DESIGN AND CONSTRUCTION OF A SEQUENTIAL SEVEN SEGMENT DISPLAY

OLANIPEKUN ABAYOMI SEGUN 2003/15434EE

Department of Electrical and Computer Engineering Federal University of technology Minna, Niger State

NOVEMBER, 2008

DESIGN AND CONSTRUCTION OF A SEQUENTIAL SEVEN SEGMENT DISPLAY

OLANIPEKUN ABAYOMI SEGUN 2003/15434EE

A Thesis Submitted to the

Department of Electrical and

Computer Engineering, Federal University of
Technology, Minna, Niger state.

NOVEMBER, 2008

DECLARATION

This is to certify that this project "Design and construction of a sequential seven segment display" was carried out by Olanipekun Abayomi Segun with registration number 2003/15434EE under the supervision of Mr.Adamu murtala B.Zungeru for the award of bachelor of engineering (B.ENG) Electrical/Computer Engineering department, Federal university of Technology Minna, Niger State

	06A) 13/11/09
OLANIPEKUN .A. SEGUN	(Signature and date)
(Name of Student)	
	All 12hVJ8
Mr. A. M. B ZUNGERU	(Signature and date)
(Name of Supervisor)	
	•
Dr. Y. A. ADEDIRAN	(Signature and date)
(Name of H. O. D)	
(Name of External Examiner)	(Signature and date)

DEDICATION

I appreciate God almighty for making me get this far in the times of my life. This project is ledicated to my deceased father and sister, my family, extended family for their care and encouragement, also to my loved ones.

ACKNOWLEDGEMENT

My sincere gratefulness goes to Almighty God who makes me walk through the valley and shadow of FUT Minna without any evil and lead me in the path of the righteousness for his name's sake.

My innermost gratitude goes to my parents Dr and Mrs. Olanipekun, Mr. and Mrs. Adulola, Mr. and Mrs. Omoyeni and Barrister Ola Olanipekun for their inspiration, motivation, prayer and financial support in making my academic pursuit come to reality.

My gratitude goes to my beloved Brothers and Sisters Eng Olu, Bimbo, Tokunbo, Bisi and Toyin for their support and encouragement.

l also appreciate the love from my cousins and nephews Femi, Funmi, Layi, ayodeji, Kola, Kunle, Yetunde, Ope, Austine, Ibukun, Tolu, Adura, Yinka, Tobi, Tinu and Tomiwa.

However, I'm thankful for the love and care from my Melody, Sade Olorunfemi your love can't be replaced, thanks so much.

My profound gratitude goes to my supervisor Engr. Adamu M.B Zungeru, who makes my project work a success. Thanks to all my lecturers who has contributed directly or indirectly to the cause of my studies.

FUT Minna wouldn't have been rosy without the love from my homeboys and friends Olaolu, Fishey, Neyo, Martins, Wale, Bukky, Dayo-guru, Sador, Viktor, Nature, Mike, spoilt kid, Ese, Grace and those I May forget to mention for their support.

I acknowledge all Undergraduates and I also extend my love to all Man "U" fans, stay cool.

ABSTRACT

This project work is a light dependent and sequentially controlled of a designed and constructed sequential lighting system. The nature of the system allows the use of any other LED based data signal to be displayed and controlled. This involved the use of 555 timers, which activates the flashing of light, which is in a serial or in a parallel out logic device to beep in a pattern corresponding to each clock pulse.

For this project seven-segment display which formed ELECTRICAL as the alphabet to be displayed in parallel so that any serial pulse (signal) generated by astable multivibrator corresponding to the common anode connected to the 12V power supply that will give a corresponding parallel output is responded by the variable resistor connected to give a desired flashing rate in a sequential mode.

The sequential seven-segment system was designed, constructed and tested

TABLE OF CONTENT

CONTENT

Title pa	agei-ii
Certific	cationiii
Dedica	itioniv
Ackno	wledgementv
Abstra	ctvi
Table	of contentvii
Chapt	er One:
Introd	luction
1.0	General introduction]
1.1	Aims and Objectives2
1.2	Significance of project3
1.3	Scope of Project3
Chap	ter two
Litera	ature Review
2.1	Introduction4
2.2	Overview of lighting system4
	Sequential lighting system5
222	Sequential seven segment lighting system

Chapter Three:

Circuit	design	and	Ana	lysi	İS
---------	--------	-----	-----	------	----

3.1	Introduction	7
3.2	Design Analysis	7
3.2.I	Power Supply Stage	8
3.2.2	2 Oscillator Stage	11
3.3	Transformer	13
3.3.	l Transformer Action	13
3.4	Diodes	14
3.5	Voltage Regulation	15
3.5.	1 LM317 regulator	15
3.6	IC Timers	17
3.7	Charging Capacity	20
3.8	Statement Of Time Constant	22
3.8.	1 Statement 1	23
3.8.	2 Statement 2	23
3.8.	3 Statement 3	24
3.9	Transistors	
3.10	The Light Emitting Diode (LED)	25
3.1		27
3.1		
3.1	3 Circuit Diagram	30

Chapter four:

Construction	and	Testing
--------------	-----	---------

4.1	Introduction31
4.2	Testing31
4.3	Implementation32
44	Construction33
4.5	Problem Encountered34
Chap	oter Five:
	clusion and Recommendation
	Conclusion35
	Recommendation36
Refe	rence37

CHAPTER ONE

INTRODUCTION

Technological advancement in microelectronics has led to the development of semiconductor devices. This breakthrough in the field of electronics has made industrial and domestic process much easier. This in turn, has supplemented human facilities and ability to observer, perceives, communicates rememember, calculate or reason. Electronics systems are classified as either analogue or digital.

Analogue system change their signal output linearly with the input and can be represented on a scale by means of a pointer. On the other, digital instrument and circuit represent their output as discrete levels ['1','0'] and could show their output in a digital display either numerically or alphabetically.

