DESIGN AND CONSTRUCTION OF AN ELECTRONIC BASKETBALL SCOREBOARD

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THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA
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Dedication

I dedicate this project first and foremost to Almighty God who facilitated my entry into this university and who has been with me throughout my time here, which has culminated into this final piece of work before your eyes. And also to my parents Mr. and Mrs P.F Olumeyan for their support all through my stay in the university.

Declaration

This is to certify that this project "the design and construction of an electronic basketball scoreboard" was carried out by Olumeyan Michael Babatunde. W. under the supervision of Mr. Nathaniel Salawu, for the award of Bachelor of Engineering (B.Eng) degree in the Electrical and Computer Engineering, Federal University of Technology Minna, Niger State.

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Acknowledgement

With great honour and deep sense of appreciation, I give thanks to the Almighty God for his protection, guidance and divine supervision during this project work.

My deepest appreciation goes to my supervisor, Mr. Nathaniel Salawu, for his encouragement, timely and useful suggestion as well as his time devoted to me as his student. I thank my parents, Mr and Mrs P.F Olumeyan, (my father and mother) for all they have done to make my stay in this school and this piece of work a huge success and also for their love and support. I also thank Mr A.M Olurunfemi for his support and advise Big thanks to my younger sisters Tope and Iye Olumeyan for their support. I also thank my brothers Solomon Olumeyan, Deji Olorunfemi, Toyin Olorunfemi, Baba Olorunfemi and my Uncle Mr. Kayode Olumeyan and his family for their support To the Head of Department, Engr Musa D Abdullahi and Mr. J N Kolo my Level Adviser and the other lecturers for the knowledge they imparted to me, I say a very big thanks. Much appreciation to Mr and Mrs G. Adesina, Babawande Owolabi, Alonge Frank, Tanomonure Olakunle, Ohakanu Steve, Ogbonna Nonso, Usifoh Ewere, Osuhor Thelma, Nwaocha Chika, Atah Nana, Bukky Adeyanju, Damola Adebayo, Nwaokobia Ijeoma, Ojekunle Peter, Oruk Rachael, Ileanwa Idachaba, Bayo, Bestman As well as my colleagues for their Love and support. And to the B-Ville crew (Jabs, Oyee, Maro, Hamza and Toks) thanks for everything. You all made my stay in this institution a great and memorable one Finally, to all those who in different ways made project a success and, I say thank you and I shall forever remain grateful.

Abstract

The project is the design and construction of AN ELECTRONIC BASKETBALL SCOREBOARD. The purpose of the project is to provide an easy, fast and more efficient way of keeping scores of the two teams during the game of basketball

The purpose of this project is achieved by using buttons labelled 1, 2 and 3 on the control panel to increment the score of a particular team since points made during a basketball game is counted in one's, two's and three's

A great advantage of this project is that it is economical to construct and also reduces the inefficiency of old methods of keeping scores during a basketball game.

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CHAPTER ONE

1.0 Introduction: -

This project is about the design and construction of a prototype of a digital electronic basketball scoreboard to keep the scores of the two teams during the game of basketball. The scoreboard is designed to display the score of the two teams during the game. The display consists of four large Light Emitting Diode (LED) display. Two displays are used to represent each team and each pair of displays can keep a maximum score of 99.

In the game of basketball A regular shot inside the arch is worth two points, beyond the arch is three points, and a free throw is one point, the design involves increment of a particular display in one's, two's or three's depending on the point or score scored by the corresponding team this is implemented in the circuit by a corresponding button.

The design is made as easy as possible to reduce cost.

1.1 Aims and Objectives: -

This project is aimed at the design and construction of a digital electronic scoreboard to keep the scores of two teams during a basketball game. It is designed to increment the score of each corresponding team in one's, two's or three's.

1.2 Methodology: -

The design involves the use of digital electronic components especially decade counters. Each digit has a corresponding counter.

The output of a particular counter is connected to a 7-segment display decoder. The 7-segment display decoder converts the 4-bit code form the counter to corresponding 7-bit code for the purpose of display. Four of this integrated circuit of two pairs is incorporated into the circuit.

The counter unit consists of four decade 4029B integrated circuit. They are grouped into a group of two each by cascading the two together for expanded maximum count of 99. Each group is controlled independently through input switches.

The display related component is the 4511B integrated circuit; four are incorporated in the circuit for the corresponding counters. The devices are Complementary Metallic Oxide Semiconductor (CMOS) in nature. This logic technique provides quite reasonable flexibility for the overall design.

Each display decoder has a specially made large Light Emitting Diode (LED) display. Each digital display consists of seven segment in which each segment holds a series connected Light Emitting Diode (LED). The display is designed for easy viewing from a reasonable distance. This shows that large digit is of great importance.

The two digit group which is limited to a maximum count of 99 is controlled independently through input switches and the device is powered only through A.C. mains and has no provisions for battery supply.

1.3 Scope of Project: -

The project is specially designed to keep the scores of two opposing teams in a basketball game but can also be modified to keep scores in other games such as handball, soccer, volleyball, rugby and netball E.T.C

1.4 Limitations and Merits of the Project: -

The merit of this project is its simplicity and the use of integrated circuits Complementary Metallic Oxide Semiconductor (CMOS) type in the design provides reasonable flexibility.

Although the display is large to some extent. The size is so to provide better visibility. This prototype is powered only by A.C mains this means that the score board won't work if there is power failure.

Modem scoreboards are now computerized which is absent in this project.

CHAPTER TWO

LITERATURE REVIEW

2.0 EVOLUTION OF SCOREBOARDS

A scoreboard is a large board for publicly displaying the score in a game or match. Scoreboards are adapted from billboards. Early billboards were basically large posters on the sides of buildings, with limited but still appreciable commercial value. Most levels of sport from high school and above use at least one scoreboard for keeping score, measuring time, and displaying statistics. Scoreboards in the past used a mechanical clock and numeral cards to display the score. When a point was made, a person would put the appropriate digits on a hook.

The first scoreboard model, manufactured in 1934 by a company called Nevco, consisted of a white oak cabinet with a glass dial clock and glass disks for the scores. Since that time, Nevco has been a leader in the transformation of the scoring and display industry.

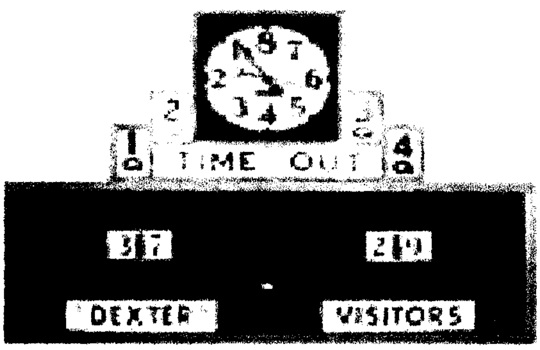


Fig 2.0 Model of the First Scoreboard

Scoreboard technology has advanced from the use of electric motors to solid state electronics; from incandescent bulb models to LED technology; and from hard wired control systems to the use of wireless controls.

Most modern scoreboards use electromechanical or electronic means of displaying the score. In these, digits are often composed of large dot-matrix or seven-segment displays made of incandescent bulbs, LEDs, or electromechanical flip segments. An official or neutral person will operate the scoreboard, by a control panel. One of the largest scoreboard manufacturers in the United States is Daktronics. Other top manufacturers include Sportable Scoreboards, Nevco, Fair-Play Scoreboards, Electro-Mech, Varsity, All American, Santech, and Spectrum. Prior to the 1980's most electronic scoreboards were actually electro-mechanical. They contained relays or stepper switches controlling digits consisting of incandescent light bulbs. Beginning in the 1980's, advances in solid state electronics permitted major improvements in scoreboard technology. High power transistors replaced mechanical relays; Light emitting diodes first replaced light bulbs for indoor scoreboards and as their brightness increased outdoor scoreboards. Light Emitting Diodes last many times as long as light bulbs, and are not subject to breakage, and are much more efficient at converting electrical energy to light. A light-emitting diode (a common display element) is a semiconductor device that emits incoherent narrow-spectrum light when electrically biased in the forward direction. This effect is a form of electroluminescence. The colour of the emitted light depends on the chemical composition of the semi conducting material used, and can be near-ultraviolet, visible or infrared. Rubin Braun stein. (Born 1922) of the Radio Corporation of America first reported on light emission from Gas and other semiconductor alloys in 1955. Nick Holonyak Jr. (bom 1928) of the General Electric Company developed the first practical visible-spectrum LED in 1962.

