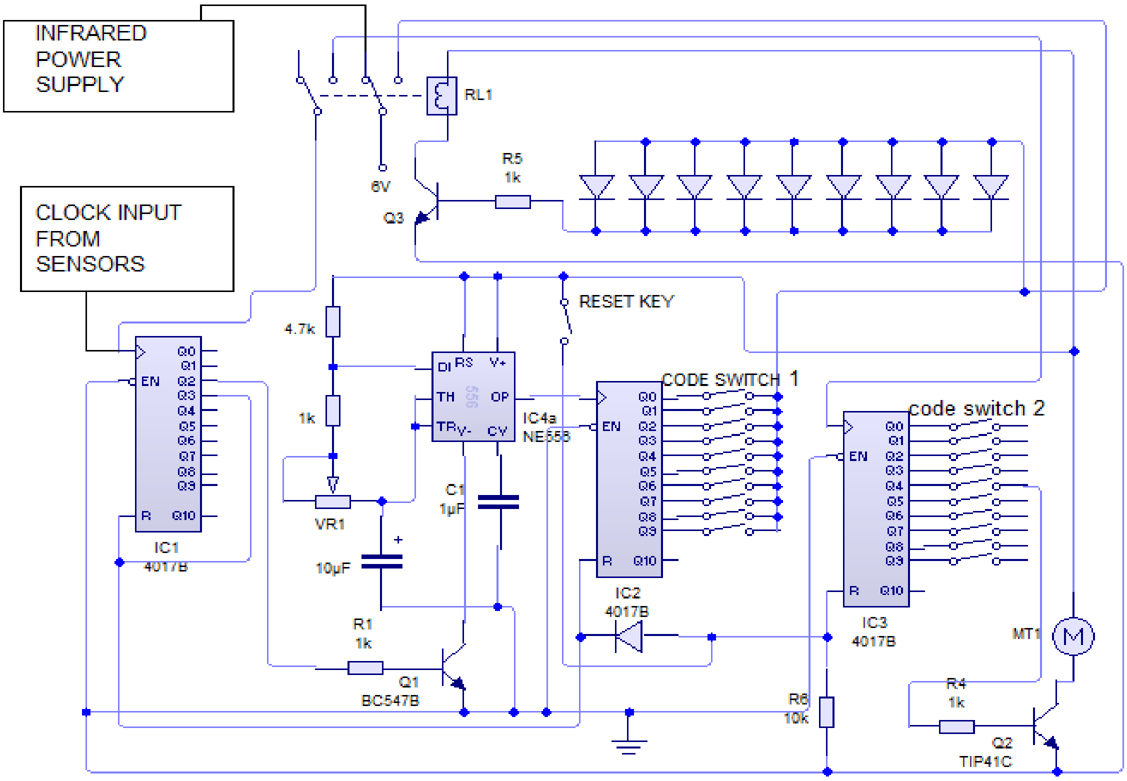

Figure 6: Sound decoder Circuit

from the circuit above the first decade counter receives the input from the sensor twice to make Q_2 high and trigger the transistor which switches on the oscillator at the same time the oscillator output is fed in the second decade counter to get an output set by the help of the dip switch, this output must correspond to the set of the second sound beat received, pleased note that to input the second sound beat, the infrared sensor is inactive thereby the sound signal received at that time is only active at the third decade counter.

2.3Construction

This work was constructed using electronic component and locally available materials, wire and plastic box for the casing of the electronic circuit. Before the construction was carry out, all the components were tested to confirm their proper working condition before proceeding into construction. Several steps were taken in the construction of the system which involved

1. To ensure that all the components to be used are functionally operating, they were first tested with a digital multi meter and ones that failed were replaced before finally soldering them on the veroboard.

2. To ensure that there was no breakage in the circuit path on the veroboard, immediately after soldering on the veroboard, the circuit path was tested using the Digital Multi-meter. This was done to also ensure continuity of circuit on the Veroboard.

3. Using Circuit WIZARD (Student Edition), National instrument simulator etc. to simulate the circuit. The results obtained from the simulation closely corresponds to the desired result, with some slight variations.

