DESIGN AND CONSTRUCTION OF A MODEL OF AN AUTOMATIC TRAFFIC CONTROLLER FOR ZEBRA CROSSING WITH RECHARGEABLE BATTERY

BY

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DEDICATION

This project is dedicated to Almighty Allah for sustaining me before, during and also after the completion of this work. It is also dedicated to my lovely parent Mr. and Mrs. Ajide for their support and encouragement always.

DECLARATION

This is to certify that this project titled "Design and Construction of Automatic Traffic controller with Rechargeable Battery'' was carried out by AJIDE RASHEEDAT DAMILOLA under the supervision of Engr. M.S AHMED and submitted to the Department of Electrical and Computer Engineering of Federal University of Technology, Minna for the award of Bachelor of Engineering (B.ENG) degree in Electrical and Computer Engineering.

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My special warmth to my lovely, caring and angelic siblings Tope, Bisola and Mubarak Ajide, and my wonderful fiancé, Abdurrazaq Salau.

I wish the skies were at my reach to write the names of my wonderful friends who were so nice to me through thick and thin during my course of study, namely: Oye, Jumoke, Timi, Richard, Kenny, Luqman, Hassan, Moh'd, Arome, Samuel, Bashirat, Sadiat, BOQ, Dupe, Toyosi and all my course mates.

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ABSTRACT

This project is on the Design and Construction of Automatic Traffic Controller for zebra crossing with rechargeable battery. The motivation behind this project is to deign a traffic controlled light that is simple and effective to control the flow of traffic on our single busy roads in Nigeria. Generally, most traffic controlled light due to high cost of maintenance is abandoned when faulty. This project when implemented; would be operational all the time because of the incorporation of rechargeable battery and its low cost of maintenance. This project makes use of 4047B (astable multiviberator) which controls the Yellow light and clocks the bistable multiviberator with its Reset and Set Output respectively. The Bistable multiviberator (4013B) controls the lighting of the Red LED and the NOR gate with its Set output. Finally, the NOR gate (4011B) controls the lighting of the Green LED. This project work works perfectly for a zebra crossing road.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 INTRODUCTION

According to Oxford Advanced Learner's Dictionary, Traffic Light is defined as "an automatic signal that controls road traffic, especially where roads meet at a cross, by means of red, orange and green lights".

Transportation is very essential in our daily life. Initially the means of transportation was moving on foot, afterwards, animals like horses, donkeys, camels were used but with the advent of technology, easier means of transportation such as bicycles, motorcycles and cars of different sizes have been invented.

The advent of motor vehicle brought about the traffic congestion and higher rate of accident have been recorded in the past years. Traffic congestion causes delay of activities and undue stress while accident causes loss of property, health and even life.

The first means of reducing traffic was by using traffic wardens; they stay at different intersections and wave their hands to either indicate "stop" or "go". After a while, it was realised that it wasn't easy to control large number of cars, also the warden in charge is compelled to stay under the sun for a long period of time and the warden can not perform his /her duty under the rain.

Engineers are meant to solve problems. The thought of a traffic light system was conceived, designed and constructed to ease the stress encountered by the wardens. Different designs have been made from manually operated traffic light to automatic controller.

The first traffic light was installed in London and the modern electric traffic light is an American invention. [1]

1.2 AIMS AND OBJECTIVES

i. The aim of this project is to reduce rate of accident on single roads
ii. To operate with or without power supply from Power Holding Company of Nigeria (PHCN)
iii. To prevent the sudden death of animals and human being on the pedestrian road
iv. To reduce the problem of traffic congestion on the commercial road

1.3 METHODOLOGY

This design was achieved by the use of astable multiviberator, bistable multiviberator (flip – flop) and a NOR gate (4 input NAND gate).

The astable multiviberator has no stable state (it is also called the free running relaxation oscillator) but has two quasi stable states which it keeps oscillating continuously without any external excitation; this is responsible for the change in the yellow LED. This LED comes on when its output Q is high (Q bar is low) and goes off when Q is low (i.e Q bar is high)

The bistable multiviberator has two stable states and each of its state changes when it is given a pulse, each pulse changes the state of the bistable output from 'high' to 'low', the output of this is fed into the Red LED, and the LED goes 'on' and 'off' when the output is 'high' and 'low' respectively.

The NOR gate has 4 NAND gates in its internal circuitry, the final output of the NOR gate feeds the Green LED. The NOR gate gives a 'high' output only when the inputs from both the astable and bistable multiviberator is 'low'. At every other point, the output is 'low'.

The Green LED comes 'on' and 'off' when the output of the NOR gate is 'high' and 'low' respectively.

The Yellow comes on, then Red, after which the Red and Yellow comes on again, the Green follows and back to yellow again.

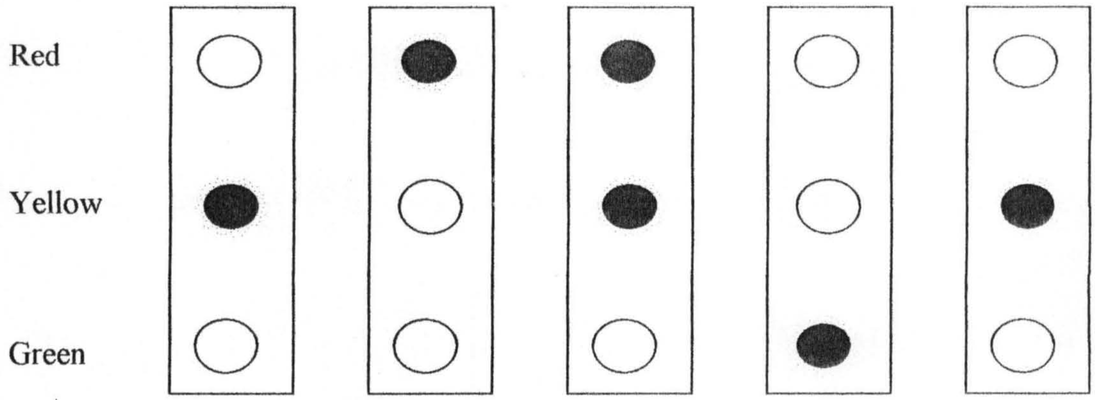


Figure 1.1: Light sequencing

The rechargeable battery was connected with is freewheeling diode, the diode helps to avoid back electromotive force when the battery is fully charged.

The battery takes over immediately there is power failure. A Red LED was fixed in the design to indicate if there is alternating Current (a.c) power supply. The LED comes on when there is supply from PHCN and indicates the battery is in its charging process while it goes off when the battery is feeding the traffic light.