Lighting schemes are classified in various forms such as direct lighting, indirect, semi-direct lighting, semi-indirect lighting and general diffusing system. All these explain the various ways at which the lighting system can be used to better off the life of human beings.

The sequential seven-segment lighting system control is purely a digital device and opens up a new range of lighting effect for devices, stage effects and commercial displays and billboards e.t.c it will no doubt find many other for advertisement and

Passing a message across. The sequential seven segment lighting system has an oscillating circuit, which sets the speed of the sequence of the flashing or beeping.

The logic control of the movement could be achieved by programming a memory device like a microprocessor or microcontroller or using discreet logic circuits. The use of the microprocessor is only economical where very complex sequence are to be achieved, hence discreet logic circuits were found to suffice for the application.

The flashing or beeping of the sequence is used to control a seven segment lighting system and effects at night, inside a car, at the sitting room or any convenient place is overwhelming. For this project ELECTRICAL will be engraved and the sequence will illuminate it in flashing mode.

The sequential seven segment lighting system is made up of four stages;

- 1. Power supply
- 2. The voltage regulator
- 3. Variable frequency oscillator
- 4. Seven segment display

1.1 AIMS AND OBJECTIVES OF THE PROJECT

Signpost has been in use for a period of time and hence led to a lot of limitation more especially at night.

Since research has shown that human eye responds rapidly to charging of lights and moving lights especially at night, therefore the aim of this project is to design an electronic system that can eliminate this setback of metallic signpost and price list in supermarkets.

Sequential seven segment lighting system can be use as a signpost, welcoming or indicator to a particular thing or as price list in bookshops and supermarkets, therefore they are reliable, durable, faster and efficient.

1.2 SIGNIFICANT (IMPORTANCE) OF THE PROJECT

Sequential seven segment lighting system attracts attention more compared to metallic signpost, prize list or indicator used in several places. They can be used in places hidden to public or at sell shelves so that a person with disability of sight can easily view the content of the display without much stress.

Sequential seven segment lighting system finds application in areas such as:

- 1. Ministries or offices where each office at the door or on the desk will take the name of the officer in charge.
- 2. In a car dash board to display the exact words needed by the owner.
- 3. Supermarkets sell shelves to display amount, names of each item on a shelve.
- 4. Signpost for direction or notification.
- 5. Digital clock to be used in offices, homes, cars e.t.c when the system is modified.

1.3 SCOPE OF THE PROJECT

This project has been undertaken to design and build a sequential lighting system. The design of this project is in such a way that ,it displays any word needed to be displayed.

But in this project a seven-segment display shall be used for the display of ELECTRICAL.

CHAPTER TWO LITERATURE REVIEW

2.1 INTRODUCTION

There have been a lot of innovations and inventions in the field of electronics.

Lighting system have also undergone such evolution from automotive lighting system, sequential lighting systems using LEDs, ASCII to the recent modification of lighting system by using seven segment display system. The background of the seven segment lighting system can be link to the achievement in modern electronics. Almost all electronics consists of semiconductors devices or integrated circuits (IC) in one stage or more

The discovery of solid-state device in the mid 19th century led to the construction of the practical diode by J.A Fleming. The diode is used as pn devices that allows current flow in only one direction among other uses [3]. Semiconductor diodes were also use for lighting system. The need for substitutes to electrical bulbs in automotive lighting system led to the modification of the pn diode. The result of this modification was a transistor (i.e transferresistance). J. Bardeen, W. Brattain, invented the transistor in 1948 and W. shockey [3]

The lighting systems are made from one or more of the devices mentioned above. The design of the lighting system is in such a way that its efficiency, realibility and speed are high.

2.2 OVERVIEW OF LIGHTING SYSTEM



Lighting system is a tight dependent and sequentially light controlled system. The broad nature of this system makes it possible for any other led based data or signals to be displayed and controlled

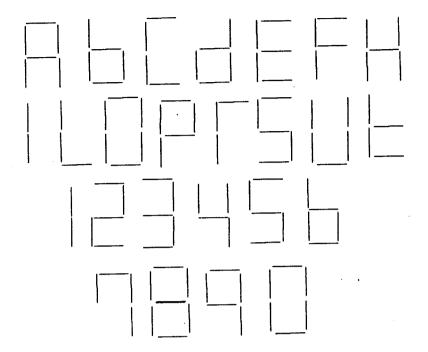
2.2.1 SEQUENTIAL LIGHTING SYSTEM (using pure LED).

This type of lighting system involves the use of shift register which activate the movement of light which is a serial in parallel out logic device to shift in a pattern corresponding to each clock pulse. It uses LED to form any kind of display required by the designer as he connects the LEDs in parallel so that any serial pulse (signal) generated by a stable multivibrator a corresponding parallel output is responded by shift register to shift the alphabet in a sequential mode.

Adebola (2004) designed and constructed a sequential lighting system that uses light emitting diodes (LED) to emit light when biased in forward direction. He constructed sequential lighting system that displayed FUTMN, and also rectified signal was used to drive a 555 timer which form the timing circuit [6]

2.2.2 SEQUENTIAL SEVEN SEGMENT LIGHTING SYSTEM

The sequential seven segment lighting system allows the display of a non alterable arrangement of alphanumeric characters, using standard seven segment display, without the associated decoders. The displays are wired with their appropriate segments connected to Vcc, in this case of a common cathode display, or the appropriate segment connected to ground in the case of common anode device. Different digits or characters can be displayed based on the maximum possible obtainable from the standard of seven segment display as laid overleaf.



The above digits are the possible outcome characters in seven segment display.

Another type of sequential seven segment lighting can be constructed by using numeric to achieve a digital clock.