Advances in large scale integrated circuits permitted the introduction of computer control. This also made it cost effective to send the signals that control the operation of the scoreboard either through the existing AC wires providing power to the scoreboard or through the air. Powerline modems permit the digital control signals to be sent over the AC power line. The most common method of sending digital data over power lines at rates less than 2400 bits per second is called frequency shift keying (FSK). Two frequencies represent binary 0 and 1. Radio transmission usually also sends data digitally. Until recently radio transmission was subject to short range and interference by other radio sources. A fairly recent technology called spread spectrum permits much more robust radio control of scoreboards. Spread spectrum, like the name implies, distributes the signal over a wide portion of the radio spectrum. This helps the signal resist interference which is usually confined to a narrow frequency band. Sportable Scoreboards is an innovator in wireless scoreboard technology.

2.1 Theoretical Background

2.1.1 How Light Emitting Diode (LED) works

This project involves LED display which is commonly used in scoreboard. Light is a form of energy that can be released by an atom. It is made up of many small particle-like packets that have energy and momentum but no mass. These particles, called photons, are the most basic units of light.

Photons are released as a result of moving electrons. In an atom, electrons move in orbital around the nucleus. Electrons in different orbital have different amounts of energy. Generally speaking, electrons with greater energy move in orbital farther away from the nucleus.

For an electron to jump from a lower orbital to a higher orbital, something has to boost its energy level. Conversely, an electron releases energy when it drops from a higher orbital to a lower one. This energy is released in the form of a photon. A greater energy drop releases a higher-energy photon, which is characterized by a higher frequency.

As we saw in the last section, free electrons moving across a diode can fall into empty holes from the P-type layer. This involves a drop from the conduction band to a lower orbital, so the electrons release energy in the form of photons. This happens in any diode, but you can only see the photons when the diode is composed of certain material. The atoms in a standard silicon diode, for example, are arranged in such a way that the electron drops a relatively short distance. As a result, the photon's frequency is so low that it is invisible to the human eye -- it is in the infrared portion of the light spectrum. This isn't necessarily a bad thing, of course: Infrared LEDs are ideal for remote controls, among other things.

Visible light-emitting diodes (VLEDs), such as the ones that light up numbers in a digital clock, are made of materials characterized by a wider gap between the conduction band and the lower orbitals. The size of the gap determines the frequency of the photon -- in other words, it determines the colour of the light.

2.1.2 The 7 Segment Display

The project is based on a 7-segement, although must modern scoreboards' displays are alphanumeric in nature. The 7 segment displays are found in many displays such the one for this project. It is just 7 LEDs that have been combined into one case to make a convenient device for displaying numbers and some letters. The pin- out of the display is shown in the figure below.

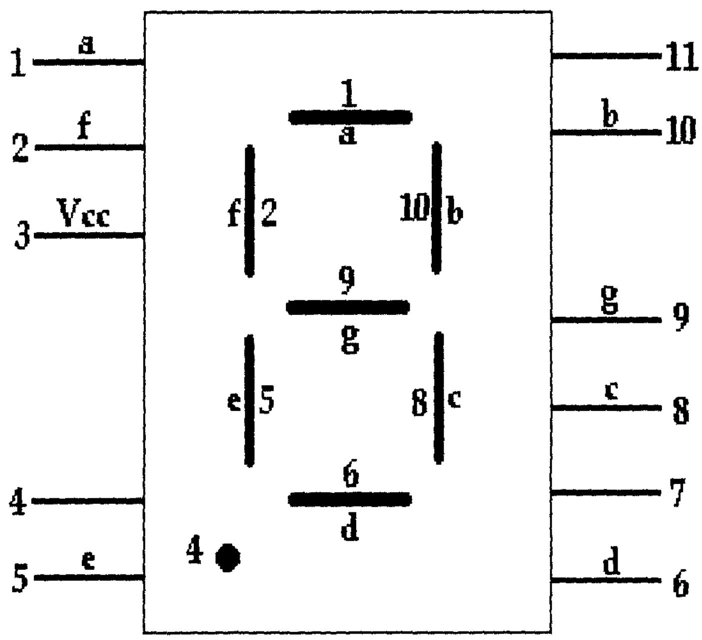


Fig 2.1 figure showing the pin out of the 7-segment display

This version is a common anode version. That means that the positive leg of each LED is connected to a common point which is pin 3 in this case. Each LED has a negative leg that is connected to one of the pins of the device then to make each segment light up, connect the ground pin for that led to ground. A resistor is required to limit the current. Rather than using a resistor from each LED to ground, one can just use one resistor from Vcc to pin 3 to limit the current. Common cathode displays are also available. The truth table is shown below.

Table 2.0 Truth table Showing the Pin Configuration for Display of Some Alphabets and Number

	A (Pin1)	B (Pin10)	C (Pin8)	D (Pin 6)	E (Pin 5)	F (Pin 2)	G (Pin 9)
0	0	0	0	0	0	0	1
1	1	0	0	1	1	1	1
2	0	0	1	0	0	1	0
3	0	0	0	0	1	1	0
4	1	0	0	1	1	0	0
5	0	1	0	0	1	0	0
6	0	1	0	0	0	0	0
7	0	0	0	1	1	1	1
8	0	0	0	0	0	0	0
9	0	0	0	1	1	0	0
A	0	0	0	1	0	0	0
B	1	1	0	0	0	0	0
C	0	1	1	0	0	0	1
D	1	0	0	0	0	1	0
E	0	1	1	0	0	0	0
F	0	1	1	1	0	0	0

2.1.3 Decimal Counters

This digital electronics scoreboard involves the use of counters which is a modern counting device. Modern counting devices incorporate decimal counters that operate with binary numbers. The simplest counter circuit is a single D-type flip flop, with its D (data) input fed from its own inverted output. This circuit can store one bit, and hence can count from zero to one before it overflows (starts over from 0). This counter will increment once for every clock cycle and takes two clock cycles to overflow, so every cycle it will alternate between a transition from 0 to 1 and a transition from 1 to 0. If this output is then used as the clock signal for a similarly arranged D flip flop, the result is a 1 bit counter that counts half as fast. Putting two together yields a two bit counter.

Decade counters are a kind of counter that counts in tens rather than having a binary representation. Each output will go high in turn, starting over after ten outputs have occurred. This type of circuit finds applications in multiplexers and demultiplexers, or wherever a scanning type of behaviour is useful. Similar counters with different numbers of outputs are also common.

The Truth Table below shows the actual counting sequence of a decimal counter from 0-9.

Table 2.1 Truth Table Showing Counting Sequence of Decimal Counter From 0-9

States				Count
D	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

CHAPTER THREE

3.0 DESIGN ANALYSIS

The circuit can be divided into the following groups:

1. Power supply unit
2. Counter unit
3. Display unit
4. Control logic unit

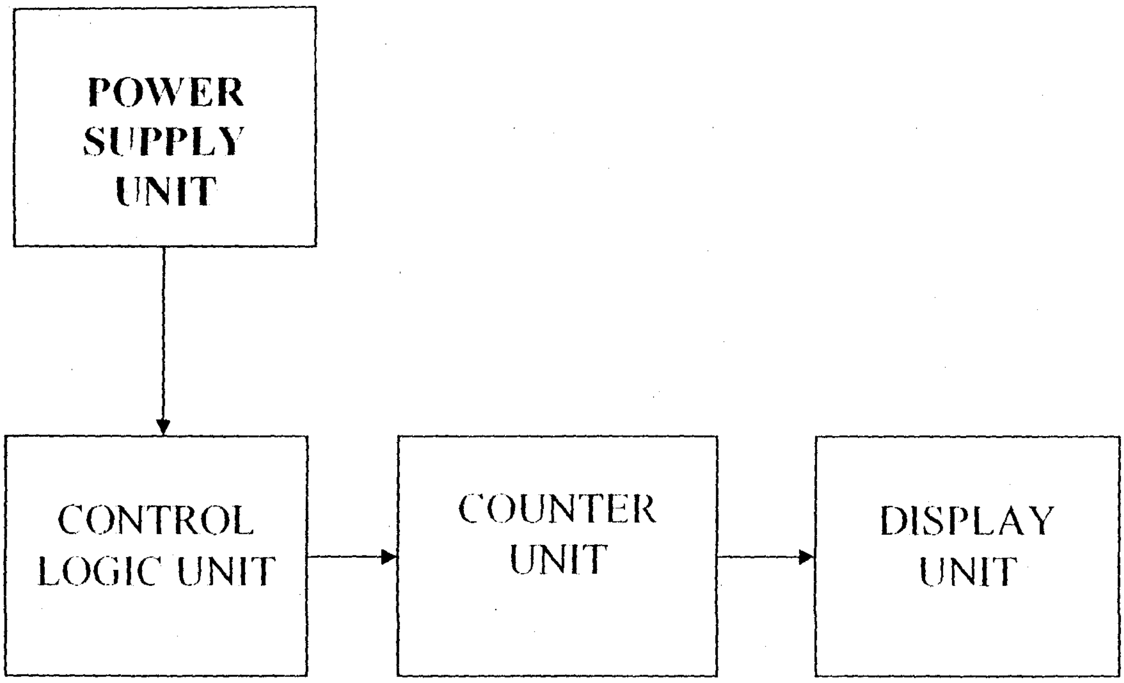


Fig. 3.0 Block Diagram of Digital Electronic Scoreboard

3.1 Power Unit

The power unit is designed using a 9V output step-down transformer which output is required to be rectified or change from A.C to D.C.

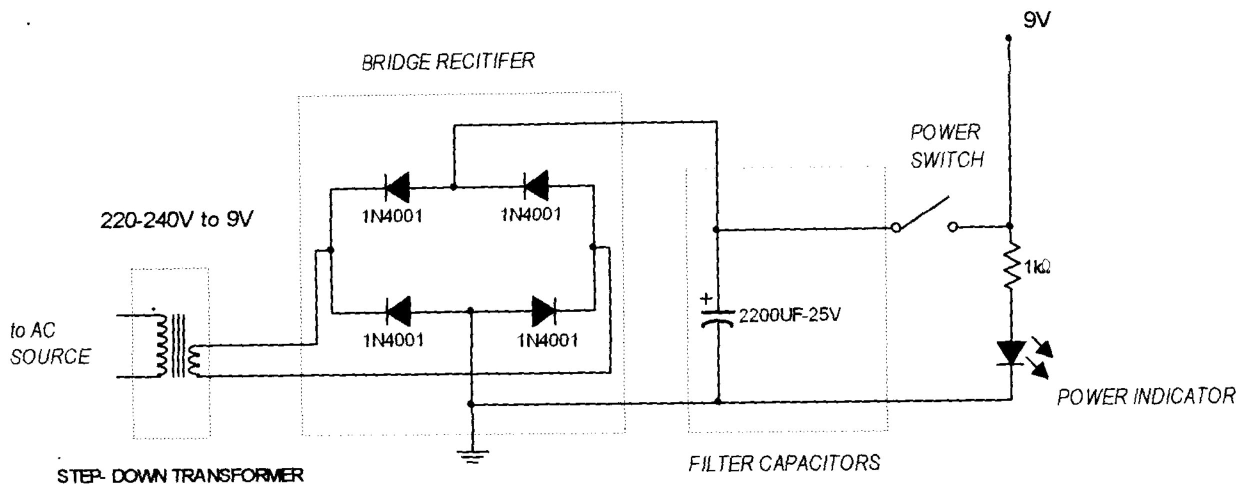


Fig. 3.1 Power Supply Unit

A bridge rectifier converts the 9V AC output from the transformer into corresponding DC voltage. The transformer is rated 500mA. Therefore, it supplies a power of roughly,

$$500 \times 10^{-3} \times 9 = 4.5 \text{ Watts}$$

The bridge rectifier comprises four rectifying PN diodes. They are configured in a manner in which only two are active in a half-cycle of the input alternating signal. The other two work at the other half of the cycle. The result is the conversion of the input AC voltage into an equivalent DC voltage.

The output of the transformer is not exactly 9V. There is a voltage drop across the involved active diodes. The rectified voltage is not completely DC. The voltage is attributed to reasonable ripple. That is, there is still certain AC component of the rectified voltage. A large electrolyte capacitor within 1000 - 3300µf range is usually connected in parallel to the output voltage o minimise the ripple effect. A 2200µf 25V capacitor is incorporated into the bridge rectifier's circuit to smoothen the flow of electric current in the circuit.

A power switch is connected in series with the positive line to close and open the complete circuit. A 47µf 16V capacitor is usually connected in parallel to their output to the ground to improve the stability of the power supply to the circuit.

A LED-resistor circuit is connected to the 9V terminal of the power circuit to indicate the presence of electric current in the circuit. It works alongside the power switch. The circuit involves a 1KΩ resistor in parallel with a light emitting diode (LED). The voltage across the diode is usually maintained at 2.7V. Therefore, the voltage across R_p is 6.3V. Assuming, a typical current of 6.0mA, Therefore,

$$R_p = \frac{6.3}{6 \times 10^{3}} = 920\Omega$$

$$R_p = 1050\ \Omega$$

Though, 1000Ω (1kΩ) is a more practical value.

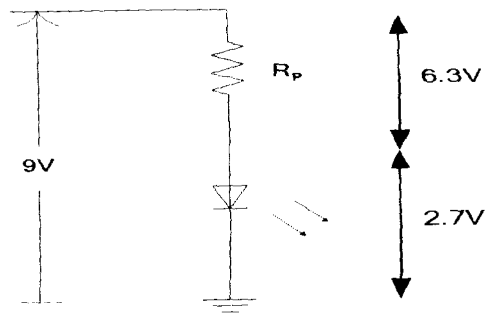


Fig. 3.2 The Power Indicator

3.2 Counter Unit

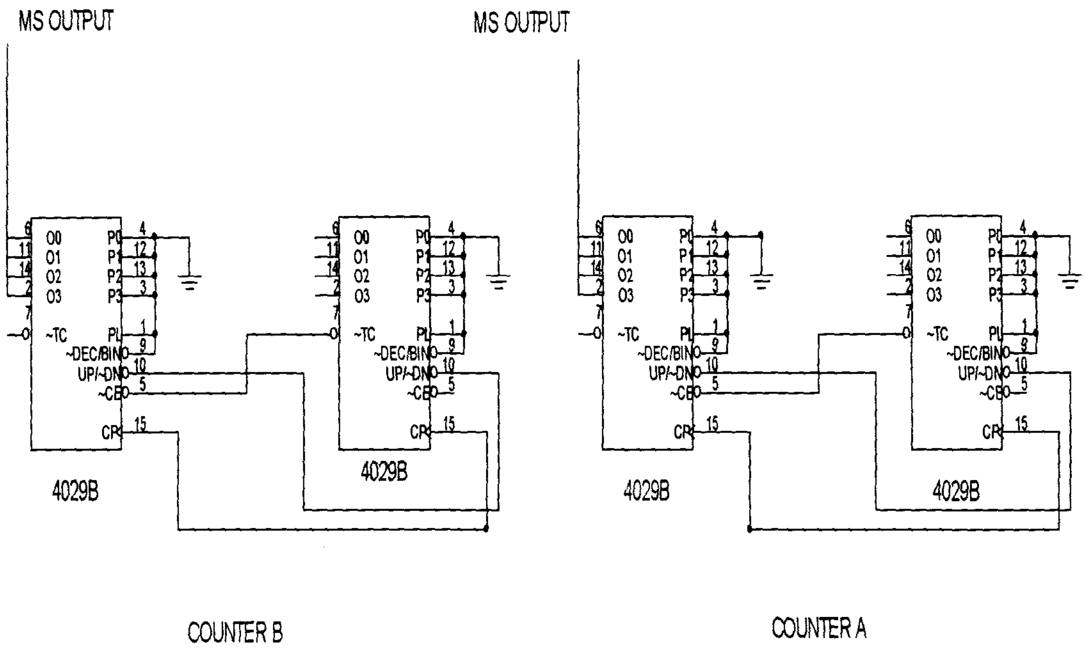


Fig. 3.3 The Diagram of The Two Cascaded Counter Circuit

Two 4029B counters made up a particular score. They are cascaded in a manner that allows independent control of each unit. The enabling of each unit is done through pin 5 of the Least Significant counter of the unit. So that, whenever the pin is low, the unit is selected. The feature allows input into a particular counter for a score. The outputs of the counters are connected to corresponding 7-segment decoders for display purpose.