1.3.1 BLOCK DIAGRAM

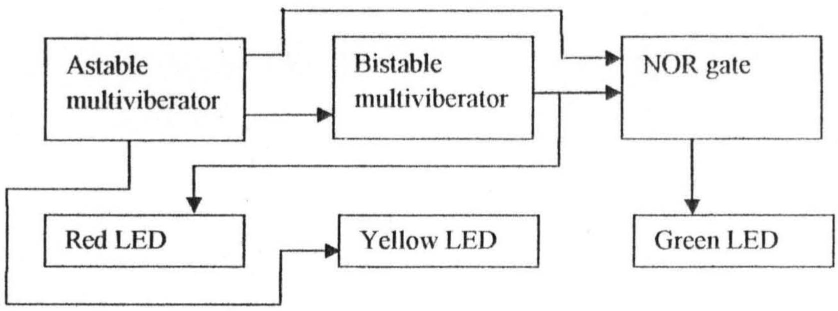


Figure 1.2: Block diagram of traffic light control

1.4 PRINCIPLE OF OPERATION

The past projects use the principle of microcontroller which is more tasking due to the fact that one must be able to write a good program for it to function and more expensive to achieve.

With the aim of simplicity and cost effectiveness, this project was achieved with the use of only three major ICs, Bistable multiviberator, Astable Multiviberator and a four input NAND gate (NOR gate).

The Bistable, power the red LED, the astable output feeds the yellow LED, the output of both the astable and bistable multiviberator are the inputs to the NOR gate and the output of the NOR gate is the pulse for the green LED

1.5 APPLICATION

This design can be used on any single road where people move up and down constantly like:

1. Schools (Primary, secondary and even tertiary)
2. Roads passing through market
3. Roads passing in front churches and Mosques.

1.6 PROJECT OUTLINE

This project consists of five chapters in a sequential manner:

Chapter One

This consists of a brief introduction about traffic light, the aims and objectives, the methodology the scope of work and the project outline.

Chapter Two

It covers the literature review (i.e the historical background) of the traffic lights, the theoretical background and the past works done in this area. This is supported by necessary references.

Chapter Three

This consists of the design implementation and the complete labelled circuit diagram of the work (Construction of Traffic light with rechargeable battery).

Chapter Four

This consists of the testing of the traffic control unit, battery charging unit, also the result and discussion of each of the unit.

Chapter Five

It covers the summary of the work, conclusion, limitations and recommendation of the whole project.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND

The modern traffic light came into being due to the advancement in the first known signal device for regulating traffic light by different inventors across the globe.

The world's first traffic light came into being before the automobile was in use, and traffic consisted only of pedestrians, buggies, and wagons. It was installed outside the British House of Parliament in London in 1868 [1,2,3,4], it was a revolving lantern with red and green signals. Red meant "stop" (this stops vehicles and horses but allows passage of persons on foot) and green meant "caution" (for allowing vehicles and horses pass over the crossing with care and due regards to safety of foot passengers) [5]. The lantern, illuminated by gas, was turned by means of a lever at its base so that the appropriate light faced traffic. On January 2, 1869, this crude traffic light exploded, injuring the policeman operating it [1,2,3].

Earnest Sirrine of Chicago, Illinois patented perhaps the first automatic street traffic system in 1910. Sirrine's system used the non illuminated words "stop" and "proceed" [5]. In 1912, a contender for "Invention of the first electric traffic light" [4], Lester wire of salt lake city, a police officer invented the first electric traffic light (unpatented)[5,7]. This was a handmade model of a wooden box mounted on a pole with a slanted roof so that rain and now would fall off. It was manually operated by a police man. [8]

The modern electric traffic light is an American invention [1]. In August 1914, the American traffic signal company installed Red and Green traffic lights at each corner of intersections of a street in Cleveland, Ohio [1,4]. The installation was patterned after the design of James Hoge [6,9] which has two colours; Red and Green for STOP and GO respectively plus a bell to warn the drivers of colour change [4].

William Ghiglieri of San Francisco, California patented (1,224,632) perhaps the first automatic traffic signal using colored lights (red and green) in 1917. Ghiglieri's traffic signal had the option of being either manual or automatic [5].

The world's first three colours (Green-go, Red-Stop and Amber-clear the intersection), four - direction traffic light was installed in Michigan in October, 1920 [4]. It was design by a police officer named William L. Potts using about thirty – seven (37) dollars worth of wires and electrical control but were also manually operated [3]. This signal remained in operation till 1924 and became a part of the world's synchronized signal system [4].

Garette Morgan in 1922, in his own research came up with the traffic light using three colours, but Morgan's signal had no yellow light; instead a third positioned light that displayed the word 'STOP' in all directions was invoked before allowing traffic to proceed in any one direction, thereby providing extra time for the intersection to clear.

The development on the above traffic light control system led to the invention of automatic controlled interconnected traffic light in March 1922, in Texas, and the first automated traffic light was in the 1950s and in Canada [1].

In the mid 1990s, cost effective traffic light lamps using Light Emitting Diodes (LED) were developed. Prior to this time, traffic lights were designed using incandescent of halogen light bulbs. The following advantages were noticed:[2]

i. LEDs have much greater efficiency,

ii. They have longer life span between replacements, measured in years rather than months,

iii. The ability to display multiple colours and patterns from same lamp'

iv. They switch faster

The traffic light is now embraced all over the world based on the three colour codes; the green, red, and amber (yellow) to resolve traffic jams and to travel more safely and efficiently without wasting human power.

2.2 AUTOMATIC TRAFFIC CONTROLLER FOR ZEBRA CROSSING WITH RECHARGEBLE BATTERY

This project is designed for a single zebra crossing road. It could be at the main gate of both Bosso and Gidankwano campus knowing the road is an express way and also in front of a busy university, this could also be placed in less developed areas and roads that are not close to 'T' junctions that have pedestrians crossing at every time. The alternative source of power is included since power supply is not reliable in this country.

2.3 THEORETICAL BACKGROUND

There are different kinds of traffic regulating systems that can be classified based on their mode of operation and how they are regulated (mode of control)

2.3.1 TRAFFIC SIGNAL CONTROL SYSTEM BASED ON MODE OF OPERATION

The mode of operation is based on the following [10]:

i. **Pre – timed traffic controlled system:** This control system employ a timer, each phase of the signal (i.e stop, ready to go and go) lasts for a specific interval before the next phase occurs. This pattern is repeated continuously. The disadvantage of this is that there might be green light for an empty road while a busy route is stopped. This mode of operation is the one this project work is employing.

ii. **Vehicle actuated traffic control system:** This is very sophisticated than the previous one. It uses an electronic sensor (e.g. a metal detector) buried in the pavement to detect the presence of traffic (vehicles in most cases) waiting at the light, thus avoid giving the green light to an empty road. It has a timer as back up incase the sensor fails to detect vehicles such as motorcycles, bicycles (with low metal content) and human causing them to wait forever.

2.3.2 TRAFFIC SIGNAL CONTROL SYSTEM BASED ON MODE OF CONTROL

Although, there are solar controlled traffic light but most are electrically controlled. The electrically controlled ones are grouped into two:

i. **Sequential Logic Traffic Controlled System:** These are traffic control systems that are designed using combinational logic (e.g. gates, flip-flops, counters, decoders, integrated circuits and so on) as their building block [3] which is a system this project is adopting.

ii. **Programmed Traffic Controlled System:** They are microcontroller based designs but also have a sequential drive circuit which has programs in the Electrically

Programmable Read Only Memory (EPROM). This type of design can be such that the different phases have different timings depending on the programmer.