In the construction of the sequential seven segments lighting system a desired effect was choosing on how the letters or alphabets will display. For this work flashing or beeping mode is choosing, in which the alphabets ELECTRICAL will be displayed on the arrangement. Is either ON/OFF at a rate determined by the user, by modifying the frequency of a square wave controlling a transistor that supplies a fixed voltage to the seven segment display.

CHAPTER THREE

CIRCUIT DESIGN AND ANALYSIS

3.1 INTRODUCTION

Semiconductor devices and integrated circuit (ICs) are not ideal so, they impose significant limitations on design. For a design therefore to be successful, there must be good understanding of the characteristic of these basic practical components. Also in the selection of a particular component for a specific purpose, the principle of operation of each component that must be considered. Then various devices and component that would suit different circuit are selected.

3.2 DESIGN ANALYSIS

The sequential seven segment lighting system is made up of five basic stages. This part contains the record of how the design parameters were calculated and how the components were selected. The block diagram of the sequential seven segment lighting system is shown below.

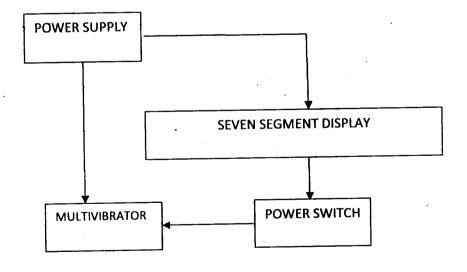


Fig 3.2 simplified block diagram of sequential seven segment lighting system

3.2.1 POWER SUPPLY STAGE

Most electronic devices and circuit require a dc source for their operation. Since the most convenient and economical source of power is the domestic ac power supply. It is advantageous to convert this alternating voltage (usually 220V) to dc voltage. This process of converting ac to dc. Voltage is called rectification. Rectification is achieved by using diodes, the rectified voltage has some sinusoidal components known as ripple. To eliminate the ripple, filtering circuits are used.

The power supply used in this project work consist of a 240/12v transformer, an LM 317T adjustable voltage regulator and a shunt filtering capacitors (2200 μ f, 0.1 μ

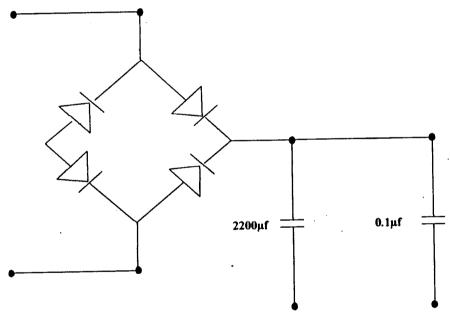


Fig 3.2.1 A circuit diagram of power supply stage;

The transformer used I this project has a turn ratio of 20:1 (i.e. Np: Ns=20:1), where;

N_p number of turns in primary winding

N_p primary winding voltage

N_s secondary winding voltage

Assuming the a.c main voltage 240v

$$\frac{V_s}{V_p} = \frac{N}{N_p}$$

Where V_s = secondary winding voltage

 $V_p = primary winding$

$$V_s = \frac{N_s}{N_p} \times V$$

20

$$= 12V$$

Therefore the voltage across the bridge rectifier is 12v that is V_s but

$$V_s = V_{rms} = 12V$$

Therefore

Peak Voltage $V_{sm} = \sqrt{2} \times 12$

=16.97v

 $V_{sm} = 17v$

Furthermore the rectifier is designed with four diodes to form a full wave bridge network, C_1 , C_2 and C_s from the later figure are the filter capacitor and they are inversely proportional to the ripple gradient of the power supply.

The fig:3.2.1b shows the ripple gradient.

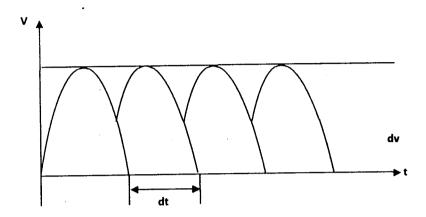


Fig 3.2.1.b ripple gradient of power supply stage.

Where dv is the ripple voltage for time dt, dt is a dependent in power supply frequency for the obtained peak voltage 15% makes dv = 2.5

$$\frac{1}{C} = \frac{dv}{dt}$$

i.e.
$$dv = 15 \times 16.97 = 2.5$$

$$C = \frac{dt}{dv}$$

$$= \frac{10 \text{ms}}{2.5}$$
 (where dt = 10ms for 50Hz from standard value from the data sheet)

$$C=2222.8\mu f$$

A preferred value of $2200\mu f$ was employed for the power supply stage. An LM 317T regulator was used for the power supply also.

3.2.2 OSCILLATOR STAGE

This is a 555-aslable oscillator, which generates clock pulse to the input voltage to the LM317T regulator and also connected to the seven segment display.

The oscillator frequency is set at different frequency by varying the variable resistor R_{b2}

The fig: 3.2.2 is the oscillator circuit.

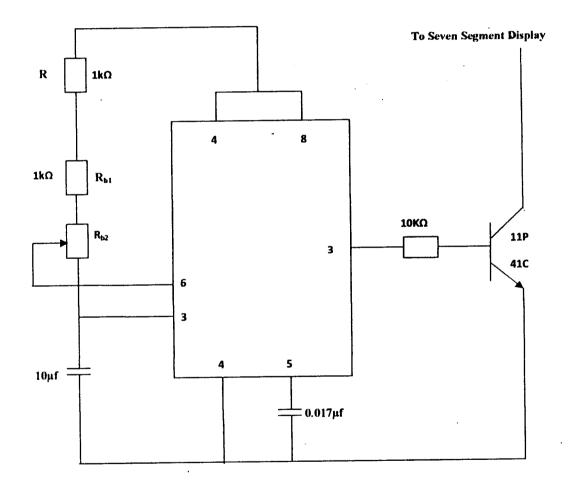


Fig 3.2.2 oscillator stage

The frequency of a 555-astable oscillator shown in fig 3.2.2 is given by

$$F = \frac{1.44}{(R_a + 2R_b)C}$$

Where

R_a, is the resistance between supply and pin 7

R_b, is the resistance between pin 7 and (6&2) and

 R_a was made variable so that various frequency could be generated and have different flash rate by extension R_b is composed of a fixed part R_{b1} and variable part R_{b2} such that

