DESIGN AND CONSTRUCTION OF A TOUCH ACTIVATED WASTE BIN WITH ALARM

BY

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2006/24450EE

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

NOVEMBER, 2011.

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A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

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DEDICATION

I dedicate this project work to God Almighty for the innumerable things He has been and will forever be to me, and to my late Daddy Mr John Dawar, may your soul rest in peace with the Lord till we meet to part no more. Amen

DECLARATION

I Dawar Katfun Philemon 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

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6/3/2012

(Signature and date)

ACKNOWLEDGEMENT

This very research work will not have been a success without the help of God, colleagues, parents, siblings and well-wishers.

I really acknowledge the immense contribution of my beloved parents; towards this research work, my siblings for their moral, financial and spiritual support, my friends, most especially HarunaKomoDauda, AmbimaMunza, David Udensi etc. for their intellectual input and encouragement toward the success of this work, I say God bless and keep you all. My own project supervisor Mr AhmedAbubakarSadiq, I am grateful for all your input, your patience and understanding, and to my co-supervisor Mr Kudu Abubakar.

ABSTRACT

This touch activated waste bin senses a touch; thereby a relay is triggered to open or close the lid of a container (the waste bin) after a specified time delay. This approach produces an affordable waste bin aimed at improving human hygiene and reduction of environmental pollution which result from municipal waste products. When the alarm incorporated into the design beeps, it implies that the waste bin is full.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

From time immemorial human beings have been face with the challenge of how to manage waste products; the effect of which is hazardous both to human beings and the environment if not properly disposed.

Waste products are unwanted materials; though some can be recycle, once it is correctly recovers. There are many types of waste products defined by modern systems of waste management, notable are;

1. Municipal waste: such as household waste, and commercial waste;
2. Hazardous waste: such as industrial waste;
3. Bio-medical waste: such as clinical waste; and
4. Special hazardous waste: such as radioactive waste, explosives and E-waste.

This touch activated waste bin is an electro-mechanical device which opens and closes the lid of a waste container on sensing touch, mainly to address municipal waste. The mechanical design has to do with the waste container and the gear mechanism that does the actual opening and closing of the lid.waste container is said to be a box usually made up of metal or plastic for temporal storing of waste products, commonly called dust bin, rubbish bin, refuse bin, litter bin, trash can etc; [1] some with lid, and others without.

The electrical part of the waste bin is the electronic circuitry which senses touch and sends an electric signal to a dc motor which is couple with a gear mechanism on the lid that does the opening and closing the lid.

1.1AIMS/OBJECTIVES

1. To enhance proper waste management
2. To protect the environment and reduce airborne contamination
3. To keep or improve good hygiene

4. For ease of recycling

5. To design a flexible and cost effective waste bin

1.2METHODOLOGY

This touch activated waste bin uses two separate touch sensors; each having one touch points; say T1 and T2. When T1 is touch, the sensor sends a signal to coils of wires in the relay (RLY 1) which becomes magnetize due to current flowing through them (hence becomes an electromagnet) attracting the common terminal of the relay to the normally open terminal, which in turn switch on the current flow to the dc motor , and after a delay of five seconds the trigger signal to the relay seize and the coils of wire in the relay becomes demagnetize; and the common terminal returns to the normally close terminal; switching off the power supply to the dc motor drive. The lid remains open until the second touch point (T2) is used. Sending the same trigger signal just like the first sensor did,from the touch sensor, to the relay (RLY 2) and to the dc motor; but these time around the polarity of the signal to the dc motor is reversed; thereby changing the direction of rotation of the dc motor in the clockwise direction leading to the closing of the waste lid. In the construction of the design it is done in modules.

Incorporated inside the bin is a waste bag, a photo source and a photo resistor. When the transmission and reception of signal between photo source and receiver is bridge by dirt, the resistance of the photo resistor increases giving rise to an Approximately 6 volts

Output from the dark sensor, which activates the relay (RLY3) attached to the dark sensor, which in turn switch on an alarm circuit.

The waste bag does the actual temporal collection of the waste to be dispose when full.

1.3SCOPE OF THE WORK

This research work is confine within the basic principles of electronics; which uses a dc motor in opening and closing a waste bin after sensing touch, with a dark sensor that trigger an alarm signifying that the waste bin is full of waste products.

1.4APPLICATION OF WORK

This can be use in residential house(s), and office(s) for temporal storage of municipal waste.

1.5LIMITATIONS

1. The ability to senses touch will not be achieve when the supply voltage drop below 4.5 volts.

2 The waste bin only work on sensing touch

3 The waste bin does not recycle the waste products

1.6 SOURCES OF MATERIALS

- The circuit diagram was developed using the basic working principle of: an electric bell; change in phase of an electric motor; light dependable resistors, and the applications of 555 Timer IC.
- The theoretical knowledge behind this project was gotten from e books, the internet, from the departmental library, and brain storming with colleagues
- While the components for the designs are gotten from the local market in Minna, Niger state.

CHAPTER TWO

LITERATURE REVIEW AND THEORITICAL BACKGROUND

2.1 HISTORICAL BACKGROUND

Waste has played a tremendous role in history. The Bubonic plague, cholera and typhoid fever were diseases that altered the population of Europe and influence monarchies [1,2]. Prior to the industrial revolution, what was considered waste was mostly vegetable matter, bones, wood, fires ash and dead bodies. These materials were buried in the ground to act as compost. At the beginning of the twentieth century, paper, cups and towels began adding to the debris, and by 1953, TV dinners were created, resulting in more disposable packaging waste [3]. And due to the increase in population, solid waste became a problem; which called for waste management.

2.1.1 OLDEN DAYS WASTE MANAGEMENT

Olden days waste management, practices involve the indiscriminate burying and burning of trash, disposing waste products at garbage dumps (burning dumps) located within the metropolitans.

