DESIGN AND CONSTRUCTION OF 'NECESA NOTICE BOARD' TOUCH/DARK TRIGGERED DISPLAY

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Dedication

I dedicate this work to my Lord and Saviour Jesus Christ who has been my source and support throughout my period of undergoing this programme. To him be all Glory, Honour and Adoration.

Declaration

I Oyetoro Olatunji Johnson declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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I also acknowledge the effort of my project supervisor Engr. M. Z. Adamu for his patience and encouragement even when I was slow at the work. To all my well wisher I say a very big thank you.

Abstract

The NECESA NOTICE BOARD touch/dark triggered display is a two output display consisting of sequential light emitting diode display and a group display of characters. This is a design to help attract student to read information on the notice board as the project is aimed at encouraging the culture of taking note of information on the notice board. The two outputs are from two differently triggered circuits. The two outputs are interlocked on one board as though it is one output. One of the outputs is triggered by touch through a touch sensor and the other output triggered by dark through a dark sensor. The output of the dark triggered circuit is indicated by the red light emitting diodes which has an ON time of 0.169 Sec. and OFF period of 0.1386Sec. and a frequency of 3.25Hz with duty cycle of 55%, this is implemented with the use of an LDR, while the output of the touch triggered circuit is indicated by the green light emitting diodes with an ON period of 2200Sec. which is implemented by attaching the touch sensor to the metal handle of the notice board door.

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CHAPTER ONE

1.0 INTRODUCTION

The need for dissemination of information either in advert, meeting notification or other need to pass information to the public has led to the search for a means to make this notification available. A solution made to meet this need is the invention of notice boards.

These notice boards are categorized into;

(i) Electronic boards

(ii) Non electronic boards.

This project focuses on the use of the electronic board as a means of notification and awareness for a notice board. The electronic notice board are said to be more attractive as they come in an array of alphabetic, numeric or combination of the two which are triggered in a sequential manner of character by character or in group of characters.

The design and construction of the NECESA NOTICE BOARD touch/dark triggered display is a sequential light emitting diode display. It is a design meant to build an array of alphabetic character of the form 'NECESA NOTICE BOARD'. The sequential light emitting diode display is built as a means of attraction to the notice board of the National Electrical and Computer Engineering Students Association (NECESA). This sequential light emitting diode display is to be placed at the top of the notice board. The display is designed to be triggered when the touch sensor is touched during the day and triggered by itself when it is dark. This implies that the circuit is to have both a touch and dark sensor which is an advantage to its operation. Other advantages of this display are:

(i) Effectiveness of information dissemination.

(ii) Visibility of display at night.

(iii) Attractiveness of the display when viewed e.t.c.

These among many other advantages are the attractive properties that warrant the need to implement this project.

1.1 AIMS AND OBJECTIVES

The design and construction of the NECESA NOTICE BOARD touch/dark triggered display was made to achieve the following objectives;

(1) To construct a sequential light emitting diode display triggered by either touch or darkness.

(2) To provide a means of attracting students to read information placed on the notice board.

(3) To construct a display that can be seen from a distance.

(4) Making a sequential display that will come on by itself when it is dark without requiring daily attention of an operator.

1.2 METHODOLOGY

The design of a sequential light emitting diode display can be achieved through the use of a programmed chip i.e. the microcontrollers and it can also be achieved through the use of a timing circuit. The design of the 'NECESA NOTICE BOARD' touch/dark triggered display is achieved through the use of timing circuits. The timer used is the 555 timer which could operate in both the Monostable and Astable modes. The use of the timing circuit involve the allocation of timing for the sequential display of the light emitting diodes which is determined by calculated values of external capacitor and resistor connected to the timer IC. The method of triggering this circuit is through touch and it can also be triggered by the presence of darkness. The various modules of this circuit are then soldered on a Vero board including the light emitting diodes which are arranged in alphabetic arrays.

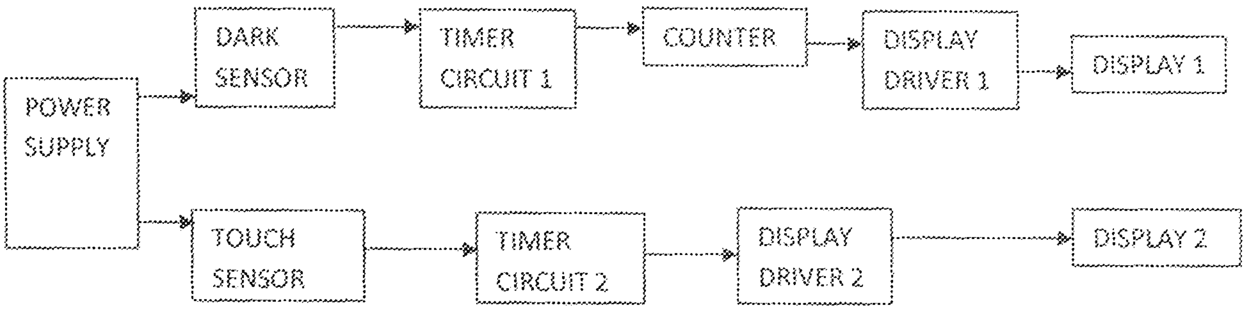


Fig. 1.1 block diagram of the NECESA NOTICE BOARD touch/dark triggered display.

1.3 SCOPE OF STUDY

The design and construction of this project has to do with the application of the knowledge of design and analysis of advanced circuits which incorporate the use of integrated circuits. The major integrated circuit is the 555 timer IC. Other components required for this sequential light emitting diode display are the light emitting diodes, transistors, resistors, capacitors, display drivers e.t.c. the design therefore requires an understanding of the mode of operation of these components, their uses and working principle. The same principles which are applied to this project can be applied to other areas such as advertisement billboards.