$$R_b = (R_{b1} + R_{b2})$$

At R_{b2} with minimum resistance for instance (1k Ω) only R_{b1} exist in the circuit, thus the output frequency of which is

$$F = \frac{1.44}{(Ra+2Rb)C}$$

$$= \frac{1.44}{(1000+2000)10\times10^{-6}}$$

$$=\frac{1.44\times10^6}{30000}$$

$$F = 48Hz$$

With R_{b2} a maximum resistance of say (100 Ω)

$$F = \frac{1.44}{[10000 + 2(1000 + 100000)]10 \times 10^{-6}}$$

$$F = \frac{1.44}{[1000 + 202000]10 \times 10^{-6}}$$

$$= 0.7094$$

$$F = 0.71Hz$$

It is observed that at minimum R_{b2} the frequency is high while at maximum R_{b2} the frequency is low, that gives a different rate of flashing on the display.

3.3 TRANSFORMER

The alternating current transmission and distribution system have developed largely because of the transformer. An alternating voltage can be increased and distributed for industrial or domestic use. It works with very little power loss with efficiency of 97% to 98%.

3.3.1 TRANSFORMER ACTION

Consider the simplest form of single-phase transformer in which there are two coils wound anda ferrous core. Usually, the coil, which is connected, to supply is called primary (p) and that which is connected to the load is the secondary. Transformers are completely reversible, that is, power can flow in either diction and transformation of voltage applied to primary circulates an alternating flux. Depending on the amount of coil or turns on the primary (p) and secondary (s) side we can get an output thus, if p > s, it is step down transformer. If p > s, it is a step- up transformer.

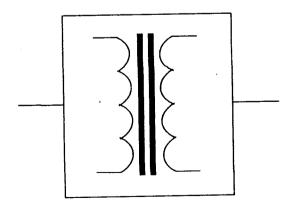


Fig 3.3.1 schematic diagram of a Transformer.

3.4 DIODES

Diodes, these are p-n device, which allow current flow in only one direction, it has two terminals known as anode and cathode.



Fig 3.4a Diode

The cathode is usually marked with a colored mark, when the diode is forward biased, that is, if the applied voltage is positive on the primary side, it opposes the contact potential and then reduce the height of the potential barrier. It begins to conduct with only a small power voltage which makes the n side more positive as indicated in the diagram below, the barriers is increased only when a negligible smallm leakage current flows through the device until the reverse break down voltage is reached. However, in small operation the reverse biased voltage should not reach the breakdown rating.

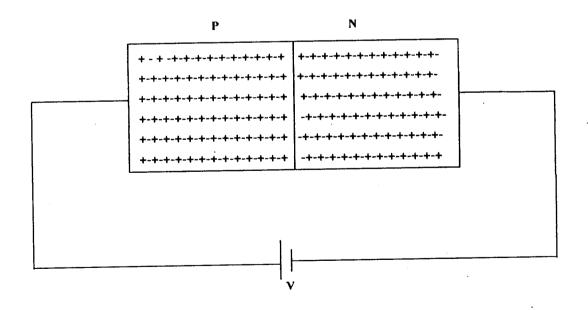


Fig 3.4b Forward Biased

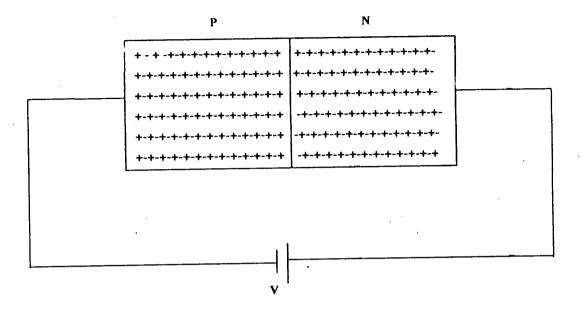


Fig 3.4c Reverse Biased

3.5 VOLTAGE REGULATIONS (LM 317T)

This is measure of a circuit ability to maintain a constant output voltage even when either input voltage or load current varies. A Zener diode when working in the breakdown region can serve as a voltage regulator. The sample voltage is compared to a zener and the current is adjusted until V sample = V zener + 0.06v or the 78 xx series can also serve as voltage regulator where xx stands for the output voltage fro the IC regulator.

3.5.1 LM 317 VOLTAGE REGULATOR

The LM 317 series of adjustable 3-terminal positive voltage regulators is capable of supplying in excess of 1.5A over a 1.2V or 37V output range. They are exceptionally easy to use and reguire only two external resisitors to set the output voltage. Further ,both line and load regulations are better than standard fixed regulators. Also, the LM 317 is packaged in standard transistor packages, which are easily mounted and handled.

In addition to higher performance than fixed regulators, the LMM 317 series full overload protection available only ICs. Included on the chip are current limit, thermal overload protection and save area protection. All overload protection circuitry remain fully functional even if the adjustment terminal is disconnected.

Normally no capacitors are needed unless the device is situated more than six inches from the output filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejections ratios, which are difficult to achieve with standard 3-terminal regulations.

Besides spacing fixed regulators, the LM 317 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input to output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, i.e, avoid short circuiting the output.

Also, it makes an especially simple adjustable switching regulator, a programmable ouput regulator or by connecting a fixed resistor between the adjustable pin and output, the LM 317 can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground, which programs the output to 1.2V where most loads draw little current.