2.1.2DISADVANTAGES OF THE OLDEN DAYS WASTE MANAGEMENT

Below are some of the disadvantages of the olden days waste management method:

1. The typical problems were; smoke; odors; flies; and surface water pollution, which directly and indirectly affects human health and constituted environmental hazard
2. The High cost of production that could be minimize by recycling some of the waste product, rather than burning them.
3. The open garbage dumps within the towns create a room for rural children and some women to be searching for valuables with their bare hands[3]

2.1.3 THE PRESENT DAYS WASTE MANAGEMENT

This involved the use of waste bin, recycling of some waste products, the creation of waste management boards and management laws, the use of landfill etc. [4]

2.1.4 ADVANTAGES OF THE PRESENT DAYS WASTE MANAGEMENT

It is more hygienic, flexible and create job opportunities for people (those working under waste management boards) compare to the olden days waste management.

2.2 LITERATURE REVIEW

In 2007, a design and construction of a touch activated security system project in the department carried out by AbdullahiAbdulmalik had a problem with the sensing unit, triggering itself without any touch; due to high sensitivity of the sensor, which can be reduce using a resistor connect to the trigger input to the 555 Timer.

Adesigncarried out by Richard as part of his Msc work in 2011, shows that medieval refuse bin were robust and without lid [4].

These particular touch activated switches have a lid, not space consuming, opens and closes only when it senses touch

2.3 THEORETICAL BACKGROUND

2.3.1 555 TIMER

The 555 Timer IC (integrated circuit) uses a maze of transistors, diodes and resistors, which comes in two packages, either the round metal- can called the ‘T’ package or the more familiar 8-pin Dip ‘V’ package, as shown below in fig. 2.1 and fig. 2.2 respectively.[5]

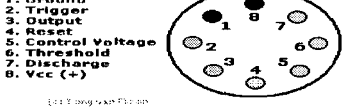


fig 2.1 ‘T’ package

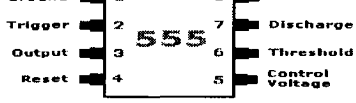


fig 2.2 ‘V’ package

The comprehensive internal circuitry of a 555 Timer is shown below in fig. 2.3

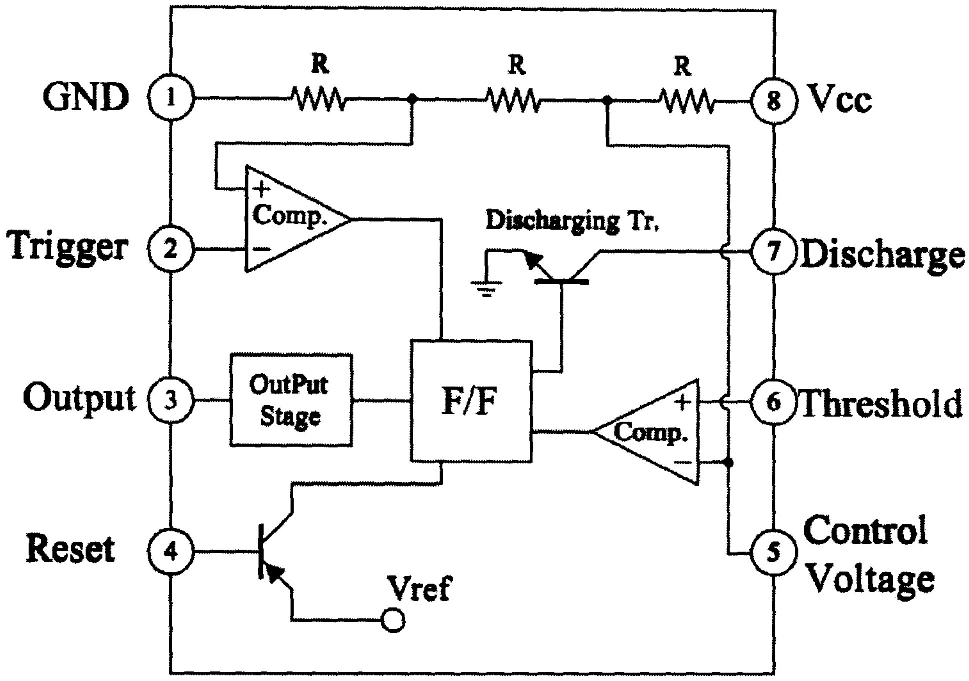


Fig 2.3 Comprehensive internal circuitry of 555 Timer

2.3.1.1 A COMPARATOR

Like an op amp, a comparator IC has two inputs. The comparator does just what its name implies. It compares the two inputs (called A and B).if the input at A is significantly greater than the input at B, the output will be about +5v.which implies logic 1, or high. If the input at A is not greater than the input at B, the output voltage will be about +2, designated as logic 0, or low.

Voltage comparators are used to actuate, or trigger other devices such as relays and electronic switching circuits. [7, 8]

2.3.1.2 A FLIP-FLOP

This is a bistable device that can remain in one of two stable states (0 and 1) until appropriate conditions cause it to change sate. Thus, a flip-flop can serve as a memory element. It has two outputs, one of which is the complement of the other. [7]

2.3.1.3 DESCRIPTION OF TIMERS

555 timers are highly stable controller, capable of producing accurate timing pulse. With monostable operation, the time delay is controlled by one external resistor and one capacitor. With astable operation, the frequency and duty cycle are accurately controlled with two external resistors and one capacitor.