1.4 LIMITATION

The limitations foreseen in the project are majorly natural conditions whose application are needed for the triggering of the circuit, for example determining the level of darkness from one place to another and from one time to another. Another value of interest is the resistance value of the human body and how it defers from one person to another. Other forms of limitation lies in the limitation of the knowledge of the working principle of these components as it relates to the design of a light emitting diode sequencer, inadequate soldering skills in the soldering of the electronic components.

1.5 PROJECT OUTLINE

The project is well arranged according to the format given in the department students' handbook. The project is segmented into chapters which are from chapter one to chapter five.

The chapter one consist of the general introduction on the design and construction of the "NECESA NOTICE BOARD" touch/dark triggered display. This includes the methodology, scope of study and limitations.

The chapter two consists of the literature review which includes the theoretical background of the work. It gives an overview of the working principles of the components used.

The chapter three gives the theory and calculations in reaching the design of the project. This chapter gives the circuit diagram of the project and how the modules are connected together.

The chapter four has to do with the testing of the circuit, obtaining result from the testing and discussion of the result.

The chapter five of this project is the final chapter which includes conclusion on the project and the recommendation made.

CHAPTER TWO

2.0 LITERATURE REVIEW

The design of sequential light emitting diode displays has taken several forms ranging from 25 Light Sequencer using Xmas lamps,60 Light Sequencer using a Matrix,72 LED Clock,28 LED Clock Timer,18 Stage LED Sequencer,10 Channel LED Sequencer, Expandable 16 Stage LED Sequencer,16 Stage Bi-Directional LED Sequencer, Discrete Multistage Light Sequencer e.t.c most of this devices are made up of same basic components such as the 4017IC decade counter, 74HCT164 shift registers and the 74HCTxxx series, and the use of an amplifier or driver circuit.

In the case of the Discrete Multistage Light Sequencer, the idea is to connect the lights so that as one turns off it causes the next to turn on, and so forth. This is accomplished with a large capacitor between each stage that charges when a stage turns off and supplies base current to the next transistor, thus turning it on.

The bi-directional sequencer uses a 4 bit binary up/down counter (CD4516) and two "1 of 8 line decoders" (74HC138 or 74HCT138) to generate the popular "Night Rider" display. A Schmitt Trigger oscillator provides the clock signal for the counter. Two additional Schmitt Trigger inverters are used as a SET/RESET latch to control the counting direction (up or down). Be sure to use the 74HC14 and not the 74HCT14, the 74HCT14 may not work due to the low TTL input trigger level. When the highest count is reached (1111) the low output at pin 7 sets the latch so that the UP/DOWN input to the counter goes low and causes the counter to begin decrementing. When the lowest count is reached (0000) the latch is reset (high) so that the counter will begin incrementing on the next rising clock edge. The three lowest counter bits (Q_0, Q_1, Q_2) are connected to both decoders in parallel and the highest bit Q3 is used to select the appropriate decoder.

Considering the Expandable 16 Stage LED Sequencer, the circuit uses a hex Schmitt Trigger inverter (74HC14) and two 8 bit Serial-In/Parallel-Out shift registers (74HCT164 or 74HC164) to sequence 16 LEDs. The circuit can be expanded to greater lengths by cascading additional shift registers and connecting the 8th output (pin 13) to the data input (pin 1) of the succeeding stage. A Schmitt trigger oscillator (74HC14 pin 1 and 2) produces the clock signal for the shift registers, the rate being approximately 1/RC. Two additional Schmitt Trigger stages are used to reset and load the registers when power is turned on. Timing is not critical, however the output at pin 8 of the Schmitt Trigger must remain high during the first LOW to HIGH clock transition at pin 8 of the registers, and must return low before the second rising edge to load a single bit. If the clock rate is increased, the length of the signal at pin 9 of the Schmitt Trigger should be reduced proportionally to avoid loading more than one bit.

The 28 LED Clock Timer is a programmable clock timer circuit that uses individual LEDs to indicate hours and minutes. 12 LEDs can be arranged in a circle to represent the 12 hours of a clock face and an additional 12 LEDs can be arranged in an outer circle to indicate 5 minute intervals within the hour. 4 additional LEDs are used to indicate 1 to 4 minutes of time within each 5 minute interval. A 14 stage 74HCT4020 binary counter and two NAND gates are used to divide the line frequency by 3600 producing a one minute pulse which is used to reset the counter and advance the 4017 decade counter. The decade counter counts the minutes from 0 to

4 and resets on the fifth count or every 5 minutes which advances one section of a dual 4 bit binary counter (74HCT393).

In the 72 LED Clock circuit, 60 individual LEDs are used to indicate the minutes of a clock and 12 LEDs indicate hours. The power supply and time base circuitry is the same as described in the 28 LED clock circuit. The minute's section of the clock is comprised of eight 74HCT164 shift registers cascaded so that a single bit can be repeated through the 60 stages indicating the appropriate minute of the hour. Only two of the minutes shift registers are shown connected to 16 LEDs. Pin 13 of each register connects to pin 1 of the next for 7 registers [1].

The electronic billboard is of a big importance because of the effect so strong that it has upon human attention. Dynamic, colour electronic displays provide cost effective and eye catching advertising medium for commercial premises allowing special offers, deals or general advertising messages to be shown at the flick of a switch. In 1993, data display received the ISO 9001 certificate and has continued to strive towards quality with world class manufacturing programs [2].

Most practical light sequencer display in use today consists of those controlled by an electrically erasable programmable read only memory (EEPROM). The EEPROM is programmed by a programmer in such a way that the visual display will light in the order in which it was programmed in the EEPROM. Although, we also have other more sophisticated visual displays, a shift register could be used to display the output using light emitting diodes in place of the more sophisticated and expensive EEPROM [3].

The design and construction of the 'NECESA NOTICE BOARD' touch/dark triggered display is implemented making use of the 18 Stage LED Sequencer technique. This is however improved upon with the introduction of two modes of triggering, which are the dark triggering and touch triggering. These modes of triggering ensure that the LED sequencer does not require regular attention of a human operator.

