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# DESIGN AND CONSTRUCTION OF A COST EFFECTIVE DOT MATRIX INFORMATION DISPLAY, FOR THE OFFICE OF THE HOD DEPARTMENT ELECTRICAL/ELECTRONICS ENGINEERING FEDERAL POLYTECHNIC MUBI, ADAMAWA STATE

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## ABSTRACT

A dot matrix display board is a tool used for the advertisement or to create awareness about a particular product or service. It uses electronic circuit to illuminate the word programmed into its memory storage. The major aim of this project is to introduce the simpler and cost effective method of dissemination of information which actually create an indelible impression to the passerby and yet used to enumerate the list of product as contained in an establishment which also can be reprogrammed as needed by the user. It was done in three stages namely the design, construction and working of a Dot Matrix Information Display. The two possible voltage levels characterized by HIGH or LOW, ON or OFF, TRUE or FALSE, PRESENT or ABSENT were represented abstractly by the digits 0 and 1. It also helps to promote the world of light emitting diode as the most important in digital technologies the project has been carefully designed such that the Dot Matrix Information Display operates with electrical power from any source alternate or direct current. Program written in Assembly language was burned into the EPROM (Erasable Programmable Read Only Memory) of the system. The operation and working were enunciated. There are recommendations as the project is of outstanding quality. The feature of multiple colors makes it unique from other single color display. It was thereafter installed at the HOD's office free from mechanical shock and vibration.

**Keywords:** dot matrix display board**,** advertisement**,** light emitting diode,

## INTRODUCTION

The importance of advertisement to an organization or firm cannot be over-emphasized, but the method or strategies employed by such organizations will determine the extent to which people are aware of their goods and services. A better advertisement plan enhances the sales of the organization and more people are aware of their services.

Various strategies have been adopted in recent times by various firms to boost their products and services. Such strategy includes advertising on newspapers, posters, billboards and electronics media such as television, internet, radio and telecommunication in general. All these are good, but are quite expensive to maintain.

Digital Information Display System (Dot Matrix Display Board) is a rapidly developing technology used to showcase a company's business to the public. Its effect on the general public gives a more striking and lasting impression, unlike that of the television, radio or telecommunication media. It involves the use of electronic components such as the light emitting diode (LED) and others in the design and construction of dot matrix display board which displays light in form of words, to pass across information encoded into its micro controller chip memory. There are different types of

electronic signboard but only two types will be highlighted with more emphasis on dot matrix display (Reprogrammable) board.

1. Dot Matrix Display (Reprogrammable)
2. Sequential Display (Non- reprogrammable)

**The Integrated Circuit**

An integrated circuit is one in which circuit components such as transistors, diodes, resistors, capacitors e.t.c. are automatically part of a small semi conductor chip. These components are interconnected in a single small package to perform a complete electronic function. Examples of such integrated circuit as used in this design are

a. AT89C52 microcontroller
b. Latch IC (74324)

**Embedded microcontroller**

The AT89C52 is a low power high performance CMOS bit microcontroller with four of flash Erasable and Programmable Read Only Memory (EPROM). The device is manufactured using very high density non-volatile memory technology and is compatible with the industrial standard MSC5ITM instruction set.

The chip flash allows the program memory to be reprogrammed in system by a conventional non-volatile memory programmer, by combining a versatile 8-bit CPU with flash on a monolithic chip. ATMEL AT89C52 is a powerful microcontroller which provides a highly flexible and cost effective solution to many embedded control application.

