DESIGN AND CONSTRUCTION OF AN ELECTRONIC CAR SEATBELT REMINDER AND DOOR SAFETY DEVICE

BY

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**A DISSERTATION PRESENTED TO THE DEPARTMENT OF ELECTRICAL/COMPUTER ENGINEERING
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NOVEMBER 2005

ATTESTATION/DECLARATION

I do hereby certify that this thesis presented in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.Eng) degree has not been presented either wholly or partially for any other degree elsewhere. And it has been fully carried out by me under the supervision of Mr. U.A.USMAN.

Any information obtained from published and unpublished work of other has been acknowledged.

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AKNOWLEDGEMENT

My gratitude goes first and foremost to Almighty ALLAH (S.W.T) for the mercy and his guidance.

My sincere gratitude goes to my beloved parent Alhaji Buhari Gidado Abukur and Hajia Fatima Buhari (only ALLAH can reward them), to my brothers, friend and colleagues.

And to all those people that help in one-way or the other, during the course of my studies, may ALLAH (S.W.T) reward you all.

My sincere gratitude also goes to my project supervisor Mr. U.A.USMAN for his tireless assistance during the course of the project.

DEDICATION

This project is respectfully dedicated to the two most wonderful women in my life

DANNA & KADI (R.I.P)

May ALLAH reward them with AL-JANNATIL- FIRDAUS Amen.

ABSTRACT

This project report deals with the design, construction and testing of an electronic car seatbelt remainder and door safety device. It was develop with the aimed of taking care of some negligence by car drivers and car passenger, who do not wear their seatbelts while driving.

The device works with the car ignition system, which compulsorily makes the car driver to wear his seatbelt before starting the car, and also while driving the car.

The second part of the project is the car door safety device equipped with time delay, which enable car passenger to open and close the car doors without the car engine stopping.

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CHAPTER ONE

1.1. INTRODUCTION

One of the topmost priorities in the design of Automobiles has always been safety. Safeties considerations have come all the way with the early manufacture of an automobile. These considerations have lead to innovation like seatbelts, airbag, car brake, car door indicator and a lot of other devices that helps in protecting vehicle occupants

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Early safety research focused on increasing the reliability of brakes and reducing the flammability of fuel systems. For example, modern engine compartments are open at the bottom so that fuel vapors, which are heavier than air, drain to the open air. Brakes are hydraulic so that failures are slow leaks, rather than abrupt cable breaks. Systematic research on crash safety started in 1958 at Ford Motor Company. Since then, most research has focused on absorbing external crash energy with crushable panels and reducing the motion of human bodies in the passenger compartment.Part of the obstacles encoutered in the use of this safety devices is the non- use of these safety devices.usually due to negligence and sometimes forgetfullness.

Cars have two basic safety problems: They have human drivers who make mistakes, and the wheels lose traction near a half gravity of deceleration.An automated control has been seriously proposed and successfully prototyped. Shoulder-belted passengers could tolerate an emergency stop if high-speed roads incorporated a steel rail for emergency braking. Both safety modifications of the roadway are thought to be too expensive by

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1.1. INTRODUCTION

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Despite technological advances, there is still significant loss of life from car accidents: About 40,000 people die every year in the US, with similar trends in Europe. This figure increases annually in step with rising population and increasing travel, but the rate per capita and per mile travelled decreases steadily. The death toll is expected to nearly double worldwide by 2020. A much higher number of accidents result in injury or permanent disability.

Here in Nigeria with authorities like FRSC (Federal road safety corpretion) who makes it mandetery for every car occupant sitting in the front seat of a car, to wear their seat belt.The lost of life from car accident have constantly being reduce.

Safety devices that will protect occupants against injury and death have been a primary focus for the automotive industry and governmental agencies. First, it was important to maintain "passenger-compartment integrity" so that occupants remain in the compartment (thanks to door-latches and safety glass) and impacts are deflected. Within the compartment, energy-absorbing devices are in the forms of padded dashboards and visors, energy-absorbing steering columns, cushioned steering wheels, and hinged steering columns. Other energy absorbers have been built into the chassis and body of the car; many of these are stress risers in the frame that buckle on impact. The final group of devices consists of active and passive restraints for the driver and passengers, of which the safety or seat belt may be the best known.

In automotive design, the seat belt may be the perfect proof that everything old is new again. In 1972, all cars manufactured in the United States were required to have seat belts and reminder systems, but 60% of car occupants admitted to not using lap belts, and less than 3% used shoulder harnesses regularly. Many states have enacted fines if drivers and passengers are not wearing seat belts when stopped. Other efforts have been directed toward inventing passive systems that don't require occupants to act to be buckled up. Ford developed the self-applying seat belt in 1966 with two ends that attached to the rear of the door with the third between the seats. Movement of the door and the passenger in the seat secure the belt

1.2. AIMS AND OBJECTIVES

The aim of this project is to design and construct an electronic car seatbelt remaider device. That will ensure that the vehicle occupants make use of seatbelt provided in the vehicle .And also to ensure firm closure of the car doors while driving the car .This electronic device will act as a passive device, which will ensure that the above condition have been fulfilled before the car engine start.And any attempt to start the car without fulfilling the condition above (driver not wearing seatbelt and the doors are not properly close),the car will not start.

1.3. SCOPE OF THE PROJECT

The project, design and construction of electronic car seatbelt remainder and door safety device.Was aimed at taking care of some minor negligence by vehicle occupant (the compulsary use of seat belt by driver and proper closure of car doors). Which usually result in accident, causing serious damages and at time leading to untimely lost of life

The design was done in such way that the vehicle ignition switch (which switch on the flow of low voltage electric current from the battery to the ignition coil ,which convert the current to high voltage.) , and the safety device designed were arrange in series . So as each of the two above must be at ON STATE before the car engine start.And any attempt by the driver to start the car without the wearing his seat belt and proper closure of the car doors, cuts the flow of low voltage current from the battery or the alternator (which supply thelow voltge while the car engine is running.) to the ignition coil .And therefore makes the car engine not to start.

Other car part of car engine apart from the car ignition system, could be used in the the desing .But due to simplicity and accessability in connection the ignition system was choose

The improper closure of car doors by the vehicle occupant is also considered in the design of this projects.Therefore for a car start all doors must be properly closed.But in the event of dropping a passenger from the vehicle .A time delay was created with the car doors ,so as to allow the openning and closing of the car doors within the created time delay in the safety device.But in the event of doors being open for a longer time than the time delay the car engine automatically stops running .