2.3.1.4 FEATURES OF 555 TIMERS

- It have a High current drive capability (200mA)
- It have an adjustable Duty Cycle
- It have temperature stability of 0.005 C
- It have a timing from microseconds to hours

2.3.1.4 APPLICATIONS OF TIMERS

- For Precision timing
- For Pulse generation
- For Time delay generation
- For Sequential timing

2.3.1.5 THE DEFINITION OF 555 TIMER PINS

1. Pin 1(ground): this is normally connected to circuit common (ground) when operated from positive supply voltages. It is the most negative supply potential to the device.

2. Pin 2 (trigger): this pin is the input to the lower comparator and is used to set the latch, which in turn causes the output to go high.

3. Pin 3 (output): an output pin from which the integrated circuit either sinks or source current.

4. Pin 4 (reset): this is an input pin that has an overriding function; that is, will force the output to a low state regardless of the state of either of the inputs. It is used to reset the latch and return the output to a low state.

5. Pin 5 (control voltage): this is connected in such a way that it allows an indirect access to the lower comparator. It allows extreme flexibility by permitting modification of the timing period, resetting of the comparator etc.

6. Pin 6 (threshold): this pin is one of the inputs to the upper comparator (other than pin 5), use in resetting the latch, which cause the output to go low.

7. Pin 7 (discharge): this pin is connected to the open collector of an NPN transistor, the emitter of which goes to ground, so that when the transistor is turned "on", the pin is effectively shorted to ground.

Pin 8 (VCC): this is the positive supply voltage terminal, with supply-voltage operating at a range of 4.5 volts minimum to 16 volts maximum, and is specified for operation between +5 volts and +15 volts. [5, 9]

2.3.1.6 OPERATIONAL MODES OF 555 TIMERS

The basic operational mode of 555 Timers are:

1. Monostable mode: in this mode, the 555 timer acts as a "one-shot" pulse generator. The pulses begin when the 555 timer receives a signal at the trigger input that falls below a third of the voltage supply. Where the pulse width is determined by the time constant of an RC (resistor and capacitor) network. The output pulse ends when the charge on the capacitor equals two-third (2/3) of the supply voltage. Fig 2.4 below shows a schematic 555 Timer in Monostable mode.

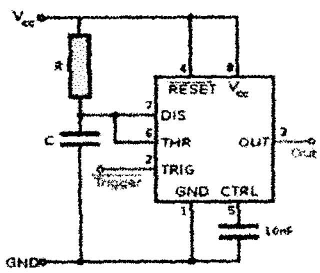


Fig. 2.4 A schematic diagram of 555 timer in Monostable mode.

2. Astable mode: in this mode the 555 timer puts out a continuous stream of rectangular pulses having a specified frequency, which depends on the values of R1, R2 and C. mathematically, the frequency is given as:

$f = 1 \div [\ln (2). C. (R1 + 2R2)]$ 2.1

$f = 1.44/ [C (R1 + 2R2)]$

And the time period is given by:

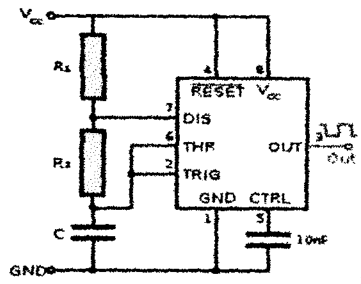
T1 (output high) = $In(2)(R1 + R2)C$ 2.2

$T1 = 0.693\ (R1 + R2)C$

T2 (output low) = $In(2). R2. C$ 2.3

$T2 = 0.693. R2. C$

Fig.2.5 below shows a schematic diagram of a standard 555 Timer circuit in Astable mode.



[9]

Fig. 2.5 A standard 555 Astable circuit

2.3.2 RESISTOR

A resistor is an electrical device whose primary function is to offer resistance to the flow of electric current. The magnitude of the opposition to the flow of current is called the resistance of the resistor, measure in ohms.

The resistance of a resistor is directly proportional to the resistivity of the material and the length of the resistor and inversely proportional to the cross-sectional area perpendicular to the direction of the current flow. Express mathematically as:

$R = PL/A$ 2.4

Where p = resistivity of the resistor material

L = the length of the resistor along direction of current flow

A = the cross – sectional area perpendicular to current flow

Resistance in terms of sheet resistivity, is equivalent to the multiply of the sheet resistivity and squares of the resistor. Where the squares are equals to the length (L) divide by the width (w).

Given as:

$Rs = Ps\,(L/w)$ 2.5

Where Ps = the sheet resistivity

L = the length of resistor

W = the width of the resistor

Rs = the sheet resistance

Resistance in terms of voltage drop across a resistor and current flow through the resistor in accordance to ohm's law is express as:

$R = \frac{V}{I}$..2.6

Where$R$ = resistance

V= voltage

I = current

2.3.2.1 RESISTOR NETWORK

Resistor network is the joining of resistors either in:

(i) series connection; or

(ii) Parallel connection.

Series network

The effective resistance (Rt) of resistors in series is equivalent to the sum of each of the resistance in the network. The mathematical equivalent of total resistance is given by:

$Rt = R1 + R2 + \ldots + Rn$ 2.7

The equivalent voltage in a series network is equal to the sum total of the entire voltage across each of the resistors in the network.

i.e$Vt = V1 + V2 + \dots\dots + Vn$ 2.8

Where Vt= equivalent voltage

$V1, V2,$ and Vn= voltage across$R1$,$R2$, and Rn respectively

The current flow in a series network is the same. i.e

$It = I1 = I2 = In$ 2.9

It = supply current (equivalent current)

I1, I2, in = are current flow through $R1, R2, and\ R3$respectively

Parallel network

In parallel network of resistors, the reciprocal of the equivalent resistance (Rt) is equal to the sum total of the inverse resistance of each of the resistors (R1, R2, ….,Rn) in the network. Express mathematically below:

$\frac{1}{Rt} = \frac{1}{R1} + \frac{1}{R2} + \cdots \frac{1}{Rn}$..2.10

The equivalent current (It) is equal to the sum total of the current flow through each of the resistors, express mathematically as:

$It = i1 + i2 + \cdots + in$..2.11

And the voltage across each of the resistor is the same with the supply voltage.

i.e$Vs = Vt = v1 = V2 = Vn$..2.12

[8, 10]

2.3.2.2 MEASUREMENT OF RESISTANCE

The measurement of resistance of a resistor can be done using multimeter, ohmmeter, and the color code of the fixed resistor.