2.4 TRAFFIC SIGNAL PLACEMENT

The placement of traffic light signal (i.e positioning) vary from place to place, the most important thing is for the traffic signal to be placed such that it will be visible to the drivers and other road users [11]. It may be mounted on poles horizontally or vertically depending on the location.

In Nigeria, the signals are mounted vertically on the poles in the following order from top: Red, Amber (yellow) and green. This is the method this design is adopting.

2.5 TRAFFIC LIGHT AND THE LAW

In all jurisdiction, it is a legal offence for road uses to disregard the commands of the traffic light signal. The enforcement of this traffic law varies from one jurisdiction to the other [12]. It is extremely strict in some places while no serious punishment is attached to such offence in other places.

2.6 ADVANTAGES OF TRAFFIC LIGHT

1. They reduce the frequency and severity of accidents along the roads

2. They are employed to interrupt heavy traffic at intervals to permit pedestrians to cross

3. They provide for orderly movement of traffic

2.7 DISADVANTAGES OF TRAFIC LIGHT

The following disadvantages occur due to ill – design, ineffective placement of the traffic light, improper operation, and poor maintenance:

i. Significant increase in the frequency of collision

ii. They could result in excessive delay

iii. People tend to follow the less adequate routes to avoid the use of traffic signals

CHAPTER THREE

DESIGN IMPLEMENTATION

The project is designed to be powered by 12 volts regulated power supply and a rechargeable battery as a backup power when there is power failure.

The design is segmented into five stages:

a. The power supply

b. The charging section

c. Astable multiviberator

d. Bistable multiviberator

e. NOR gate

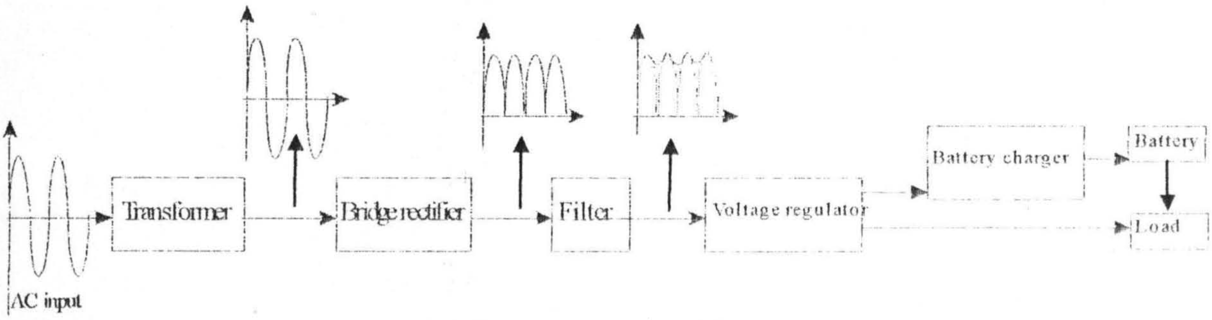


Fig 3.1: Power supply block Diagram

3.1 THE POWER SUPPLY

12 volts dc is required for this project and was achieved by stepping down 240 V a.c mains supply. The block diagram in figure 3.1 show the stages involved in order to achieve the regulated 12 V d. c. supply to drive this circuit.

3.1.1 TRANSFORMER

A step down transformer with the rating 230 / 13 V was employed in the transformation of the mains supply

3.1.2 BRIDGE RECTIFIER

The common bridge rectifier comprises of four rectifying diode is used to convert the transformed ac to dc pulsating voltage.

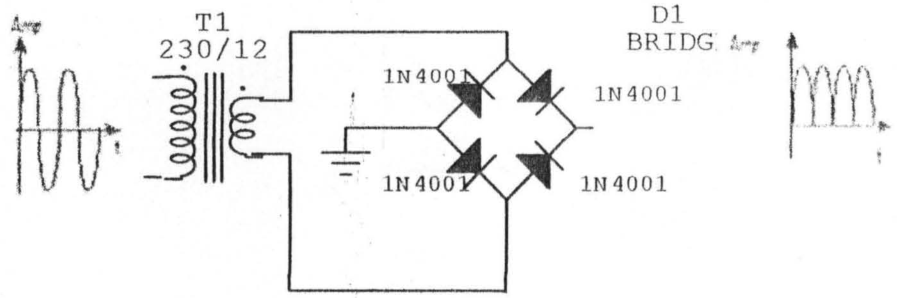


Figure 3.2: Bridge rectifier

As depicted in figure 3.2 above, during the positive half cycle of the a.c signal, D_2 and D_4 are conducting in series with the input while D_1 and D_3 are off. When he input signal reverses its polarity, D_1 and D_3 switch into conduction thereby switching off D_2 and D_4. The resulting d.c is a pulsating d.c which is clearly shown in fig 3.1.1.

Since the peak inverse voltage (PIV) of the diodes used should be well above the peak secondary voltage of the transformer to avoid the diodes breaking down with V_{sec} = 15 r.m.s

$$Peak\ \mathrm{Vsec} = \sqrt{2}\ x\ 15 = 21.2V \quad (1)$$

Hence, 1N4001 diode with PIV of 50V at 1.0Amp was chosen.

The peak d.c output of the rectifier is calculated as:

$V_{dc} = 12\sqrt{2} - 1.4 = 15.6V$ (2)

With V_{drop} on diode = 0.7V (Silicon Diode)

3.1.3 FILTERING

Pulsating d.c obtained so far still contains some ripples which are eliminated with the aid of a filter (electrolytic capacitor). This is made possible by the characteristic of electrolytic capacitor that when it's connected in parallel to a required signal, it decouples the signal (i.e. eliminate all a.c components). The higher the value of the capacitor, the higher the filtering capability.

For this project;

Let the maximum allowable ripple be 15% of the r.m.s value of the secondary of the transformer.

$dv = \frac{15}{100} \times 12 = 1.8V$ (3)

With a load current of 1A and operating frequency of 50Hz, the ripple is minimum at twice the operating frequency

Therefore,

$\frac{Idv}{2f} = \frac{1A \times 1.8V}{2 \times 50Hz}$ (4)

$= 0.018f = 18000\ \mu f$

A preferred value of 20000μf was selected.

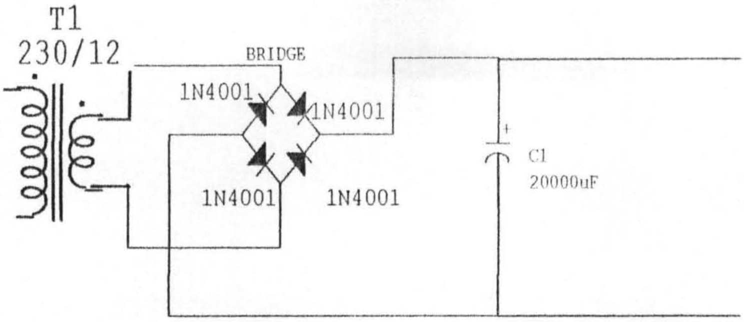


Figure 3.3: Complete Power circuit

3.2 BATTERY CHARGING SECTION

The building of the charging unit is LM317T.