4. The period of time for the alarm remained high unless reset, the main reason for testing all the components before they were finally soldered on the Veroboard are to avoid the painstaking effort it will take to dia-solder faulty components at the end of the day. From the continuity test carried out on the Vero board to check the circuit path, it was discovered that the circuit was in a perfect working condition as continuity was ensured. Simulation of the circuit design was also done as mentioned. This section described the steps taken in the verification of calculated results through the real time implementation and measurements. The construction of the system is in 2 stages; the soldering of the components and the coupling of the entire system to the casing. The power supply stage was first soldered stage by stage. Each stage was tested using the multi-meter to make sure it is working properly before the next stage is done. This helps to detect mistakes and faults easily. The soldering of the circuit was done on a 10cm by 24cm Veroboard.

2.4 The Door Construction

The door was constructed from coated plywood with a maximum weight of 1.7kg, with a dimension of 150mm$\times$ $25mm$ $\times$325mm, the dc motor used on the door perform two vital functions which are;

To provide a pivoting point for the door and To provide the required turning torque

2.5 Opening Mechanism

The door uses a simple lever system in turning and closing of the door using a permanent magnet motor of 6v, 500mA. No complex control network was done on the dc motor. The direction of rotation depends on the polarity connection of the dc motor to power if reversed the direction revers too