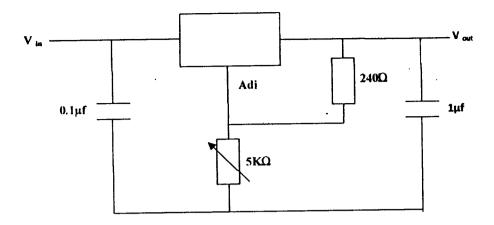


Fig 3.5.1 1.2V -25V Adjustable regulator.

In operation, the LM 317 develops a nominal 1.25V reference voltage, V_{ref} between the output and adjustment terminal. The reference voltage is impressed across program resistor 240Ω and since the voltage is constant current then flows through the output set resistor of minimum value $5k\Omega$, giving an output voltage of

$$V_{out} = V_{ref} [1 + R_2/R_i]$$

3.6 IC TIMERS

The emanation of IC timers eliminated a wide range of mechanical and elecromechancal timing devices. It also helps in the generation of clock and oscillator circuits. Timing circuits are those, which will provide an output charge after predetermined time interval. This of course the action of the monostable multivibrator, which time delay after a fraction of a second to several minutes quit accurately.

The most popular of the present IC, which is available in an eight pin dual-in-line package in both bipolar and CMOS form. The 555 timers is a relatively stable IC cable of being operated as an accurate bistable, monostable or astable multivibrators.

The timer comprises of 23 transistors, 2 diode and 16 transistors in its internal circuitry. Its functional diagram is shown below.

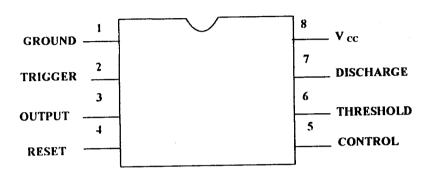


Fig 3.6a 555-timer pin orientation

The functional diagram consist of two comparators, a flip flop two control transistors and a higher current output stage. The two comparators are actually operational amplifier that compare, input voltage to internal reference voltages which are generated by internal voltage divider of three 5K resistors. The reference voltage provided and one third and two thirds of V_{cc} . When the input voltage is either of the comparators, which is higher than the reference voltage for comparators; the amplified goes to saturation and output signal to trigger the flip-flop. The output of the flip-flop controls the output stage of the timer. The 555 timer chip works from a dc supply between 3V to 15V and can source or sink up to 200mA output. The operation of the 555 timers is further defining the function of all the pins. The details regarding connection to make to pin are as follows.

current of minimum value of 0.1A must be supplied to this pin since third determines the maximum value of resistance that can be connected between the positive side the supply and this pin. For a 15v supply the maximum value of resistance is 20m.

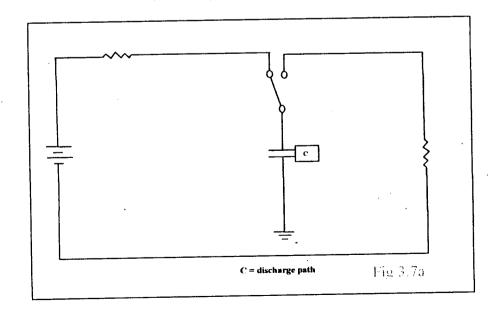
Pin 7: This is the discharge pin. It is connected to the collector of an NPN transistor while the emitter is grounded. Thus the transistor is turned ON and pin 7 is efficiently grounded.

Usually the external timing capacitor is connected between pin 7 and is thus discharged when the transisitor goes on.

Pin 8: This is the power supply and is to the positive of the supply. The voltage applied may vary from 4.5 to 16v although devices, which operate up to 18v, are available.

3.7 CHARGING CAPACITY

The circuit arrangement of figure 2.12 below shows a capacitor, which may be charged through a high resistance R from a battery of V volts, when the switch S is connected to terminal [A] C is charged but when it is connected to [B] C-is short-circuit through R and is thus discharged, the voltage across the capacitor n plates continually being measured by the use of a voltmeter.



Pin 1: This is the ground pin and should be connected to the negative side of the supply voltage.

Pin 2: This is the trigger input. A negative going voltage pulse applied to this pin¹ when falling below 1/3 Vcc causes the comparator output to charge state. The output level then switches from low to high. The trigger pulse must be of shorter duration than time interval set by the external CR network otherwise the ouput remains high until trigger input is driven high again.

Pin 3: This is the output pin and is capable of sinking or sourcing. A load requiring up to 200mV and can drive TTL circuit. The output voltage available is approximately 1.7v

Pin 4: This is the reset pin and is used to reset the flip-fop that controls the state of output pin 3. Reset is activated with a voltage level between 0v and 0.4v and forces the output low regardless the state of the other flip-flop inputs. If reset is not required, then pin4 should be connected to same point as pin8 to prevent accidental resetting.

Pin 5:This is the control voltage input. A voltage applied to this pin allows the timing variation independently of the external timing network. Control voltage may be varied between "45 to 90" of the Vcc value in monostable mode. In a stable mode the variations is fro 1.7 to the full value of supply voltage. This pin is connected to the internal voltage divider so that the voltage measurement from here to the ground should read 2/3 of the voltage applied to pin8. If this is not used it should be bypassed to ground ,typically use a 10μf capacitor. This helps to maintain immunity from noise. The CMOS ICs for most application will not require the controlled voltage to be decoupled and it should be left unconnected.