3.2.1 VOLTAGE REGULATOR

An integrated circuit LM317T, a three terminal adjustable regulator was used to effect charging of the integral secondary cell. It is available in several packages such as T0220, T03 e.t.c. the figure below shows a typical one of them.

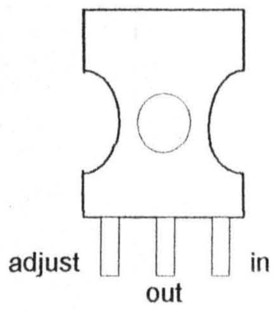


Figure 3.4: Voltage regulator

i. Pin 1 (control / adjusting pin): controls the charging voltage
ii. Pin 2 (output pin): it's the regulated output; it is connected to the positive terminal of the battery.

iii. Pin 3 (input pin): a rectified d.c voltage supply is connected to this pin

The device can provide regulated voltages V minimum of 1.2V and maximum of 37V with a nominal output current of 1.5A at package dissipation less than 20Watts [11]. It has no ground terminal; instead, it adjusts V_{out} to maintain a constant 1.25V (band group) from the output terminal to the adjustable terminal LM317T is wired as shown in the figure below. The rectified 19.2V is still bigger than the desired voltage for operating the circuit, hence, the need for a voltage regulator.

In this case, LM7812 is used to achieve 12V pure d.c to power the circuit.

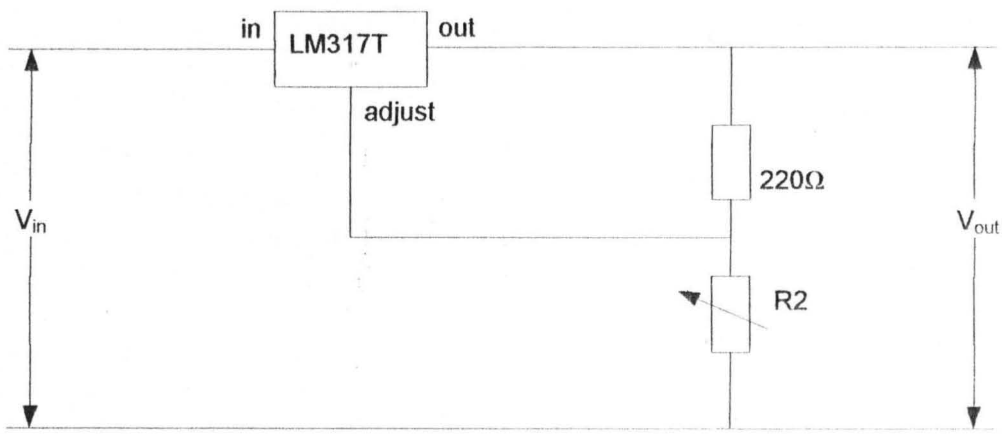


Figure 3.5: LM317T Voltage Regulator

The output voltage is given by the relation [12]:

$$V_{out} = \left[1.25\left(1 + {}^{R_2}/_{R_1}\right)\right] V \quad (5)$$

Where

1.25 = internal reference voltage

R_1 = 220Ω (from the manufacturer's recommended value)

R_2 = voltage setting resistance

Note that R_2 is normally adjustable only over a narrow range

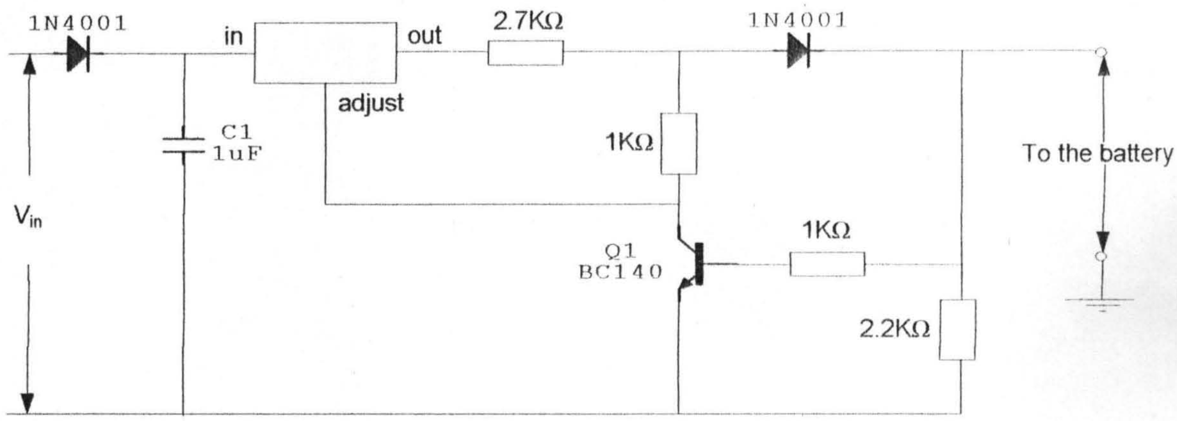


Figure 3.6:Battery charging unit

Diode D_2 prevents back discharge of the battery when the input charging voltage is removed. R_3 and R_4 are biasing elements for Q_1. Q_1 provides a shutdown of the LM317T at maximum battery terminal voltage. When the battery is fully charged, the transistor Q_1 has its terminals changed (the emitter becomes positive with respect to the collector and the voltage flows within the LM317. When the voltage of the battery drops below 6.3V, the emitter becomes negative and the battery continues charging.

Q_1 switches on when $V_{bc} > 0.7V$ putting collector to 0V.

3.2.2 THE BATTERY

A Battery is a device ideally capable of providing a constant voltage independent of current flowing through it. 12V lead acid battery was used in this project work.

The current symbol of a battery is shown in the figure below.

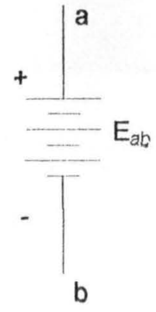


Figure 3.7: Circuit symbol of a battery

According to the battery manufacturer, a battery should be charging with only 10% of the current in ampere of the Ah (Ampere Hour) value.

For example, battery of 5Ah value should be charged with 0.5A current. This rule is adhered to in the charger circuit.

As the battery gets charged, the current flowing through R_1 increases and this increases the current and voltage from LM317. When the battery becomes fully charged, charger reduces the charging current to the battery and the battery is charged in the trickle charging mode.

The input voltage at LM317 is expected to be at least 3 Volts higher than the output voltage from the LM317. LM317 requires a minimum of 1.2V for its operation.