The Figure 1 below illustrate the work of the safety device in a system block with the car ignition system

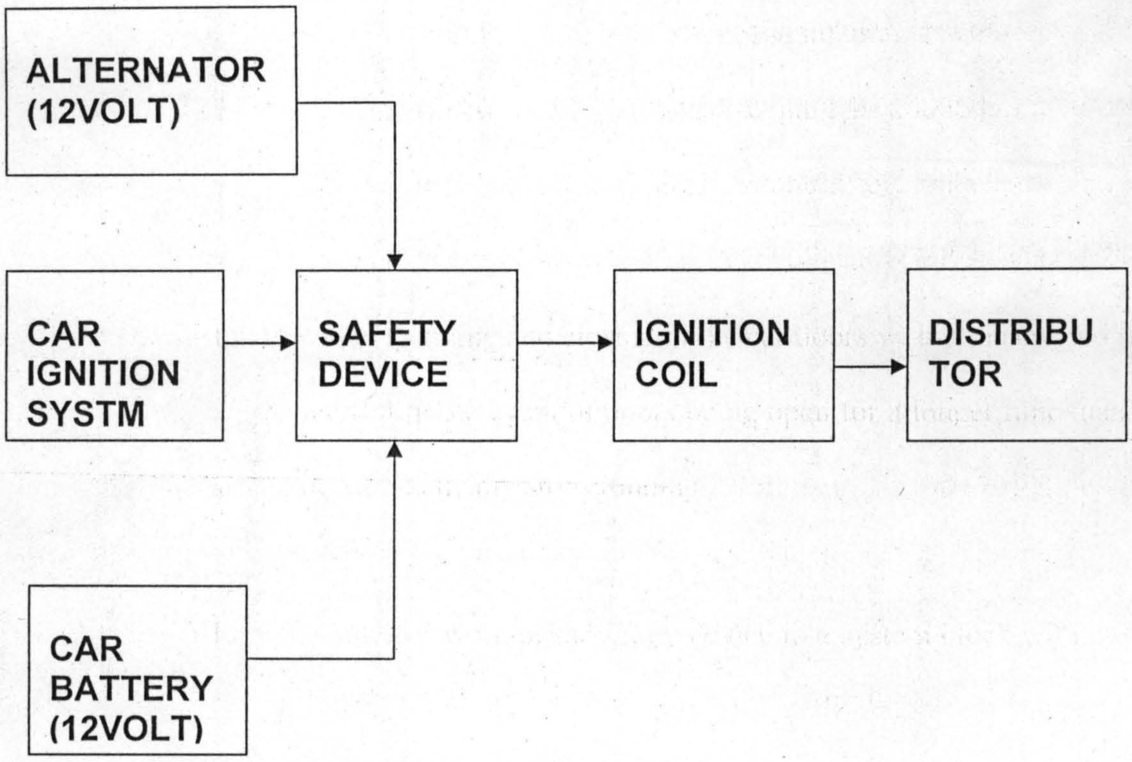


FIG 1: SYSTEM BLOCK DIAGRAM OF CAR IGNITION SYSTEM WITH SAFETY DEVICE

1.4. LIMITATION

In the design of the project several obstacle have been encountered, which limit the ultimate function of the design concept. But nevertheless a substitute was made in every case, so as to achieve the desired goal. Parts of this problem encounter are:

1- Unavailability of some component used in the design, which limits us to design the device with the available component. Though this does not hinder the function of the device. But it affects the performance of the device.
2- Price of the electrical component. Which limit the selection of some expensive and more effective electrical component.
3- Unavailability of car, to fully test the device.

1.5. SOURCES OF THE MATERIAL.

Most of the materials (component) used in the design are the most common and familiar components found in the market. Though substitution was made for those components that are scarce in the market. But nevertheless the aim of the project was achieved.

COMPONENTS USED INCLUDE

1- CD4098 IC (dual monostable)

2- CD4082 IC (four-input AND GATE)

3- 55TIMER

4- 2 X 2N3055 TRANSISTOR

5 - 2 X RELAY

6- 7 X 1N4005 DIODE

7- 12-VOLT BATTERY

8-CAPACITORS (different rating)

9 – RESISTORS (different rating)

10- 5 X 1N4001 DIODE.

1.6.0 OVERVIEW ON HOW CAR IGNITION WORKS

Ignition system creates high voltage sparks at the proper time to the compressed fuel vapour mixture in the engine cylinder. Usually the 12V primary voltage supply by the car battery is stepped- up to about 20,000V in the secondary circuit (secondary coil).

1.6.1 BATTERY

The battery is the source of electrical power needed to operate the ignition system .It does not store electricity when charging, it converts electrical energy into chemical energy, when discharging, it convert chemical energy to electrical energy. Automobile usually use 12V lead acid battery.

1.6.2 IGNITION COIL

The ignition coil step up the 12V voltage supply by the battery to a high voltage required to make the current jump the spark plug gap.The air-fuel mixture between the two electrode present a high resistance to the passege of the current.The voltage (pressure) must be very in order to push current from the centre to the outside electrode. The ignition coil has two circuit ,primary and secondary .The primery circuit is made up a few of a hundred turn of heavier wire,while the secondary circuit is made of large amount of wire ,normally in ratio to the primary side of the ignition.

1.6.3 DISTRIBUTOR

All contact ignition system and most electronic ignition system, have an ignition distributor .It is self contain unit, the wiring start one lead from the battery through the ignition switch to the unit distributor. The distributor is a unit that distributes the high voltage from the ignition coil to the spark plugs.

It also triggers the ignition coil to produce a series of high voltage surge by opening and closing the primary circuit. It is controlled by the action of mechanical switch (the contact point) or an electronic switch (transistor).

1.6.4 SPARKS PLUG

The spark plug is a metal casing in which a porcelain insulator is fastened. An electrode extends through the center of the insulator. A second electrode is attached to one side of the shell. This electrode is bent towards the center electrode. Thread on the metal shell allow into a tapped hole in the cylinder.