Pin 6: This is the threshold input. It rests flip-flop and hence drives the output low, if the applied voltage arises above two-third of the voltage applied to the pin 8. Additionally, a

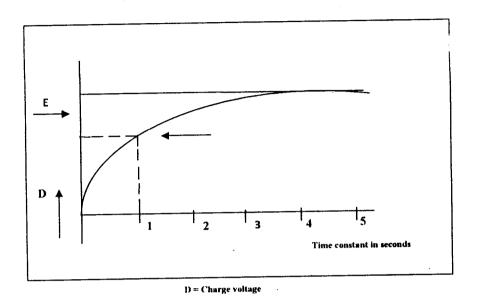


Fig 3.7b

E = Applied voltage

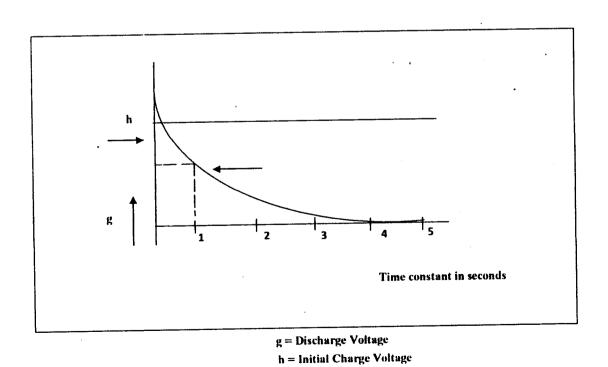


Fig 3.7c

The voltage across c does not rise to 60v instantaneously but builds up slowly. Charging current is maximum at the start i.e. when C is uncharged the I gradually increase and finally covers over p.d. access capacitor plated become equal and opposite of that of the battery.

3.8 STATEMENT OF TIME CONSTANT

Just at the start p.d across the capacitor is zero, hence applying Kirchhoff's law,

 $V_s = V_r + V_c$, but $V_r = 1R$ current flowing in the circuit is related to the voltage across the capacitor by

$$I = C[dv/dt]$$

Simple elimination then yields

$$V_5 = RC_d V_c + V_c$$

 D_{ι}

Introducing the time constant C as f;

$$F = CR$$

If V_s is a constant i.e. independent of time, then a particular solution of V_c can be found by $V_{cp} = V_s$, the homogenous solution is found by setting the source term to zero and solving the resulting homogenous different equation.

Dv
$$dv + V_{ch}/f+0$$

Dt

$$V_{ch} = V_s + Cle^{-vf}$$

$$V_c = V_{cp} + V_{ch}$$

$$= V_s + Cle^{-vf}$$

This is equivalent to showing that the voltage across the capacitor is zero initially $V_{\rm c}[0]$

$$[0] = Q[0]/C = 0$$
. This implies

Cl = -Vs; therefore, $Vc = V[1-e^{-\nu t}]$. If this rate of rise were maintained, then the time of voltage V would have been CR. This time is known as the time constant of the circuit.

STATEMENT 1

The time constant of an RC circuit is defined as the time during which voltage across capacitor would have reached its maximum value V had it maintained its initial rate of rise.

Also, form
$$V_c = V[1-e^{t/r}]$$

We find that if t = f then,

$$VC = V[1-e^{t/\Gamma}]$$

$$=V[1-e^{tf}]$$

$$= 0.0632v$$

STATEMENT 2

The time constant may be defined as the time during which capacitor voltage actually rises to 0.632 of its final steady value. Also, from

$$1 = V/Re^{-tT}$$

=
$$Lne^{-t \cdot f}$$
 by put $t = f^1$, we get

$$1 = Lne^{-trf}$$

$$= Lne^{-1}$$
 $= Ln/2.718$

1 = 0.371h

STATEMENT 3

The time constant of a circuit is also the time during which one charging current falls to 0.37 of its initial maximum value

3.9 TRANSISTORS

Transistors are active components used basically as amplifiers and switches. The two main type of transistors are the bipolar transistors whose operation depends on the flow of both minority and majority carriers and the unipolar or field effect transistors[called FETs] in which the current is due to majority carries only (either electrons or holes). The transistor as a switch operates in class A mode. In this mode of bias, the circuit is designed such that current flows without any signal present. The value of bias current is either increased or decreased about the mean value by the input signal (if operated as an amplifier) or ON and OFF by the input signal (if operated as-a switch)

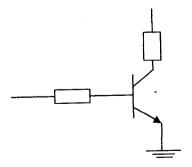


Fig 3.2.7 Transistors is a switch

For the transistor configuration, since the transistor is biased to saturation

 $V_{ee} = 0$ when the transistor is ON which implies that

$$V_f = I_C R_C + V_{CC}$$
 2.5

$$V_{in} = I_B R_B + V_{BE}$$

$$l_{C} = h_{fe}$$
 -----2.7

 1_{B}

Where:

 $l_C = collector current$

 l_b = base current

V_{in}= input voltage

V' =supply voltage

V_{ce}= collector emitter voltage

hse = current gain

3.10 THE LIGHT EMITTING DIODE (LED)

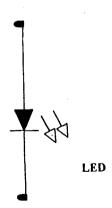


Fig: 3.2.8aLED

The LED is a pn junction device that emits light when biased in a forward direction. They are frequently used as pilot lights in electronics appliance to indicate whether the circuit is closed or not. The light emitted can either be invisible (infra red) or can be light in the visible

spectrum. The flat side of the bulb or the shorter of the two wires extending from the LEDs is the negative end and should be connected to the negative side of the battery LEDs operate relatively at low voltage between 1 to 5volts and draw current of about 10 to 50 mA. Voltages and current substantially above these values can melt an LED chip. From our cause of study the LED has two region separated by a function. The P region is dominated by positive charges the n-region by negative elective charges. When a voltage is applied and the current starts to flow ,electron in the n-region have sufficient energy across to move across the junction into the p region. Once in the p-region, the electrons are immediately attracted to the charges due to the mutual coulomb forces of attraction between opposite elective charges. Each time an electron recombines with a positive charge.

