DESIGN AND CONSTRUCTION OF AN INTRUDER DETECTOR

BY

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OCTOBER 2008

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NATIONAL DIPLOMA PROJECT REPORT

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REG.NO: N/EET/06/8569

THIS PROJECT IS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY NUHU BAMALLI POLYTECHNIC ZARIA

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF NATIONAL DIPLOMA CERTIFICATE IN ELECTRICAL/ ELECTRONICS ENGINEERING

DEPARTMENT OF ELECTRICAL/ELECTRONICS ENGINEERING

SCHOOL OF ENGINEERING, NUHU BAMALLI POLYTECHNIC

ZARIA

KADUNA STATE, NIGERIA.

OCTOBER, 2008.

DECLARATION

I declare that this project has been conducted by me under the supervision of Mallam Rabiu Al-Tanko a lecturer in the department of electrical and electronics engineering technology, Nuhu Bamalli Polytechnic Zaria.

MATTHEW DOGO ISHAKU _____ 12/11/2008

Name Date

APPROVAL PAGE

The under signed officials, having been convinced that the project research is my effort to satisfy one of the obligations leading to the award of national diploma in electrical electronics engineering technology.

Mal. Rabiu Al-tanko Umaisha
(project supervisor)

12/11/08
Date

Mr. Emmanuel Akut
(Project Coordinator)

2/12/08
Date

Muhammad Garba
(Head of Department)

Date

DEDICATION

I dedicate this project to God Almighty the giver of wisdom and knowledge, who inspired and guided me throughout this project.

ACKNOWLEDGEMENT

My appreciation goes first to God, the creator of all things and the giver of life who saw me throughout this project in good health and sound condition.

I sincerely thank my supervisor Mal. Rabiu Al-Tanko who instructed me, giving me valuable suggestions towards the success of this project. Also I really appreciate the efforts of my parents Mr. & Mrs. Ishaku zumunta and my elder brother Mr. Yusuf Ishaku who have collectively contributed toward the success of my studies. My lovely sister Lydia Ishaku and my two cousins Patrick and Abigail your contributions are not forgotten. I also want to say "thanks to Mr. and Mrs. S.A Samuel who has contributed a lot to the progress and success of my project.

To the entire lecturers of electrical/electronics engineering technology am grateful for your support and patience in educating me with the knowledge of been a future engineer. May God bless you.

Finally to my friends, colleagues, the love brothers, chapel officials and those I can't recall or mention, may our good Lord bless you all.

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ABSTRACT

This project is aimed at designing and construction of an intruder detector to make impact or break through towards the technological advancement which serves as basis for any meaningful development.

The circuit is generally an oscillator that generates an audio signal when a certain connection (wire) is broken. This circuit has an IC AN 7112 as its active component which is responsible for producing the oscillation. Other components like resistors, capacitors, switch, battery, and speaker also contribute their own quota in the design.

The audio output signal is delivered to the loudspeaker. When the connection is made, the circuit remains quite but the moment the connection is broken, a very loud audio sound is heard from the loudspeaker to alert you of what is happening.

The purpose of the device is to detect the presence of an unwanted visitor who intends to smuggle into our houses, cars or valuables. It is my sincere hope that this project will be beneficial to students in ND, N.C.E, technicians and any person who might be interested.

CHAPTER ONE

INTRODUCTION

1.0 HISTORY AND DEFINITION

Technology which is a great trend has led to the invention and production of different forms of electrical/electronic devices used for different purposes by man. One of the devices invented by man through technology is the detector (intruder detector).

Detector was first discovered by William crocked in 1903 which detected radiation from the medium displayed in a florescent screen. The second detector was produced by C.T.R Wilson cloud chamber. The third was that of Geiger Muller counter which was also used to detect object radiation and particles.

Detector is defined as "any mechanical or electronic sensing device used in detecting any object by producing sound. Thus an intruder detector as the name implies is an electro mechanical device that sends signal (either so und or light) to keep awareness against intruders. The intruder detector which improve security and increases communication rate between two places, is mostly applicable in places like hospitals, military bases, banks e.t.c. this device is installed

in an un noticeable strategic position mounted on a dark region to detect an intruder without his/ her awareness.