CHAPTER TWO: LITERATURE REVIEW

2.1 DEFINITION OF SAFETY DEVICES

Safety device are those devices found in motor vehicle. Which are used to sense or avoid car accident, or to minimize the harmful effect caused by car accident. Particularly with regard to human live. These devices are used to protect the occupant of the vehicle

The designs of car safety device can be dates back to when the production of automobile begins. But at the beginning much emphasis was given to the reliability of car braking system and reducing the flammability of fuel system

2.2 TYPES OF SAFETY DEVICES

An automobile vehicle is filled with safety devices. Most of which are to protect the occupants of the automobile from severe injuries, in the event of car accident. While other safety device are used to give information or to communicate with the other road users.

These safety devices include

1-Car windscreen

2-Car brake system

3-Car set belt (which this projects centers on)

4-Car headlamp and trafficator

5-Car doors alarm/indicator.

6-ABS (automatic brake system)

2.3 SEATBELT AS SAFETY DEVICE

Safety devices to protect occupants against injury and death have been a primary focus for the automotive industry and governmental agencies. First, it was important to maintain "passenger-compartment integrity" so that occupants remain in the compartment and impacts are deflected. Within the compartment, energy-absorbing devices are in the forms of padded dashboards and visors, energy-absorbing steering columns, cushioned steering wheels, and hinged steering columns. . The final group of devices consists of active and passive restraints for the driver and passengers, of which the safety or seat belt may be the best known.

Seatbelt is a safety device used in a car to protect the occupant against injury during accident. Naturally when a car is moving at a speed of say 50KM/hour, the occupants of the car are also moving at the speed of the car. Therefore whenever the moving car hits an object that brings the car to an abrupt stop. The occupants of the vehicle, if not using seatbelts will still be moving at the speed of the car. Which will cause the occupant to hits the object at the speed of the car, causing injuries and other casuality. The role of seatbelt in a vehicle is to, stop the car occupant from moving at the speed of the car, whenever the car hits an object.

Seatbelt plays an important role in the safety of the vehicle occupant. In fact seatbelt is the most important safety device that reduce the occupant of the car from exposure to high risk during accident

2.4 *HISTORY OF CAR SEATBELT AND OTHER SAFETY DEVICE*

In automobile design, seatbelt may be the perfect proof that everything old is new. The motorcar of 1930 vintage used tiller to steer and were fitted with rigid wheels or tires. In the 1903 car a small bump will simply eject the driver out of the car.

As early as 1885, E. J. Claghorn was awarded a patent for a lap belt (A seatbelt anchored at two point, bucked across the occupant hip). Richard Radtke, in 1908, designed a sophisticated lap belt, shoulder harness, and chest harness that was fastened to the frame with springs to allow some comfort and flexing with small motions. Similar belts and harnesses were adapted to early airplanes and have been used consistently in aircraft. As better seats, windshields, tires, and steering improved the comfort and apparent security of the automobile.

Tests in the 1940s showed that severe head injuries could be reduced if lab belts restrained car occupants. During the period from 1956 through 1970, some companies borrowed the reel-type lap belt from a design made for aircraft by Pacific Scientific Products. The reel allowed the strap to be slowly extended but it would lock with sharp movements. Another design had a locking ball that would roll into place only with rapid acceleration or deceleration. Shoulder harnesses were added when experiments using crash test dummies showed that riders often jackknifed into the dashboard. Lap and shoulder belts are made of reinforced fabric that can withstand loads of 6,000 lb (2,700 k). Latches that can be attached and released quickly were designed to encourage passenger use while withstanding the same forces

In 1972, all cars manufactured in the United States were required to have seat belts and reminder systems, but 60% of car occupants admitted to not using lap belts, and less than 3% used shoulder harnesses regularly. Many states have enacted fines if drivers and passengers are not wearing seat belts when stopped. Other efforts have been directed toward inventing passive systems that don't require occupants to act to be buckled up. Ford developed the self-applying seat belt in 1966 with two ends that attached to the rear of the door with the third between the seats. Movement of the door and the passenger in the seat secure the belt.

2.5 *RELATED WORK ON SEATBELT REMINDER*

Engineers have been trying to create a permanent solution to the non-use of car seatbelts by some car users (especially car driver). By either indirectly enforcing the car user to use the seatbelt, or the use of some passive device that makes the driver to use the seatbelt. This part of the project will discus in brief, the related work done on car seatbelt. And other related works that ensure the safety of the car occupant.

2.5.1 AUTOMATIC SEATBELT FOR CAR

In 1967 Chrysler introduce what is called automatics for cars. This system works once a passenger enters into a car the seatbelt automatic buckle the passenger upon closing the car door .the design of the seatbelt is a two end that attached to the rear of the door with the third between the seats. Movement of the door and the passenger in the seat secure the belt. This development works perfectly with car user in securing the seatbelts.

But this device can be disconnected, which make most car user to disconnect this new development. And as a result they expose themselves to severe injuries in the event of an accident.

2.5.2 BREATH ALCOHOL CONTROLLER

The design of the system was made so as to test the individual blood alcohol level by analyzing the breath exhales into the system. The systems will analyze the driver breathe with respect to alcohol.

The main objective of the design is to prevent or to keep away drunk drivers off the road.

2.5.3 SEATBELT REMINDER

This design of the system is to remind the car driver while starting a car that he should put on his seatbelt. This system is aim at bringing awareness or campaign against driver that ignore their seatbelts.

2.6 DOOR SAFETY DEVICE

The design of the door safety device was aimed at bringing awareness to the vehicle occupant, to close their car door properly while driving a car. This safety device increases the safety of the car occupant.

Previous work on this was the popular car door alarm system on the dashboard of a car. This device always indicates whenever one of the car doors is not properly closed. In this project effort has been made to indirectly force car occupant, who in one way or the other ignore this car door indicator, to close their car door properly.

CHAPTER THREE

3.0 DESIGN ANALYSIS

This chapter contains the design consideration of the car electronic safety device. The design of the project was done based on the system block diagram shown in Fig 2 below. The inter-working of the circuit of the individual block diagram gives the desired result. The project as a whole works with the other system found in the automobile, these include the car seatbelts, car door indicators, car alternator and car ignition system.