Elective potential energy is converted into electro-magnetic energy. A quantum of electro-magnetic energy is emmite in the form of photon of light. Different colored LEDs emit predominantly light of a single colour. The energy (E) of the light emitted by an LED is given as: E = qv

Where q = electric charge of an electron = -1.6×10^{-19} C

V = voltage required to light the LED

Therefore, to find the energy required lighting the red LED:

$$ER = 1.6 * 10^{-19} C$$
 * voltage across red LED = $1.6 * 10^{-19} * 1.99$

$$= 3.18 * 10^{-19}$$
 joules

The frequency of light is related to wavelength of light. A spectrometer is used to examine the light from the LED and to estimate the peak wavelength of the LED.

F = c/a

Where $c = \text{speed of light} \quad 3*10^8 \text{ m/s}$

A wave light of light red from the spectrometer (in units nanometer)

3.11 SEVEN SEGMENT DISPLAY

The selected seven-segment display is a common anode type, the entire cathode of the ten display were connected together and taken to the 12v regulated output from the LM317T as shown below.

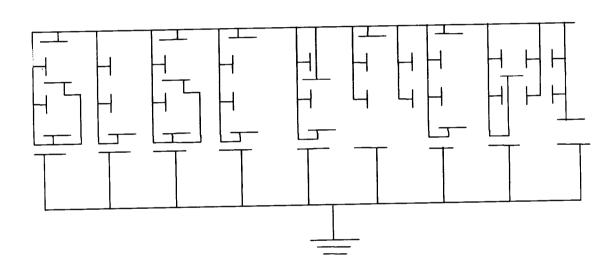


Fig 3.2.7 seven segments displayed

Fig 3.2.7 shows how the ten seven segment were arrange in serial-parallel to give the desired output ELECTRICAL. The ten cathodes were also connected and taken to the collector of a TIP 41C power transistor whose base current is controlled by an astable oscillator

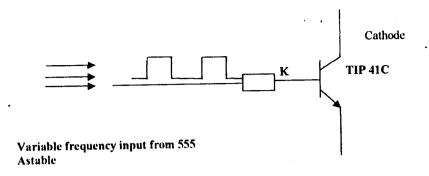


Fig: 3.2.7b TIP41C

The alternate high and low portions of the square waveform drive the transistor ON and OFF by sourcing or cutting off the base drive to TIP41C. This electronic make and break or ON and OFF cyclically repeating operations of the transistor causes a discontinuous current flow in the ten displays, forcing them ON and OFF. This produces the flashing effect.

3.12 CIRCUIT OPERATION

The project work provides a simplified means of providing a pulsed display for a seven segment display wired to generate a desired alphanumeric pattern.

The display pulsing is achieved by rapidly switching ON and OFF the LED segments. A variable frequency square-wave oscillator with a user adjustable display pulsing control generates the switching pulses.

The generated square-wave output drives an NPN transistor, causing it to be either saturated or cut-off, depending on the 555 oscillator.

A variable display pulse rate is affected by adjusting a resistance that is part of the frequency determining components. Actually, R_B'S varied, and since this is directly a part of the relation.

$$F = 1.44$$

$$(R_A + 2R_B)$$

Varying R_b changes the frequency, and the rate at which the display pulses

LIST OF COMPONENT USED

C_1	35V/2200μf
C_2	0.1μf
C_3	25V/47μf
C ₄	0.047µf
C ₅	50V/10μf
R_1	220Ω
R_2	132Ω
R_3	10Ω
$R_4 = R_5$	ΙΩ
R ₆	Variable resistance
IC ₁	Bridge Rectifier
1C ₂	Voltage Regulator (LM317T)
IC ₃	555 Timer

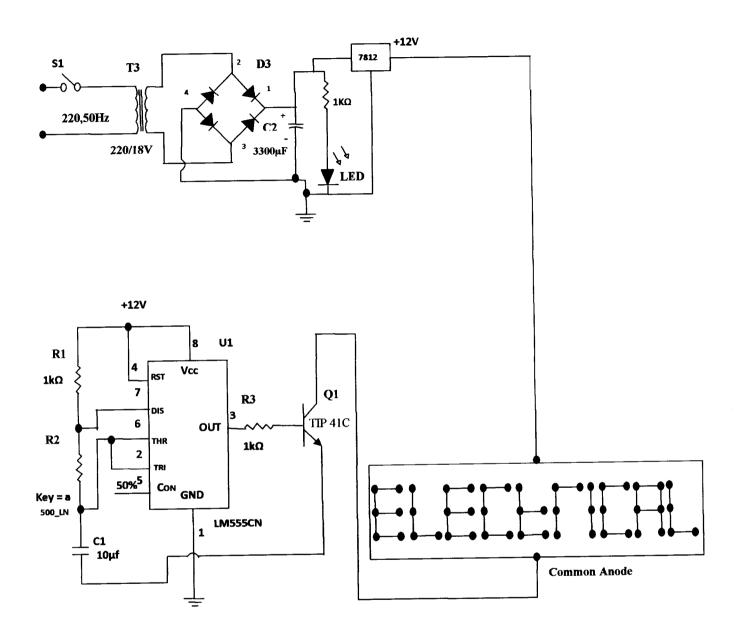


FIG 3.13 COMPLETE CIRCUIT DIAGRAM OF THE SEQUENTIAL SEVEN SEGMENT LIGHTING SYSTEM

CHAPTER FOUR

TESTING AND CONSTRUCTION

4.1 INTTRODUCTION

This chapter gives the detailed explanation of how, the circuit was constructed and also the testing and operation of the circuit. The construction was done in accordance with the specification in design. In some instances; some of the parameters calculated were adjusted and/or modified to make the circuit work properly.

4.2 TESTING

The physical realization of the project is very vital. This is where the fantasy of the whole idea meets reality. The designer will see his or her work not just on paper but also as a finished hardware.

After carrying out all the paper design and analysis, ythis project was implemented and tested to ensure its efficiency and was finally contructed to meet a desired specifications. The process of testing and implementation involved the use of some equipment stated below.