This project is designed and constructed on the bases of elementary theories of electronics to carry out minor task.

1.1 AIMS AND OBJECTIVES

- To design and construct an intruder detector
- To make a design that is cheaper, compared to the imported type
- To improve the security network.

1.2 MOTIVATION

I decided to design and construct an intruder detector in order to contribute towards the control of high crime rate in our society (especially through bulging of houses and snatching of cars), by improving the security network of our people.

1.3 SCOPE AND LIMITATION

Scope: this project (intruder detector) send alarm only when the wire Of the detector is cut –off as an intruder passes across it.

Limitations: it gives alarm at anyone who crosses it.

The circuit is in sensitive to both animate and inanimate object e.g. animals, strong wind which could break the circuit.

1.4 SIGNIFICANCE OF THE PROJECT

- To prevent intrusion
- It is designed for industrial commercial and residential use to improve security network.

1.5 APPLICATION OF THE PROJECT

This project is applicable in places like

i. Hospitals

ii. Banks

iii. Military bases

iv. Houses

v. Cars

CHAPTER TWO

LITERATURE REVIEW

2.0 HISTORICAL BACKGROUND OF THE PROJECT

One of the devices invented by scientist for various purposes to humanity was the detector. The idea of this device first came from William crocked in 1903 which was used to detect radiation from the medium displayed in a fluorescent screen. The second scientist that also built on this project design was C.T.R Wilson cloud chamber. And the third was the Geiger Muller counter which was used to detect object radiation and particles.

Today the ideas of these scientists are already modified such that it is presently used in our generation to detect the presence of unwanted persons and objects. This project device having undergone several circuit designs is now used as an intruder dictator to notify the security bodies of houses, banks, hospitals e.t.c against the presence of an intruder.

2.1 **RESISTOR**

A resistor is an electrical device whose primary aim/ function is to introduce resistance to the flow of electric current. The magnitude of opposition to the flow of current is called the resistance of the resistor. The resistance is measured in ohms (Ω) named after the discoverer George Simon Ohms in 1826. Thus an ohm is the resistance that arises when a current of one ampere is passed through a resistor subjected to one volt across its terminals.

Therefore resistance of a resistor can be expressed in terms of:

1) Been directly proportional to the resistivity of material and the length of the resistor and inversely proportional to the cross- sectional area perpendicular to the direction of current flow.

$R=^{\rho l}/_{A}$ where ρ= resistivity

L=length of the resistor

A= cross sectional Area

2) the voltage drop across the resistor and current through the resistor rated by ohms law

$R=^{v}/_{I}$ where v= voltage applied

I= current through the resistor

COLOR CODING OF RESISTORS

Colour coding or direct digital marking are used in identifying resistors and types to be used in any device. Hence it comprises of four bonds of different colors. The first is the most significant figure followed by the second while third is the multiplier and then the fourth band is the tolerance on the resistance value. The table is shown below in fig 2.1

S/NO.	Color	1st band	2nd band	3rd band	4th band tolerance%
1	Black	0	0	1	
2	Brown	1	1	10	
3	Red	2	2	10^2	
4	Orange	3	3	10^3	
5	Yellow	4	4	10^4	
6	Green	5	5	10^5	
7	Blue	6	6	10^6	
8	Violet	7	7	10^7	
9	gray	8	8	10^8	
10	White	9	9	10^9	
11	Gold			10^{-2}	5%
12	Silver			10^{-3}	10%
13	No band				20%

Fig 1

TYPES OF RESISTOR

Resistor is of three major types namely

1. The fixed resistors which values cannot be varied after manufacture are classified into; composition resistor, wire-wound resistor and metal film resistor

2. variable resistors whose value of resistance could be varied are also classified into the potentiometer (voltage divider),

Rheostat (current controller)

General symbol: 

APPLICATION [USES] OF RESISTOR

i) Setting bases,

ii) Controlling gain

iii) Fixing time constants

iv) Matching and loading circuits

v) In voltage division

vi) Heat generation

2.2 CAPACITORS

Capacitors which are also electrical components are used in storing and discharging of electric changes. Where as capacitance is the concept of energy storage in an electric field and is restricted to the area, shape and spacing of the capacitor plates and property of the material separating them.