Table 2.1 Resistor color code

COLOURS	FIRST SIGNIFI-CANT DIGIT	SECOND SIGNIFI-CANT DIGIT	THIRD SIGNIFI-CANT DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	0	0	$x10^0$	1%
BROWN	1	1	1	$x10^1$	2%
RED	2	2	2	$x10^2$	-
ORANGE	3	3	3	$x10^3$	-
YELLOW	4	4	4	$x10^4$	-
GREEN	5	5	5	$x10^5$	0.5%
BLUE	6	6	6	$x10^6$	0.25%
VIOLET	7	7	7	$x10^7$	0.10%
GREY	8	8	8	$x10^8$	0.05%
WHITE	9	9	9	$x10^9$	-

[10]

2.3.3.0 RELAYS

A relay is an electrically operated switch. They are used where it is necessary to control a circuit by a low-power signal with complete electrical isolation between control and controlled circuits, or where several circuits must be controlled by one signal.

They operate in two modes; the normally close mode and the normally open mode. A trigger signal makes or breaks the circuit. When the circuit is broken the magnetic field created will collapse, generating a voltage spike and creates an arc at the breaking point of the circuit's path. The relay's connections are usually labeled COM, NC and NO:

- COM stands for common; where the moving part of the switch is always connect to
- NC stands for Normally Closed, this is connected when the relay coil is not energize
- NO stands for Normally Open which is connected when the coil of the relay is energized [11, 12]

2.3.3.1 Comparison between transistors and relays

Like relays, transistorscan be used as an electrically operated switch. For switching small DC currents (< 1A) at low voltage they are usually a better choice than a relay. However transistors cannot switchhigh voltages (such as mains electricity) and they are not usually a good choice for switching large currents (> 5A). In these cases a relay will be needed, but note that a low power transistor may still be needed to switch the current for the relay's coil! The main advantages and disadvantages of relays are listed below:

2.3.3.2 Advantages of relays over Transistors:

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch high voltages, transistors cannot.
- Relays are a better choice for switching large currents (> 5A).
- Relays can switch many contacts at once. [12]

2.3.3.3 Disadvantages of relays over Transistor:

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly (except reed relays), transistors can switch many times per second.
- Relays use more power due to the current flowing through their coil.
- Relays require more current than many ICs can provide, so a low power transistor may be needed to switch the current for the relay's coil. [12]

2.3.4 BUZZER

Buzzer is a device that produces an audible tone in the influence of an external applied voltage. This audible output may be either in the form of a buzzing or a beeping sound. The sound is created by inducing rapid movement in the diaphragm of the buzzer. [13, 7]

The can be operated by either ac or dc power source, classify majorly into two types:

1. Electromechanical Buzzer, such as call bell used in offices, the horn used in automobile. There vibrations are made by self-made oscillations through the rapid switching of an electromagnet. Commonly known as magnetic Buzzer

2. Electronic Buzzer: the vibration are made by an oscillator circuit which drives a piezo to produce the sound; commonly known as a piezo Buzzer. [13, 14]

The piezoelectric buzzers 12" have sound intensity of 108 dB

2.3.4.1 A comparison between Magnetic Buzzer and Piezo Buzzer

Table 2.2Acomparison between Magnetic Buzzer and Piezo Buzzer

	Magnetic Buzzer	Piezo Buzzer
Operating voltage	1. Have a low operating voltage rangin from 1.5V to 24V	1.It have a high operatin voltage ranging from 3V to 220V
Current consumption	2. high consumption current ranges fron 35mA – 60mA	2.low current consumption Ampere, between 5mA – 20mA
Size	3. small between 6mm – 25mm	3. big between 10mm – 50mm
Resonant frequency	4. low between 1KHZ – 3KHZ	4. High between 2KHZ – 6KHZ

[13]

2.3.5.0 DC ELECTRIC MOTOR

These are device that converts direct current (dc) energy into rotating mechanical energy Were the source of electricity is connected to a set of coils, producing magnetic fields. The attraction of opposite poles, and the repulsion of like poles, is switched in such a way that a constant torque, or rotational force, results. The greater the current that flows in the coils, the stronger the torque and the more electrical energy is needed.

2.3.5.1 TYPES OF DC MOTORS

1. shunt-wound motor: The field winding of the dc motor is in parallel with the armature across the supply.

$V = E + IaRa$ 2.12

$I = Ia + If$ 2.13

Where V= supply voltage

Ia= armature current

E = generated e.m.f

Ra = armature resistance

If= field current

2. Series – wound motor: the field winding is in series with the armature across the supply.

Supply voltage

$V = E + I(Ra + Rf)$

3. Compound – wound motor: there are two types:

I. Cumulative compound, in which the series winding is so connected that the field due to it assists that due to the shunt winding

II. Differential compound, in which the series winding is so connected that the field due to it opposes that due to the shunt winding. [8,15]

2.3.6.0 Theoretical background of the Light Receiver (Light Dependent Resistor)

The Light Dependent Resistor as used in this project is acting as the receiver end of the sensor unit that senses any interruption in the light from LED falling on it in other to trigger a relay and an alarm

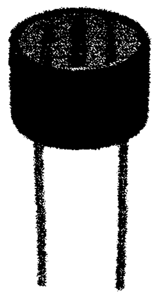


Fig 2.6 Light Dependent Resistor

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms (1MΩ), but when they are illuminated with light resistance drops dramatically [16]. There are just two ways of constructing the voltage divider; with the LDR at the top, or with the LDR at the bottom [16].