2.1 THEORETICAL BACKGROUND

The several methods implemented in achieving these sequential LED display have a common stage to stage arrangement which is necessary to achieve the sequential LED display. These different stages are;

(i) Power supply.

(ii) Timing circuit.

(iii)Display driver.

(iv)Display unit.

(v) Trigger unit.

2.1.1 POWER SUPPLY

The power supply is made up of the electricity supply of A.C source which is averagely 230V. This 230V A.C is passed to a step-down transformer. For the purpose of this design, the voltage is stepped down to from 230V-12V, 50Hz. This transformer gives 12V A.C which is rectified through a bridge connection of diodes. The rectified used is a full bridge rectifier circuit. To achieve a smoothening effect and removing the ripples that remains in the rectified output, a capacitor of rated voltage and capacitance required for the circuit is used. The output from the capacitor is further passed through a voltage regulator integrated circuit (IC) to obtain a stable d.c voltage supply for the circuit.

Summarily, the power supply circuit module consists of the following;

(i) Step down transformer.

(ii) Rectifier circuit consisting of diodes.

(iii) Smoothening capacitor.

(iv) Voltage regulator output.

2.1.2 TIMING CIRCUIT

The timing circuit is to set the timing period of the display unit of the sequential LED display. The timing integrated circuit (IC) used and most often used to achieve the timing is the 555 timer. The integrated circuit is made of a combination of linear comparators and digital flip flops. The entire circuit is usually housed in an eight pin package. A series connection of three resistors sets the reference voltage levels to the two comparators at $2V_{cc}/3$ and $V_{cc}/3$, the output of these comparators setting or resetting the flip flop unit, the output of the flip flop circuit is then brought out through an output amplifier stage. The flip flop circuit also operates a transistor inside the 555 timer IC, this transistor collector usually being driven low to discharge a timing capacitor [4]. The 555 IC is unique in that it simply and accurately serves as a free running Astable Multivibrator, square waver generator, or signal source, as well as being useful as pulse generator. The pins configuration is pin to pin compatible from one manufacturer to the other.

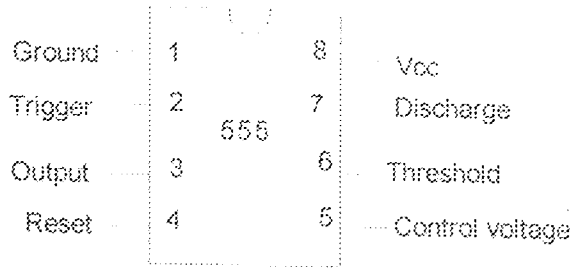


Fig. 2.1 Diagram of pin configuration of the 555 Timer IC.

It can be used with any power supply in the range of 5-18volts, this useful in many analog circuits. The 555 timer can be used as a Monostable Multivibrator (one shot), as an Astable Multivibrator, as a voltage ramp generator, as missing pulse detector, as a pulse width modulator and in many other applications. The timing is dependent on the charging and discharging of a simple RC network [5].

2.1.2.1 ASTABLE MODE OF 555 TIMER IC

The astable configuration of the 555 timer circuit uses two resistors and a capacitor to define the oscillator frequency. The voltage across the external capacitor is measured at the trigger and threshold input i.e. pin 2 and pin 6 respectively [5]. The frequency of operation of the astable circuit is dependent upon the values of R_1, R_2 and C. the frequency can be calculated with the formula

$$F = \frac{1}{K \times C\,(R_1 + 2R_2)} \qquad (2.1)$$

To obtain K, we have;

$$K = \log_e (1/(1-\eta)) \qquad (2.2)$$

Where $\eta = intrinsic\ standoff\ ratio$

$$\eta = \frac{r}{r + r} \tag{2.3}$$

$$K = \log_e (1/0.5) \tag{2.4}$$

$$K = \log_e 2 = \ln 2 = 0.693$$

Therefore

$$F = \frac{1}{0.693 \times C\,(R_1 + 2R_2)} \tag{2.5}$$

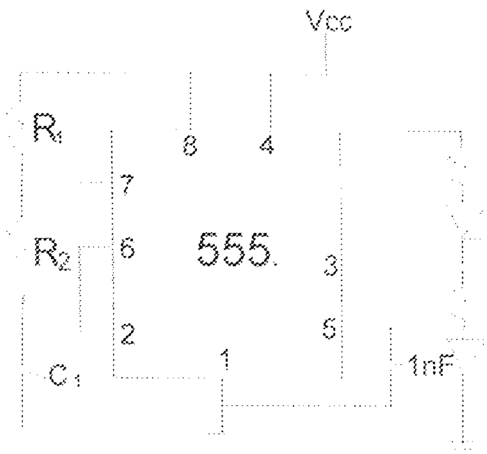


Fig. 2.2. Diagram of 555 timer Astable configuration

Frequency F is in Hz, R_1 and R_2 are in ohms, and C is in farads. The time duration between pulses is known as period, and usually designated with 't'. The pulse is on for t_1 seconds, then off for t_2 seconds. The total period t is equal to $t_1 + t_2$. That time interval is related to the frequency by the relationship

$$F = \frac{1}{t} \text{ OR } t = \frac{1}{F} \tag{2.6}$$

The time intervals for the on and off portion of the output depend upon values of R_1 and R_2. The ratio of the time duration when the output pulse is high to the total period is known as the duty cycle can be calculated with the formula

$$D = \frac{t_1}{t} = \frac{(R_1 + R_2)}{(R_1 + 2R_2)} \quad (2.7)$$

Where $t_1 = 0.693 \times (R_1 + R_2) C$ (2.8)

$t_2 = 0.693 \times R_2 \times C$ (2.9)

The duty cycle can be adjusted by varying the values of R_1 and R_2 [4].