- (i): BENCH POWER SUPPLY: Here the supply voltage to the various stages of the circuit during the breadboard test before the power supply in the circuit was built, was observed. Also during the soldering of the project power supply was still used to test various stages before the d.c power supply used in the project was finally constructed.
- (ii): OSCILLOSCOPE: The oscilloscope was used to observe the ripple in the power supply waveform and ensure that all waveformb were correct and their frequencies were

accurate. The waveform of the oscillator stage used for the bridge rectifier was observed on the oscilloscope to confirm oscillation and also to confirm the frequency.

(iii): DIGITAL MULTI-METER: The digital multi-meter basically measure voltage, resistance, continuity, current, frequency, temperature and transistor life. The process of implementation of the design on the breadboard required the measurement of parameters like voltage, continuity, resistance values of the components and in some cases frequency measurement. The digital multi-meter was used to check the various voltage levels of the stages in the circuit, especially the power supply stage.

4.3 IMPLEMENTATION

The implementation of the project was done on the breadboard. The power supply was first derived from a bench power supply in the school electronic laboratory. (To confirm the work ability of the circuit before the power supply stage was soldered).

Stage by stage, testing was done according to the block representation on the breadboard before soldering of circuit commenced on Vero board. The various circuit and stage were soldered intending to meet desired workability of the project.

For proper understanding of how the system operates and allow for troubleshooting, the pin configuration of the IC's and other active components used are shown below.

Fig 4.3a shows the pin out of the 555 timers, which was used as a one astable oscillator to generate clock pulse for the counter.

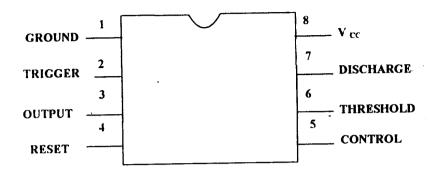
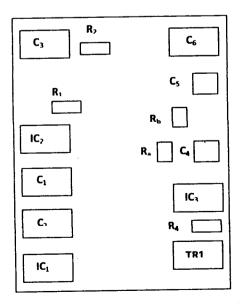


Fig 4.3a NE 555 timer pin orientation.

4.4 CONSTRUCTION

The construction of the project was done into different stages; the soldering of the circuits and the coupling of the entire project to the casing. The soldering of the project was done on a Vero board, and was soldered on a single Vero board. The power supply was soldered first before all other stages.

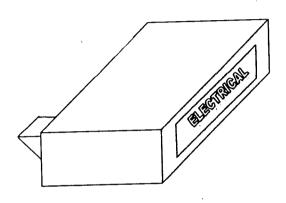
Fig 4.3a below shows the picture of the component arrangement on the Vero board.



The second phase of the project construction is the casing of the project.

This project was coupled to a plastic tile. The casing material being smooth plastic is designed with specification.

Fig 4.4b shows the isometric view of the casing



4.4 PROBLEMS ENCOUNTERED

Series of problems were encountered during the implementation, testing and construction of the project, which are as follows;

- (1) There was noise on the de-regulated supply. This must be due to small rippleson the supply. A capacitor of 47-μf was put at the output of the power supply to filter of the unwanted noise signals.
- (2) Overheating.
- (3) There was difficulty encountered during implementation of the seven segment display. The segment some fail before and after compilation but proper check was made and correct ones were used.
- (4) Other problems include soldering and measurement errors but these problems were solved proper troubleshooting serious cases in the construction of the project.

5.2 RECOMMENDATIONS

- 1. The department should standardize the practical taken by the students in the 300 and 400 levels. That will go a long way in exposing the students to the methodologies of design and construction of simple circuits. It will therefore make the students ready to face the challenges posed by project design and construction. Likewise the department should also acquire more research oriented books in the department should acquire more research oriented books in the department library, to make enough material available for students to use.
 - 2. A software of this project can be designed to enable interfacing with the pc and to increase the performance. (e.g. making the lighting system in a random mode)
 - 3. The project sequential seventh segment lighting system can be modified with additional circuit to form a digital clock counter.
 - 4 I would recommend that further work to be done on the area of microprocessor since this would add artificial intelligence to the system, reduce the possibility of error and give room for data storage.

References

- 1. WESTPORT H.S. STUTTMAN. The new Illustrated Science and invention
- 2. Encyclopedia, Vol 21, pp 459-465.
- The new Encyclopedia Britannica Volume VI (1973): Helen Hemingway Benton.
 U.S.A
- 4. GROUPER, encyclopedia Americana Vol.17 (1983), pp 380-392.
- 5. JOSEPH A.AEDMI.Introduction to Electronics circuits, New Edition (1986) 208-215.
- 6. Project work of Adebola Olubunmi Olatunji 98/7166EE
- 7. THERAJA B.E and THERAJA A.K, Electrical Technology, S.Chand and company Ltd, India, (1999), pp 1699-1720, 1734-1737, 1998-2006.
- 8. INTERNET: www.electroforu.net
- 9. INTERNET: www.electronic-labs.com

INTERNET: www.fmwllcomponents.com NISTER, Electronic circuit, Mc-Graw hill books, SI edition, pp 16-23

- 10. BERNARD GROB, Basic Electronics, 4th Edition, pp 599-630. I.I. RALPH J. SMITH, circuit Devices & systems, pp 315-322, 503-518, 590.
- 11. FLOYD L.THOMAS, Digital fundamentals, Prentice-Hall, 6th edition, (1997), pp 470-478.
- 12. PEATMAN J.B., Digital Hardware Design.(1980) pp 47-50.
- 13. HOLT C.A., Electronics circuits: Digital and Analogue (1978) pp 22.
- 14. RASHID M.A, Power Electronics Circuits Devices, and Application (Long man 1986) pp 245-248.
- 15. MITCHELL F.H., Introduction to Electronics designs (1982) pp 85-86.
- 16. RIDHARD C.D.