DC motor turning torque= force $\times$ distance

where

Force = mass $\times$ acceleration due to gravity

$\tau = 25 \times 0.3 = 7Nm$

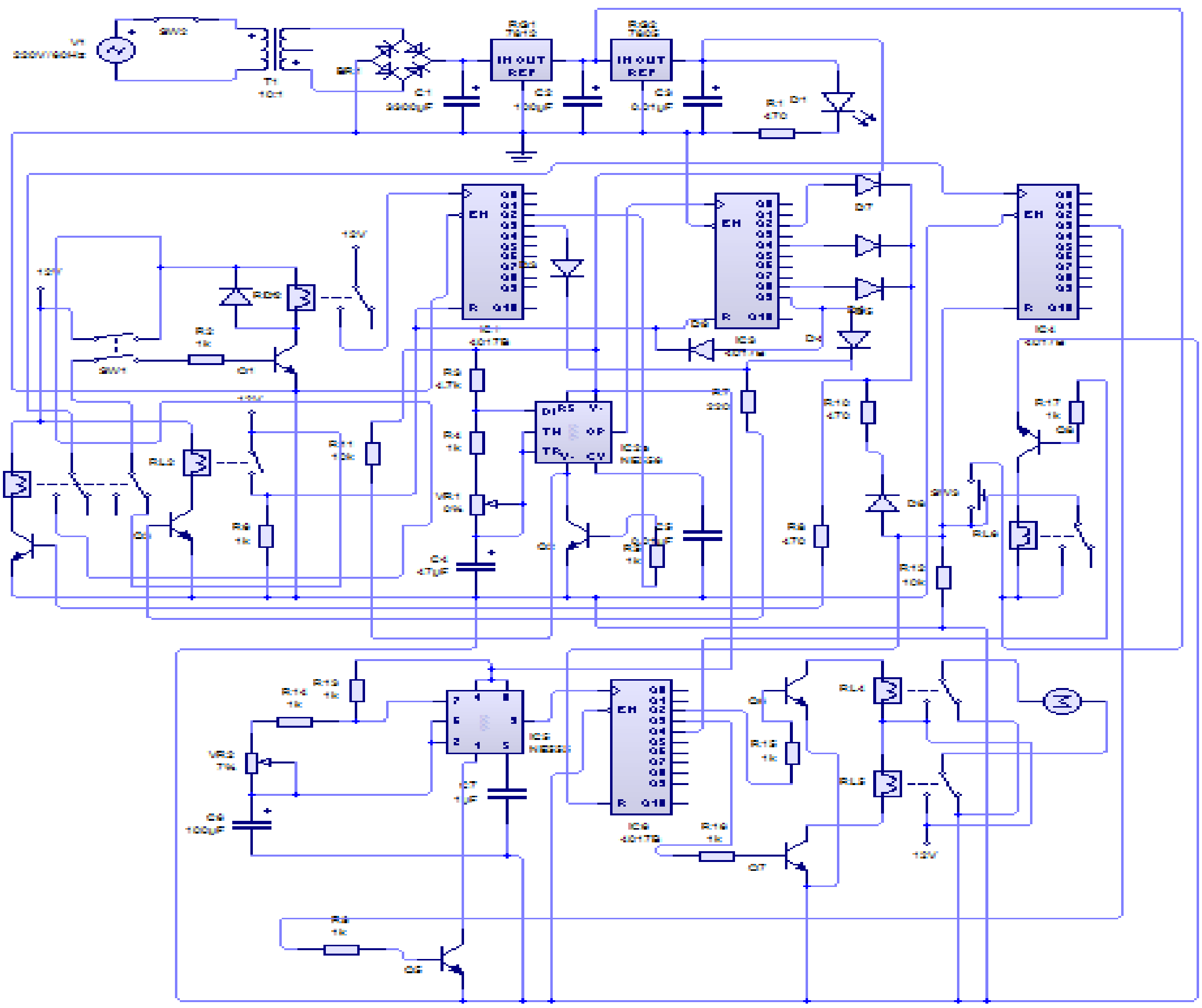

Figure 7: Circuit Diagram of the Sound Control Door Lock System

III. RESULTS AND DISCUSSION

3.1 Results

The testing was carry out with the mind of sensitivity of the circuit in relation to sound intensity and distance, the maximum distance the sound sensor can detect a sound is 7meters, it worked well both in ac and dc voltages, lastly it was not affected by weather or environmental noise .

3.2 General Circuit Operations

The mode of operation of this circuit is very simple, starting from the sensor, immediately the infrared sensor detects an obstacle within a length of 10cm it sends a signal (voltage) to the transistor which makes the transistor to conduct between the collector and emitter(negative voltage) to the relay, at this point, any positive voltage sent by the sound sensor will trigger the relay. Hence, a positive voltage is sent to pin 14 of IC_1(4017) pin 4 of IC_1 is connected to a transistor(Q_2) which causes the 555timer to oscillate sending pulses to pin 14 of IC_2, during this, the output of IC_2(4017) operate in a sequential mode from Q_0 to Q_9, The main function of the code switch is to set the number of beat that will set IC_3 into the desire sequential output set by the operator. In figure 6, IC_3 was set at Q_3 this means that after the first two sound input, the second sound input must be four time for the door to open and lastly the knock must follow a pattern set by code switch 1else the code switch pattern will reset the circuit and when inputting the first sound signal must be twice, otherwise the circuit will reset. The figure 7 shows the circuit details of the work while figure is the simulation result of the DC motor response during the opening of the door.

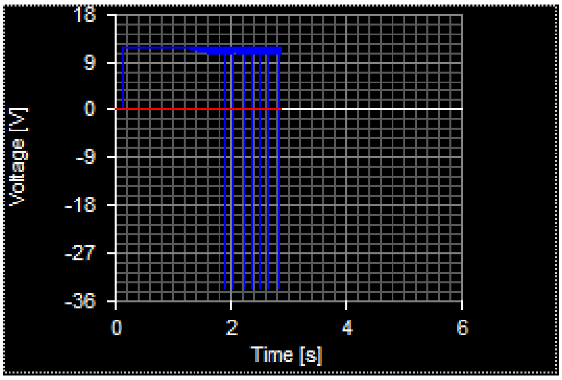

Figure 8: DC motor response voltage during operation

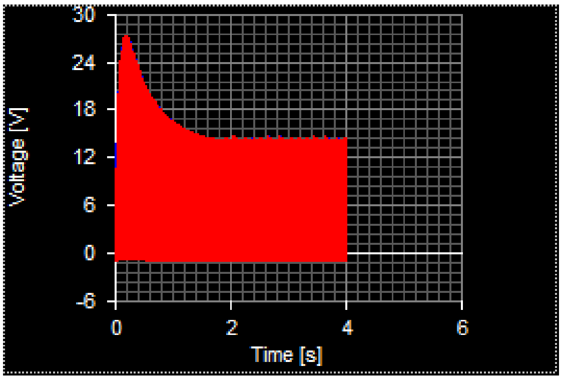

Figure 9: Circuit Response due to Sound

Figure 9 is the response of the simulation result of the sound decoder circuit. At the instance when the sound is produced, its raises the voltage at the decoder to 27V and thereafter, decays exponentially to 13V, this signal then sets the switch which then energizes the relay to operate the DC motor to open the door.

IV CONCLUSION AND RECOMMEDATION

4.1 Conclusions

It can be concluded that the sole aim of carrying out the design of sound control door was achieved.The work when tested responded quick to the security of preventing intruders. One factor that accounts for the cheapness of the product was the proper choice of components used. The ones that were readily available were used, while a close substitute was found for those that were not readily available. The reliability of the entire work was considered in every aspect of design and construction. The system was tested and found to be working to specifications and predictions.

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