When electrical current flows into a capacitor, a force is established between two parallel plates separated by a dielectric. This energy is stored and remains even after the input is removed. By connecting a conductor across the capacitor, the charged capacitor discharges. Its stored charge and thus regain its electron balance. Its general symbol is as shown below:

It unit is farad (F) and other sub-units used include micro-farad (μF), nano farad (nF) and pica farad (pF).

Also the capacitance of a capacitor and the energy stored in a capacitor and the capacitive reactance of a capacitor is expressed mathematically as;

i) for capacitance of a capacitor

$C=QV$

iii) capacitive reactance

$XC=1/2\Pi fc$

Where C=Capacitance

Q=Charge

V=Voltage applied [P.d]

ii) Energy stored (E) $=1/2CV^2$

TYPES OF CAPACITOR

Capacitor is namely divided in to two, which include:

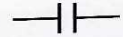
i. Electrolytic capacitor and

ii. Non Electrolytic capacitor

- NON – ELECTROLYTIC

These capacitors include:

- ceramic capacitor film capacitors
- Mica capacitor
- Paper –foiled – filled capacitor

Symbol 

- ELECTROLYTIC CAPACITORS

Capacitors include;

- Aluminum electrolytic capacitor

-Tantalum capacitor

The polarity must be connected correctly

USES/ APPLICATION OF CAPACITORS

Capacitors are used to filter, couple tune, block Dc, pass a.c, by pass shift phase, compensate, feed through, isolate, store, energy, suppress noise and start motors.

FACTORS THAT EFFECTS THE EFFECTIVENESS OF A CAPACITOR

i. Size (they must be small in size)

ii. Weight (higher in weight).

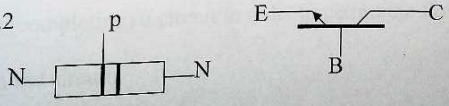
iii. Reliable and with stand adverse conditions.

2.3 TRANSISTOR

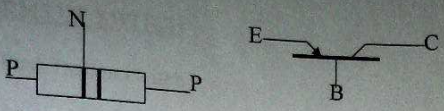
A transistor is a semi conductor with a very thin filling of either an NPN material or PNP type. They also consist of three parts namely the emitter (E), base (B) and the collector(C), which makes it a three terminal device.

In the NPN transistor, the emitter is of N- type, base is p- types and the collector N- type. In the PNP transistor it's the same except that it is in the opposite form i.e. emitter p-type, base is N- type while the collector P- type. Their circuit symbol is as shown below;

Fig 2.2



NPN transistor



PNP Transistor

TYPES OF TRANSISTOR

There are three types of transistor namely;

i. Bipolar junction transistor (BTT)

ii. Junction gate field effect transistor (JUGEFET)

iii. Metal oxide semi conductor field effect transistor (MOSFET)

USES OF TRANSISTOR

i. It is called as a current amplifier

ii. Used as an insulation in a circuit

iii. Used as an electronic switch

iv. Serve as a current control component

v. Used as a semi-conductor in a circuit.

2.4 SWITCH

This is an electrical with two state ON/Off for opening (breaking) and closing (completing) a circuit in order to permit the flow of current through the circuit.

FORMS OF SWITCH

- Push Bolton switch
- Juggle switch
- Rotary switch

TYPES OF SWITCH

❖ ON -off switch (SPST; single pole single throw switch)

Current flows only when the switch is closed

i. Two way switch (SPDT; single pole double throw switch)

ii. DUAL ON – OFF switch (DPST: Double pole single throw switch)

Others include;

❖ Reversing switch or DPDT: Double pole double throw.

❖ Push switch (push to make) (Normally open No)

USES OF SWITCH

- It is used in controlling circuit through electromechanical means.
- Used for remote control of electromagnetic apparatus. 2.25

2.5 BATTERY

This is a device that produces electrical current without the use of mechanical moving parts. This consists of two or more cells connected by ether to provide a single source of electricity.