3.3 ASTABLE MULTIVIBERATOR

The building block of this astable multiviberator is 4047B IC. It has stable states; hence, two output state result: Q (ON state) and $\bar{Q}$ (OFF state). The rate at which the output changes state depends on the values of C_1 and R_1. Varying the value of R_1 either increases or decreases the frequency of oscillation. Increasing the value of R_1 decreases frequency of oscillation and vice versa

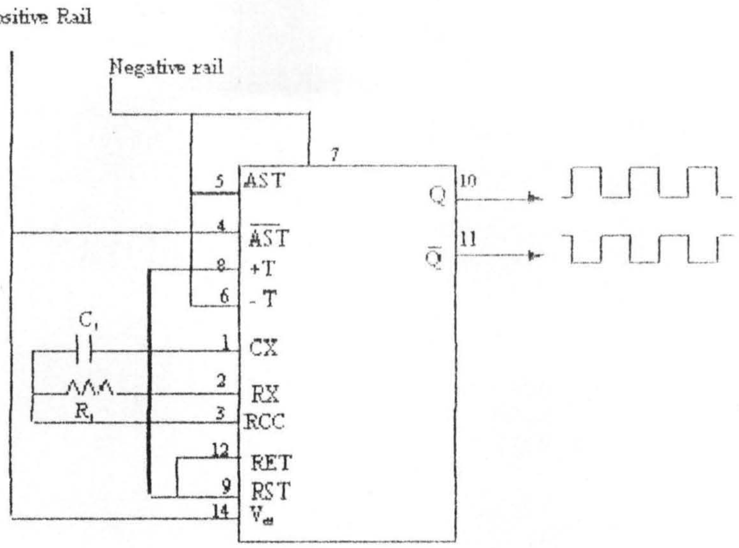


Figure 3.8: Connection diagram for astable multivibrator

In the ON – state, it forms a clocking input for the bistable multivibrator; while in the OFF – state, it clocks both the NOR gate as well as drives the yellow LED (lights)

T_{on} = 1.1 R_1 C_1

= $1.1 \times 10 \times 10^6 \times 0.1 \times 10^{-6}$ = 1.1 secs.

3.4 BISTABLE MULTIVIBERATOR

The major constituent of this is 4013B IC. It is also known as D type bistable; a subsystem with two stable states.

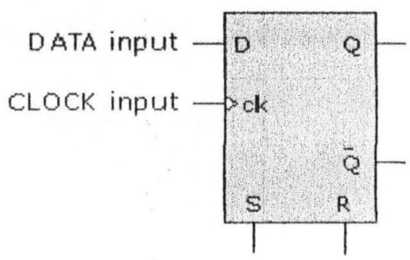


Figure 3.9: Input and output connections of a single D type bistable multivibrator

The 4013 IC consists of two D flip-flops that can work independently

It has four inputs defined below:

i. Data input: it is connected either to negative rail (i.e. low voltage), logic 0 or to a high voltage, logic 1

ii. Clock Input: it is the set output of the astable multiviberator. This is always edge triggered, i.e. it responds to sudden changes in voltage but not to slow changes or to steady logic levels.

iii. Set Input: it is normally held LOW. When pulsed HIGH, the outputs are forced simultaneously to the SET state, Q = 1 and $\bar{Q}$ = 0

iv. Reset Input: the reset is normally held low so that a high clock pulse forces the outputs of the bistable immediately to the reset state; Q = 0 and $\bar{Q}$ = 1

3.4.1 BASIC OPERATION

The Reset output $\bar{Q}$ is connected back to the D input as shown below:

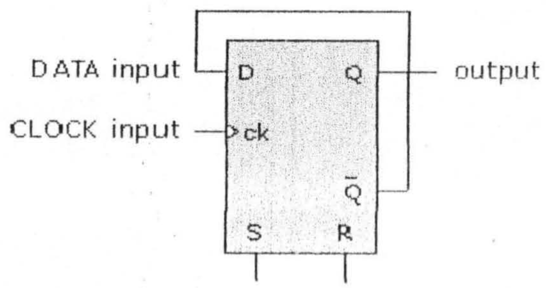
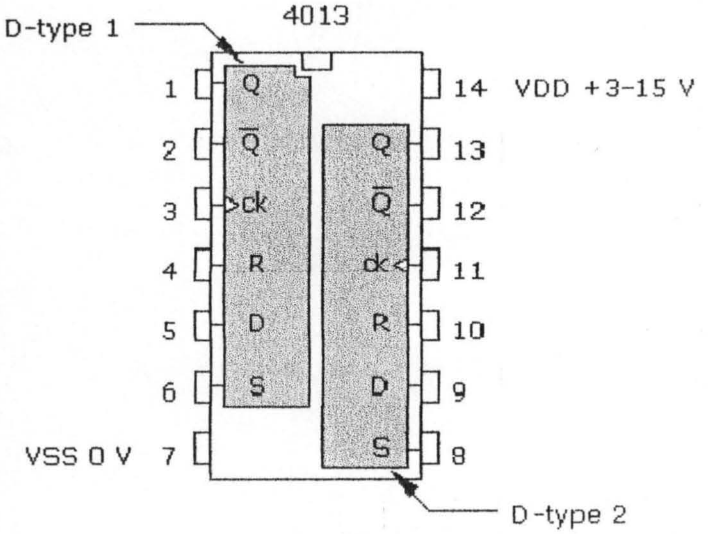


Figure 3.10: The basic operations of D flip flop.

The D input must be connected to either to LOW or to HIGH and must not be left open circuited. The Set and Reset inputs are connected to 0V.

A transistor switch 2N3904 is connected to the output of the bistable to avoid loading the output with the $\bar{Q}$ linked to D – input, the D – type bistable changes state every time it receives a clock pulse.

The Set (Q) output of the bistable multiviberator forms the input parameter for the NOR gate as well as driver for the RED LED (light).



D – Data input

Ck – trigger input

R – Reset

S – Set

Figure 3.11: The configuration of the Bistable multiviberator.

3.5 NOR GATE

The major purpose of NOR gate in this project is to on the GREEN LED (light) depending on the states of its inputs. There are two inputs that drive it, one from the bistable and the other from the astable multivibrator.

The output of the NOR gate is not sufficient to ON the GREEN LED; hence, transistor 2N3094 is employed to boost the output signal.