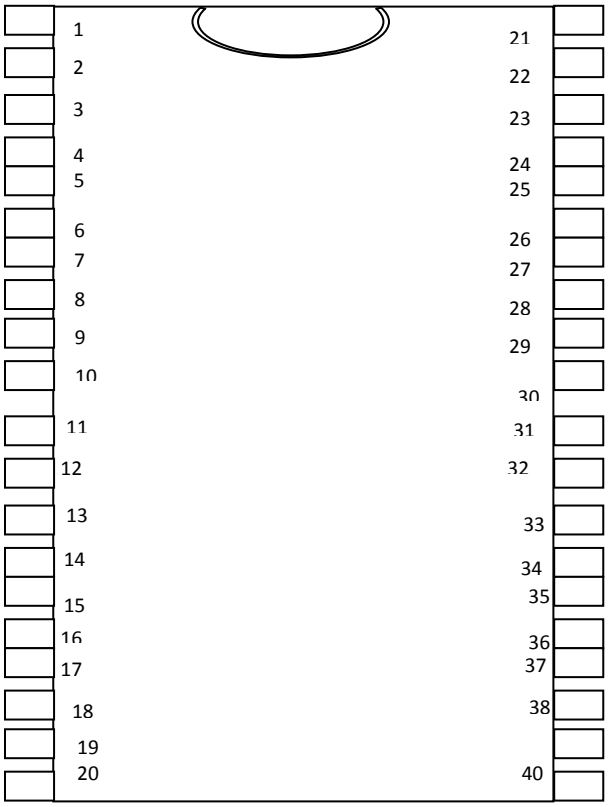


**Fig 1: A Microcontroller (AT89C52)**

**A latch IC**

This is a digital IC whose input and output are limited to two possible levels that is LOW and High. It is so because digital signals are usually binary. Digital circuits are sometimes referred to as switching circuits, this digital IC include logic gates, Calculation chips, microprocessor, flip-flop e.t.c. 74374 IC which is also known as a latch c and flip-flop is used as a switching circuit which consists of an input pins and output pins and it enable spins as shown in the fig 2 below.

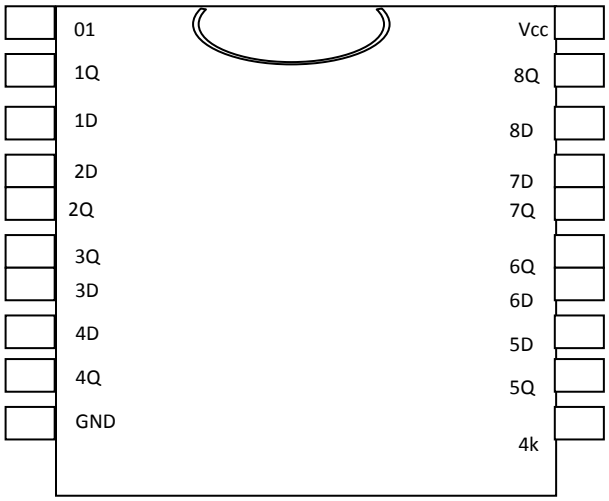


**Fig 2: The pin layout of 74374 IC**

## MATERIALS AND METHODS

**Design**

The design is divided into two parts which comprises of the following: the hardware design and the software design.

***Hardware Design***

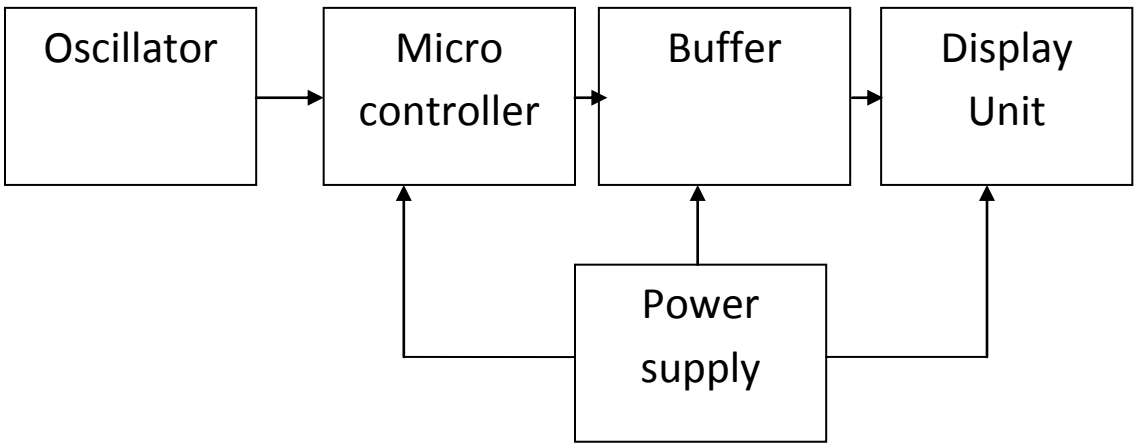


**Fig 3: Block Diagram of a dot matrix display**

The block diagram above is a functional block of a dot matrix display which shows how the circuit works. It comprises of four blocks namely the microcontroller, the buffer, the display unit and the power supply.

