DESIGN AND CONSTRUCTION OF A REACTION TIMER

BY

ADEBO SAMUEL ATTAI

2003/14921EE

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

NOVEMBER, 2008

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL / COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERTING DEGREE (B. ENGR) IN ELECTRICAL AND COMPUTER ENGINEERING.

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DEDICATION

This project work is dedicated to the Almighty God for his mercy, guidance and protection granted to me, through out my research and entire work of the project.

I also dedicate this project to my parents, Elder R. I. Adebo and Mrs. Jane Adebo. (In blessed memory)

DECLARATION

I, Adebo Samuel Attai declare that this project was done by me and has never been presented anywhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

ADEBO SAMUEL ATTAI

(Name of student)

11-11-08

(Signature and date)

ENGR DR Y.A ADEDIRAN

(Name of H.O.D)

....

(Signature and date)

ENGR. A. S MOHAMMED.

(Name of supervisor)

11/11/08

(Signature and date)

....

(Name of external supervisor)

....

(Signature and date)

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ABSRACT

The design and construction of "reaction Timer" is described in this project write up. Over the years, there has been problem on ascertaining how fast or slow people react to signal. This has become a problem in the recruitment / selection of security personnel.

A second's moment of delay in responding to signal can pose a serious problem to an individual or a nation at large. On the other hand, quick and timely response to signal can save an individual or a group.

Therefore, a detailed understanding of one's reaction time goes a long way to help him know where he fits in, in terms of responding to signal.

The gadget that is capable of measuring the time it takes a person to react to a signal is what this project is aimed at producing. With practice, one might even improve and could compare his performance with that of other people.

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CHAPTER ONE

1.1 INTRODUCTION

Time is the concept used in describing when events take place and how long they last. Therefore, the significance of time in all human endeavors cannot be overemphasized. As such, it is very important to provide the means of timing to aid human being in achieving a particular aim at the appropriate time. All events which happen in nature involve the idea of time. In the laboratory, time is usually measured by a stopwatch or a stop clock.

Timer is a device used for timing one's activities, operations of electrical/electronics and mechanical equipment. They also serve as safety device for some appliances, when incorporated in them. [1].

Timers come in various sizes and ranges based on its intended application. Accuracy and stability are trademarks of a good timer.

However, most analogue long period electronic timers use a 555 one-shot and a large electrolytic capacitor as their main timing element. Conventional electrolytic capacitors have a very wide tolerance and consequently suffer from relatively large and unpredictable large leakage current. As a result, these simple circuits cannot be relied upon to give accurate timing periods.

Timers that use electrolytic capacitor and one-shot 555 timer IC as the basic timing element suffer the effect of stability. [2]

John G Truxal in his contribution to Clock control system in the encyclopedia in science and technology grouped the timing devices into five functional group, time switches, time delay relays, internal timers time cycle controllers and the timers schedule controller.

This project consists of five chapters. Chapter one points at what this project is all about, the objectives and the methodology of the work. Chapter two deals with literature review / theoretical background of the project. Furthermore, chapter there presents the design and implementation of the project while chapter four discusses the tests, results and discussion. Finally, chapter five summarizes the enter work and gives recommendation for improvement.

1.2 AIM AND OBJECTIVE.

This project, "THE DESIGN AND CONSTRUCTION OF REACTION TIMER". Is aimed at producing a gadget that is capable of measuring the time it takes a person to react to a signal.

1.3 MOTIVATION

The need for quick response of individuals especially, the military personnel and other security operatives cannot be overemphasized. As such, it becomes paramount to use reaction timer in the recruitment of military personnel and security operatives. Hence this becomes a motivating factor.

1.4 METHODOLOGY

This project involves the design and construction of reaction timer to count the time it takes an individual to react to signal. The frequency of counting is determined by the value of the resistor and the capacitor.

The 4060 integrated circuit is a ripple counter. It goes on and off continuously. It has sixteen (16) pins. Pin 12 of 4060 IC is clock enable. It is active low. It enables the IC to start operating when connected to the negative, hence it starts counting. The frequency output of 4060 IC is fed to the clock input of 4518 IC.

There are other pins of 4518 whose functions are not to set a time duration output but rather to ensure other operation like 'RESET' to take place. The output of the 4518 integrated circuit is fed into the input of 4511 which is responsible for the display of the time on the seven segment display.

1.5 SCOPE

The logic (CMOS) is seen in modern electronic devices, especially in computer technology. The most exposed demerits are statistics distribution and low speed. Today's CMOS provide high speed capability.

As a result of inadequate electronic exposure and limited information resources, a lot of students that carry out projects based their design mainly on transistor-transistor-logic

(TTL), 555 timers only. But in this case, I have decided to use 4060 integrated circuit to generate the constant clock pulses.

CMOS logic integrated circuits are extremely denser than any other logic techniques. As such it makes design very compact. The use CMOS technology is the driving force of today's technological success.