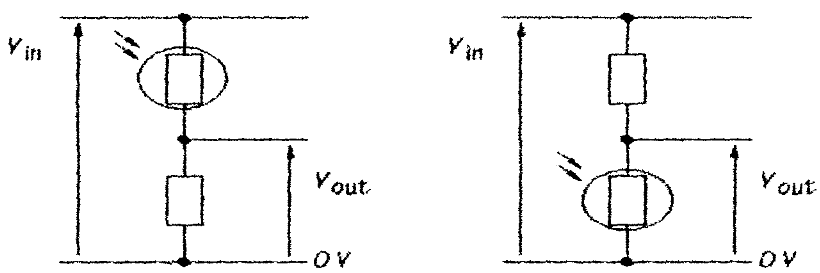


Fig 2.7 light dependable resistor voltage divider circuitry

So that $Vout = \frac{Rbottom}{Rbottom + Rtop} \times Vin$ ………………………………………………2.14

With the resistance of the LDR changing as light falls on and off it, to give a require output voltage.

2.4.0 THE BLOCK DIAGRAM

Below is the block diagram of the touch activated waste bin

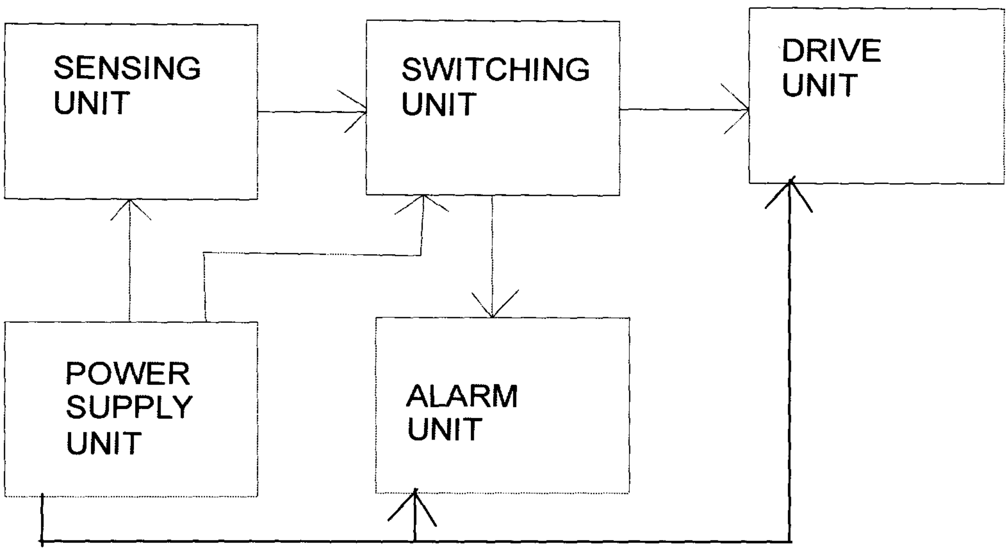


Fig 2.8 Block diagram of touch activated waste bin

2.4.1 POWER SUPPLY UNIT

It useda non-rechargeable 9 volt battery which powers the entire circuit; generally batteries are combination of simple cell either in series connection or parallel connection, categories majorly as primary batteries and secondary batteries.

Primary batteries are non-rechargeable batteries such as carbon – zinc batteries, zinc – chloride batteries, mercury batteries, silver oxide batteries, lithium manganese batteries etc

Secondary batteries are rechargeable batteries such as lead – acid batteries, alkaline batteries etc. [8, 10]

2.4.2 SENSING UNIT

This unit comprises of a touch sensor that trigger a motor drive to either open or close the lid of the waste bin when it senses touch; and a dark sensor which senses a bridge in transmission of light to a photo resistor or light dependable resistor.

2.4.3 SWITCHING UNIT: This unit comprises majorly of three relays that serves as a switch to the alarm and to the dc electric motor.

2.4.4 DRIVE UNIT

This unit does the actual work of the opening and the closing of the lid, the dc electric motor changes direction of rotation whenever the polarity is interchange causing the back and forth movement of the waste lid with the help of a mechanical gear system.

2.4.5 ALARM UNIT

This unit notifies the user of the waste binthat it is full by alarming, this is as a result of dirt's coming in between the rays of light from the white LED and the photo resistor; when this occur, the resistance decrease and thereby leads to an increase in the voltage across the 1N4004 diode, from which a 6 volt d.c relay is connected to rather switch on or off an alarm.

CHAPTER THREE

The project design is carry out in the following sub units:

1. The sensing unit
2. Switching unit
3. driving unit
4. The alarm unit

3.1 SENSING UNIT

This unit has two basic sensors:

- A touch sensor; and
- A dark sensor

3.1.1Touch sensor

The major component for the touch sensor is an NE555 timer, operating in monostable mode. When the output is high, the red LED (light emitting diode) will comes up, and when it is low, it will turns off. The sensor has a touch probe that senses touch and sends a trigger signal to a relay, with a delay of five seconds. Fig.3.1 below shows the circuit diagram of the touch sensor.