**THE POWER SUPPLY STAGE**

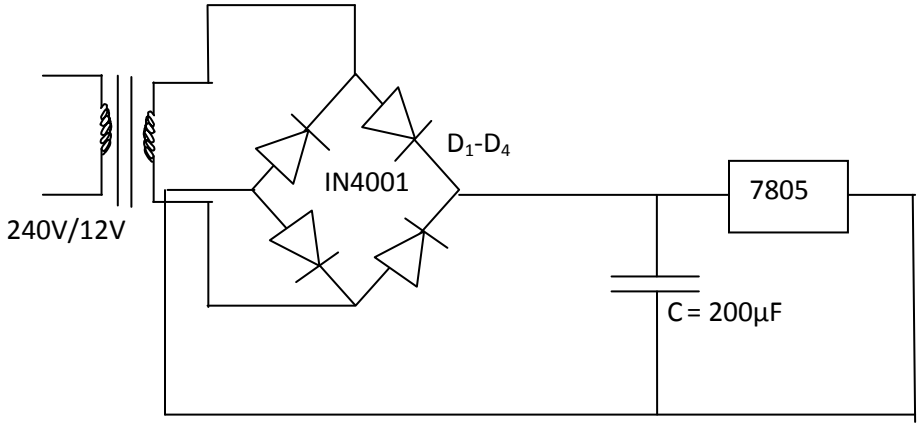


**Fig 4: Power Supply Stage**

Output current D.c. = 450mA = 0.45A
Output voltage dc =12V
Peak ripple to be 4%

However, $I_m$ Value of the current on the secondary winding of the transformer from the relationship

$$I_{dc} = 2\frac{I_m}{\pi}$$

$$we\ have\ I_m = \frac{\pi I_{dc}}{2}$$

$$\frac{3.142\ (0.45)}{2} = 0.707A$$

$$But\ I_{rms} = \frac{I_m}{\sqrt{2}}$$

$$= \frac{0.707}{\sqrt{2}}$$

= 0.499924A
= 0.5A

$$we\ have\ V_m = \frac{\pi V_{dc}}{2}$$

$$\frac{3.142\ (12)}{2}$$

= 18.8496V

$$But\ V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$= \frac{18.8496}{\sqrt{2}}$$

= 13.32V
= 13V

**TRANSISTOR BIASING STAGE**

In this section, the value of the chosen base biasing resistor as used in the biasing of the seven transistors are calculated

By using Base Resistor Method:

Assuming β = 100,

Vcc = %V

$V_{BE}$ = 0.3V

The zero signal collector current ($I_C$) is set at 0.47A.