In the design, it was aimed at achieving a logical circuit that produced a maximum current enough to switch ON/OFF the electromechanical relays (which in turn cut off the current flow from the car battery /car alternator to the car ignition coil)

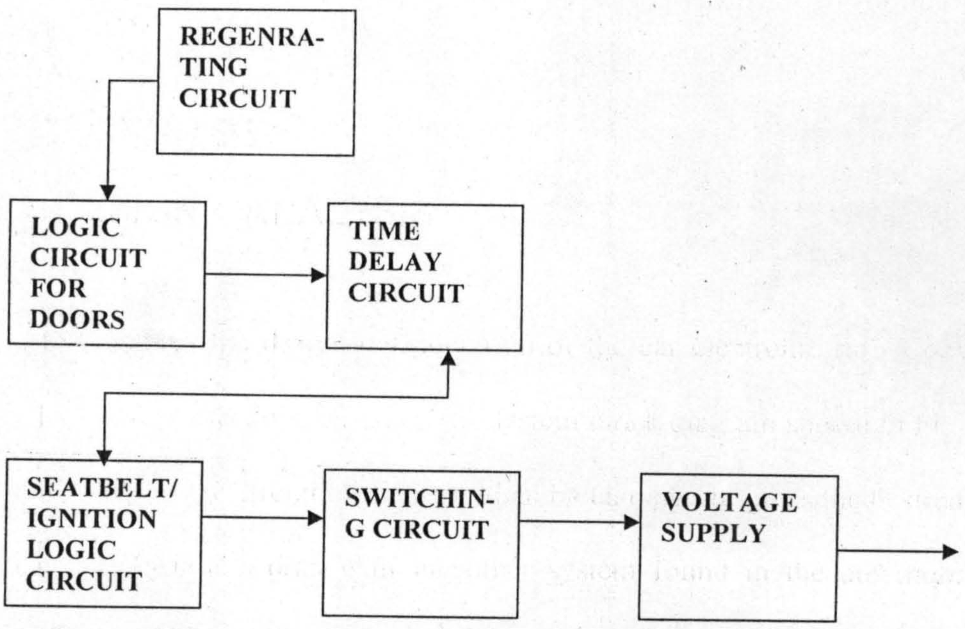


FIGURE 2: CIRCUIT BLOCK DIAGRAM OF THE SAFETY DEVICE

The voltage supply of the system is from the 12-Volt car battery .As in the case of other electrical component in the car.

The following sub-section will discuss each of the functional block diagrams in the system block diagram above.

3.1. DOOR LOGIC CIRCUIT

The design of the door logic circuit was based on the principles of AND GATE (using the integrated circuit CD 4082). An AND GATE has two or more inputs and one output. The output of the AND GATE will only be HIGH or LOW depending on the state of the input. If the inputs are all HIGH then the output will also be HIGH. But if all or any of the inputs are LOW then the output will only be LOW.

For the door logic circuit all the input must be HIGH, except for the input from the regenerating circuit, which has its output as a square waveform from the astable multivibrator (HIGH /LOW). So as to make the output of DOOR LOGIC CIRCUIT also square waveform (pulse), this will be fed into the input of the time delay circuit.

TRUTH TABLE

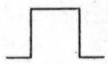
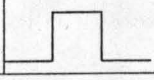
A	B	C	D	ASTABLE	OUTPUT
0	0	0	0	X	0
1	0	0	0	X	0
0	1	0	0	X	0
0	0	1	0	X	0
0	0	0	1	X	0
1	1	1	1		

TABLE 1: TRUTH TABLE FOR DOOR LOGIC CIRCUIT

A, B, C and D represent the switches placed on the car doors. If the car door is close the logic gate input corresponding to the car door would also be HIGH. Astable represent the output of the regenerating circuit and also one of the inputs of the car door logic circuit. The output of the logic circuit will only be HIGH, if the output of the regenerating circuit and all the inputs of the car door are all HIGH. But if astaable output goes back to LOW then the output of the logic circuit will also be LOW.

ASTABLE	LOGIC CIRCUIT OUTPUT
0	0
1	1

TABLE 2: ASTABLE OUTPUT

This only works when all the other inputs are at HIGH. This will make the output of the logic circuit to be in square waveform.

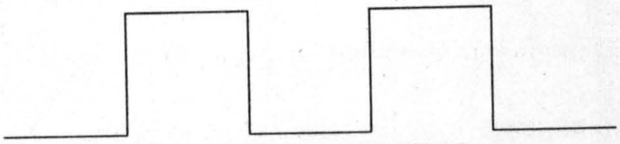


FIG 3: SQUARE WAVEFORM

The aim of the astable input (which will be fully discussed later) is to make the output of the logic circuit 1 to be in square waveform. Which is only suitable for the input of the monostable multivibrator (time delay circuit).

3.2. LOGIC CIRCUIT II

Logic circuit II, which have three inputs and one output. Input 1 is attached to the driver seatbelt switch. Input two is attached to the car ignition system, and also the output of the time delay, which serves as the input3.

A	B	C	OUTPUT
0	0	0	0
`	0	0	0
0	1	0	0
0	0	1	0
1	1	1	1

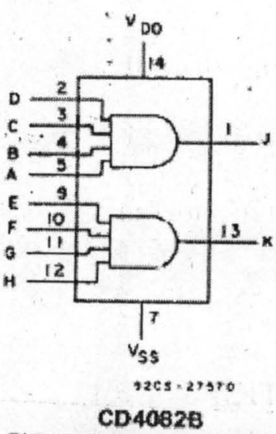
TABLE 3: TRUTH TABLE FOR LOGIC CIRCUIT II

The principle is the same as in the logic circuit 1. Only that the output of the circuit is either HIGH or LOW. If the output is HIGH, it then sends the appropriate current to switch on the transistors, in the switching circuit (to be discuss later).

3.2.1 THE IC (INTEGRATED CIRCUIT) CD4082

The IC (integrated circuit) CD4082 is a dual 4 –input one output and gate

CD4082 provides designer with direct implementation of AND GATE copy of its data sheet is attached.