The NOR gate internal circuitry consists of four (4) NAND gates cascaded from the inputs to the output

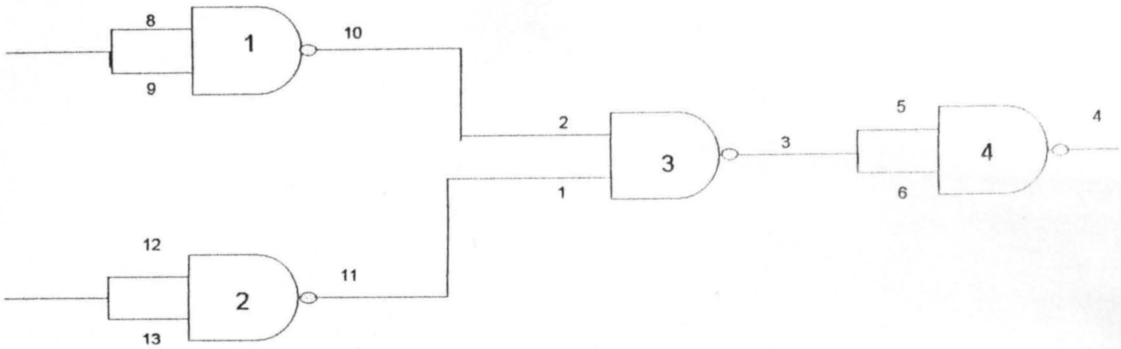


Figure 3.12: Internal circuitry of the NOR gate

Table 3.1: Truth table for the NOR gate

Input 1 ($\bar{Q}$ of Astable)	Input 2 (Bistable output)	Output at Gate 1	Output at Gate 2	Output at Gate 3	Final Output (Gate 4)
0	0	1	1	0	1
1	0	1	0	1	0
0	1	0	1	1	0
1	1	0	0	1	0

From Table 3.1 above, it is clear that when the output of both bistable and astable are low, the output of the NOR gate goes high. By interpretation, when the both RED and YELLOW LEDs are off, then the GREEN LED comes on indicating that vehicle can pass.

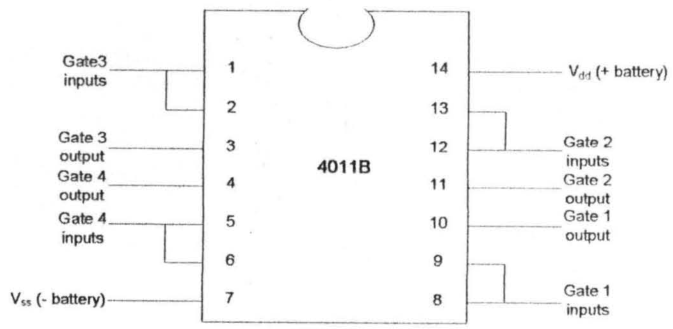


Figure 3.13: The configuration of NOR gate

3.6 LIGHT INDICATOR

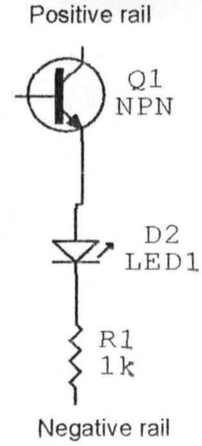


Figure 3.14: Light indicator circuit

The transistor 2N3904 is operating in the common collector mode. The output is obtained on the emitter. A 330Ω resistor is connected in series with the LED to limit the voltage drop on the LED; this prolongs the life span of the LED.

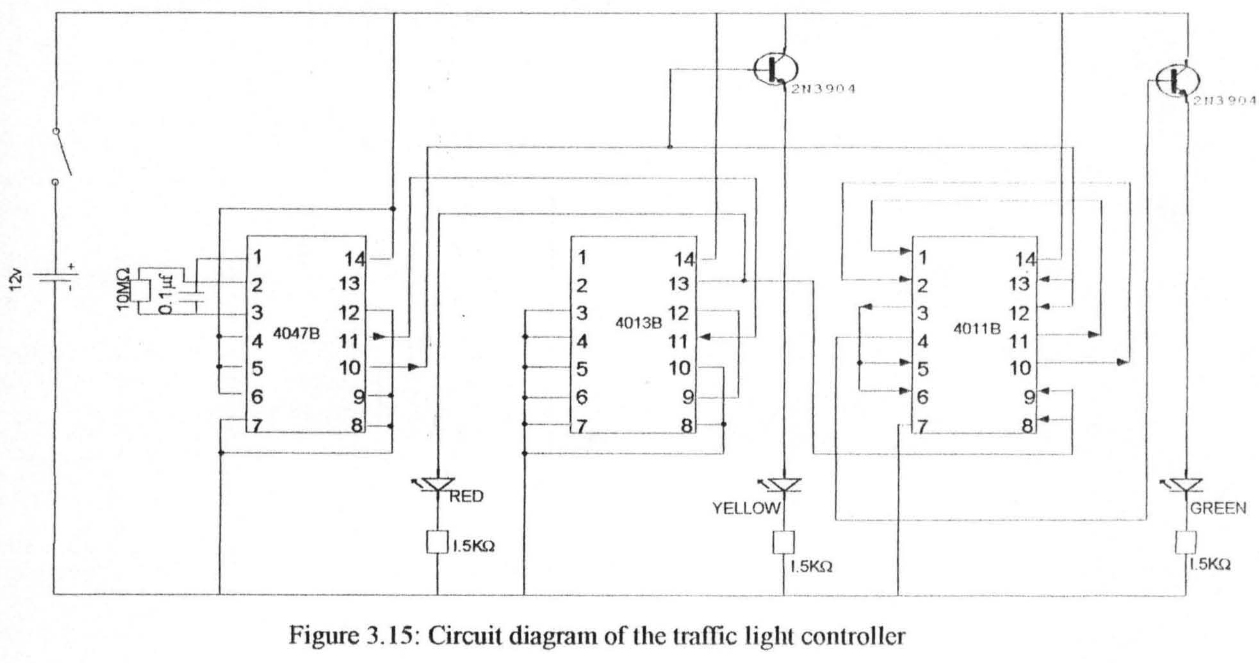


Figure 3.15: Circuit diagram of the traffic light controller

CHAPTER FOUR

CONSTRUCTION, TESTING AND DISCUSSION OF RESULT

4.1 CONSTRUCTION PROCEDURE

Construction simply means the practical aspect, which involves the assembly of the components and testing. The project work consists of both the electronics and the casing parts

The electronics part consists of the power supply unit, battery charging unit, astable multiviberator, bistable multivibrator and the NOR gate units.

All these were constructed one after the other as designed and analyzed in the design aspect of this project (Chapter three)

After all the calculations and design completed, the components with the preferred values were brought, then the components were arranged on the bread board starting with the power supply unit or modulus. Then up to the battery charging stage and to the final stage on the circuit diagram.

The function of the breadboard is for prototyping purposes, as it allows components to be added and removed with ease without soldering.

Initially, the circuit was implemented on a breadboard as earlier mentioned. The problem encountered when using breadboard was used is that, connection on the board is temporal; noise from the board was noticeable by just powering the circuit.

Obtaining a uniform result with the breadboard circuit prove to be very difficult so the next best solution before developing a full PCB was to use a vero board.

A vero board requires soldering and has copper interconnection tracks making it less prone to noise. With the vero board, the size of the current was needed significantly and the entire unit was arranged in a casing. The majority of the noise was eliminated by using the vero board.

4.2 MATERIALS USED

4.2.1 MATERIAL USED FOR THE POWER SECTION AND BATTERY CHARGING UNIT

i. Transformer (230/13V)

ii. Bridge rectifier containing four Diodes (1N4001)

iii. Capacitor (22000μf)

iv. LM317

v. Resistors

vi. Capacitors

4.2.2 MATERIALS USED FOR TRAFFIC LIGHT CONTROL CIRCUIT

i. Astable Multiviberator (IC – 4047B)

ii. Bistable Multiviberator (IC – 4013B)

iii. NOR gate (IC – 4011B)

iv. Two npn transistors (2N3904)

v. Disc ceramic capacitor (0.1μf)

vi. Three LEDs (Red, Yellow and Green)

vii. Pvc covered tinned copper wire

viii. 10MΩ resistor (Brown, Black, Blue)

ix. 330Ω resistor (Orange, Orange, Red)

x. Vero board

4.2 PREVENTIVE MEASURES TAKEN

1. Polarity of the components (where applicable) were considered before connecting them to prevent damage and ensure proper sequence of operation.