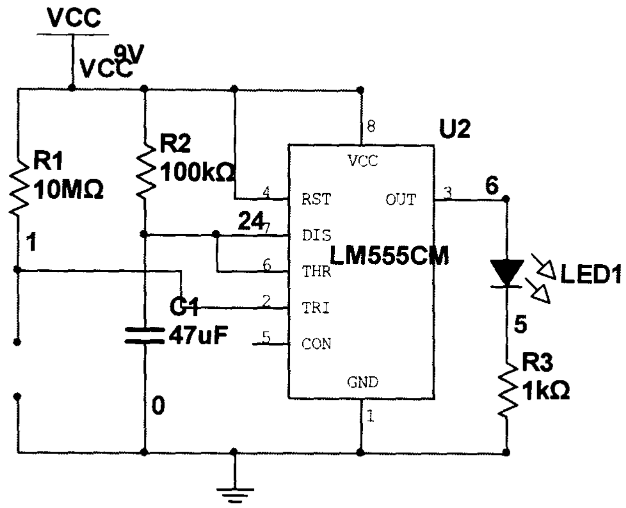


Fig 3.1 Touch sensor

The 1K resistor is use to protect the LED from excessive voltage, the capacitor (C) and the resistor (R) determine the delay time or duty cycle of the sensor; the 47µf capacitor is charge via the 100KΩ resistor. The LED serves as an indicator which helps in troubleshooting the system. The 10M resistor on pin 2 causes the circuit to be very sensitivity to the touch. The transistor amplifies the output of the touch sensor on pin 3 and feed it into the 6 volt relay. The trigger probe is connected to pin 2 of the 555 timer and will trigger the relay, using someone body resistance when touched, where the touching part has to be clean

The time delay for the trigger signal $(T1) = 1.1 \times R2 \times C1$

Where $R2 = 100K\Omega$, for a target delay of 5 seconds

$C1 = T1 \div (1.1 \times R2)$

$C1 = 5 \div (1.1 \times 100 \times 10^3)$

$C1 \approx 46 \times 10^{-6}$Farad

$47\mu F$ Capacitor is used in the design because it is the readily available capacitor that is close to the calculated value.

Current flow through the light emitting diode (LED I) = $(Vin \div R3) - (Vled \div R3)$

$LEDI = (Vin - Vled) \div R3$

Where Vin = supply voltage = 9 volts

V led = voltage drop across the led $\approx 1.7\,V$

$R3$= the series resistor with the led = 1KΩ

LED I = $(9 - 1.7) \div (1 \times 10^3)$

$= 7.3 \times 10^{-3}$

$= 0.0073A$

3.1.2 The dark sensor unit

The dark sensor design comprises of a photoresistor, and 2N3904 transistor as the major components. Below is the dark sensor circuit diagram.

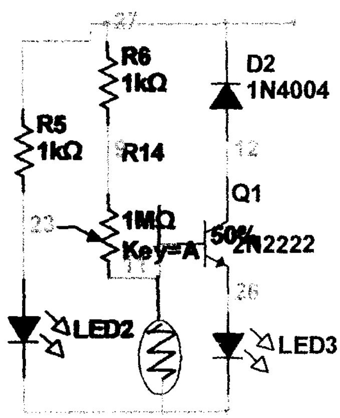


Fig 3.2 Dark sensor circuit

The basic working principle of the dark sensor

1. In light the photoresistor has low resistance allowing all of the current to flow through to ground. And because the base of the transistor 2N3904 gets no voltage, the transistor is switch or turn off
2. The resistance in the photoresistor increases linearly with darkness, providing more voltage to the base of the transistor which switch or turn on the transistor.
3. Setting the potentiometer at low resistance will result in more voltage flowing through, with less voltage drop making it easier for the 2N3904 Transistor to turn on [17,18]

The voltage across the photoresistor

$$Vout = [Rpr \div (Rpr + R)] \times Vin$$

$$Vin = 9volt$$

$$R = (1000 + Rpt)$$

$$Vout = 2.9Volts\ (measured)$$

$$Rpr = Rphotoresistor = ?$$

$$at\ Rpt = 800\Omega$$

$$Rpr = [R \div (Vin - Vout)] \times Vout$$

$$\therefore Rpr = [(1000 + 800) \div (9 - 2.9)] \times 2.9$$

$$Rpr = (1800 \div 6.1) \times 2.9$$

$$Rpr \approx 855.74\Omega$$

The resistance of the photoresistor that will turn ON the alarm is approximately 855.74Ω

3.2 SWITCHING UNIT

This unit comprises of a relay and 1N4004 diode as shown below

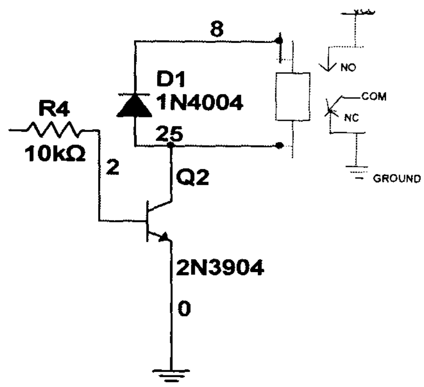


Fig 3.3 the switching unit circuit

The 6 volt dc electrical relay is an electrically operating switch,when an electric current is passed through the coil of the relay, it generates a magnetic field that attracts the armature; and the consequent movement of the movable contact(s) either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position.