Generally, the design is based on components that are cheap and readily available in the market. This project was carried out with sufficient information and Data sheets of all components from their manufacturer where obtained and carefully worked with. [9]

CHAPTER TWO

2.1 THEORETICAL BACKGROUND

Time has played a central role right from the very beginning, yet it remains one of the most mysterious aspects of the world in which we live. The beginning of civilization on earth required knowledge of the seasons and the mysteries surrounding the length of the year, length of the month and length of day began to be studied. All the world religion gave a central role, be it astrology, stories of creation, cyclical world histories, notion of eternity etc [3]

Philosophers have tried to come to grips with the concept; some have argued that time is a basic property of the universe while others have argued that it is an illusion or a property of human mind and not of the world. A huge effort has been put into making devices to measure time with ever increasing accuracy from the beginning of recorded history to the present day. [3]

Ideas about time have changed dramatically in the 20th century. At the beginning of the century, time was viewed as Newton's Universal, absolute mathematical time. There has been remarkable progress towards more accurate measurement and at the beginning of the century pendulum clock had been perfected to the extent that they recorded time to an accuracy of less than $^{1}/_{100}$ of a second error in a day. [3]

2.2 TIME AND THE HISTORY OF ITS MEASUREMENT

From the earliest periods, man has used some forms of time measurement, be it only the seasons of the year or phases of the moon. This was all that was needed in simple nomadic or agricultural communities and prices enough for their daily needs. As people began to congregate in villages and forms of religions ceremonies began, more refined methods of time measurement were needed. Civilization in early times was concentrated around the Mediterranean, where there was lots of sunshine and water, plenty for the then relatively small populations. Here time keeping was developed along two main line-from the shadow sticks, probably the earlier and then the water clock. [3]

Although crude by modern day standards, sundial and water clocks were eventually developed to give surprising accuracy. But probably, the most accurate, early devices were those designed and used by the Chaldeans. The Chaldeans, the tribe of Moses, were the first people attributed with dividing the day, and the night into twelve hours each. [3]

Despite early fascination with time-keeping by water or candle, undoubtedly the most accurate early time tellers were Sundial. Time was measured from noon one day to noon the next day that is for one revolution of the earth on its axis. [3]

Many ancient churches had sundials long before the more usual steeple clocks. A few churches have simple marks gouged in the stone of the walls with a hole where a peg would be inserted to cast its shadow to indicate the various time of worship. These are known as scratch dials. [3]

Early Mechanical clocks were bad time keepers and were often adjusted by the local sundial. As the time keeping of these clocks improved, so the short comings of some of the cruder local sundials became apparent. However, country people, ever suspicious of townsfolk, took a long time to accept the more accurate and universal time measurement. [3]

2.3 HISTORY AND DEVELOPMENT OF TIMERS.

2.3.1 MECHANICAL TIMERS.

Early mechanical timers used typical clockwork mechanisms, such as an escapement and spring to regulate their speed. Inaccurate, cheap mechanisms use a flat beater that spins against air resistance. Mechanical egg-timers are usually of this type [4]

More accurate mechanisms resemble small alarm clock. The advantage is that they require little battery or electrical power, and can be stored for long periods of time. The most widely-known application is to control explosives. [4]

2.3.2 ELECTROMECHANICAL TIMERS.

Electromechanical timers have two types. A thermal type has a metal finger made of two metals with different rates of thermal expansion (steel and bronze are common). An electric current flows through this finger, and heats it. One side expands less than the other and an electrical contact on the end of the finger moves away from an electrical switch contact, or makes a contact (both types exist). The most common use of this type is now in the "flasher" unit that flashes turn signals in automobiles, or sometimes in Christmas lights. [4]

Another type of electromechanical timer (a cam timer) uses a small synchronous AC motor turning a cam against a comb of switch contacts. The AC motor is turned at an accurate rate by the alternating current, which power companies carefully regulate. Gears slow this motor down to the desired rate, and turn the cam. The most common application of these timers now is in washers, driers and dishwashers. This type of timer often has a friction clutch between the gear train and the cam, so that the cam can be turned to reset the time. Electromechanical timers service in these applications because mechanical. Switch contacts are still less expensive than the semiconductor devices needed to control powerful lights, motors and heaters. [4]

In the past, these electromechanical timers were often combined with electrical relays to create electro-mechanical controllers. Electromechanical timers reach a high stage of development in the 1950's and 60's because of their extensive use in aerospace and weapons systems. Programmable electromechanical timers controlled launch sequence events in early rockets and ballistic missiles. [4]

2.3.3 DIGITAL TIMERS.

Digital timers can achieve higher precision than mechanical timers because they are quartz clocks with special electronics. Integrated circuits have made digital logic so inexpensive than many mechanical and electromechanical timers. Individual timers are implemented as a simple single-chip computer system, similar to a watch. Watch technology is used in these devices. [4]

2.3.4 COMPUTER TIMERS.

Most computer system has one to sixteen electronic timers. These are usually just digital counters that are set to a number by software, and then count down to zero. When they reach zero, they interrupt the complete. [4]

Another common form of timer is a number that is compared to a counter. This is somewhat harder to program, but can be used to measure events or control motors. Embedded systems often use a hardware time to implement a list of software timers. [4]

Basically, the hardware timer is set to expire at the time the next software timer of a list of software timers. The hardware timer's interrupt software handles the house-keeping of notifying the rest of the software, finding the next software time to expire, and resetting the hardware time to the extent software timer's expiration. [5]

CHAPTER THREE

3.0 DESIGN AND IMPLEMENTATION

The circuit was designed and constructed using CMOS 4060, CMOS 4518, CMOS 4511 as well as various values of capacitors and resistors

All electronic component are listed below

1. CMOS 4060 IC (Oscillator)
2. CMOS 4518 IC
3. CMOS 4511 IC
4. Capacitor, C_1 = 470μF (Filter capacitor)
5. Capacitor, C_2 = 6.8nF (timing capacitor)
6. Resistor R_1=33KΩ
7. Resistors R_2 =100Ω
8. Resistors R3-R9=100Ω
9. Bridge rectifier
10. 21 LEDs (common cathode)
11. Power Switch
12. Reset switch
13. IC sockets
14. Probe meter cable

4000 SERIES CMOS LOGIC ICs

The CMOS LOGIC ICs used in this design are all 4000 series.