The counter unit consist of two groups of 4029B counters with each of maximum count of 99.Each group serve the score of a particular team.

The 4029B is a presettable up/down counter which counts in either binary or decade mode depending on the voltage level applied at binary/decade input. When binary decade is at logical "1", the counter counts in binary, otherwise it counts in decade. Similarly, the counter counts up when the up/down input is at logical "1" and vice versa. A logical "1" preset enable signal allows information at the "jam" inputs to preset the counter to any state asynchronously with the clock. The counter is advanced one count at the positive-going edge of the clock if the carry in and preset enable inputs are at logical "0". Advancement is inhibited when either or both of these two inputs is at logical"1". The carry out signal is normally at logical "1" state and goes to logical "0" state when the counter reaches its maximum count in the "up" mode or the minimum count in the "down" mode provided the carry input is at logical "0"state.All inputs are protected against static discharge by diode clamps to both VDD and VSS.

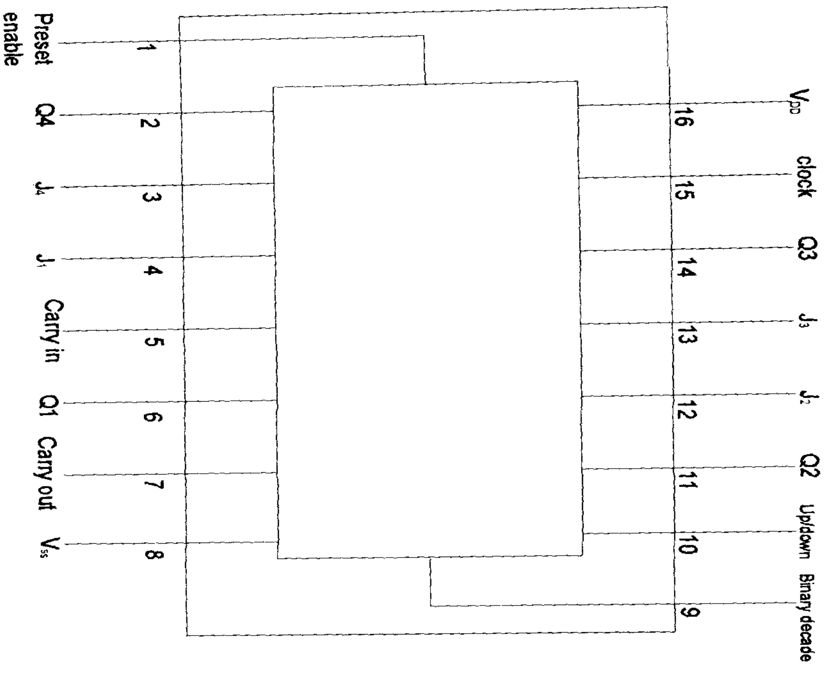


Fig. 3.4 Pin Configuration of the 4029B

3.3 Display Unit

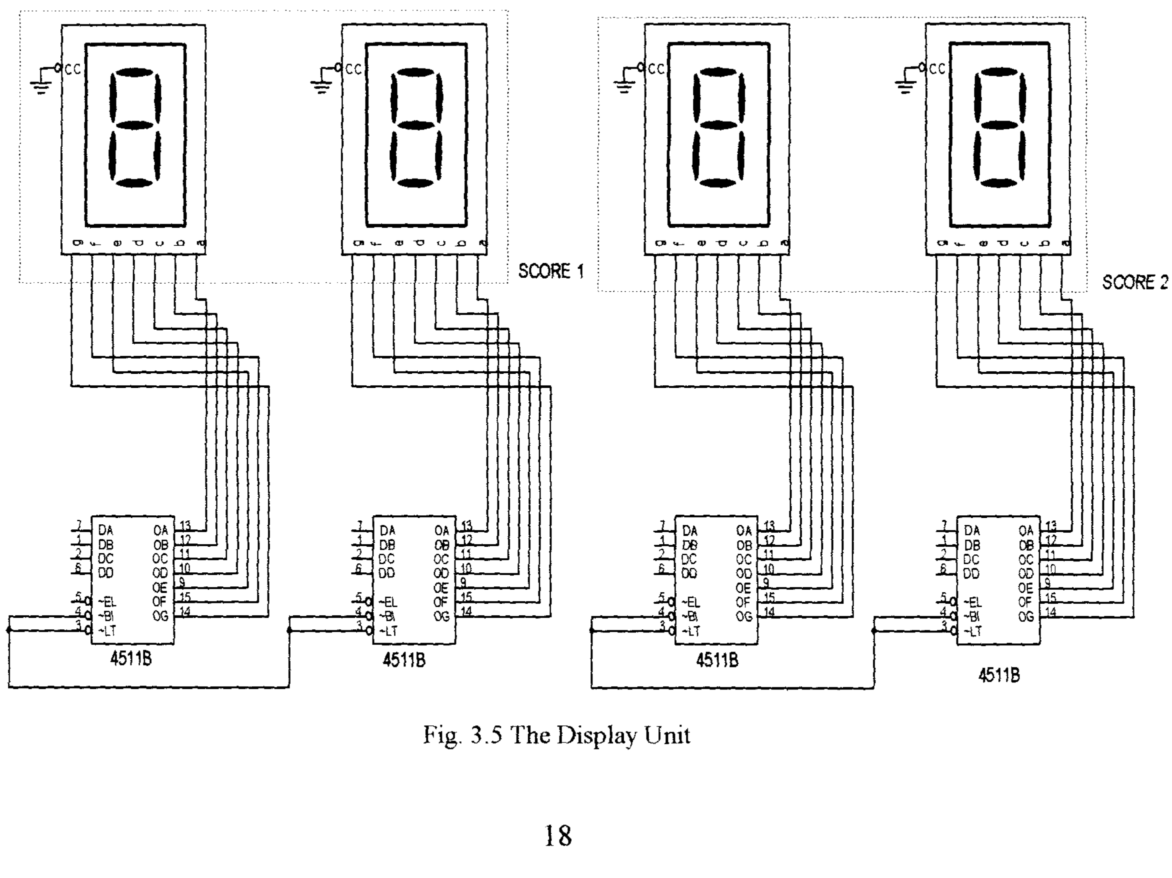


Fig. 3.5 The Display Unit

The 4-bit output (involving pins, 7, 1, 2, and 6) of a particular 4511B 7-segment decoder is connected to corresponding output of a BCD counter (4029B).The seven output of the decoder are connected to corresponding terminals of a 7-segment common cathode display. Because three Light Emitting Diodes (LEDs) are used for a particular segment, the usually current limiting resistors are not involved in the circuit.

The display unit involves four 4511B. The 4511B types are BCD-to-7-segment latch decoder drivers constructed with COS/MOS logic and n-p-n bipolar transistor output devices on a single monolithic structure. Their inputs are usually connected to the outputs of BCD counter such as 4029B.

These devices combine the low quiescent power dissipation and high noise immunity features of COS/MOS with n-p-n bipolar output transistors capable of sourcing up to25 mA. This capability allows the 4511B types to drive LED's and other displays directly.

Lamp Test (LT), Blanking (BL), and Latch Enable or Strobe inputs are provided to test the display, shutoff or intensity-modulate it, and store or strobe a BCD code, respectively. Several different signals may be multiplexed and displayed when external multiplexing circuitry is used.