The 1N4004 diode is placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike that is dangerous to semiconductor circuit components; and to avoid self-activation of the touch sensor, refer to as the back e.m.f. suppression diode. The 2N2222 transistor amplifies the output of the sensor and the 10KΩ protects the transistor

Where

$VBE = 0.75V$

$IBE = 0.45mA$

$I2 = current\ flow\ through$ $10K\Omega$ (R4)

$I = output\ current\ \ from\ timer$

$Vout\ (from\ timer) = V4 + VBE$

$Vout = I2R4 + VBE\ \ (paralle\ connection)$

$I2R4 = (Vout\ \ - VBE)$

$I2R4 = Vout - VBE$

$I2R4 =\ 5.2 -\ 0.75$

$I2R4 =\ 4.45V$

$$R4 = \frac{4.45}{0.00045} \approx 9888.8888$$

$I1 = (Vout\ \ - Vled) \div R1$

$I1 = (5.2 - 1.7) \div 1000$

$I1 = 3.5mA$

$I = (3.5 + 0.45) \times 10^{-3}$

$I = 3.95\ mA$

The current require to turn the transistor on is $0.45mA$ while the output current from the NE555 timer is$3.94mA$

3.2.1 Basic design and operation of the relays

The electromagnetic relay consists of a coil of wire surrounding a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts. The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. One of the two sets of contacts in the relay is closed, and the other set is open. The relay has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the printed circuit board.

3.3.0 ALARM UNIT

Below is the circuit diagram of this section.

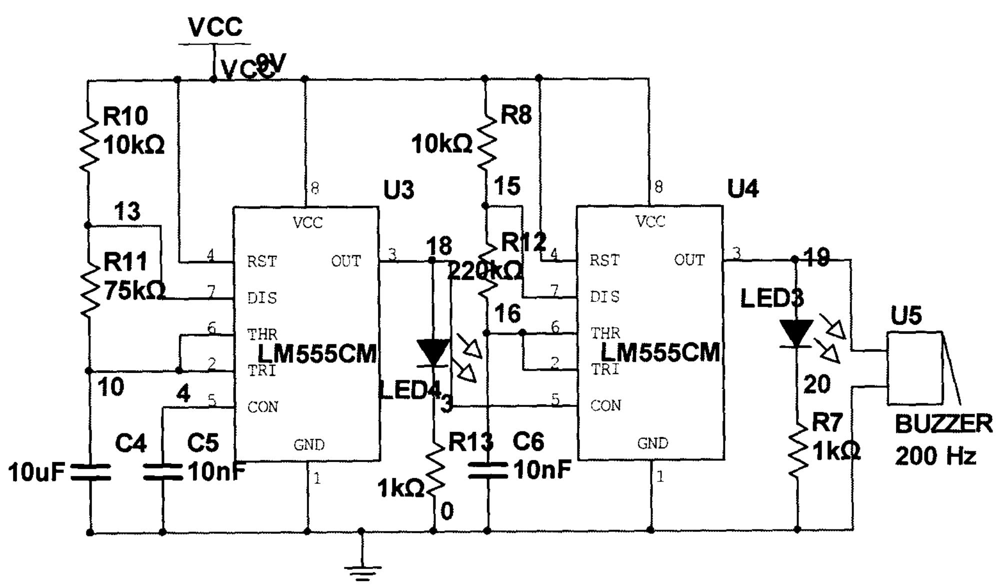


Fig 3.4 the alarm circuit

This unit uses a light dependable resistor (photo resistor) to senses darkness and to activate a relay (R3) which switches the alarm circuit. The diode 1N4004 serves as a protective device to avoid feedback effect from the discharge of stored charges from the coils of the relay; the NPN transistor 2N2222 amplifiers the voltage, the buzzer produces the sound while the 10uf capacitor regulates the high and low sound that the buzzer is making

The frequency of operation in astable mode is dependent upon R7, R8 and C2, given by frequency $F = 1.44 \div [(R7 + 2R8) \times C2]$

The time duration between the pulses ("period") = the time when the pulse is High (t1) + the time when the pulse is low (t2)

$t1 = 0.693\ (R7 + R8)\ C2$

$t2 = 0.693 \times R8 \times C2$

The duty cycle (D) that is, the time when the output pulse is high to the period

$D = \quad t1 \div t$

$D = (R7 + R8) \div (R7 + 2R8)$

Considering the first IC Where R7 = 10KΩR8 = 75   C2 = 10μF

$t1' = 0.693(10 + 75) \times 10^3 \times 10 \times 10^{-6}$

$t1' = \quad 0.58905\ seconds$

$(t2') = 0.693 \times R8 \ \times C2$

$= 0.693 \times 75 \times 10^3 \times 10 \times 10^{-6}$

$t2' = 0.51975\ seconds$

$t' = t1' + t2'$

$t' = 0.58905 + 0.51975$

$t' = 1.1088\ seconds$

$D' = t1 \div t$

$D' = 0.58905 \div 1.1088$

$D' = 0.53125$

$f' = 1.44 \div [(R7 + 2R8) \times C2]$

$= 1.44 \div \{[(10000) + 2(75000)] \times 10 \times 10^{-6}\}$

$f' = 1.44 \div 10001.5$

$f' = 0.144 \times 10^{-3} Hz$

$f' = 0.144 mHz$

Considering the second IC (timer 4)

$R10 = 10K\Omega$

$R11 = 220K\Omega$

$C4 = 10uF$

$(t1'') = 0.693 \times (R10 + R11) \times C4$

$t1'' = 0.693 \times (10 + 220) \times 10^3 \times 10 \times 10^{-6}$

$t1'' = 1.5939\ seconds$

$t2'' = 0.693 \times 10 \times 10^3 \times 10 \times 10^{-6}$

$t2'' = 0.0693\ seconds$

$t = t1'' + t2''\ t = 0.63\ \times R2\ \times C1$

Therefore t =1.5939 + 0.0693

$t = 1.7325 seconds$

Duty cycle $D = t1\ \div t$

$D = 1.5939\ \div 1.7325$

$D = 0.92$

The frequency of operation $f'' = 1.44\ \div [(R1 + 2R2) \times C1]$

$f'' = 1.44\ \div \{[(10000) + 2(220000)] \times 10 \times 10^{\wedge} - 6\}$

$f'' = 1.44\ \div 10004.4$

$f'' = 0.1439 mHz$

3.4 THE DRIVE UNIT

This comprises of resistors, a dc motor and a mechanical gear system. When one of the relay switched from the normally close to the normally open mode, it send a trigger signal to the dc motor which rotate the gear mechanism causing the lid to either open or close.