2.1.2.2 MONOSTABLE MODE OF 555 TIMER

The monostable configuration of the 555 timer basically consists of two components which are the resistor and a capacitor. The capacitor charges through the external resistor. As soon as the charge on the capacitor equal 2/3 of the voltage supply, the upper comparator triggers and resets the control flip flop. Whenever a trigger pulse is applied to the input of this monostable mode of 555 timer, it generates a single duration output pulse. The duration of the pulse in seconds is approximately equal to;

$$T = 1.1 \times R \times C \quad (2.10)$$

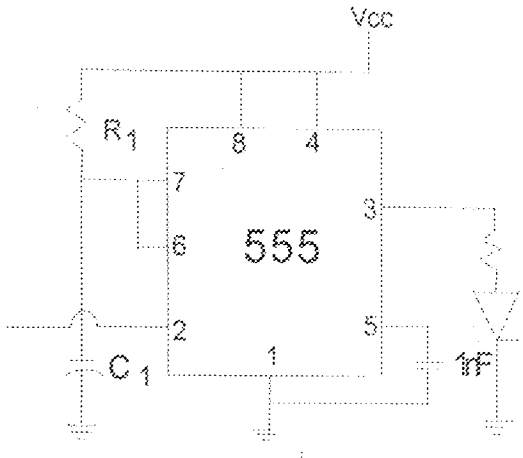


Fig. 2.3 Diagram of 555 timer Monostable configuration

The output pulse width is defined by the above formula and with relatively restrictions, timing component R(t) and C(t) can have a wide range of values.

2.1.3 DISPLAY DRIVER

The display driver is the section of the design that is used to drive the different character sections in a sequential order. The driver unit is the section that amplifies the current needed to power the entire number of LEDs used per character. To achieve this, two major components are required. These components are:

(i) Counter.

(ii) Transistor.

2.1.3.1 COUNTER

These components give the sequential arrays at which the characters are displayed. The 74LS164 IC is referred to as the shift register with eight outputs. The 74LS164 and its family are connected in several combinations to suit the required use.

The 4017 on the other hand is referred to as the decade counter with 10 decoded outputs. Small NPN transistors are used to increase the output current for the LEDs [1]. This 4017 IC can also be cascaded to obtain more than ten outputs as is the case of this project.

2.1.3.2 TRANSISTOR

The transistor is used to achieve current amplification in order to drive the group of LEDs. The choice of transistor is the bipolar junction transistor which is used in two broad areas as a linear amplifier to boost or amplify an electrical signal or as an electronic switch [6]. The common emitter amplifier is the most usual way of connecting a transistor amplifier which provides both current and voltage gains and therefore provide the best power gain. Another configuration is the common collector which produce current gain but nearly equal to unity voltage gain. The third configuration of the bipolar junction transistor is the common base configuration which provides voltage gain but nearly equal to unity current gain [7].

2.1.4 DISPLAY UNIT

This is basically the output of the entire circuit which consists of an array of LEDs. These LEDs are triggered directly from the display driver unit. The LEDs forms the alphabetic characters needed for the display and these characters are triggered in a sequential or group mode as the case may be. Important to note in the display unit are:

(i) LED connection (parallel & series).

(ii) LED specification.

2.1.4.1 LED CONNECTION

The LEDs are connected in basically two orientations which are the parallel and series connection.

Fig.2.4. Symbol of a light emitting diode

2.1.4.1.1 PARALLEL ORIENTATION OF LEDs

To form each of the characters needed for the display, the connection used is the parallel connection. It is therefore needed to determine the value of resistor needed to connect in series to the parallel connection of LEDs in order to limit the current flowing through the LEDs. This is done to avoid damage on the LEDs.

2.1.4.1.2 SERIES ORIENTATION OF LEDs

The series connection of LEDs involves the cathode to anode connection of the LEDs. All the LEDs connected in series pass the same current. The series connection of LEDs also requires a resistor connected in series with it [8].

2.1.4.2 LED SPECIFICATIONS.

LEDs are available in a wide variety of sizes and shapes. The standard LED has a round cross section of 5mm diameter and this is probably the best type for general use, but 3mm round LEDs are also available. Round cross section LEDs are frequently used and they are very easy to install. They also come in a variety of colours. Viewing angle is also a peculiarity to LEDs. The viewing angle illustrates how much the beam of light spread out. Standard LEDs such as ECG 3020, ECG3024, ECG3021 e.t.c. have a viewing angle of 60°. Below is a table of a more comprehensive specification [9].

Table 2.1 Specification Of Some Light Emitting Diodes.

Type	Colour	I_f max	V_f typ	V_f max	V_R max	Luminous Intensity	Viewing Angle	Wavelength
Standard	Red	30mA	1.7V	2.1V	5V	5mcd at 10mA	60°	660nm
Standard	Bright red	30mA	2.0V	2.5V	5V	80mcd at 10mA	60°	625nm
Standard	Yellow	30mA	2.1V	2.5V	5V	32mcd at 10mA	60°	590nm
Standard	Green	25mA	2.2V	2.5V	5V	32mcd at 10mA	60°	565nm
High intensity	Blue	30mA	4.5V	5.5V	5V	60mcd at 20mA	60°	430nm

Table 2.1 (continued)

Super bright	Red	30mA	1.85V	2.5V	5V	500mcd at 20mA	60^0	660nm
Low current	Red	30mA	1.7V	2.0V	5V	5md at 2mA	60^0	625nm

Where

I_f max = Maximum Forward Current.

V_f typ = Typical Forward Voltage.

V_f max = Maximum Forward Voltage.

V_R max = Maximum Reverse Voltage.