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

$$= \frac{0.47}{100} = 4.7mA$$

$$I_B = 4.7\ x\ 10^{-3} A$$

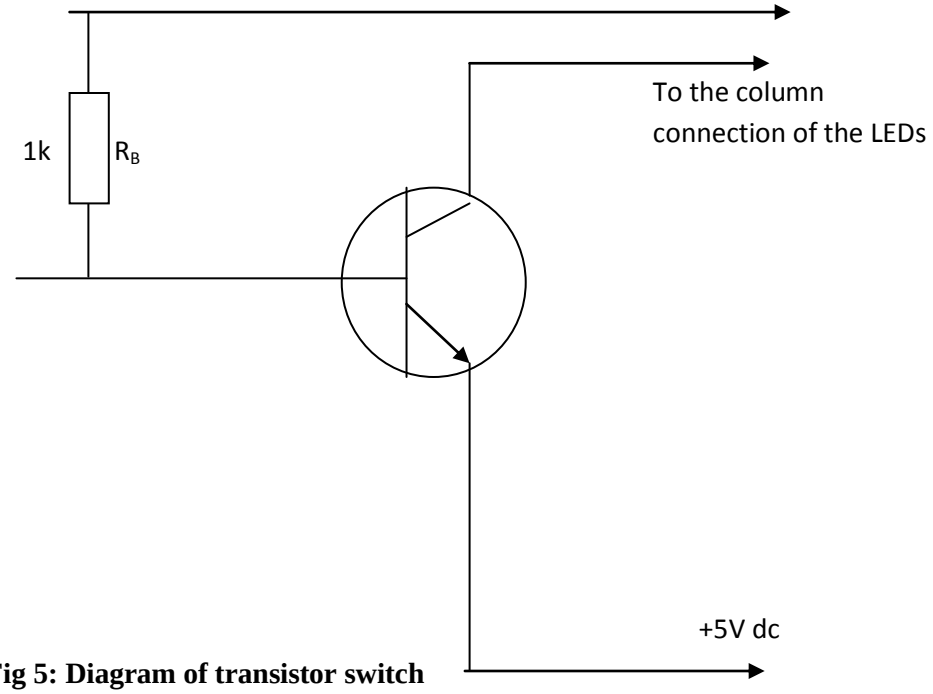


**Fig 5: Diagram of transistor switch**

Note: TIP 41 used is made from a germanium material

The standard $V_{BE}$ = 0.3V
Using the relation, Vcc = $I_B R_B + V_{BE}$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$

$$R_B = \frac{5 - 0.3}{4.7\ x\ 10^{-3}} = 1000\Omega$$

$$R_B = 1k\Omega$$

This is actually applicable in all the transistors in this project

**The Software Design Using Assembly Language**

| | | |
|---|---|---|
| Org ooh | | |
| Mov PO, #O | Call let L | Call let n |
| Start: | Call PL | Call PL |
| Call let W | Cal let E | Call let I |
| Call Pl | Call PL | Call PL |
| Call Let E | Call let C | Call let C |
| Call PL | Call PL | Call PL |
| Call let L | Call let T | Call let S |
| Call PL | Call PL | Call PL |
| Call let L | Call let R | Call lets SS |
| Call PL | Call PL | Call PL |
| Call let C | Call let I | Call let E |
| Call pl | Call PL | Call PL |
| Call let O | Call let C | Call let N |
| Call pl | Call PL | Call PL |
| Call let m | Call let a | Call N |
| Call pl | Call PL | Call PL |
| Call let e | Call let L | Call let G |
| Call pl end | Call PL | Call PL |
| Call let T | Call let L | Call letter I |
| Call Pl | Call PL | Call PL |

| | | |
|---|---|---|
| | Call Slash | Call let N |
| Call Pl | Call Let E | Call PL |
| Call let I | Call PL | Call let E |
| Call pl | Call let L | Call PL |
| Call let S | Call PL | Call E |
| Call let S | Call let E | Call PL |
| Call pl | Call PL | Call let R |
| Call let SS | Call let C | Call pL |
| Call Pl | Call PL | Call let I |
| Call let 1 | Call let T | Call le tPl |
| Call Pl | Call PL | Calal let |
| Call let S | Call let R | Call PL |
| Call PL | Call PL | Call let G |
| Call let S | Call let O | Call Pl |
| Call PL | Call PL | Call Letss |
| Call let E | Call let N | Call PL |
| Call Pl | Call PL | Call let F |
| Call Pl | Call PL | Call PL |
| Call Let E | Call let C | Call let C |
| Call PL | Call PL | Call PL |
| Call let L | Call let T | Call let S |
| Call PL | Call PL | Call PL |
| Call let L | Call let R | Call lets SS |
| Call PL | Call PL | Call PL |
| Call let C | Call let I | Call let E |
| Call pl | Call PL | Call PL |
| Call let O | Call let C | Call let N |
| Call pl | Call PL | Call PL |
| Call let m | Call let a | Call N |
| Call pl | Call PL | Call PL |
| Call let e | Call let L | Call let G |
| Call pl end | Call PL | Call PL |
| Call let T | Call let L | Call letter I |
| Call Pl | Call PL | Call PL |
| Call let U | Call Slash | Call let N |
| Call Pl | Call Let E | Call PL |
| Call let I | Call PL | Call let E |
| Call pl | Call let L | Call PL |
| Call let S | Call PL | Call E |
| Call let S | Call let E | Call PL |