CD4082B
FUNCTIONAL DIAGRAM

Features:

- **Medium-Speed Operation – t_{PLH}, t_{PHL} = 60 ns (typ.) at V_{DD} = 10 V**
- **100% tested for quiescent current at 20 V**
- **Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C**
- **Noise margin (full package-temperature range) =**
  1 V at V_{DD} = 5 V
  2 V at V_{DD} = 10 V
  2.5 V at V_{DD} = 15 V
- **Standardized, symmetrical output characteristics**
- **5-V, 10-V, and 15-V parametric ratings**
- **Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"**

FIG 4: FUNCTIONAL DIAGRM OF CD4082

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range (For T_A = Full Package Temperature Range)	3	18	V

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A=25°C, Input t_r, t_f=20 ns, and C_L=50 pF, R_L=200 kΩ

CHARACTERISTIC	TEST CONDITIONS		ALL TYPES LIMITS		UNITS
		V_{DD} Volts	TYP.	MAX.	
Propagation Delay Time, t_{PHL}, t_{PLH}		5 10 15	125 60 45	250 120 90	ns
Transition Time, t_{THL}, t_{TLH}		5 10 15	100 50 40	200 100 80	ns
Input Capacitance, C_{IN}	Any Input	—	5	7.5	pF

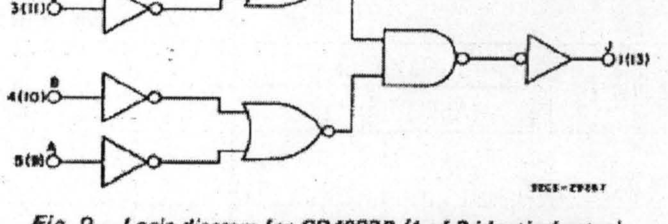


Fig. 9 — Logic diagram for CD4082B (1 of 2 identical gates).

3.3. *THE REGENERATING CIRCUIT*

The 555-Timer is use as the regenerating circuit, which acts as an astable multivibrator. An astable circuit produces a square waveform, with a sharp transition between LOW (0 Volt) and HIGH (+Volt)

The circuit is called astable because it is not stable in any state.

3.3.1 555 – TIMER

The 555 Timer is one of the most useful chips ever made. It is use in many projects. With just a few components it can be used to build many circuits. The description of the 555-timer is as follows;

PIN 1: Is the ground input and should be connected to the negative side of the supply.

PIN 2: trigger input when < $^1/_3$ Vs ('active low') this makes the output high (+Vs). It monitors the discharging of the timing capacitor in an astable circuit. It has a high input impedance > 2MΩ.

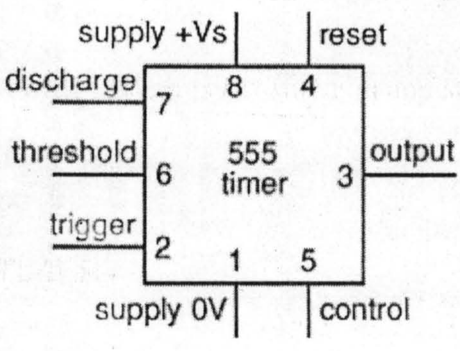


FIG 5: 555- TIMER IC

PIN 3: output pin and is capable of sinking or sourcing a load requiring up to 200mA and ca n drive TTL circuit .the output voltage available is approximately –1.7V

PIN 4: Reset input when less than about 0.7V ('active low') this makes the output low (0V), overriding other inputs. When not required it should be connected to +Vs. It has an input impedance of about 10kΩ.

PIN 5: Control input can be used to adjust the threshold voltage, which is set internally to be $^{2}/_{3}$ Vss. usually this function is not required and the control input is connected to 0V with a 0.01μF capacitor to eliminate electrical noise. It can be left unconnected if noise is not a problem.

PIN 6: Threshold input when > $^{2}/_{3}$ Vs ('active high') this makes the output low (0V)*. It monitors the charging of the timing capacitor in astable and monostable circuits.

PIN 7: The discharge pin is not an input .it is connected to 0V when the timer output is used to discharge the timing capacitor.

PIN8: Is the power supply pin and is connected to the positive supply. The voltage applied may range between 4.5V-16V.

3.3.2. 555-TIMER AS ASTABLE MULTIVIBRATOR

The diagram below represents a 555 Timer that function in an astable mode. The key component is the capacitor C1.The astable function can be drilled into just this: chance a capacitor discharge a capacitor...repeats indefinitely. The charging and discharging is done through the resistors R1 and R2.

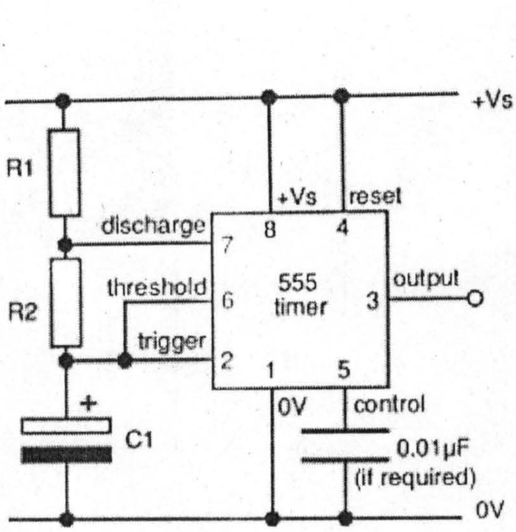


FIG 6: 555 TIMER AS ASTABLE MULTIVIBRATOR

In the design, the capacitance of the capacitor C1 was choose to be 22ηF.while the resistors R1 and R2 were chosen to be 22kΩ both.

3.3.3. DESIGN CALCULATION

The time period (T) of the square wave is the time for one complete cycle. But it is usually better to consider Frequency (F), which is the number of cycle per second.

$$T = 0.693\ (R1 + R2)\ C1$$

BUT

$$F = 1.4 / (R1+2R2)\ C1$$

Where

T= Time period in second(s)

F= Frequency in hertz (Hz)

R1=R2= Resistance in ohm=33KΩ

C1= Capacitance in farad (F)=22ηF

The time interval can be divided into two.

Tm =mark time (output high) = 0.693(R1+R2) C1

Ts =space time (output low) = 0.693(R2) C1

But

T = Tm + Ts

Tm = 0.693(R1+R2) C1

= 0.693(33KΩ +33KΩ) 22ηF

= 0.693(66*10^3Ω) 22*10^ -9

=1.00624*10^ -3 Second

Ts = 0.693(33KΩ) 22ηF

= 0.50311 *10 –3 Second

And

T =Tm + Ts

=1.00624 *10 ^ -3 + 0.503118 * 10^ -3

= 1.509358 *10^ -3 Second

The output waveform of the astable multivibrator will be in this form

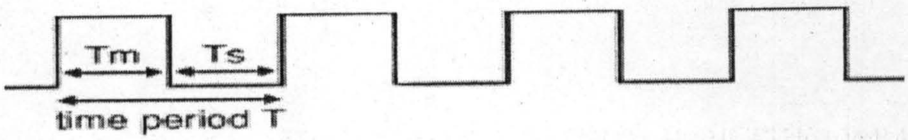


FIG 7: WAVEFORM OF ASTABLE MULTIVIBRATOR INDICATING Tm AND Ts

Whereas the waveform of charging and discharging of the capacitor C1 can be plotted as follow.