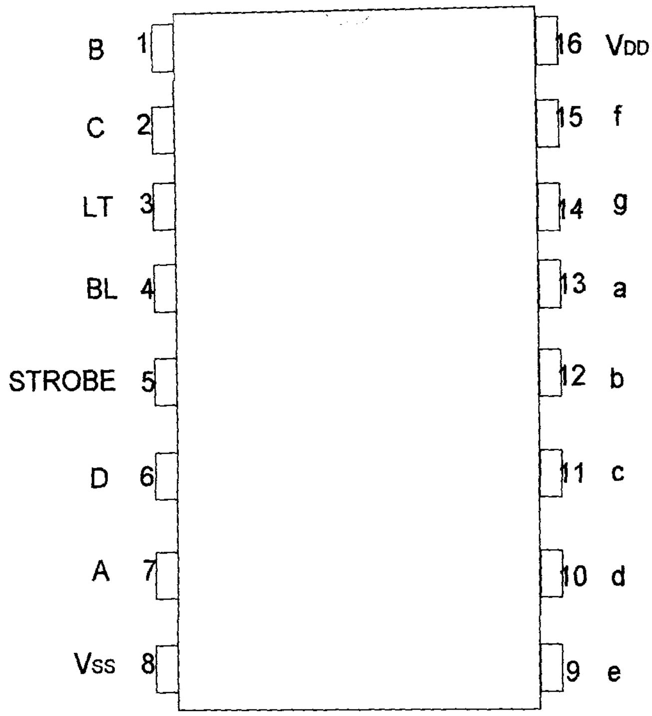


Fig. 3.7 Pin Configuration of the 4511B

Fig. 3.8 Display Pattern of the 4511B

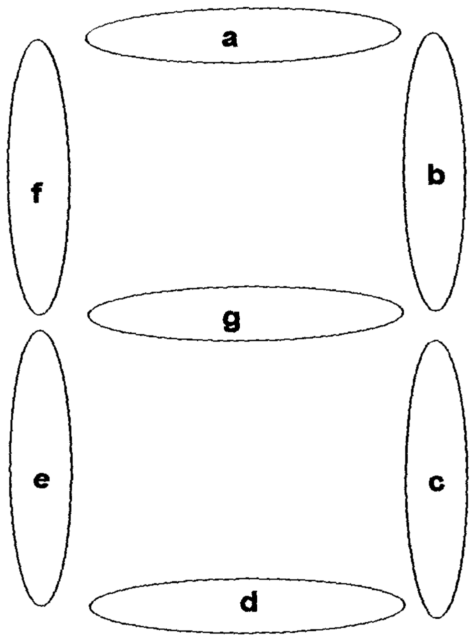


Fig. 3.9 The 7-Segment Configuration

Each Segment consists of three series connected Light Emitting Diodes (LEDs) and seven are configured to form a common cathode 7-segment display, as shown below.

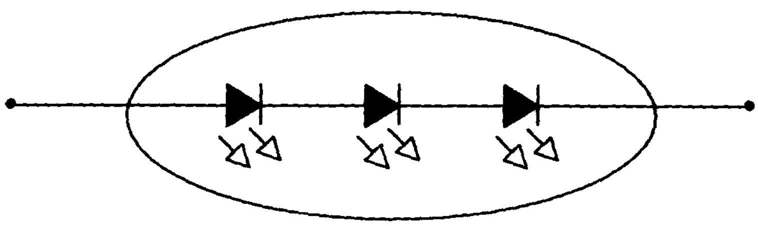


Fig. 3.10 Layout of a Single Segment

Table 3.0 The Truth Table Of The 4511B

LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	Display
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	1	1	0	1	1	0	1	2
0	1	1	0	0	1	1	1	1	1	1	0	0	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	1	0	0	0	0	7
0	1	1	1	0	0	0	1	1	1	1	1	1	1	8
0	1	1	1	0	0	1	1	1	1	0	0	1	1	9
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	1	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X				*				*

X= IRRELEVANT

3.4 Control Unit

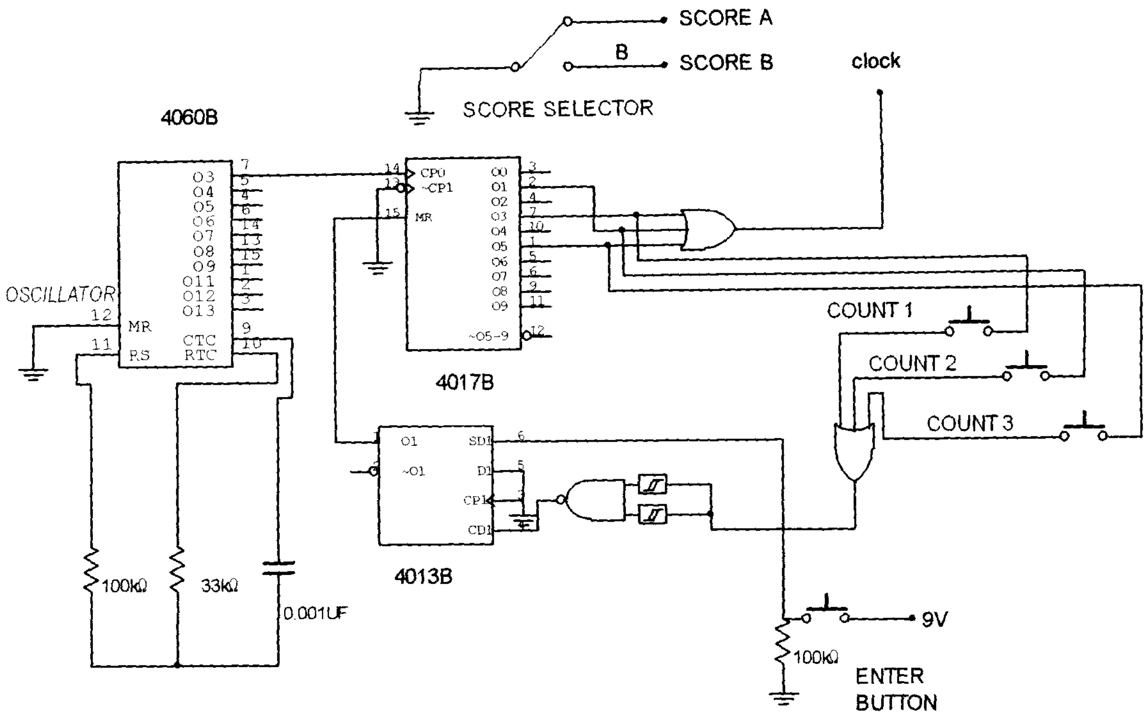


Fig 3.11 A Diagram Of The Control Logic Unit

The control unit mainly involves the 4060B (oscillator), 4017B (stepper), and 4013B (latch).their combination allows one, two, and three pulses to be used for triggering a selected counter unit.

The 4060B produces a high frequency signal in which the 4017B splits into 1,2, and 3.This is done with count buttons 1,2, and 3.Whenever any of the button is pressed corresponding number of pulse is applied to a selected counter. The involved OR gates sum up the outputs of the switches to a common terminal which possess thorough a Schmitt trigger 2-input AND gate connecting to a latch. The latch holds counting operation during input control. And the Schmitt trigger allows sharp response of the latch. During an input operation on the device, the enter button must be held on. as 3-input OR gate sums up the output from the 4017B in triggering the counter.

3.4.1 The 4060B (Oscillator)

The 4060B is a 14–stage binary ripple counter with an on–chip Oscillator buffer. The oscillator configuration allows design of either RC or crystal oscillator circuits. Also included on the chip is a reset function which places all outputs into the zero state and disables the oscillator. A negative transition on Clock will advance the counter to the next state. Schmitt trigger action on the input line permits very slow input rise and fall times.