2.1.5 TRIGGER UNIT

2.1.5.1 USE OF LDR WITH ASTABLE MODE OF 555 TIMER

The configuration of an astable multivibrator mode of the 555 timer connected alongside the LDR also known as the dark detector can also be used to trigger LED display. This is to allow the display to come up by itself once it is dark [10]. The LDR is connected directly to the input of the timer based trigger. The LDR has a light dependent resistance characteristics with its resistance increasing with decreasing light intensity. In dark environments, the resistance of the light sensor is very large, in the range of Mega ohms. An appropriate value of resistance is chosen to ensure that the device has great sensitivity to the transition from light to darkness and vise versa [11].

2.1.5.2 TOUCH TRIGGER

The touch triggering works based on the principle of the earthing effect of the human body to ground a circuit. This principle can be found applicable to the triggering of the monostable mode of the 555 timer.

CHAPTER THREE

3.0 DESIGN AND CONSTRUCTION

3.1 POWER SUPPLY

The power supply stage of this design takes its input from the public power supply of 230V A.C. therefore the construction makes use of a power cable withy a plug connected to the socket. This 230V A.C has to be reduced to 12V which leads to the next stage of this design which is voltage transformation.

3.1.1 VOLTAGE TRANSFORMATION

The 230V A.C is connected to the input terminals of the step down transformer with rating 230V/12V, 50Hz. This transformer steps the voltage down to 12V A.C. this 12V A.C output is obtained fro0m the output terminals of the transformer these terminals are the positive and the negative terminals.

3.1.2 RECTIFICATION

The output from the transformer has to be rectified to obtain a D.C output. The form of rectification used here is the full wave diode rectification for every half cycle of the sinusoidal A.C wave form produced. The diodes D1 and D3 are forward biased in the positive half cycle, while diodes D2 and D4 are reversed biased. For the negative half cycle diodes D2 and D4 become forward biased while diodes D1 and D3 becomes reversed biased. This achieves a 12V D.C output. The diode use of are the 1N5391.

3.1.3 RIPPLE FILTERING

The output from the rectification stage is still found to have some ripples which requires filtering. The filtering is achieved by passing the rectified output through a smoothening capacitor.

Let V_p = Primary/input voltage = 220V

V_s = Secondary/output voltage =12vΩ

V_{peak} = peak voltage

V_{dc} = Dc voltage

Now the

Vpeak = √2 x Vc

= √2 x 12 = 16.97V

To obtain C

Q = It = Cdv

$C = {}^{It}/_{dv}$

Assuming dv = 15% of the V_{peak}

V_{peak} = 16.97V

$Dv = {}^{15}/_{100} \times 16.97 = 2.5V$

$t = {}^{1}/_{2f} = {}^{1}/_{100} = 0.01s$

I = 500mA = 0.5A

Therefore

C = (o.5 x 0.01)/2.5 = 2000µf

But due to the non-availability of the capacitor bearing the above value, then I preferably used a capacitor of 2200μf which is available.

3.1.4 VOLTAGE REGULATION

The filtered output is connected to the voltage regulator to ensure that a stable voltage value is fed to the circuit. This is achieved by using the 7812 IC chip which regulates the voltage to 12V even when A.C input voltage deviates or the load varies.

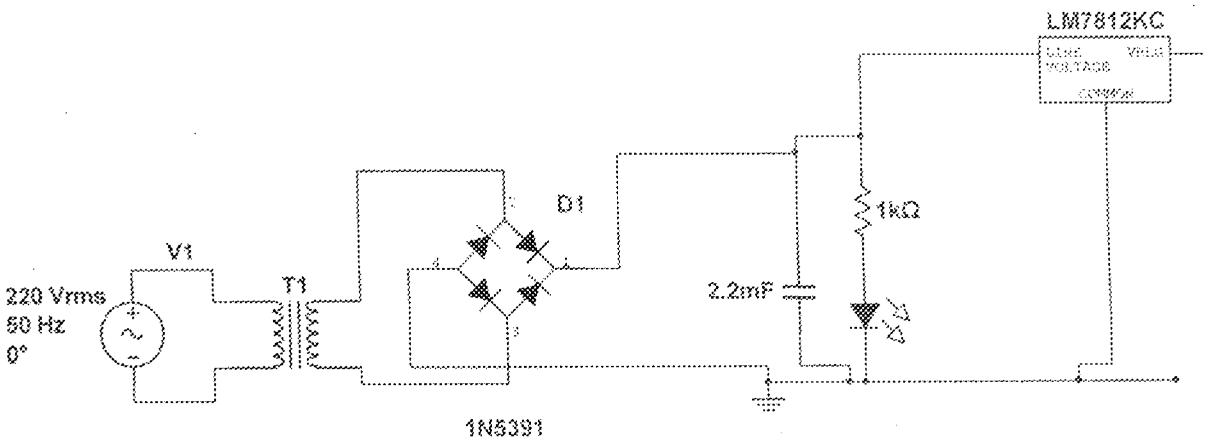


Fig 3.1 Complete Circuit Diagram of The Power Supply.

3.2 TRIGGER UNIT

The circuit for the NECESA NOTICE BOARD touch/dark triggered display is triggered from different sources, which are through dark and touch. The design of these two are analysed in this section.

3.2.1 DARK SENSOR

The dark sensor utilized in the circuit is implemented making use of a 555 timer and a light dependent resistor (LDR) as the major components. The reset pin (pin 14) is used to reset the latch and return the output to a low state. The reset input is an overriding function; that is, it will force the output to a low state regardless of the state of either of the other inputs. The reset is activated when voltage level is anywhere between 0V and 0.4V.