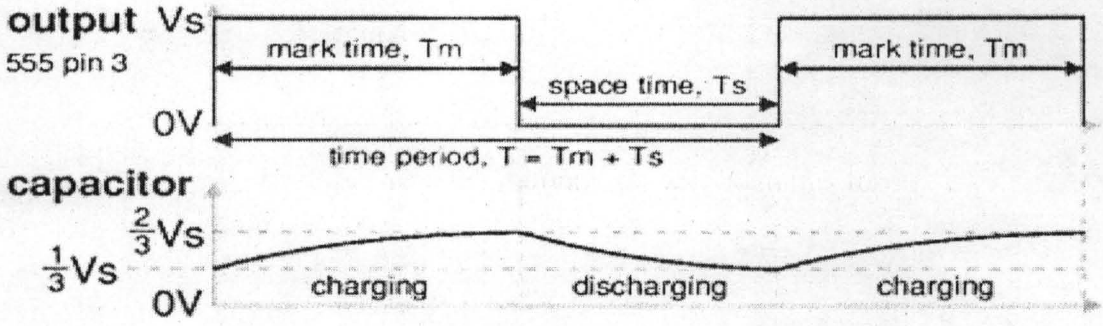


FIG 8: WAVEFORM SHOWING THE BEHAVIOUR OF THE CAPACITOR.

And

F =1.4 / (R1+2R2) C1

$=1.4 / (99K\Omega)\ 22\eta F$

$=1.4 / 0,002178$

$= 642.785\ Hz$

F = number of cycle per second.

3.3.4 DUTY CYCLE

A duty cycle is the proportion of the complete cycle for which the output was high (the mark time). It is usually given in percentage

Duty cycle = Tm / (Tm +Ts)

$= (R1 + R2) / (R1 + 2R2)$

$=1.00624 / 1.509358$

$= 0.666$

$= 66.66\%$

3.4. TIME DELAY CIRCUIT

The time delay circuit, which delay the output of the logic circuit 1 (from the car doors) for a certain time. The importance of this circuit is to create a time delay, which will enable car passenger to open and close a door for specified time without the car engine going off.

A monostable multivibrator is a pulse generating circuit in which the duration is determined by the RC network connected externally. In a stable or standby state, the output of the circuit is approximately zero or logic –low level. But when external trigger pulse is applied, the output is force to go high. The time for which the output remains high is determined by the external RC network connection to the timer. At the end the timing interval, the output automatically revert back to its logic-low stable state. The output stay low until trigger pulse is applied. Then the cycle repeat .the monostable has only one stable state (output low)

3.4.1 CD4098 MONOSTABLE MULTIVIBRATOR

The CD4098 monostble provides stable retriggered/reset-Table one-shot operation for a fixed voltage timing application. The external resistance R1 and capacitance C1 provide wide range of output pulse width from Q and Q' terminals. The time delay from triggered input and output transition (triggered propagation delay) and the time delay from the reset input to output transition (reset propagation delay) are independent of R1 & C1

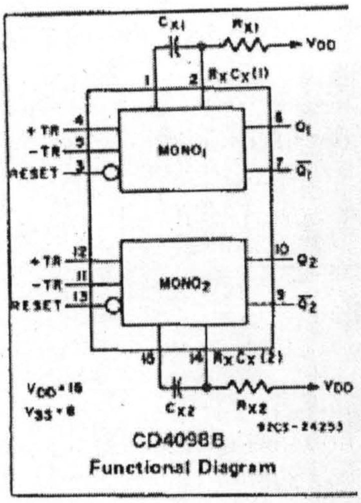


FIG 9: FUNCTIONAL DIAGRM OF CD4098

Leading edge triggering (+TR) and trailing edge triggering (-TR) inputs provided for triggering from either edge of an input pulse. An unused +TR input should be to Vss. An unused –TR should be tied to Vdd.

In normal operation the circuit triggers (extended the output pulse period) on the application of each new trigger pulse .the time period for this multivibratorcan be approximated by :

T= 1\2 (RxCx)

Where the value of the T vary from unit to unit as a function of voltage, temperature, and R1C1.

The output pulse has variation ±2.5% typically over the temperature range of -55° to 125°.

Input pulse =

Triggerable mode pulse width = 

3.4.2. DESIGN CALULATION

For a monostable time delay with an external resistor R1 and external capacitor C1.the time delay T is giving by:

$$T= 0.5\ R1C1$$

Where

$$R1= 600K\Omega$$

$$C1=100\mu F$$

Both values were selected from initial design of the project. And are subjected to change, depending on the delay timer the designer desired.

$$T=0.5*600,000*100\mu F$$

$$=30 \text{ second.}$$

Attached to the report is the data sheet of the CD4082.

3.5. THE SWITCHING CIRCUIT

The switching circuit consists of two transistors, which act as a switching device for the relay. The relay is to switch ON/OFF the current flow from the car battery and the car alternator.

3.5.1 TRANSISTOR AS SWITCH

One of the many uses of transistor is its ability to turn things ON/OFF, As long as the appropriate current is being applied at the base of the transistor.

While there are limitations as to what we can switch on and off, transistor switches offer lower cost and substantial reliability over conventional mechanical relays.

The secret to making a transistor switch work properly is to get the transistor in a saturation state. For this to happen we need to know the maximum load current for the device to be turned on and the minimum HFE of the transistor.