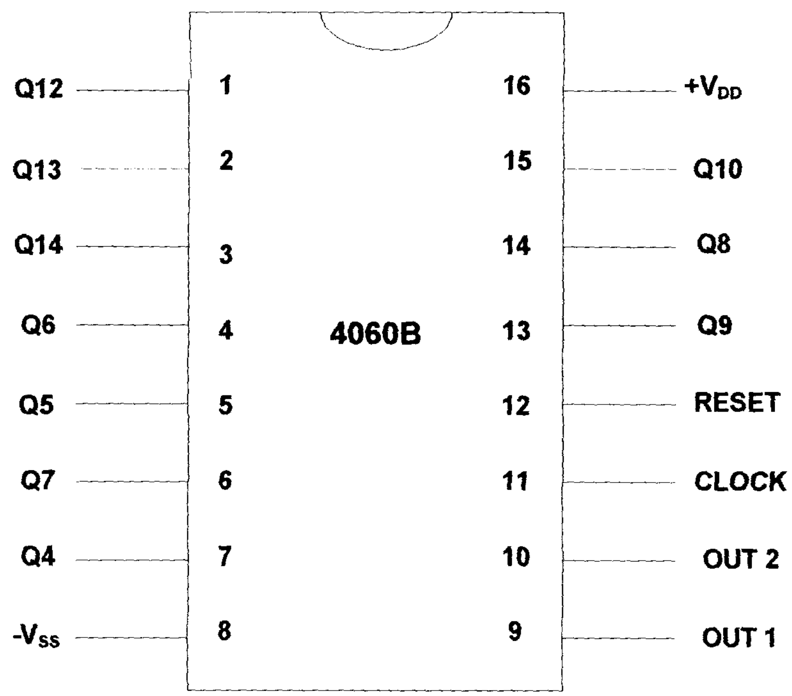


Fig3.12 (a.) The Pin Layout of the 4060B,

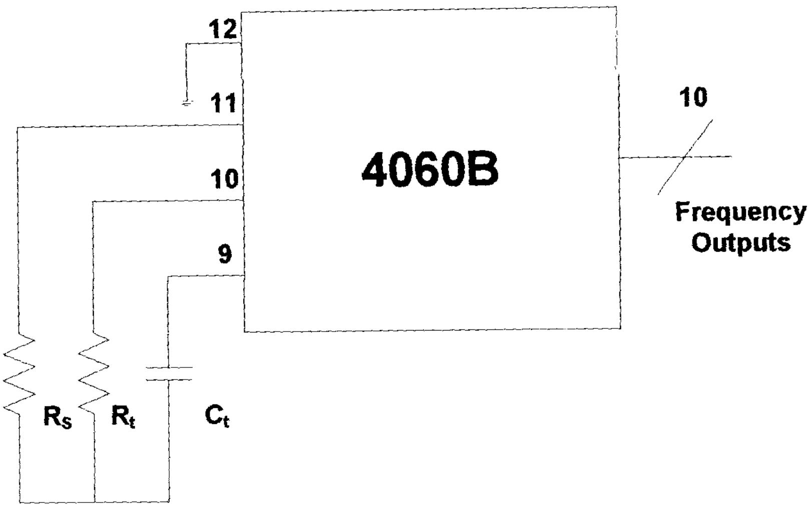


Fig. 3.12 (b.) Normal RC Configuration of the 4060B

R_f and C_f are concerned with the main frequency. The main frequency is gotten from its datasheet with the formula given as:

$$f_m = \frac{1}{2.3\ R_t C_t}$$

The relationship between R_t and R_S is given below:

$$10\ R_t \geq R_S \geq 2R_t$$

The value of the resistor must be below 1MΩ which is recommended by the manufacturers.

The device is used for generating a high frequency pulse for counting purpose. The frequency is given,

The main frequency of the 4060B configuration in accord with the data sheet is

$$Fm = \frac{1}{2.3 \times 33 \times 10^{3} \times 0.002 \times 10^{-6}} = 6.5876\ \text{kHz}$$

The two values, 33kΩ and 0.002μf, are typical for the 4060B. The frequency output of pin 7 is given by:

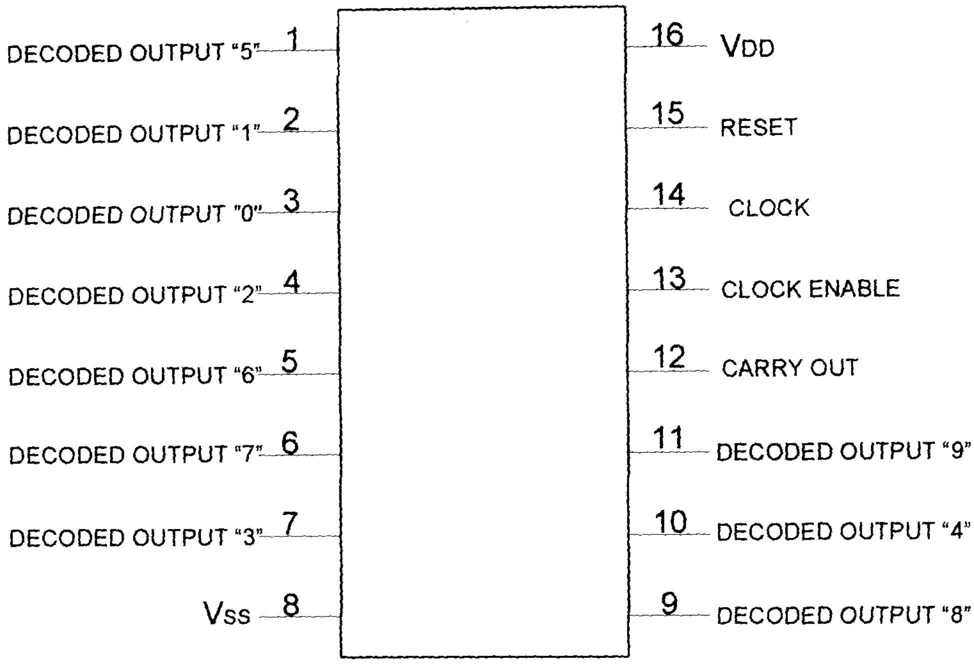
The two values, 33kΩ and 0.002μf, are typical for the 4060B. The frequency output of pin 7 is given by:

$$F_{pin\ 7} = \frac{f_m}{2^4} = \frac{6587.6}{2^4} = 411.72\ Hz$$

3.4.2 The 4017B (Stepper)

The 4017B allows a particular number of pulses from the high frequency for triggering the counters. The CD4017BC is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit. The counters are cleared to their zero count by a logical"1" on their reset line The counter is advanced on the positive edge of the clock signal when the clock enable signal is in the logical "0" state.The configuration of the 4017 permits medium speed operation and assures a hazard free counting sequence. The 10 decoded outputs are normally in the logical "0" state and go to the logical "1" state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 10 clock input cycles and is used

as a ripple carry signal to any succeeding stages.



3.13 The Pin Configuration Of The 4017B

3.4.3 The 4013B (Latch)

Another device in this unit, 4013B, is used for holding control. The 4013B is a 14-pin CMOS integrated circuit holding two D - flip-flops or latches alongside both SET and RESET features. The sub-devices work independent of each other. The whole inputs are active high.