This battery have both negative and positive terminal.

- Cell  (a single components that makes up a battery)

- Battery  (series of cells connected together)

USES OF BATTERIES

– It is use in the production of single source electricity.

Used in other device like

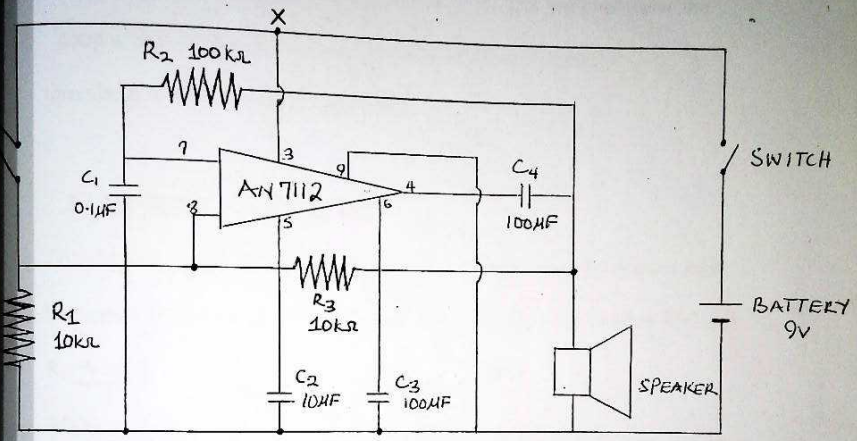
- Night light touch light
- Alarms
- Radio etc

CHAPTER THREE

DESIGN

MAIN CIRCUIT DIAGRAM

The circuit diagram of the intruder detector is as shown below:



CIRCUIT DIAGRAM OF AN INTRUDER DETECTOR

3.0 MODE OF OPERATION

IC which is the main active component of this project design sets up an oscillation with an audio frequency output established by the network of the capacitor C_1 and resistor R_2 – The feed back needed to maintain constant Oscillation is obtained through resistor R_3 and feed to the IC through pin 8. The capacitor C_2 and C_3 connected between pin 6 and pin 9 and ground, filters any ripple from the output. The output is delivered to

the speaker through the pin 4 of the IC. The Vcc and the ground to the IC are through pin 3 and pin 5 respectively. On reaching mode "X" as shown in the figure above into two portions, one part goes to pin 3 while the other goes through the top wire. In this condition, the circuit remains quite because the current is not enough to turn it ON. But the movement the coop wire is broken the whole current goes to pin 5, which turn alarm to start rolling at the intruder.

3.1 DESIGN CALCULATION

To calculate for R_1 value, when the top wire is connected the resistor R_1 is between Vcc and the ground such that maximum by –pass current 0.92 mA

$$R_1 = \frac{Vcc - 0}{I} \qquad \frac{9 - 0}{0.92mA} \qquad \frac{= 9 =}{0.93 \times 10^{-3}} \qquad 10k\Omega$$

Also,

To calculate for the of R_2, is between the negative input of the op-amp and the output terminal- where V_o (max) is 3. 25v and input to negative op-amp of Vmin = 0.3v and the maximum feed back current is I_o = 0.0 3ma

$$R_2 = \frac{V_o\,(max) - Vmin}{I_b} = \frac{3.25 - 0.3}{0.03mA} = 100k\Omega$$

Thus for R_3, the resistor R_3 is between the output and of the positive input of the op-amp. There also V_o (max) is 3.25V and the positive input is V min = 1.2V were the required current is 200mA

$R_3 = \frac{V}{I} = \frac{3.25 - 1.2}{200mA} = 10k\Omega$

For C, the line reactance of the capacitor is 330Ω and frequency of oscillation is 5 kHz

$X_C = \frac{1}{2\pi f C_1}$; $C_1 = \frac{1}{2\pi f X_c}$

$C_1 = \frac{1}{2\pi \times 5000 \times 330}$

$C_1 = 0.1 \times 10^{-6} = 0.1\mu F$

The capacitor $C_2 = 10\mu F$ and $C_3 = 100\mu F$ arbitrarily selected to ground any ripple noise from the output. The capacitor C_1 and resistor R_1 provide the feed back path to the based of the NPN transistor in order to maintain constant of oscillation.