| | | |
|---|---|---|
| Call pl | Call PL | Call let R |
| Call let SS | Call let C | Call pL |
| Call Pl | Call PL | Call let I |
| Call let 1 | Call let T | Call le tPl |
| Call Pl | Call PL | Calal let |
| Call let S | Call let R | Call PL |
| Call PL | Call PL | Call let G |
| Call let S | Call let O | Call Pl |
| Call PL | Call PL | Call Letss |
| Call let E | Call let N | Call PL |
| Call Pl | Call PL | Call Num 0 |
| Call num | Let Z | |
| Call PL | Mov 46, #1111111111b | PL: |
| Call num 0 | Mov 45, #1111111111b | Call shift L |
| Call Pl | Mov 44, #1111111111b | Call shoot |
| Call num 3 | Mov 43, #1111111111b | Call shift L |
| Call pl | Mov 42, #1110011111b | Call shoot |
| Call num 4 | Mov 41, #1100000001b | Set b p2.7 |
| Call PL | Mov 40, #1111111111b | Call shift L |
| Call num 2 | Ret | Call shoot |
| Call Pl 1 | | Call shift L |
| Call num 1 | Dot: | Call shoot |
| Call PL | Mov 46, #1111111111b | Call shift L |
| Call num 8 | Mov 45, #1111111111b | Call shoot |
| Call Pl | Mov 44, #1111111111b | Call shift L |
| Call num O | Mov 43, #1111111111b | Call shoot |
| Call num 1 | Mov 42, #1110011111b | Call shift L |
| Call PL | Mov 41, #1100000001b | Call shoot |
| Call num 8 | Mov 40, #1111111111b | Call shift L |
| Call Pl | Ret | Plend: |
| Call num O | Slash: | Call Pl |
| Call num 9 | Mov 46, #1111111111b | Call Pl |
| Call Pl | Mov 45, #1111111111b | Call Pl |
| Call Pl and | Mov 44, #1111111111b | Call Pl |
| Call plend | Mov 43, #1111111111b | Call Pl |
| Call PL end | Mov 42, #1110011111b | Call Pl |
| Jmp start | Mov 41, #1100000001b | Call Pl |
| Num O; | Mov 40, #1111111111b | Call Pl |
| Call pl | Call PL | Call let R |
| Call let SS | Call let C | Call pL |

| | | |
|---|---|---|
| Mov 46, #1111111111b | Ret | Call Pl |
| Mov 45, #1111111111b | Let ss: | ret |
| Mov 44, #1111111111b | Mov 46, #1111111111b | Shoot: |
| Mov 43, #1111111111b | Mov 45, #1111111111b | Mov r4, #4 |
| Mov 42, #1110011111b | Mov 44, #1111111111b | Daddy call screen |
| Mov 41, #1100000001b | Mov 43, #1111111111b | Djr2r4, daddy |
| Mov 40, #1111111111b | Mov 42, #1110011111b | ret |
| ret | Mov 41, #1100000001b | |
| | Mov 40, #1111111111b | |
| | Ret | End |