3.1 CMOS SERIES

4000 CMOS series introduced by RCA and 14000 CMOS series introduced by Motorola were the first CMOS series. Now 4000 series is designated as 4000 A called conventional series and an improved version 40000 B series is also there, which has higher output current capabilities and it is called the buffered type device. These series are widely used and have many such functions, which are not available in other series. [6]

3.2 GENERAL CHARACTERISTICS OF 4000 SERIES CMOS

3.2.1 Supply voltage: 3 to 15v, small fluctuations are tolerated

3.2.2 Inputs: They have very high impedance (resistance). This is good because it means, they will not affect the part of the circuit where they are connected. However, it also means that unconnected inputs can easily pick up electrical noise and rapidly change between high and low states in an unpredictable way. This is likely to make the IC behave erratically and it will significantly increase the supply current. To prevent this problems, all unused inputs must be connected to the supply (either +Vs or OV), this applies even if that part of the IC is not being used in the circuit. [5] and [6]

3.2.3 Outputs: Output can sink and source only about 1mA if you wish to maintain the current no need to drive CMOS inputs. If there is no need to drive any input the maximum current is about 5mA with a 6v supply, or switch larger currents, you can connect a transistor. [6]

3.2.4 Power dissipation: When CMOS logic circuit is in static state, power dissipation in this series is extremely low since in any of the output state of the gate there is always a high resistance between the ground and supply. So, power dissipation of CMOS is only 2.5nW per gate. This is the reason why CMOS is used so widely. [6]

3.2.5 Fan-out: One output can drive up to 50 inputs. [6]

3.2.6 Gate propagation time: Typically it takes 30ns for a signal to travel through a gate with a 9v supply; it takes a longer time at lower supply voltages. [6]

Frequency: The frequency is about I MHz. above that the 74 series is a better choice. [6]

3.3 STATIC PRECAUTIONS

The CMOS 4000 IC series circuitry is static sensitive. Touching a pin while it is charged with static electricity (from your clothes for example) may damage the IC. In fact most IC in regular use are quiet tolerant and earthing your hands by touching a metal before handling them will be adequate. ICs should be left in their protective packaging until you are ready to use them. [6]

3.4 CMOS 4060 IC

This is a ripple counter. The count advances as the clock input becomes low. This is indicated by the bar over the clock label. This is the usual clock behavior of ripple counters and it means a counter output can directly drive the clock input of the next counter on a chain. [6]

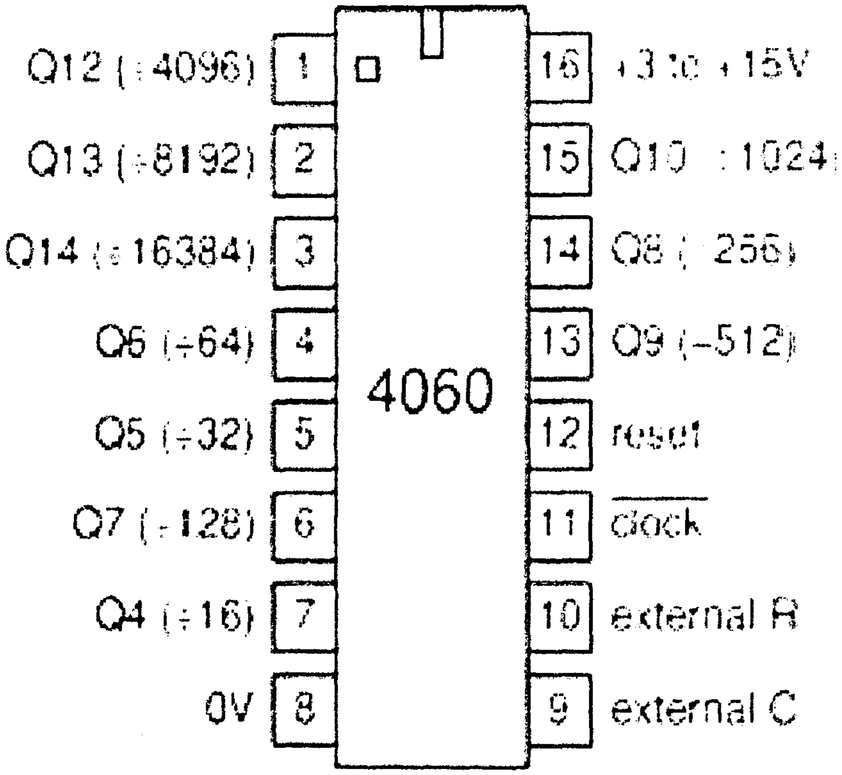

Fig 3.1 CMOS 4060 IC

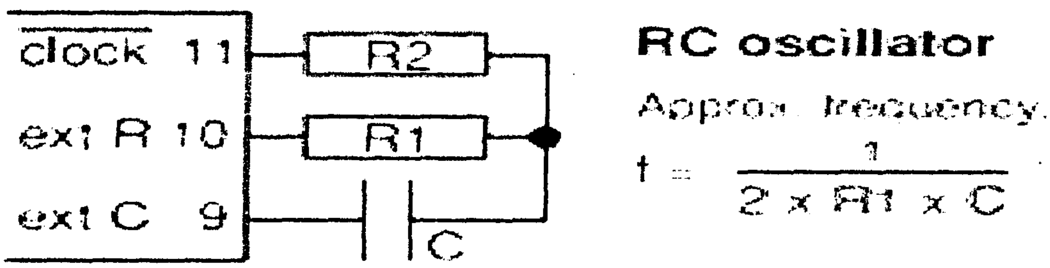

Fig 3.2 RC Oscillator

The reset input should be low for normal operation (counting). When high it reset the count to 200. The 4060 I C includes an internal oscillator. The clock signal may be supplied in two ways:

(i) From an external source to the clock input, as for a normal counter. In this case there should be no connections to external C and external R (pins 9 and 10)

(ii) RC oscillator is as shown in fig. 3.2 above. The oscillator drives the clock input with an approximate frequency $F = \frac{1}{2 * R1 * C}$ (it partly depends on the supply voltage).

$$F = \left(\frac{1}{2 * 33 * 10^3 * 6.8^{-9}}\right) / 1024$$

$$F = \frac{2228.163993}{1024}$$

$$F = 2.18Hz$$

R_1 Should be at least 50kilo-ohms of the supply voltage is less is less than 7v R_2 should be between 3 and 10 times R_1. [6]

3.5 4511 BCD TO 7-SEGMENT DECODER

BCD stands for binary coded Decimal. ABCD counter has four outputs usually labeled A, B, C, and D. By convention, A is the least significant bit, LSB. [7]

The function of a BCD to 7-segment decoder is to convert the logic states at the outputs of a BCD counter into a form which will drive a 7-segment display. The display shows the decimal numbers 0-9 and is easily understood. The easiest way to understand what a BCD counter does is to follow the counting sequence in truth table form as shown below

Pulses	Output D	Output C	Output B	Output A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Table 3.1 Truth table of BCD counter

3.6 4511 BCD 7-SEGMENT DISPLAY DRIVER

The appropriate output a-g becomes high to display the BCD (binary code decimal) number supplied on inputs A-D. The outputs a-g can source up to 25mA. The 7-segment display segment must be connected between the outputs and OV with a resistor in series (330Ω and a 5V supply). A common cathode display is required. [7]

In a **common cathode** display, the cathodes of all the LEDs are joined together and the individual segments are illuminated by HIGH voltages. In a **common anode** display, the anodes of all the LEDs are joined together and the individual segments are illuminated by connecting to a LOW voltage. [7]

The 4511 is designed to drive a common cathode display and won't work with a common anode display. [7]

Display test and blank input are active-low so they should be high for normal operation. When display test is low, all the display segments should light (showing number 8). The 4511 is intended for BCD (binary coded decimal). Input values from 10 to 15 (1010 to1111 in binary) will give a blank display (all segments off). [7]

Pin connections

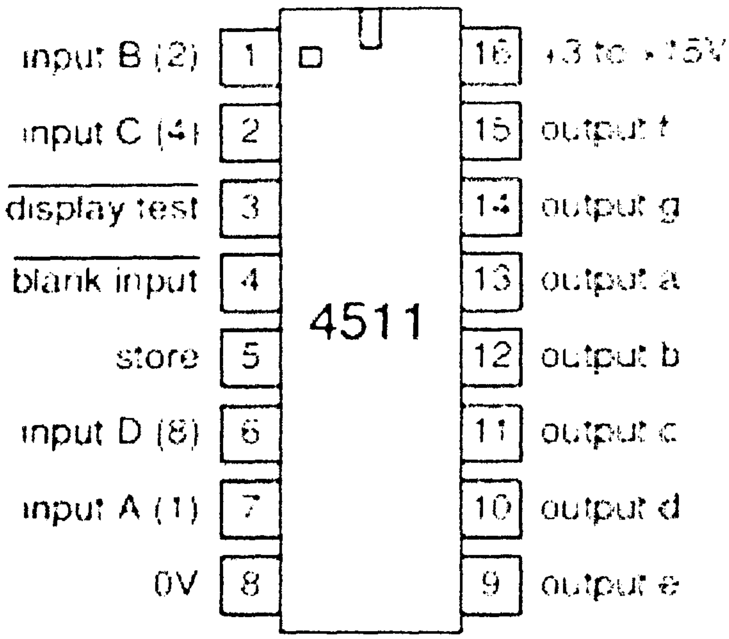

Fig 3.3 CMOS 4511 IC

The individual segments making up a 7-segment display are idemtified by letters follows:

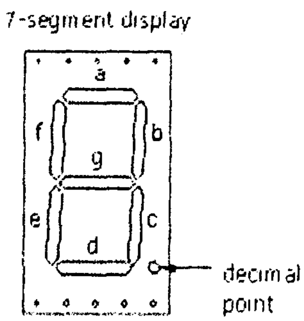

Fig. 3.4 7-Segment display

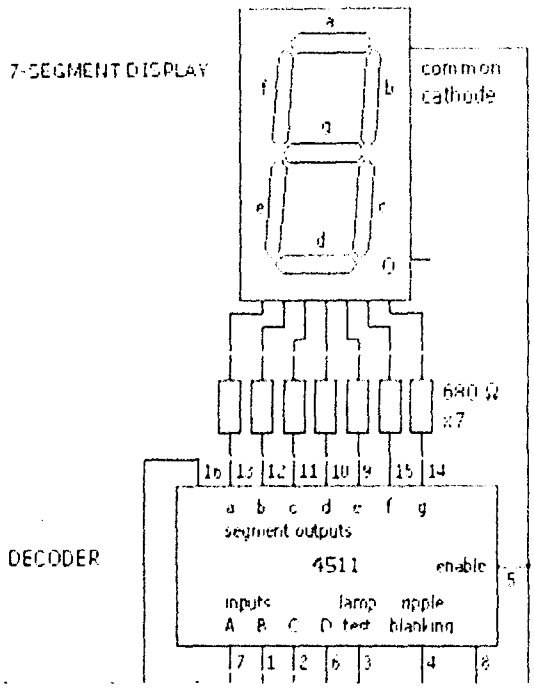

Fig.3.5 Connection of 7-Segment display to CMOS 4511 IC

The 4511 is designed to drive a common cathode display and would not work with a common anode display. When the 4511 is set up correctly, the outputs follow this truth table:

BCD inputs				segment outputs							display
D	*C*	*B*	*A*	*a*	*b*	*c*	*d*	*e*	*f*	*g*	
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	0	0	1	1	9

Table 3.2 Truth Table of BCD 7- segment display

There is a question about whether the 6's and 9's should have tails. The 4511 produces a display without tails. If other binary values, greater than 1 0 0 1 are connected to the inputs of the 4511, the outputs are all 0's and the display is blank. The function of a BCD to 7-segment decoder is to convert the logic states at the output of a BCD counter of 4511 into a form which will drive a 7-segment display. The display shows the decimal number 0-9. [7]

3.7 CMOS 4518 IC

Normally, a clock signal is connected to the clock input, with the enable input held high. Counting advances as the clock signal becomes high. For normal operation the reset input should be low. Making it high resets the counter to zero (0000, QA low). [7]

Counting to less than the maximum (9 or 15) can be achieved by connecting the appropriate output(s) to the reset input, using an AND gate if necessary. For example, the count 0 to 8, connect QA (i) and QD (80 to reset using an AND gate.

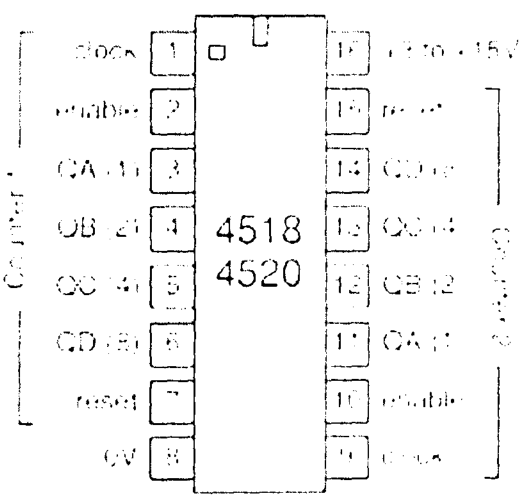

Fig. 3.6 CMOS 4518 IC

3.8 BASIC OPERATION

In normal operation, the lamp test and ripple blinking inputs are connected HIGH, and the enable (Store) input is connected LOW.

The circuit diagram above shows the connection of 4511 and a 7-segment cathode display. In any electric circuit, the current in the entire circuit is equal to the voltage cross that circuit divided by the resistance of the circuit. Resistors are often made to have a specific value of resistance so that the characteristics of the circuit can be accuratey calculated. [7]

3.9 CAPACITOR

Capacitor, or electrical condenser, is a device for storing an electrical charge. In its simplest form a capacitor consist of two metal plates separated by a non conducting layer called the dielectric. When one plate is charged with electricity from a direct-current or electrostatic sources the other plate will have induced in it a charge of the opposite sign, that is, positive, if the original charge is negative and negative if the charge is positive.

The Leyden jaris a simple form of capacitor in which the two conducting plates are metal foil coatings on the inside and outside of glass bottle or jar that serves as the dialectic. The electrical size of a capacitor is its capacitance, the amount of electric charge it can hold. Capacitors are limited in the amount of electric charge they can absorb. They can conduct direct current for only an instant but function well as conductors in alternating current circuit. This property makes them useful when direct current must be prevented entering some part of an electric circuit. Fixed capacity and variable capacity capacitors are used in conjunction with coils as resonant circuit in radios and other electronic equipment. Large capacitors are also employed in power lines to resonate the load on the line and make it possible for the line to transmit more power. [8]

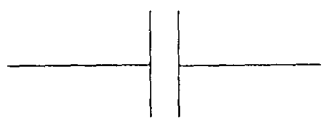

Fig 3.7 Circuit symbol of a capacitor

3.10 RESISTORS

Resistor is a component of an electric circuit that resists the flow of direct or alternate electric current. Resistor can limit or divide the current, reduce the voltage, protect an electric circuit, provide large amount of heat or light. [8]

An electric current is the movement of charged particles called electron from one region to another. The amount of resistance to the flow of current that a resistor causes depends on the material it is made up of as well as its size. Resistors are usually placed in electric circuits, which are devices formed when current moves through an electric conductor (a material that allows the current to flow without much resistance, such as copper wire) and when the conductor makes a complete loop. [9]

Fig.3.8 Circuit symbol of a resistor

When voltage, or electric potential, is applied to opposite ends of a circuit, it causes current to flow through the circuit. As the current flows, it encounters a certain amount of resistance from the conductor and any resistor in the circuit. Each material has wood is a bad conductors because it offers high resistance to the current whereas copper is a better conductor because it offers less resistance. [8]

R1 =33kΩ

R2 = 100Ω

$$R1//R2 = \frac{R1 * R2}{R1 + R2}$$

$$R1//R2 = \frac{33K * 100K}{33K + 100K}$$

$$R1//R2 = \frac{33 * 10^8}{133K}$$

R1//R2=25K

V= IR

V= 12 Volts

I= 0.12 ampere

R=?

R= V/I

$$R = \frac{12}{0.12}$$

R1= R2= 100Ω

330Ω resistor and 5V supply are required for 7- segment display.