The light dependent resistor is connected in a voltage divider network in order to determine the voltage level at the reset pin. The dark detector has certain resistance value at different level of illumination. In bright light the value is 100Ω, at normal room lighting resistance value is at 10KΩ, the resistance value in total darkness is 10MΩ

Considering the voltage at pin 4, making use of the voltage divider network.

$$V_4 = V_{CC} \times \frac{R_{LDR}}{(R_{LDR} + 100K\Omega)}$$

at bright light, LDR resistance = 100Ω

$$V_4 = 12 \times \frac{100}{(100 + 100K\Omega)}$$

$$V_4 = \frac{1200}{100100} = 0.012V$$

at room lighting, R_{LDR} =10KΩ

$$V_4 = 12 \times \frac{10K\Omega}{(10K\Omega + 100K\Omega)}$$

$$V_4 = \frac{120000}{110000} = 1.091V$$

At total darkness, $R_{LDR} = 10M\,\Omega$

$$V_4 = 12 \times \frac{10M\Omega}{(10M\Omega + 100K\Omega)}$$

$$V_4 = 12 \times \frac{120000000}{10100000} = 11.88V$$

The output of the dark detector is used to trigger the input of the timing circuit in the next stage which is the timing circuit. The output voltage will be approximately 1.7V less the supply Vcc.

$V_O = Vcc - 1.7$

$V_O = 12 - 1.7 = 10.3V$

3.2.2 TOUCH SENSOR

The touch sensor operates on the basis of the principles of operation of the monostable mode of the 555 timer IC. The monostable mode of the 555 timer has its output set high when the input trigger is grounded. For the case of the touch sensor, the grounding is achieved by the touch from the human body. The touch sensor is also used to set the duration of the output pulse.

$T = 1.1 \times R \times C$

$T = 1.1 \times 20 \times 10^6 \times 100 \times 10^{-6}$

T = 2200 Sec.

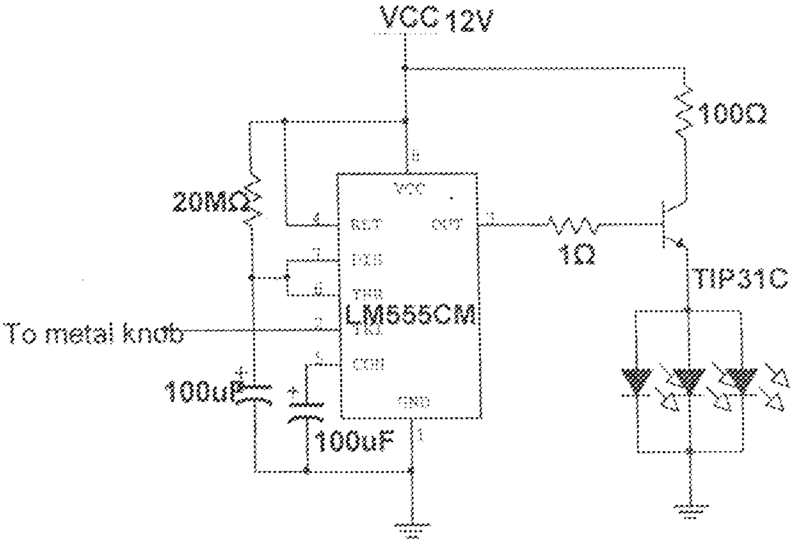


Fig 3.2 Circuit Diagram of Touch Triggered Display Circuit

3.3 TIMING CIRCUIT

This circuit is powered by the dark detector circuit. This implies that it will only be powered ON when it is dark. This circuit is therefore powered at about 10.3V. The timing period can thus be calculated as below;

$t_1 = t_{on} = 0.693\ (R_1+R_2) \times C$

Where $R_1 = 2.2K\ \Omega$

$R_2 = 10K\ \Omega$

$C = 20\mu F$

$t_{on} = 0.693\ (2.2 \times 10^3 + 10 \times 10^3) \times 20 \times 10^{-6}$

$t_{on} = 0.169$ Sec.

$t_2 = t_{off} = 0.693\,(R_2 \times C)$

$= 0.693\,(10 \times 10^3 \times 20 \times 10^{-6})$

$t_{off} = 0.1386$ Sec.

Period : $T = t_{on} + t_{off}$

$= 0.169 + 0.1386 = 0.3076$

Frequency of oscillation:

$$F = \frac{1}{T}$$

$$= \frac{1}{0.3076} = 3.25Hz$$

$$DUTY\ CYCLE = \frac{t_{on}}{T} = \frac{0.169}{0.3076} = 0.549$$

$= 55\ \%$

3.4 DESIGN OF DISPLAY DRIVER

The display driver for this project comprises of two different driver setups. One of the drivers is to drive the output of the dark detector and the other for the touch sensor.

This implies a design for the following

(i) Display driver for dark detector.

(ii) Display driver for touch sensor.

3.4.1 DISPLAY DRIVER FOR DARK DETECTOR

The display driver unit for the dark detector comprises of the decade counter and a connection of transistors acting as an amplifier. The output triggers the set of red LED`s.

3.4.1.1 CASCADING OF TWO 4017IC

Two decade counters are cascaded to give 18 output pulses. Its clock input is triggered by the timing circuit with a voltage of approximately 8.6V, being the output voltage of the timing circuit when High and drop top around 0V when Low. For this cascading to be achieved two AND gates required. The first AND gate takes input from first counter and the timing circuit. When this first AND gate is high it triggers the clock input of the second counter which starts the sequence of display. The tenth output of the second counter alongside the output of the timing circuit then enables the second AND gate. The cascade is also complemented using a RC rest network whose value is gotten thus;

$$F = \frac{1.44}{2RC}$$

Where frequency of oscillation: f = 3.25Hz

$$3.25 = \frac{1.44}{2 \times R \times 0.00002}$$

$$R = \frac{1.44}{2 \times 3.25 \times 0.00002} = 11076.92\Omega$$

Therefore R = 11K Ω

C = 20μF

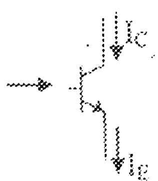
3.4.1.2 TRANSISTOR NETWORK CONNECTION

The transistor being used is the TIP31C which is an NPN transistor. This network consists of a base resistor from the output of the 4017 connected to the base of the transistor. The series resistor is to limit the current flowing to the LED's and to set the current per led. The transistor is setup in the common emitter mode and the output is taken from the emitter to the LED.