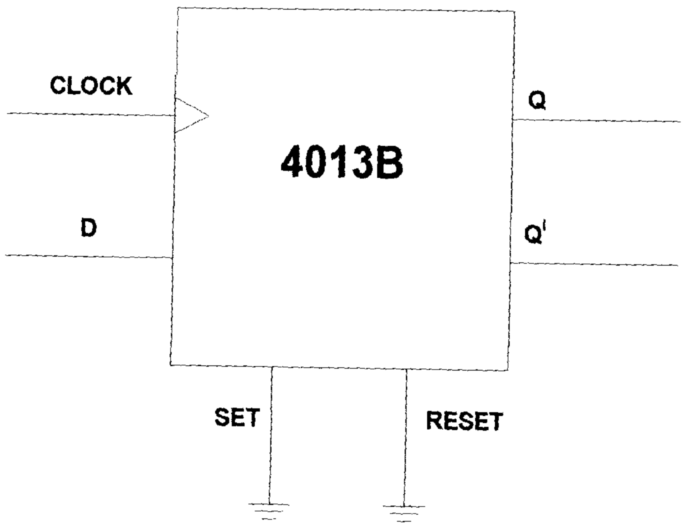


Fig. 3.14 (a.) The D-type Configuration of the 4013B

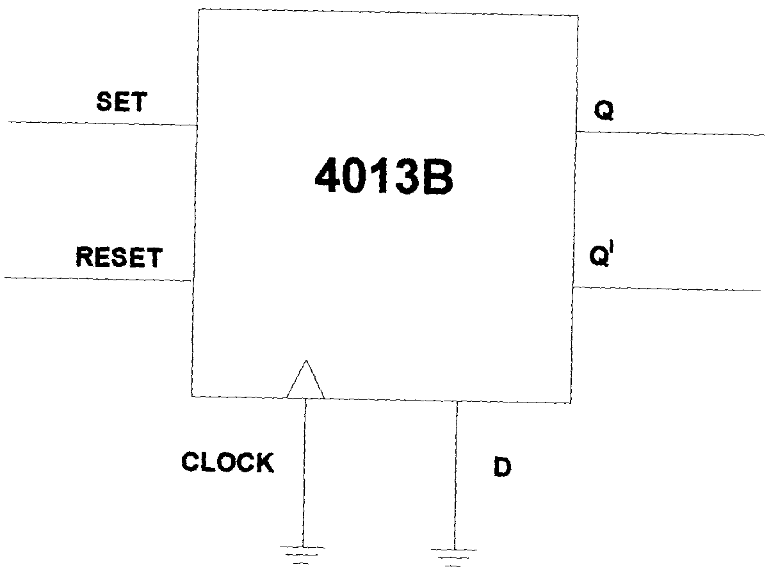
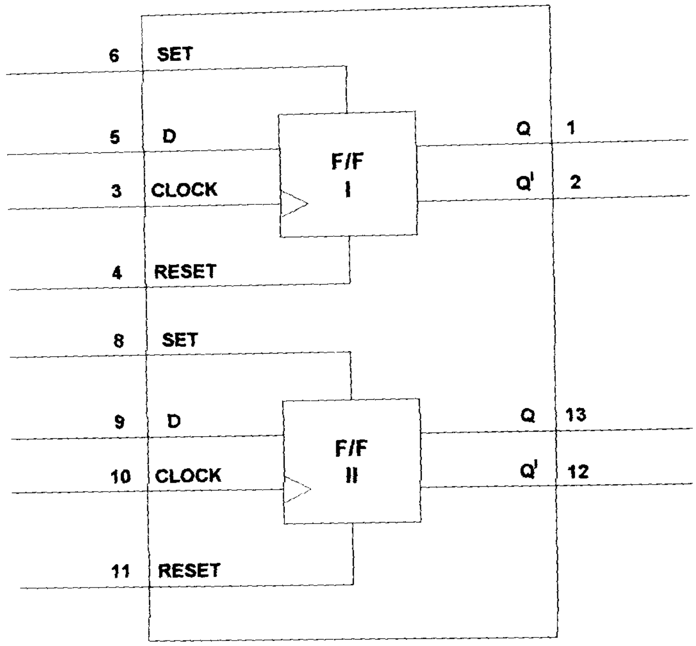


Fig. 3.14 (b.) The SR-type Configuration of the 4013B



(c.)

Fig.3.14 (c.) The Functional Diagram of the 4013B

Table 3.1 The Truth Table Of The SR-Type Configuration Of The 4013B

S	R	Q	Q'
1	0	1	0
0	1	0	1
1	1	1	1
0	0	Qn	Q'n

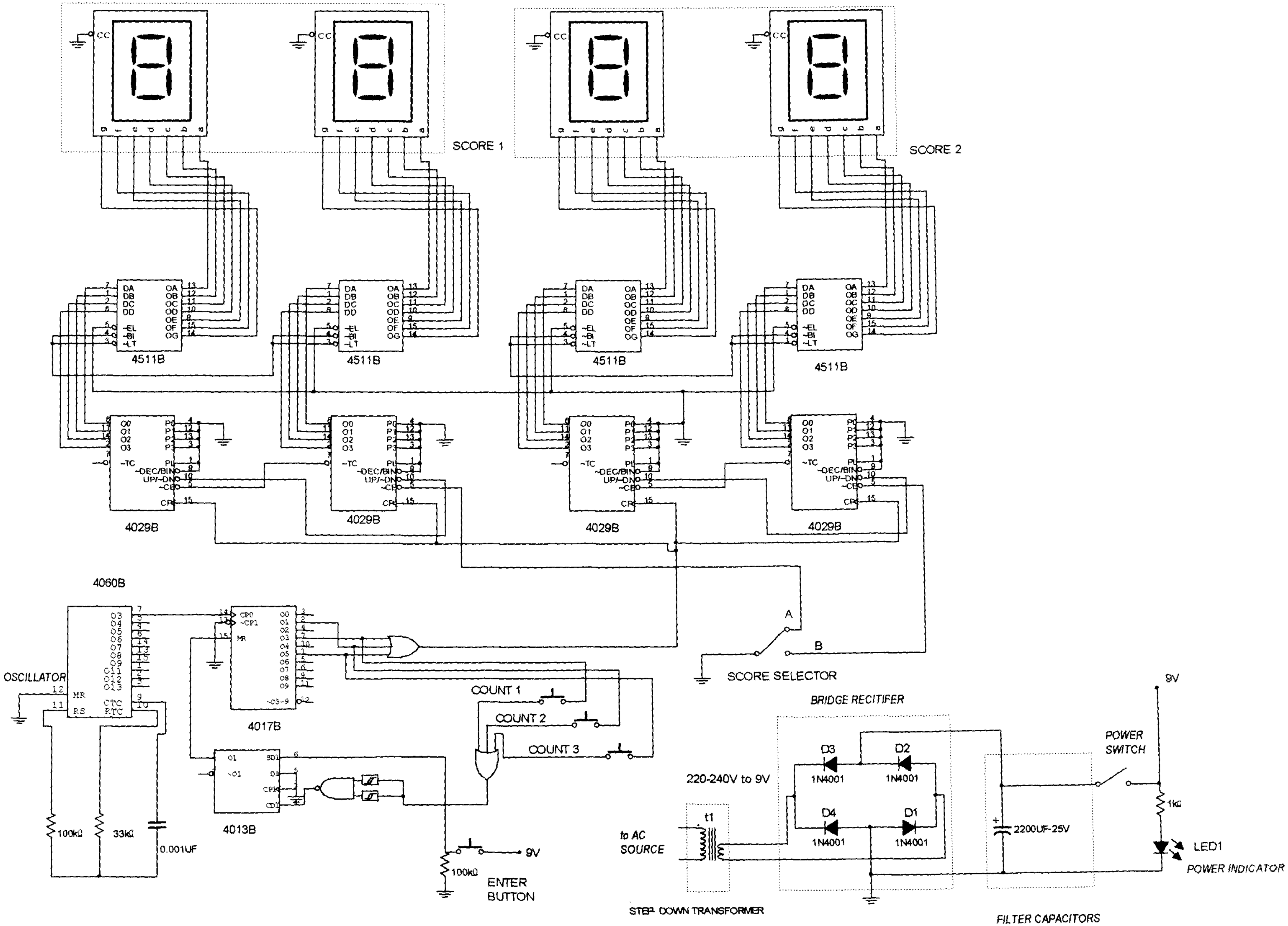


Fig 3.15 Circuit Diagram of Digital Electronic Basketball Scoreboard

CHAPTER FOUR

TESTS, RESULTS, AND DISCUSSION

4.0 Construction

The construction of the project was done as follows:

1. Firstly, the project circuitry was designed and simulated using electronic workbench software "multisim" the result of the simulation shows how well the circuit drawn will work.
2. The purchase of materials and component such as different Integrated circuits ICs needed for the construction of the circuit. Breadboards and Vero board were also bought resistors, transistors and connecting wires.
3. the next construction procedure was the building of the circuitry on the breadboard this was a little cumbersome and the result gotten from the building of the circuit on the breadboard was not very accurate because some of the Integrated circuits did not sit well thereby producing partial contact
4. The next procedure carried out was the building of the circuit permanently on the Vero board this includes the soldering of the Integrated Circuit and other components to the scoreboard with each components connected together with the thin connecting wire this was done carefully to prevent some of the havoc below are some of the care taken during the construction on Vero board.

- Care was taken to avoid short circuiting or bridging two conducting points especially those that needed to be separated.
- Those conducting points needed to be in the same potential level were put together.
- No excess traces of the soldering were allowed to remain on the vero board.
- Hatching separated the stages from one another.
- The Vero board was properly cleaned to avoid overall failure of the design and short circuit.