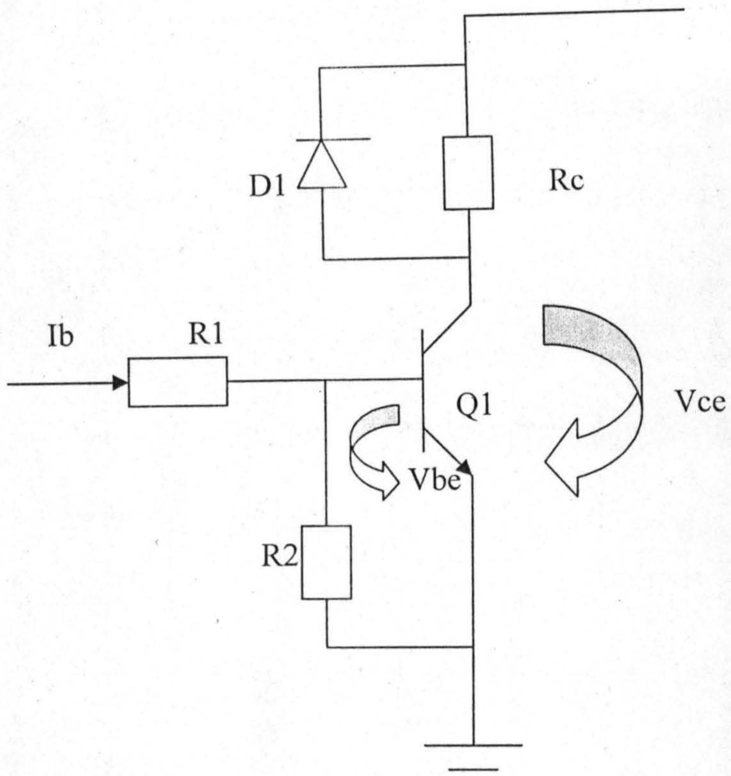


FIG 10: SCHEMATIC DIAGRAM OF NPN TRANSISTOR

Attached to the transistor Q1 is the following component

R1= R2 = 10 KΩ

Rc= Relay coil resistance= 170 Ω

Ib = (Vdd-Vbe)/Rb =0.72mA

Ic = Ib hfe = 0.72mA*100 =0.072mA

Vce (sat) =Vcc-IcRc

$= 12 - 0.072 * 170$

$= 0.24$ volt

Vce (sat) = the voltage that will switch ON/OFF the electromechanical relay.

Ib = the transistor base current

Vbe = the transistor base –emitter voltage, but in most of the time is considered negligible since Vcc >>> Vbe

HFE= is the transistor gain.

Ic = load current (the appropriate current to switch ON the device).

Rc = load resistance.

The presence of diode D1 in parallel with the relay is to prevent the kickback voltage in the reverse polarity from destroying the transistor. This reverse voltage occurs momentarily when the normal current stops flowing through the coil. It is good practice to always use a diode when turning on any inductive load. Transistor switches are often used to take the low-level output from logic circuits to turn on or turn off a particular device.

The resistor R2 is generally use to insure that the transistor switch is turn OFF. It also insures that the base of the transistor does not go negative, which will cause a small amount of current to flow.

Two similar transistors are use in the design, both for switching ON/OFF the two electromechanical relays found in the circuit.

3.6. ELECTROMECHANICAL RELAY

In the design of the project, two relays are use, both for switching ON/OFF the current flow from the car battery and the alternator. The relays are being turned ON/OFF by the transistors.

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double thrown or (changeover) switches.

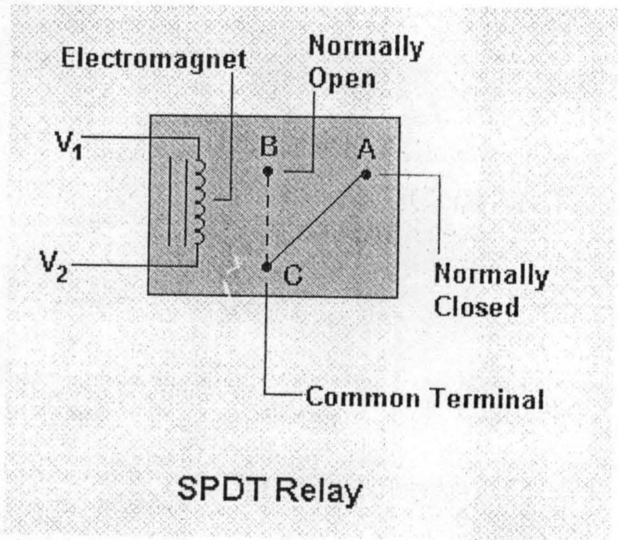


FIG 11:FUNCTIONAL DIAGRAM OF A RELAY

When electricity is applied to V1 and V2, the electromagnetic acts upon the switch so that B and C Terminals are connected. Whenever electricity is disconnected, the A and C terminals are connected. Relays allow one circuit to switch a second circuit, which can be completely separate from the first

When choosing a relay certain features are to be considered, more especially with the type of work the relay will do. Those features include:

1-PHYSICAL SIZE AND ARRANGEMENT-If you are choosing a relay for an existing PCB you will need to ensure that its dimensions and pin arrangement are suitable. You should find this information in the supplier's catalogue.

2-COIL VOLTAGE-The relay's coil voltage rating and resistance must suit the circuit powering the relay coil. Many relays have a coil rated for a 12V supply but 5V and 24V relays are also readily available. Some relays operate perfectly well with a supply voltage, which is a little lower than their rated value.

3-COIL REISTANCE-The circuit must be able to supply the current required by the relay coil. You can use ohm's law to calculate the current.

4-SWITCH RATING -The relay's switch contacts must be suitable for the circuit they are to control. You will need to check the voltage and current ratings. Note that the voltage rating is usually higher for AC, for example: "5A at 24V DC or 125V AC".

Relays are mostly protected by diode DI discussed in the section above.

3.7. OTHER ELECTRICAL COMPONENTS

Other electrical components such as (resistors, capacitors) are used in the design of the project so as to smooth the working efficiency of the device constructed. These components are discussed briefly below:

1-RESISTOR-is an electrical device use to control the size of current flow in an electrical circuit.

2-CAPACITOR-is an electrical device use for storing an electrical charge in an electrical circuit.

3-DIODE- an electrical device that allow the flow of electrical current in one direction.