The characters to be powered have the following number of LED's each.

N – 18, E – 15, C – 11, s – 12, O – 15, A- 15, T – 11, R – 16, D -16, B -17. To determine the

base resistance with respect to the current gain, the following approach is used for each



$I_E = I_B + I_C$

$$\beta = \frac{I_C}{I_B}$$

Therefore $I_C = \beta I_B$

$I_E = I_B + \beta I_B$

$I_E = (1 + \beta)I_B$

Required $I_E = I_f \times$ number of LED'S

$I_{fmax} = 30mA$

Using the TIP31C NPN at typical current gain $\beta = 75$

Character N

Required $I_E = 18 \times 30mA = 540mA = 0.54A$

Determining I_B

$$I_B = \frac{I_E}{1+\beta}$$

$$= \frac{0.54}{1+75} = 7.105 \times 10^{-3}\ A$$

$$R_B = \frac{V_{OC}}{I_B} = \frac{10}{0.007105} = 1407.5\Omega$$

$I_C = I_E - I_B$

$I_C = (0.54 - 7.105 \times 10^{-3})$

$I_C = 0.533A$

With $V_C = 12V$

$$R_C = \frac{12}{0.533} = 22.5\Omega$$

Character E

Required $I_E = 15 \times 30mA = 450mA = 0.45A$

Determining I_B

$$I_B = \frac{I_E}{1+\beta}$$

$$= \frac{0.45}{1+75} = 5.92 \times 10^{-3}\ A = 5.92mA$$

$$R_B = \frac{V_{OC}}{I_B} = \frac{10}{0.00592} = 1689.2\Omega$$

$I_C = I_E - I_B$

$I_C = (0.45 - 5.92 \times 10^{-3})$

$I_C = 0.444A$

With $V_C = 12V$

$$R_C = \frac{12}{0.444} = 27.03\Omega$$

For character C

Required $I_E = 11 \times 30mA = 330mA = 0.33A$

Determining I_B

$$I_B = \frac{I_E}{1+\beta}$$

$$= \frac{0.33}{1+75} = 4.34 \times 10^{-3}\ A = 4.34mA$$

$$R_B = \frac{V_{OC}}{I_B} = \frac{10}{0.00434} = 2304.12\Omega$$

$I_C = I_E - I_B$

$I_C = (0.33 - 4.34 \times 10^{-3})$

$I_C = 0.32566A$

With $V_C = 12V$

$$R_C = \frac{12}{0.32566} = 36.85\Omega$$

The value for the following characters are approximated to be the same.

N ,B ,D , R ,A , O , E with the value for base resistor available at the market being 2.2KΩ and collector resistor of 33Ω

C ,S ,T with the value for base resistor available at the market being 2.2KΩ and collector resistor of 20Ω

3.4.2 DISPLAY DRIVER FOR TOUCH SENSOR

Since the touch sensor is a one shot i.e monostable output, its driver unit consist of a transistor network consisting of transistor, diode and a base resistor.

For a total of 231 green LEDs

Required $I_E = 231 \times 25mA = 5775mA = 5.775A$

Determining I_B

$$I_B = \frac{I_E}{1+\beta}$$

$$= \frac{5.775}{1+75} = 7.599 \times 10^{-2} A$$

$$R_B = \frac{V_{OC}}{I_B} = \frac{10.3}{0.07599} = 135.54\Omega$$

$I_C = I_E - I_B$

$I_C = (5.775 - 7.599 \times 10^{-2})$

$I_C = 5.699A$

With $V_C = 12V$

$$R_C = \frac{12}{5.699} = 2.11\Omega$$

3.5 LED DISPLAY

The output of the entire circuit is a parallel connection of light emitting diodes. Red LEDs are connected in parallel as the output for the dark detector triggered circuit while green LEDs are used as the output for the touch sensor triggered circuit.

The parallel LEDs has its anodes connected to the emitter of the transistor and the cathode to the 0 Volts potential