CHAPTER FOUR

CONSTRUCTION, TESTING AND DISCUSSION

4.1 CONSTRUCTION AND TESTING

The main construction was done in two stages:

1. The soldering of the bread boarded circuit to the Vero board: The soldering of the components on the breadboard was done neatly in modules and tested regularly. The power supply unit was soldered and tested to ensure that it produced the desired result before the other modules were soldered to the board in other to prevent the burning of other components. After every module was soldered, continuity or bridging was tested to ensure accurate results.
2. The coupling of the entire project to the casing: After the soldering of the circuit to the Vero board, to protect and house the circuit board.

Tools used for the construction of the project are given below:

1. Breadboard and insulated copper wire: These were used to build a prototype model for testing before the circuit was finally transferred to the Vero board.
2. Soldering iron and lead: A 60W soldering iron and lead were used in soldering all components together on the Vero board.
3. Sand paper: This was used to rub the face of the Vero board to aid polarization.
4. Cutter: this was used to trim off excesses that shot out of Vero board from components after soldering.

The Construction of the electrical circuit on vero board was carried out following the circuit diagram in figure 3.5. Splitting the inter circuit on the vero board into two main sub-sections to make it easier for implementation.

The first main sub circuit comprises of:

- power supply
- touch sensor
- switching relays

The second main sub circuit comprises of:

- power supply
- dark sensor circuit
- switching circuit
- alarm circuit

4.1.1 CONSTRUCTION OF WASTE CONTAINER

The model waste bin is constructed using wood with a length of 25cm, width of 17cm and depth of 26.5cm.where the electrical circuit and the waste bag is embedded inside.

4.2.0 IMPLEMENTATION

4.2.1COMPONENT LAYOUT

The arrangement of the components on the veroboard is done in sections. The power supply unit is connected to the various subs – sections on the vero board using jumpers. The arrangement is done in such a way that, less space was use on the vero board by arranging the components closer to each other, where the sensing section is close to the switching relays.

4.2.2 PRECAUTION TAKEN

The precautions taken in the various unit of the project are as follow:

1. PThe overheating of the batteries and NE555 timer IC is avoided to prevent explosion or burning the components by checking for any bridge in the soldered connection.
2. Eight pin Ic sockets were soldered on the vero board in place of the 555 Timer IC; which is prone to damage due to heat.
3. Too much solder (lead) was not applied to avoid flowing into other places which can cause short circuiting.
4. The whole soldering of the other components were done before supplying power to avoid damaging the component, especially the light emitting diode.

4.3.0 TESTING

The following steps were taken in testing the project work

1. To ensure that all the components to be used were functioning properly and to ascertain there specification, they were first tested with a digital multi meter
2. A digital multi meter was used to test the continuity of the circuit, to check for any open circuit
3. Testing of the continuity of the jumper using multi meter set at continuity
4. The output voltage and current of the touch activated switch were measured and recorded under results.
5. An object was place in between the transmitter (photo diode) and the receiver (photoresistor) to test if the buzzer will alarm.

4.4.0 RESULT

The touch activated waste bin is working base on specifications on touching the first probe the lid of the waste bin open, on touching the second probe the lid closes and the alarm was working when the light ray was bridged.

4.5.0 DISCUSSION OF RESULT

The touch sensor was sensitive when the two wires that form the touch probe was touched; the required delay time was approximately implemented, while the audibility of the alarm circuit (buzzer) was also implemented; though it drops with decrease in supply voltage.

The sensitivity of the touch sensor varied for different individual's base on the difference in resistance of their hands; either wet or dry, the higher the resistance the greater the voltage drop across the person and the better the sensitivity of the touch sensor.

4.6.0 PROBLEMS ENCOUNTERED IN IMPLEMENTING THE PROJECT WORK

1. The higher version of the NE555 timer, which have higher features was not found in Minna
2. Inadequate familiarization with electrical components, electrical and electronics websites that slowed the pace of the work.

3. The first approached of using an electromagnet for the opening and closing of the waste lid was not achievable due to the low field strength of the electromagnetic and the sound it was generating

4. The wasn't any directly related waste bin project in the departmental library to use as a guide or reference

CHAPTER FIVE

5.0 CONCLUSION

The design and construction of the touch activated waste bin with alarm was accomplished using electronic components that are available locally. This project was constructed bearing in mind the need for proper waste management in other to minimize the breeding of mosquitos etc, and polluting the environment. The performance of the project after testing showed that the system met the design specifications.

5.1. RECOMMENDATION

1. An improvement on the opening and closing of the lid; instead of using two different touch pad for normal opening and closing, let one touch pad be use to open the lid for some second and then close it, to avoid or reduce the chances of leaving the waste bin open.

2. To use a hinge lid to reduce the space that the waste bin will occupy

3. To incorporate a design of a battery charge to help in charging the battery use in system

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APPENDIX

4.7 TROUBLESHOOTING GUIDE

1. Test the power supply to ensure that the output voltage does not drop below 7 volts, which will have a direct effect on the switching of the relays if it does.

2. Test for the continuity of the circuit:

- Test for continuity between the battery and the various sub circuits
- Test for continuity along the common anode connection;
- Test for continuity along the common cathode (ground) connection;
- Test for continuity between pin(s) of the IC(s) to either the ground or VCC base on the design circuit.

3. Check if either of the touch pad (probes) is not permanently close

COMPLETE CIRCUIT DIAGRAM OF TOUCH ACTIVATED WASTE BIN WITH ALARM