Let R3=330Ω

R3=R4=R5=R6=R7=R8=R9=330Ω

$$V=IR$$

$$I=\frac{V}{R3}$$

$$I=\frac{5V}{330}\Omega$$

$$I=0.015A$$

The total current required by the 7-segment is 0.015A

But in this project LEDs were used. As such the voltage of 12volts with 100Ω is appropriate.

The current, I= V/R

$$I=\frac{12v}{100}\Omega$$

$$I=0.12A$$

Hence, the current of 0.12A is required in the display.

LIGHT-EMITTING DIOCE (LED)

This is a semiconductor device that converts electrical energy efficiently into visible light by electro-luminescence at a forward –based p-n junction. It is also known as solid state lamp. Such a junction may be produced with p-type and n-type compounds of gallium arsenide.

An LED will take 10-15mA with a voltage drop of about 2V to give a small amount of light. If a voltage greater than 2V is to be used, there must be a resistance (330Ω-1KΩ) connected in series with the LED. [9]

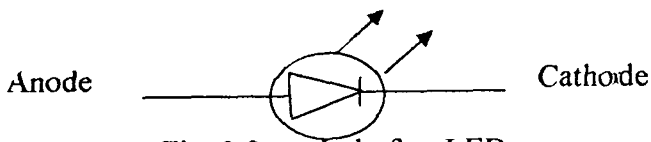

Fig. 3.9 symbol of an LED

3.11 PRINCIPLE OF OPERATION

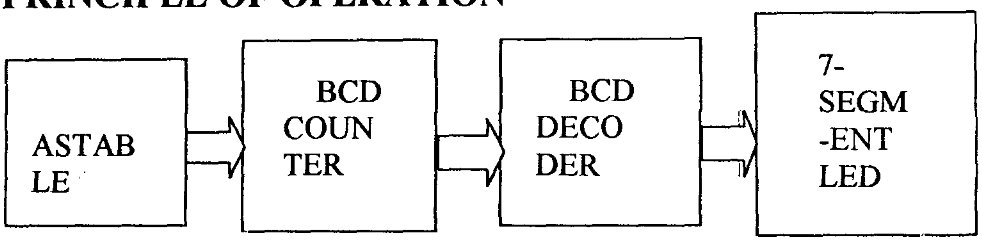

Fig. 3.10 block diagram of the circuit

Electronic counters work on the binary system. But we are used to the decimal system and so it is most convenient to use counters which display answers in their output in decimal form.

In this reaction timer, switching on S3 enables the astable to send fairly fast square wave pulses (their frequency is determined by the values of R1 and C1) to the BCD counter. This consists of four bistables, like the binary counters, BCD is connected internally so that it only uses ten of these states, it counts from 0-9.

The ten states (numbers 0-9) are fed in turns as each astable pulse arrives, in binary form, to the four outputs of the counter. For example, when the count is three, (in binary 0011), outputs one and two (pins 6 and 11) are 'high' and outputs three and four (pins 14 and 2) are ‘low’. Moreover, when the count is 9 (in binary 1001), outputs one and four are ‘high’ and outputs two and three are ‘low’. This is why it is called a BCD or Binary Coded Decimal Counter – it represents decimal numbers in binary form

The BCD decoder receives the four outputs from the counter at its four inputs (pins 1,2,6, and 7) and has to convert them into a form which makes a decimal display possible. The 7-segment LED display consists of seven small LEDs which produce the numbers 0 to 9 when various combinations of the seven segments light up. The BCD decoder therefore has to create seven outputs (pins 9 to 15) from its four inputs. This it does and feeds to the display.

R2 is a common current-limiting resistor for all seven segments of the display.

3.12 POWER UNIT

Power generation is one of the most important aspect of circuit design, generating a good voltage and current threshold for the desired circuit to operate at an optimal performance. In this project construction, a constant DC (direct current) is needed to power the ICs using a 9v battery would work perfectly well but for longer time duration of operation, a direct supply is rather used instead. Taking this into cognizance, a 220V power supply from a constant AC source which has to be stepped down using a 12V step down transformer was designed.

The 12V AC was rectified by the four diode network to a 12V DC plus some amount of ripple AC signals. A filter capacitor of 470 μF is used to shunt out AC signals across the 2 terminals of the DC supply.

The block diagram illustrating dc power supply is depicted in the figure below.

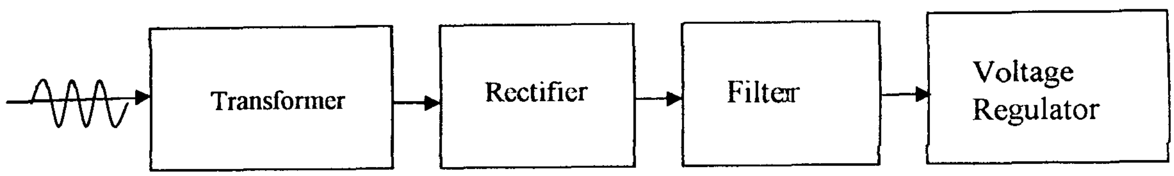

Fig. 3.11 Block diagram of the power supply

TRANSFORMER

It is to step up or mostly to step down a.c supply voltages. It consists of inductive coils, which are electrically separated but magnetically linked through the galvanic separation between the means (a.c input) and the d.c output.

In this project, a $220V_{rms}$ /12V step down transformer was used to reduce the 220V a.c from PHCN supply to 12V ac, which is rectified to give the required 12V d.c.