2. All the components were independently tested before use, to ensure that they are all in good condition.

3. Water and moisture were prevented from coming in contact with the circuit constructed.

4. Badly soldered joints were avoided by applying a little soldering lead into the joints.

5. Necessary portions of the electronic board (vero board) were isolated to avoid continuity which may result in short circuit

4.3 TESTING

The whole circuit was traced and tested to ensure that there is no short or open circuit when all soldering has been completed.

4.4 PROJECT CASING

After the construction was completed and tested, a container was used to protect prototype project on the vero board and make it safe for use.

The casing unit of the project constructed is made of wood of rectangular in shape having dimensions of 15cm x 17cm x 10cm.

4.5 DISCUSSION OF RESULT

The project consists of three LEDs: Red, Yellow and Green.

In the traffic control, Red light signifies 'STOP', yellow means 'GET READY' and green means 'GO'.

The waveform of the traffic light control is below.

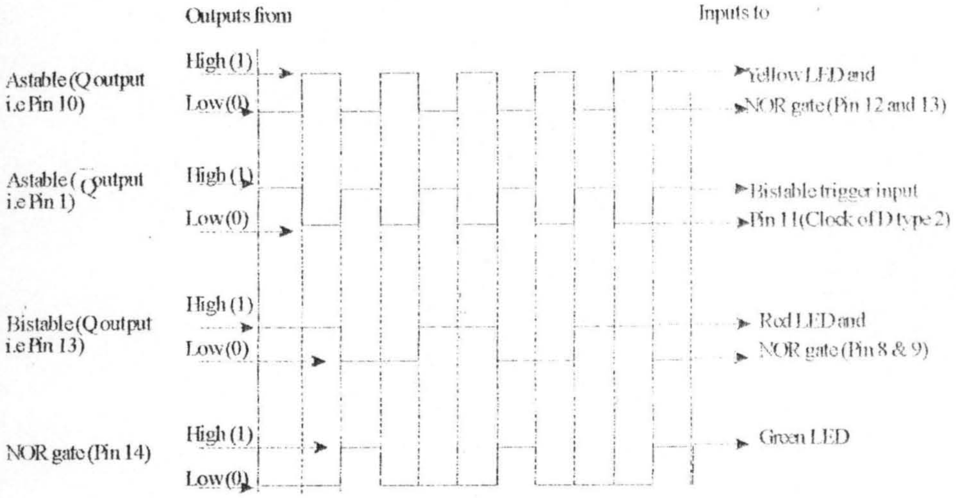


Figure 4.1: Waveform of the traffic light control.

Table 4.1: Traffic control activities

Stage	RED LED (R)	YELLOW LED (Y)	GREEN LED (G)
1st	1	0	0
2nd	1	1	0
3rd	0	0	1
4th	0	1	0
5th	1	0	0

From figure 4 above;

The first line shows the square pulses from one of the outputs of the astable (Pin 10). This drives the yellow light as well as one input of the NOR gate (Pin 12 and 13).

The second line shows the square pulses from the second output the astable (Pin 11). This forms a clock pulse for the bistable and the positive edge of each one triggers the bistable, causing its output to switch from LOW to HIGH or from HIGH to LOW. For example, AB on the first pulse makes the bistable output go 'high' and remain 'high' until CD on the second pulse, arrives and switches from HIGH to LOW.

The third line shows the output from the bistable (Pin 13): the pulses occur at half the rate of those arriving from the astable but each one is HIGH or LOW for longer. The output of the bistable is fed to RED LED, making it light up when the output is HIGH. It is also connected to the second input of the NOR gate (Pin 8 and 9).

The NOR gate opens and gives HIGH output only when both inputs (that from the astable and from the bistable) are LOW. If we look at the pulses of the first and third lines in diagram (the coloured ones), you can see why the fourth lines gives the output of the NOR gate (at Pin 14) – it's HIGH only when the output from the bistable is LOW.

The fifth line in the diagram shows the colours that are on each stage. It is tabled in Table 4.1 Above.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

This project (Design and Construction of Traffic Light for zebra crossing with a Rechargeable Battery) is a way of controlling traffic congestions with three colours (Red – STOP, Yellow – Ready to STOP or GO as the case may be and Green - GO).

It consists of astable multiviberator, bistable multiviberator and a NOR gate and three Light Emitting Diodes (Red, Yellow and Green). The design is simple and cost effective.

5.2 CONCLUSIONS

The objective of this project (Automatic traffic controller with rechargeable battery) has been achieved (with negligible error) to a very satisfactory extent. The design was tested with three LEDs (Red, Yellow and Green) and it worked according to the specified constraints.

5.3 LIMITATIONS

Practical are not done the way they should be done, this makes the final project design and construction very difficult as it is almost like the first time one is handling electronics. Since this project is designed for a single road, it can't work for a conventional traffic route. Another major limitation is the fact that once there is no Power supply for a long time, the battery cannot be charged and the system will not function.

5.4 RECOMMENDATION

Based on the above construction, for better and more reliable alternative source of power supply, I recommend solar energy.

REFERENCES

[1] History of Traffic light

http://en.wikipedia.org/wiki/traffic

[2] Technology Optics and lighting http://en.wikipedia.org/wiki/traffic

[3] William L. Potts, Fascinating facts about the invention of the Traffic Light

http://www.ideafinder.com/history/inventions/trafficlight.html

[4] http://www.33.brinkster.com/iiiii/trfclt/

[5] The History of Roads and Asphalt http://inventors.about.com/library/inventors/bglas_mask.htm

[6] Edward A. Mueller "Aspect of the History of Traffic Signals", IEEE Transaction on Vehicular Technology Vol. VT -19, no.1 pp 6 -17

[7] www.ai/antenergy.com/docs/groups/public/documents/pub/po1332jhcjp

[8] http://home.cogeco.ca/rpaisely/circuitindex.html

[9] Gordon Sessions, Traffic devices. Historical aspects thereof (Washington DC: Institute of traffic engineers; C.1971)

[10] Unpublished work - A project titled Design and Construction of an 8 – way Traffic Light Control System by Omokanye Shade Khadijat (2001/12088EE) November

[11] Emergency Vehicle Traffic signal pre –emption system, United state Patent and Trademark office, Retrieved on October 7, 2005