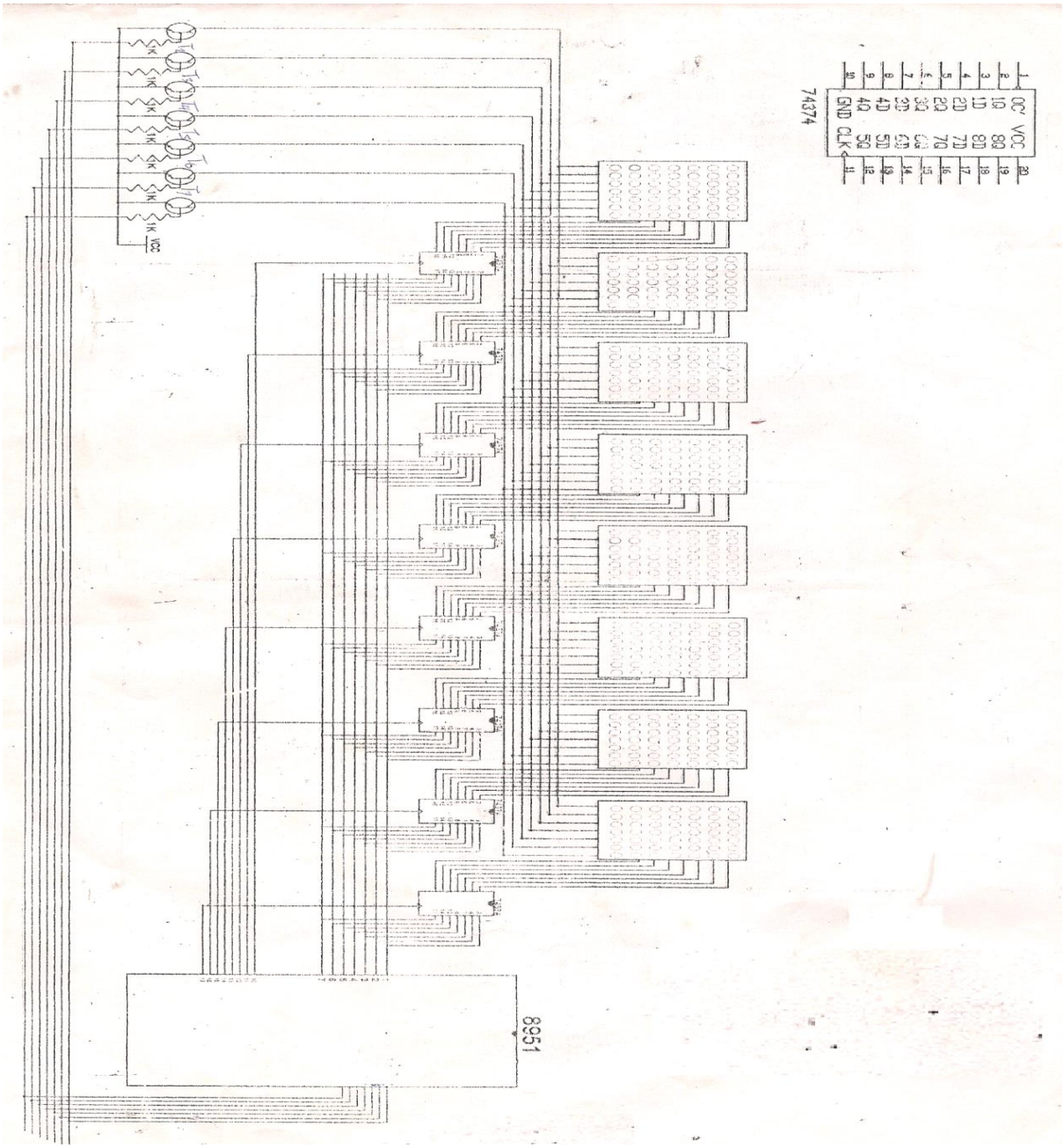


**Fig 6: Complete Circuit Diagram**

**Materials Required For Wiring**

The various components used in wiring of the Dot Matrix Display Board circuit are shown in the table below:

**Table 1: Component list and its cost**

| S/N | Component | Identification letter | Values | Quantity | Cost (Naira) |
|---|---|---|---|---|---|
| 1 | Transformer | T1 | 12V | 1 | 250 |
| 2 | Diodes | D1-D4 | iN4001 | 4 | 80 |
| 3 | Fuse | F1 | | 1 | 20 |
| 4 | Capacitors | C1 | 2200µf, 25V | 1 | 20 |
| 5 | Ceramic capacitors | C2 | 30pf | 2 | 20 |
| 6 | Crystal oscillator | Cr | 16MHz | 1 | 100 |
| 7 | Micro switch | Sw1 | 0.05A | 1 | 20 |
| 8 | Power Regulator | IC1 | 7805 | 5 | 250 |
| 9 | Resistors | R1-R16 | 1kΩ | 16 | 80 |
| 10 | Transistors | Q1-Q7 | TIP 41 | 7 | 560 |
| 11 | LEDs | L1-L246 | Red (5mm) | 246 | 246 |
| 12 | Power outlet | - | - | 1 | 20 |
| 13 | Latches IC | Ic2-IC5 | 74374 | 5 | 500 |
| 14 | Micro controller | IC1 | 89C52 | 1 | 600 |
| 15 | 10 x 10 IC socket | - | - | 5 | 100 |
| 16 | 20 x 20 IC socket | - | - | 1 | 40 |
| 17 | Capacitor | C3 | 10µf, 25V | 1 | 20 |
| 18 | Jumper wires | J | - | 10 yards | 200 |
| 19 | Lead | - | - | 1 roll | 600 |
| 20 | Casing | | | | 1500 |
| | Total | | | | 7440 |

**Constructional Procedure**

The construction of dot matrix display board was carefully carried out. The circuit was tested first and checked to a working condition. Care was also taken to ensure that the circuit components selected is of correct value. The components were connected on the simulator to confirm appropriate functioning of the circuit. Due to the complexity of the circuit, testing on the board was very difficult but rather we use the simulator program which made it very easy to handle such cases.

After confirming the workability of the circuit diagram, it was transferred to the strip board for final implementation process. A good soldering technique was employed, in order to get the soldering as neat as possible. The surface of the strip board was kept oil free for effectual flow of the solder lead. Every other necessary engineering tool was employed to get the work as supposed.