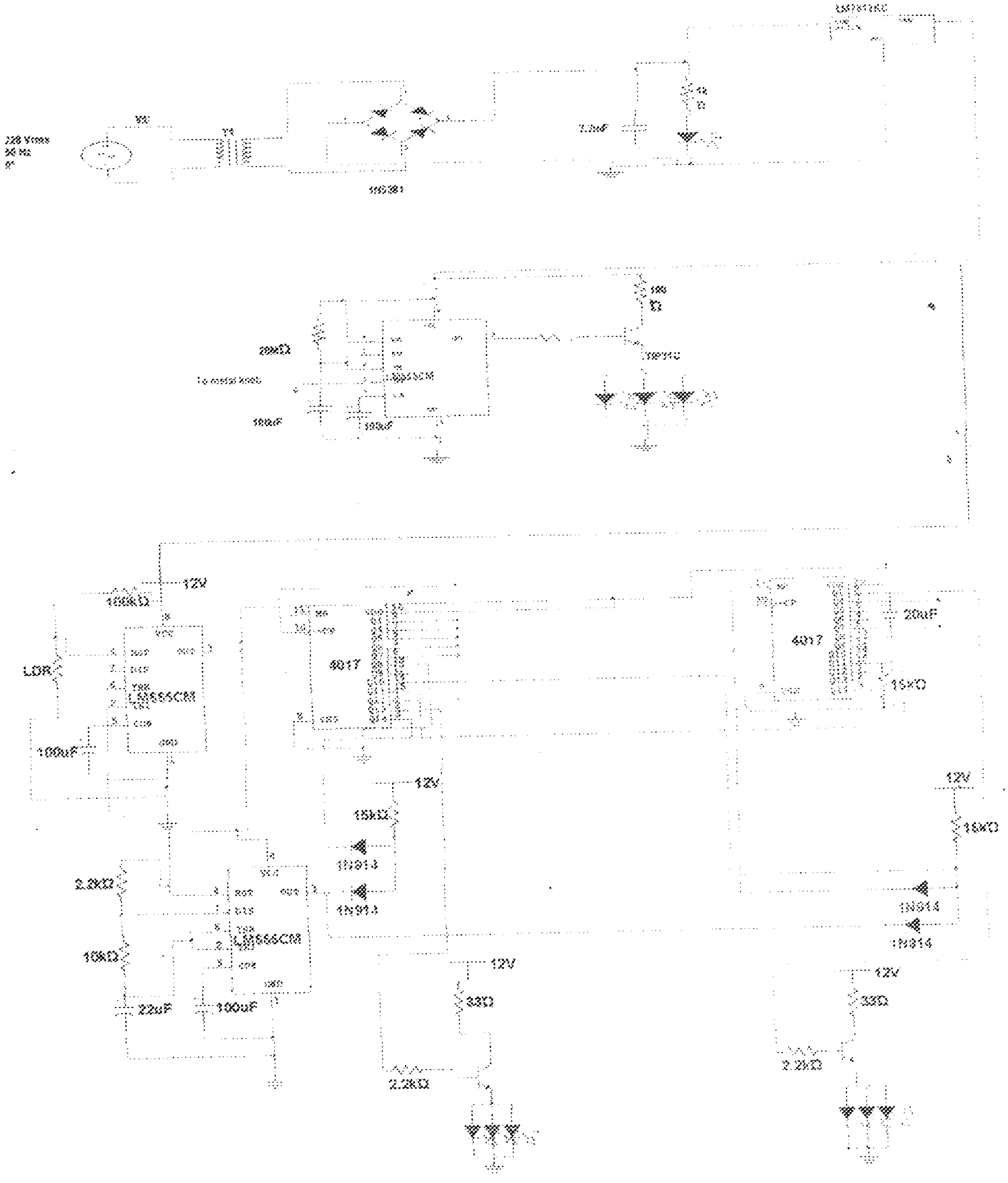


Fig 3.2 Overall Circuit Diagram Of The NECESA NOTICE BOARD touch /dark triggered display

Table 3.1 Output Pin Allocation For The Alphabets

	4017(1)	4017(2)
Pin 3	-	N
Pin 2	I	E
Pin 4	C	C
Pin 7	E	E
Pin 10	B	S
Pin 1	O	A
Pin 5	A	N
Pin 6	R	O
Pin 9	D	T
Pin 11	-	-

CHAPTER FOUR

4.0 TEST, RESULT AND DISCUSSION

4.1 TEST

The circuit was connected as shown in the circuit diagram. The connection was made on a breadboard for the testing of the working conditions of the circuitry. The circuit is powered with the specified voltage value being 12V. At each stage of the testing an LED was used to test the output when it is necessary such as in the case of testing the output of the 4017 IC. The testing also involved measuring the output voltage from the power supply to the output of the counter.

4.2 RESULT

The output of the power supply unit is approximately equal to 12V, with the use of a voltage regulator IC.

The dark detector 12V supplied as its Vcc and the output is approximately the theoretical value. The output is approximately 10.3V. The timing circuit for the touch sensor also gives an output voltage of 10.3V.

The timing circuit for the dark detector triggered display gives an output voltage of approximately 10V.

The timing period is so short that it can barely be recorded with the available timing clock available. It can also be said that the oscillation time comes in the range of the calculated values.

The output of the cascaded 4017 IC gives a digital output with the following binary representation of the decade counter

Table 4.1 Representation of The Output Of The Decade Counter

DECIMAL	BINARY	PIN ALLOCATION
0	0000	3
1	0001	2
2	0010	4
3	0011	7
4	0100	10
5	0101	1
6	0110	5
7	0111	6
8	1000	9
9	1001	11

4.3 RESULT DISCUSSION

In most cases, the theoretical values correspond with the calculated. This implies that following the specifications made for the various components and applying the theoretical principles correctly, the display will function properly. The display works properly as specified in the calculations earlier made.

The 0000 output of the first decade counter which is zero in decimal triggers the second counter along with the output of the 555 timer. The second decade counter is then triggered which also starts with the 0000 output. The decade counter then counts to 1000 output and its next count which is 1001 then triggers the first counter which continues its count from 0001 and then counts to 1001 and this counter gets back to zero 000. This leads to a restart of the whole process. This leads to a continuous sequential display as long as the triggering condition for the dark sensor is fulfilled. The output of the touch sensor usually stays On once the touch sensing surface is touched and grounding is achieved. This output remains High for the stipulated time duration of 2200 Sec.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The completion of this project has proved the theoretical background to this work, with the principles of a counter implemented. Taking a look at the objectives of the project work, the conbination of the green and red colours of light emitting diodes (LED) gives an attractive display with the sequential order in which the LED's goes ON and OFF. The project is appropriate for mounting without need for daily attention of an operator to put it ON or FF. This has been achieved through the implementation of the light dependent resistor (LDR) which possesses varying resistance values depending on the level of illumination available.

This project has also implemented a touch sensor which introduces another functionality of a touch sensor outside its use for security purposes as mostly utilised before now. The lighting display is an attractive sight which calls the attention of people; hence one of the objectives of this project which is to draw the attention of people to read information on the notice board is achieved. With the objectives of this project achieved, the following recommendations are therefore made.

5.2 RECOMMENDATIONS

Having complemented the design and construction of the NECESA NOTICE BOARD touch/dark triggered, I, therefore recommend that sequential light displays should be powered using a dark detector circuit. This will help avoid the use of an operator to make it work. The application of the dark detector circuit can also be diversified into various fields of application alongside the touch sensor aside in security purpose.

I also recommend that the handle of the door to the notice board should be replaced with a metal handle (knob). This is to ensure continuity for the touch sensor which is to be attached to the door handle. This implies that the green light emitting diodes will remain On for 1100Sec after a new information has been placed on the notice board or somebody touches the touch sensor.

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