3.8. THE RESULTANT CIRCUIT

The combination of the above block diagrams discuss resulted in the circuit design for electronic car seatbelt remainder and door safety device. The overall circuit diagram is presented below:

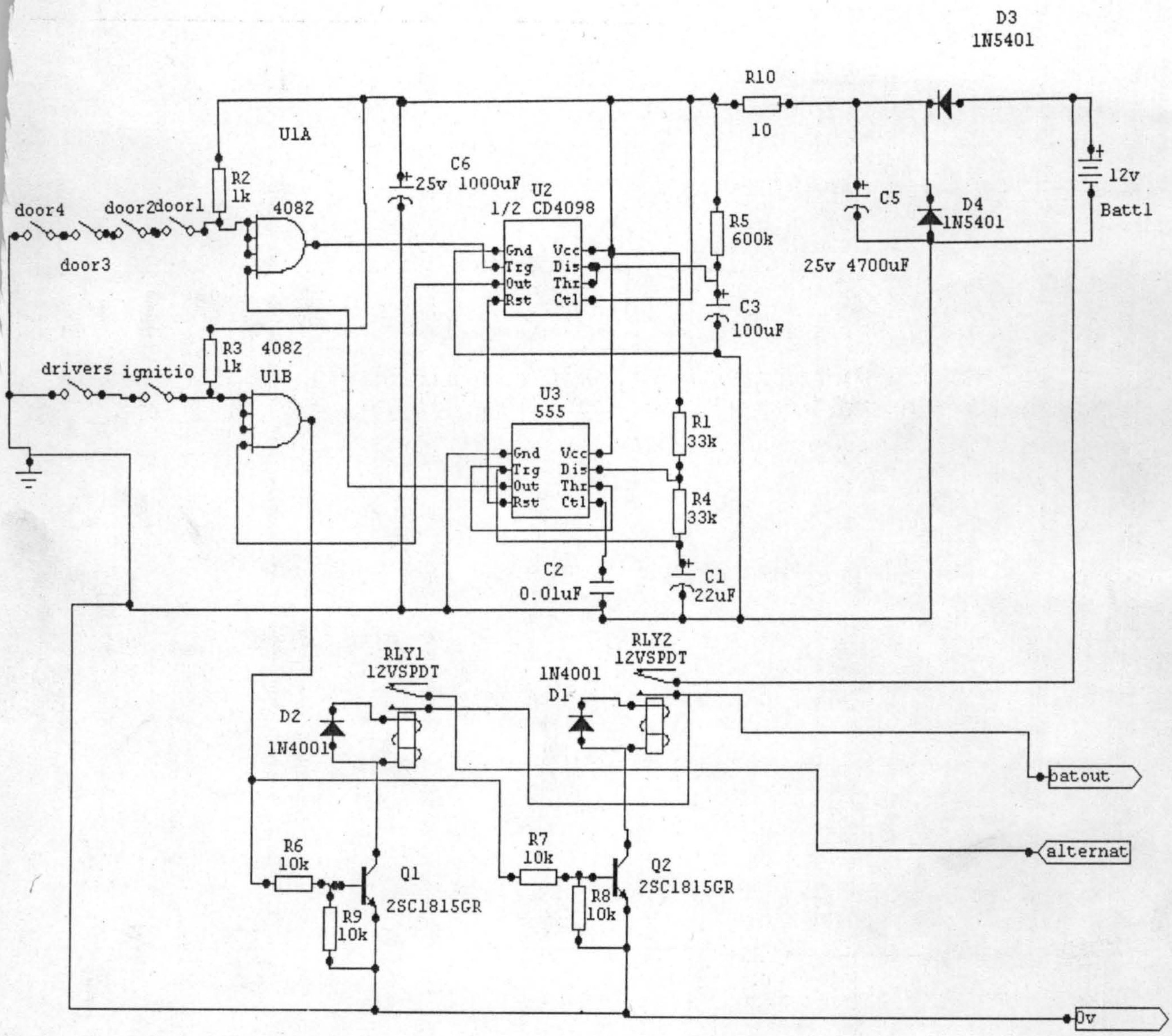


FIG 12: COMPLETE CIRCUIT DIAGRAM

CHAPTER FOUR

4.0 CONSTRUCTION AND TESTING

4.1.0 CONSTRUCTION PROCEDURE

Construction of the project, electronic car seatbelt remainder and door safety device was done as follows

1-First after the design of the project has been completed, the circuit was simulated using electronic workbench software "multism". And the result obtained from the simulation shows that the device designed will work if constructed.

2-The second step of the construction was the substitution of some electrical components that are not common here in Nigeria, and those expensive components, with the readily available and the inexpensive component.

3-The third step was the buying of the needed component from the market.

4-Then the circuit was laid down on the breadboard for another around of testing. At first the circuit did not work on the breadboard. But after replacement of the breadboard with another the circuit works fine.

5-The next step was the laying out the circuit on the Vero board. During the soldering of the circuit on Vero board the following point were carefully considered.

(i)-Care was taking to avoid shorting or bridging two conducting points, especially those needed to be separate.

(ii) Those conducting points needed to be in the same potential level were joined together.

(iii) No excess traces of soldering were allowed to remain on the board.

(iv) Hatching separated the stages from one another.

(v) The transistors were connected with the heat sink.

4.2.0 TESTING

The testing of the project was first done using electronic workbench 'multism'.

After construction a voltmeter was placed at the output of the AND GATE (U1B) and the ground. A voltage drop was notice whenever all the switches were closed. But if any of the switch from logic circuit 1 opens the voltage drop immediately to zero. This shows that the logic circuit 1 is connected in series with the car ignition system.

Also whenever any of the switches from the logic circuit 2 are switch off a delay of 30second was noticed before the voltage drop to 0V.This shows the effect of the time delay circuit on the project.

Other tested area on the circuit was the Vce(Sat) which is the appropriate voltage to turn ON/OFF the electromechanical relay.

4.3.0 CASING

The casing of the device was supposed to be of plastic. But due to financial constraints, a cuboid tile casing of 15cm x 6.5cm x 5cm was constructed.

CHAPTER FIVE

5. O RESULT AND DISCUSSION OF RESULT

The result obtained after completely testing the device was almost similar to the one expected from the initial design of the project. Though there was some variation of some of the result obtained after completion. This variation includes;

1- The Vce(sat) measured after construction ,was different from the measured when the device is being simulated with electronic workbench (multism).

2-The delay time of the circuit reduced from the initial design calculations of 30second to approximately 27.6second.

The above problems encountered can be attributed to the following

i-the voltage supply tends to be lower than the initial design voltage of the device (normally it drops from 12V to the values between the range of 11V-8.5V).

ii-The error due to real components, which makes some values to change from the initial design value.

5.1 CONCLUSION AND RECOMMENDATION

This project report covers extensively, the design and construction of the electronic car seatbelt safety device constructed.

All efforts were made to overcome some problems encountered during the construction, which includes;

1- The substitution of some expensive component with the more affordable component found in the market.

2- The variation of the result obtained after the device was constructed from the result obtained from simulation.

This will go along to take care of some minor negligence by the car driver and the passenger, which usually lead to serious injuries in the event of an accident.

Not withstanding the work still leaves room for further improvement by making it more economical, more reliable and more compact.

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