CHAPTER FOUR

CONSTRUCTION AND TESTING

4.0 CONSTRUCTION

The circuit was first built on a temporary project board to test it working ability. The project was found to work accurately on the project board and then finally transferred to the vero-board for permanent construction. The whole components were arranged on the board together with the wire representing terminal of the transistor and later the components were soldered on the vero-board.

4.1 TESTING

This was carefully conducted. This is because a lot of component could be destroyed due to carelessness thus, the assembling of the component to enable the design process become operational was properly dealt with.

During the construction process, the project is made from few numbers of electrical components. The future characteristics and life was taken into consideration. The construction was carried out to avoid any damage of components. The processes involved in the construction include;

i. carefully soldering was taken not to destroy the component

ii. the correct values of the components were used

iii. the polarities of the components were properly placed

Two tests were carried out i.e.

- ✓ on the temporary project board and
- ✓ Finally on the Vero-board where proper placement and soldering were carried out.

4.2 RESULT AND CASING

RESULT: This happens when the wire of an intruder detector already switched ON is cut off (either by opening the door of a house or a car where the intruder detector is connected) it sounds an alarm.

CASING: the project is cased using a plastic material. This is like a rectangle as shown below;

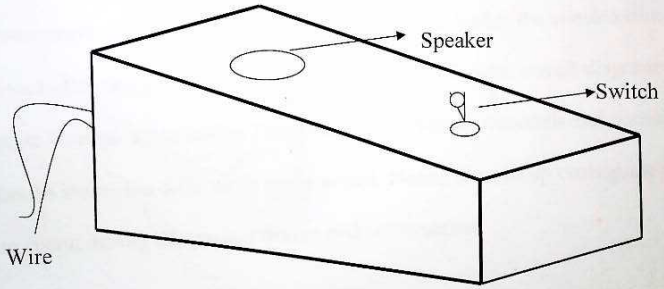


Fig 4

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 **CONCLUSION**

An intruder detected has been constructed in this work and tested working such that the loud speaker sounds clearly. The designed construction was tested to be effective when anything or any body passes or opens the door (where the detected is connected) by braking cutting –off the wire of the already switched or device thus sending a sound signal to the person in charge (E.g. the security guard).

5.1 DIFFICULTIES

In the course of designing and construction of this project, some of the components were damaged during soldering. Also after the construction was concluded, the project was found not working. Thus the circuit diagram was gone through again before finally adjusted. Writing materials and consulting books were also difficult to come across. Hence this end up costing me a lot to spend during the project design and construction.

5.1.2 ACHIEVEMENT

After the difficulties encountered in the course of this project designing and construction, the project was finally tested and found working as suppose. Thus making the actual target of this project design successfully.

5.1.3 RECOMMENDATION

I am recommending this project to the whole indigenous Nigeria engineers, that they should try and modify this intruder detectors circuit such that it will perform greater task even more effective than that of the while man. This device which was constructed on the base of sending out signal to detect an intruder or height emitting diode (light signal) could also be connected to a digital display. This is to help count the number of people passing or in counting census. It could also be applicable at the fore gate, where accurate numbering of cars or vehicle needs to be documented for proper revenue collection.

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APPENDIX

The components used for the design and construction of an intruder detector are shown in the table below:

TABLE OF COMPONENT USED

S/ NO	NAME OF COMPONENT	COMPONENT DESCRIPTION	QUANTITY
1	IC	AN7112	1
2	Battery	9V	1
3	Capacitor	100μF = 2, 0.1μF, 10μF	4
4	Switch	Single pole single throw	1
5	Resistor	10k ¼ W=2, 100k	3
6	Speaker		1

Fig 5

ELECTRONIC ABBREVIATION

kΩ Kilohm ; kilohms

kV Kilovolt; kilovolts

V Volt

MF micro Farad (10^{-6})