5. After construction on Vero board, the circuit is now tested (troubleshooting) and appropriate faults discovered is repaired.
6. Test was carried out to determine the actual points which will count in one's, two's and three's and buttons were fixed there and labeled accordingly.
7. After the troubleshooting and repair of the system the faults are fixed and then the system was then arranged together and put in an appropriate casing

The following are some of the tools used during the construction:

(i) Soldering iron

(ii) Cello tape

(iii) Soldering lead

(iv) Scissors

(v) Multimeter

(vi) Pliers

(vii) Pen knife

4.1 Testing

The major tests carried out during the construction was to see if the Light Emitting Diode used for the display were working properly and see if the series connections of the Light Emitting Diodes were okay

Another test was carried out to pick the actual buttons for a certain increment and also to ensure the buttons were working properly and also to pick the corresponding button for the increments in one's, two's and three's and also to make sure that the selector button is selecting the right side on which a particular increment will be made

4.2 How the Scoreboard Is Operated

Whenever a certain score either one, two or three is going to be added to a selected side, the switch is first of all used to select the side the score is going to added to then the button of the score made that is either one, two or three is held down then the enter button is pressed down too in order to release the score and both buttons are released at the same time.

Note. Pressing the button of the point alone will only run the display accuracy is better achieved if two people are around the control panel with one person in charge of the switch and the other person in charge of the buttons

4.3 RESULT

When a side was selected by the selector switch and the button to increment the scores in either one's, two's or three's was held down and the enter button was pressed to enter the value the actual side that was selected was incremented by the value of the button pressed and when the reset button was pressed the score went back to 00.

CHAPTER FIVE

CONCLUSION

This project report covers extensively the design and construction of a Prototype of a Digital Electronic Scoreboard, which is meant to keep the scores of two separate teams during a basketball game by incrementing the scores in one's, twos, and three's. The major components used to achieve the design are Integrated circuits (ICs).

5.0 PROBLEMS ENCOUNTERED

Some problems were encountered during the construction of the project. Some of the problems include:

1. Problem of short circuit on the vero board
2. Availability of the materials: - some of the components were not readily available we had to travel far distances to get the components
3. Due to how expensive and scarce superior quality of components are in market we went for less superior and less expensive components which are readily available and some of these components get spoilt easily because they are of low quality.

5.1 Recommendations

This project is a prototype which involves the use of different Integrated Circuits (ICs) to display the scores of teams during a basketball team. Although it is an advancement of the Mechanical scoreboard. But recently various advancements have been made on the digital electronic scoreboard. Present day scoreboards are now computerized.

The use of microcontrollers have made the design of the present day scoreboard easier and less cumbersome all you need to do is to program the microcontrollers to carry out the various functions.

Present day scoreboards have other features it can display apart from the score of both teams. They can also display the names and different statistics of each team player. All these are done easily with the aid of the microcontroller with the microcontroller interfaced to a computer system.

Wireless technology has been incorporated into the present day scoreboard. Wireless control panels are now used to control the scoreboard all these are made easier with the aid of the microcontroller technology.

This prototype is powered by only A.C mains therefore can only work with electricity but the design can be enhanced to work with rechargeable battery which takes over whenever there is power supply failure since power supply is not stable in Nigeria.

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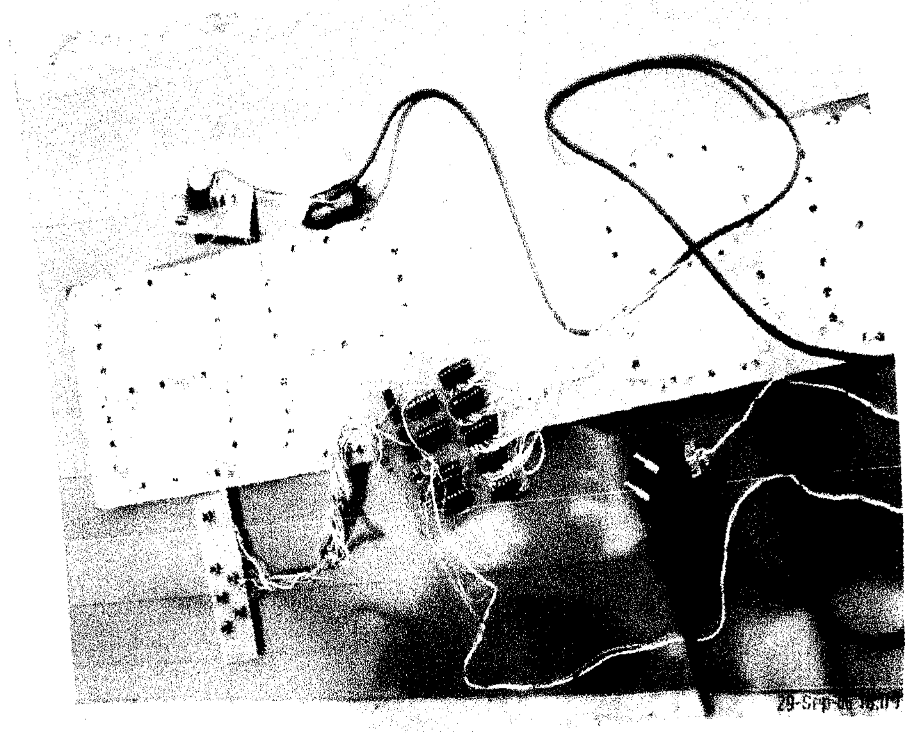
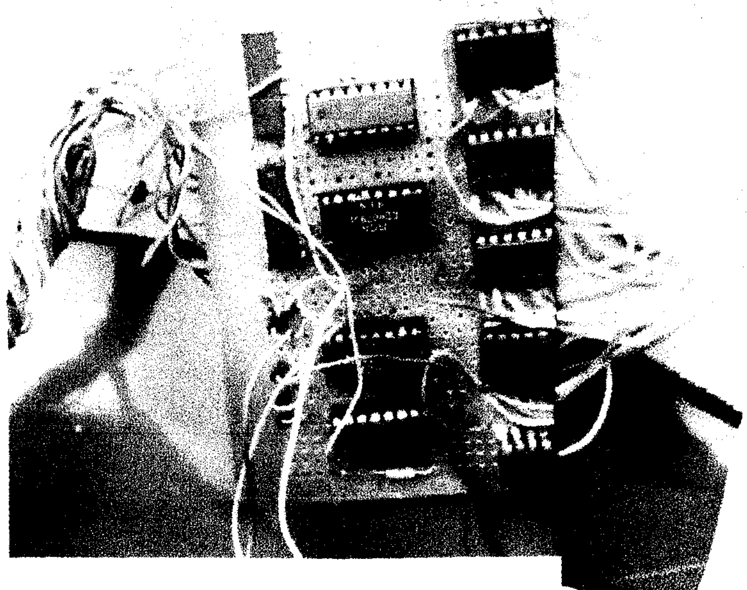
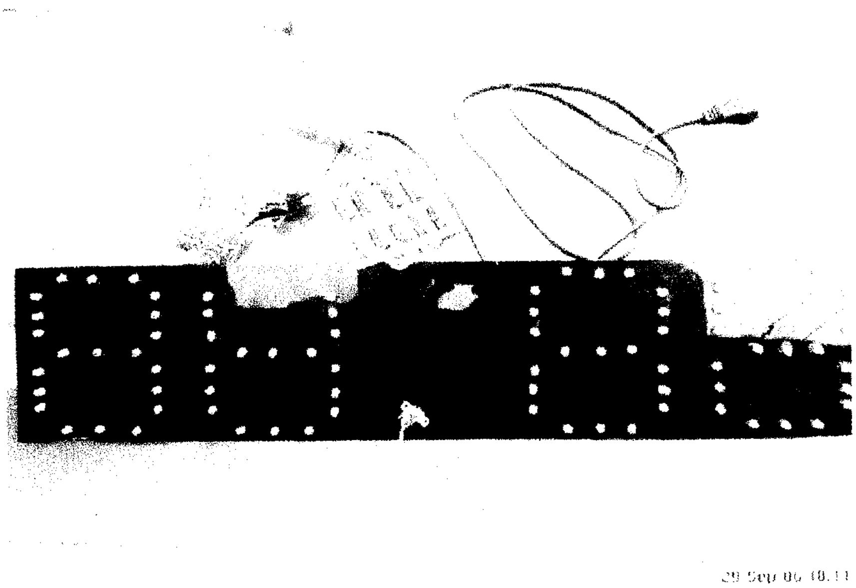
APPENDIX 1







Some Pictures Of The Project During The Construction Stage