List of some of the items used i.e. the tools used

i. Soldering iron: used for melting lead
ii. The plier: used for holding and bending of components
iii. Hack cutter: used for cutting the terminals of some materials]
iv. The multi meter: used for testing the continuity, to clear any problem of short circuiting and for voltage test.
v. Hammer: used for sending blows to nails which secures the casing ]
vi. Sucker: used for de-soldering process.
vii. Brush: used for cleaning the surface of the circuit board.
viii. Razor blade: For cutting the board of the metal points.

**Description of the Circuit Connection**

The 8952 is the major programmable IC used in which the whole information are encoded. From pin 1 to pin 7 of the micro controller 8952, the zero voltage are sent as seen in the connection. Pin 1 is connected to all the pin 3 of the 74374. Pin 2 is connected to pin 4 of the 74374. The same way, pin 3, pin 4, pin 5, pin 6 and pin 7 of the 8952 are all connected to pin 7, pin 8, pin 13, pin 14 and pin 17 of the 74374 respectively.

From pin 10, pin11, pin 12, pin 13, and pin 14. Each of the pins 11 of the 5 74384 latch IC are connected respectively.

Another connection from 8952 are the connection to port 2, which in pin 21, pin 22, pin 23, pin 24, pin 25, pin26 and pin 27 and they are all connected to the transistors Q7, Q6, Q5, Q4, Q3, Q2, Q1 respectively which actually biases them when instructed from the micro controller.

Through the transistors emitter, the positive legs of the Led as arranged in a matrix form are connected. Just as it is in the diagram, all the connection are made in the strip board.

Note: The negative LEDs of the LED are connected via a latch IC to the port 1 of the micro controller and positives are connected as already described above.

**The Packaging**

The construction of the casing for the packing of the microprocessor display board was done using aluminum. The desired dimensions were marked using measurement, tape, pencil and steel rule. The aluminum was cut according to dimensions and was polished. Nails were used to hold the joining the were cut to form the desired shape of the case

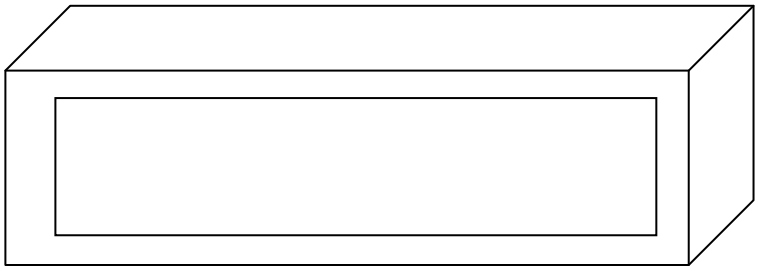

**Fig 7: Casing of the Dot Matrix Display Board**

**RESULTS AND DISCUSSIONS**

On completion of the circuit construction, the circuit was troubleshot and little errors were detected and rectified. The EMF was measured using a digital multi-meter the terminal voltage were also measured. A test was carried out to ensure proper display of the programmed words during the test and it was discovered that the light emitting diode depends on the micro controller and the buffer.

It was also discovered that the higher the value of the crystal oscillator, the faster the display on the screen of the light emitting diode and the lower the value of the crystal oscillator the slower the displaying speed.

After comparing the behavior of different ratings of the crystal oscillator, 12MHz are considered useful

The following points were also listed and results as follows:

| | | |
|---|---|---|
| AC Input Voltage | - | 220Volts |
| AC output Voltage | - | 12Volts |
| IC output Voltage | - | 5 volts |
| IC output voltage | - | 5 volts |
| IC output voltage | - | 5 volts |
| Input of the micro controller | - | 5 volts |

## CONCLUSION

In conclusion, the realization of this project is a technical breakthrough in the right direction. The result of this design satisfies the desires of the Dot Matrix Display Board as a gadget which can actually be recommended to be used with a guaranteed time limit before any breakdown.

In the course of carrying out this project, a lot of knowledge in the connection of components and effective soldering technique was acquired. This project has exposed one really to the world of digital electronics. The workability and the effectiveness of this project can provide a lot of help to students who are into construction of Dot Matrix Display Board.

## RECOMMENDATION

The use of digital signboard as a medium of dissemination of information in the country should be prompted as much as they can in order to meet up with the global requirement of the Light emitting diode technologies.

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