RECTIFICATION

Rectification is defined as a process of changing a pulsating a.c voltage to d.c voltage. They are:

- Half – wave rectification
- Full-wave rectification bi-phase rectification
- Full wave bridge rectification.

This project adopts the use of a full wave bridge rectifier circuit because of its ability to produce the appropriate varying and reference voltages.

THE BRIDGE RECTIFIER

The bridge rectifier employs four diodes for the rectification purpose in obtaining a desired a.c voltage to be rectified. The output terminals are independent completely. These are two d.c terminals; neither is common for the a.c voltages. The four diodes are arranged in a diamond configuration called the full wave bridge rectifier as shown in the figure below.

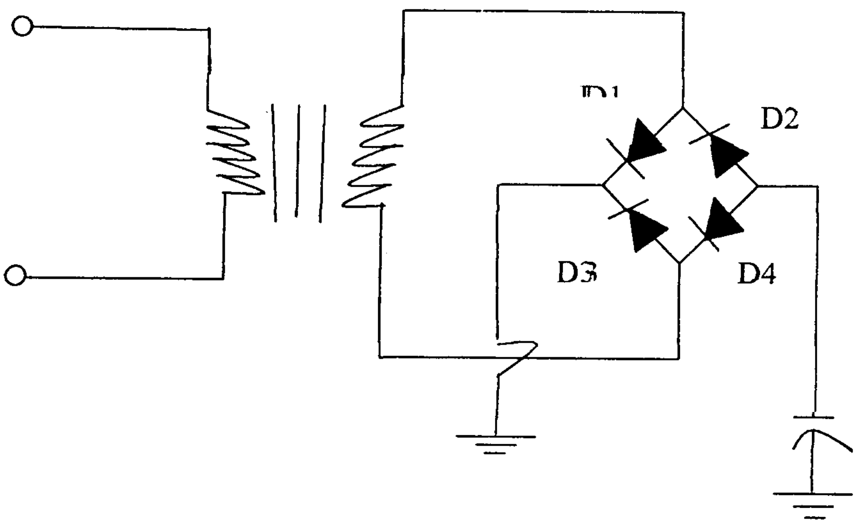

Fig. 3.12 Bridge Rectifier.

The maximum instantaneous voltage between the terminal is $V_m = \sqrt{2}\, V_{rms.}$ The d.c voltage is given by $\frac{2V\max}{3.142} = 0.636V_{max.}$ But the PIV (peak inverse voltage) should be greater than $V_{max.}$ Also, $V_m = 2V$.

This value prompted the need of selecting a 2A bridge rectifier.

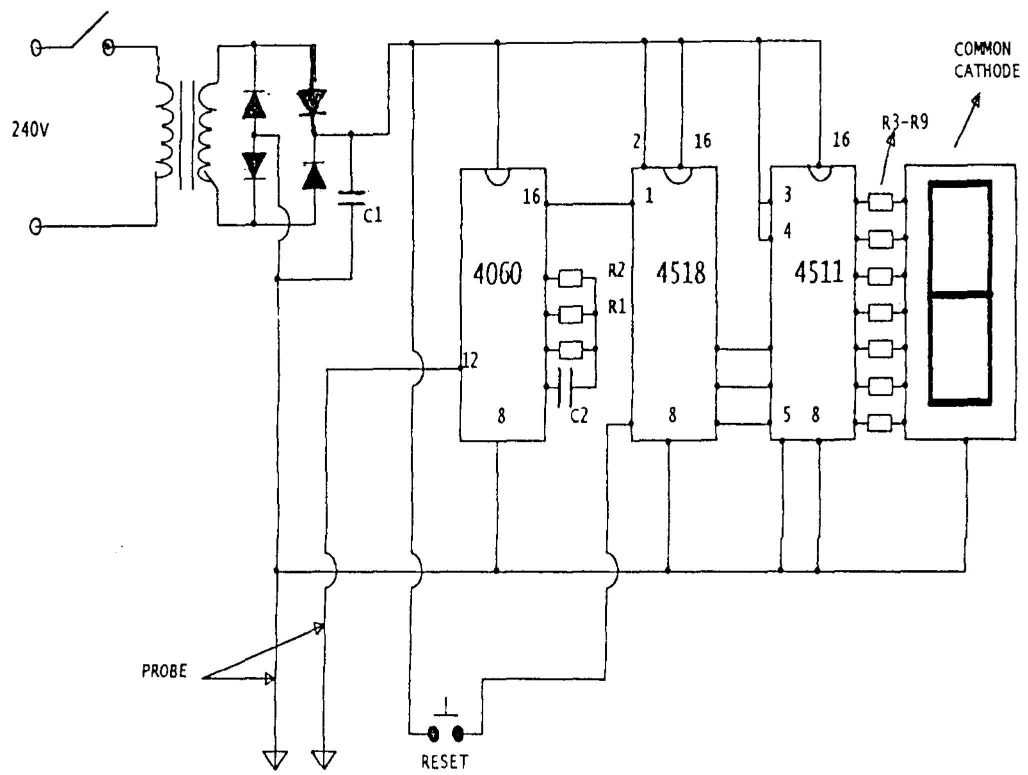

Fig. 3.13 the complete circuit diagram of the reaction timer imdicating all components.

CHAPTER FOUR

4.0 CONSTRUCTION, TESTING AND RESULT

4.1 CIRCUIT CONSTRUCTION

Electronic simulation software (electronic workbench) was first of all used to ascertain the workability of the circuit and the circuit diagram was carefully followed module by module until the construction was completed. When tested it worked.

The second phase of the testing was to build the circuit on the bread board using 9v battery source to check the pulse generated and the various time outputs of the integrated circuit.