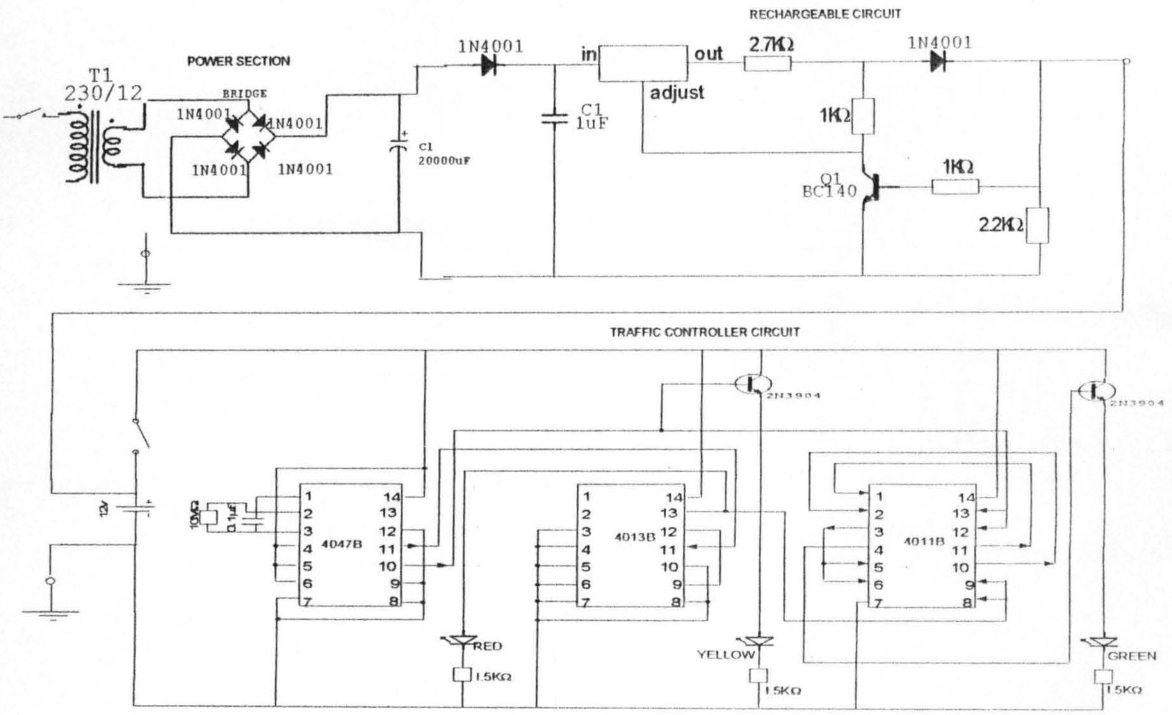
[12] 2007NSW RTA Road Users Handbook

[13] http://www.freepatentsonline.com last updated 27th Sept, 2008, date visited 28th Sept,

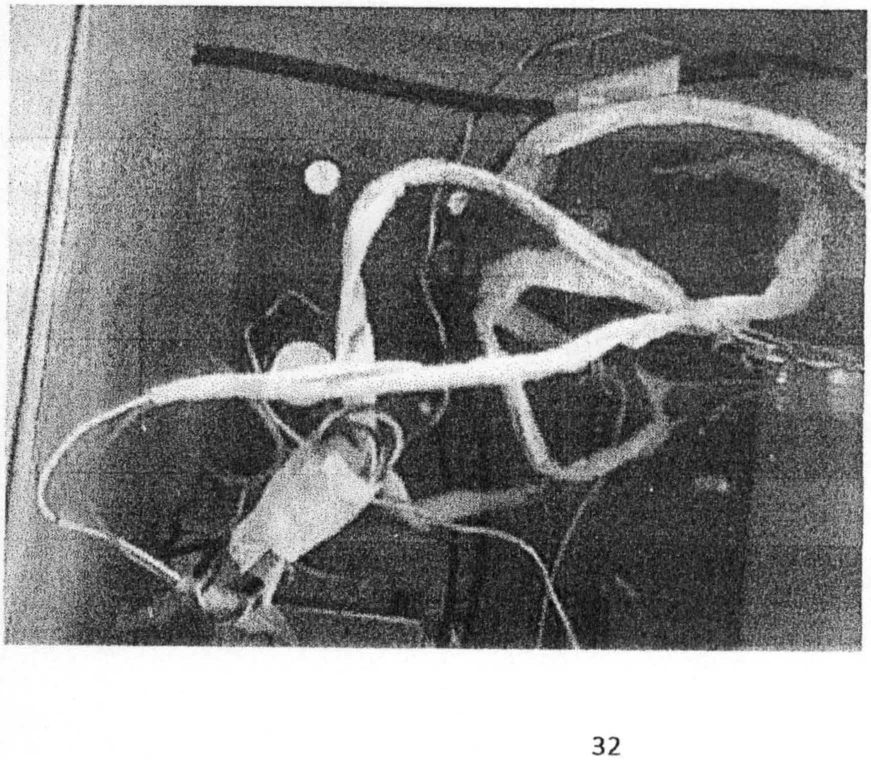
[14] 2008Paul Horowitz and Winfreld Hill, the art of electronics, 2nd Edition, Cambridge University Press, pp 344 – 356

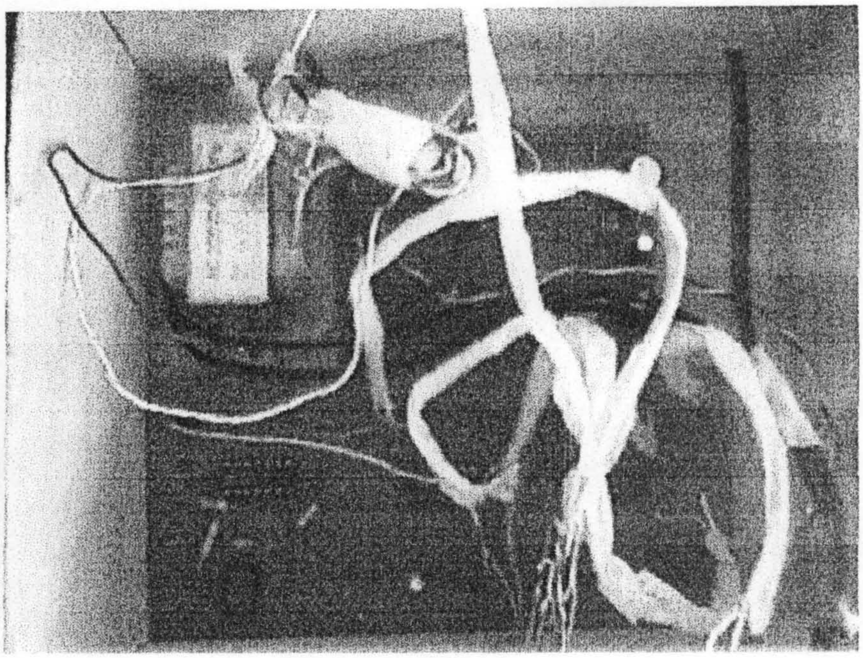
APPENDIX

APPENDIX 1: Complete Circuit Diagram



APPENDIX 2: The internal circuitry





APPENDIX 3: The picture of the cased Project