The circuit construction involved the connection of components directly on the bread board by means of lead soldering.

The components needed for the constructions were acquired. They were new and apparently in good working condition. They were also tested with a digital multi-meter to confirm their accurate values and continuity.

Listed below are the instruments and working tools used in the construction of the project.

1. A cutting scissors
2. An electric soldering iron
3. A rim of soldering lead
4. Razor blade
5. Tinned copper wire (connecting wires)

6. A digital multi-meter.

The components were arranged on a sizeable vero-board and soldered one after the other, considering the components that make up each module as well as the one preceding it. They were then connected together to complete the circuit.

The circuit construction was done on a vero-board. Below is the photograph of the construction.

The casing was made out of transparent plastic and well glued at every side to maintain rigidity of the construction.

The switches, push buttons and the probes sections were protruded out off the surface of the casing through appropriate holes created for them.

Below is the pictorial view of the construction in its casing.

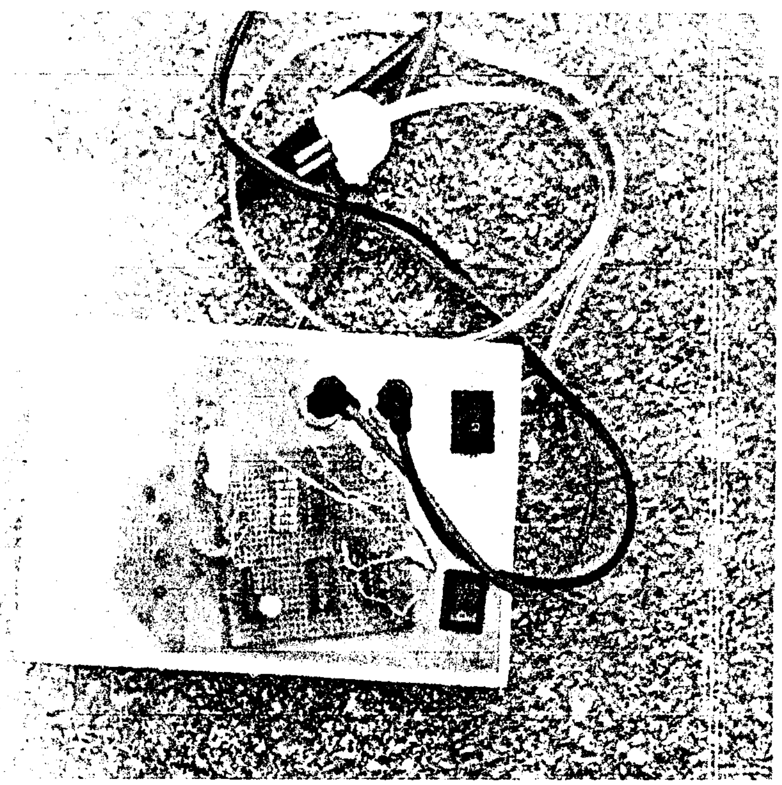

Fig.4.1 pictorial view of the construction in its casing.

4.2 TESTING

Testing of the circuit was performed at each module of the construction work as well as at the completion of the entire circuit construction. This was done by connecting the device to the electric power supply and different persons were used to test the ability of the circuit to measure the reaction time of different people.

When the device was first connected to the AC mains and the probes were held, the reading by the seven-segment display began and continued. But as soon as the person reacts to the signal by removing his hands from the probes, the last number then remained on the display, indicating that, that number is the reaction time of the person concerned.

4.3 RESULT

Different people were used on the device during the test. The main aim of the test which was not only to keep the seven segment on but also to measure their individual reaction time.

The table below shows the different people used and their different reaction time.

S/N	Person Tested	Reaction Time in seconds
1	A	5
2	B	4
3	C	8
4	D	7
5	E	6
6	F	6
7	G	4
8	H	9
9	I	5
10	J	5

Table 4.1 Table of result

4.4 DISCUSSION OF RESULT

From the table of results in the result section above, following the testing of the construction, the main aim of the project can be said to have been achieved. It was observed as expected that when the device was connected to power and switched on, the reading commenced and stopped at the last figure on which the hands were removed from the people.

PROBLEMS ENCOUNTERED DURING CONSTRUCTION

1. Bridging of close terminals during soldering.
2. Mistake in connection (e.g. on the pin of the integrated circuit).
3. Problem in resetting the counter.

CHAPTER FIVE

5.0 CONCLUSION, PRECAUTION AND RECOMMENDATION

5.1 CONCLUSION

The successful completion of this project is due to the fact that organized steps and procedures were ensured. This goes a long way to show how important the concept of time is in today's world of technological advancement.

All information gathered from the data sheet of all components used was very useful in the construction of this device.

A few new and interesting knowledge were acquired during the course of carrying out this project. Likewise the great importance of the application of integrated circuit in the fabrication of electronic gadgets was appreciated.

APPRECIATION

I really give thanks to the Almighty God for seeing me through to the completion of this project work and for the means to purchase the components used in the construction of the project.

5.2 PRECAUTION

1. Insulation of some part of the circuit was done to prevent circuit bridging.
2. A digital meter was used to test the readings of the expected output values at certain points of the circuit.
3. Soldering was done with maximum care to prevent burns and damage of the component(s) in use.
4. Integrated circuit sockets were used to reduce risk of damage to the IC in the case of troubleshooting the circuit.

5.3 RECOMMENDATIONS

1. The use of an alarm system could be incorporated to indicate the completion of the device's task

2. The device should be made to work automatically

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