DESIGN AND CONSTRUCTION OF A MICROCONTROLLER BASED BILL BOARD

BY

OGUNDELE EBENEZER. O

(2004/18849EE)

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING,

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MINNA. NIGER STATE.

NOVEMBER, 2009.

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A THESIS SUBMITTED TO THE DEPARTMENT OF

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DEDICATION

I dedicate this project to God, the beginning and end of everything who has helped me to the end of this program. Also to my family for being there for me, especially my late Dad, Overseer Akinola Ogundele.

DECLARATION

This is to certify that this project research was fully carried out by Ogundele Ebenezer with registration number 2004/18849EE, of the department of Electrical and Computer Engineering, Federal University of Technology, Minna. It is supervised by Mr. Nathaniel Salawu.

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ACKNOWLEDGEMENTS

I deeply want to appreciate God for His love, grace and mercy for keeping my life till now. May His name be praised forever.

My profound gratitude goes to my parents who have been my greatest treasure all my life. Your support in all ramifications cannot be over-emphasized. Also to my siblings, Mr. Samuel and his lovely wife, Sir Timothy, Sir Michael and his dear wife, my only sister Bukky and her husband, Doctor Isaac and my sweet nieces (Deborah, Eunice and Tonikeyin) and my nephew Clement. I love y'all.

To my supervisor, Mr. Nathaniel Salawu, you are wonderful sir. Also my Co-supervisor, Mr. Bukola Olawuyi, your contributions throughout the program is immeasurable.

To my H.O.D, the whole Electrical/Computer Engineering department lecturers and my academic advisors and, I am so grateful for your support and encourage in every way.

And to you all my friends Grace, Positive, T Yanks, Dinah, and my own H.O.H family of WCF and all that I can`t mention, you guys are just the bomb. Joy, you are priceless.

I am surrounded with wonderful classmates that I can`t forget in a hurry. Deji my friend and project colleague, Afoma, Ade and Ola, you guys are the best. I can't forget our "class chat" together. We will do greater things together in the soonest future. Let`s move on.

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ABSTRACT

This project is based on the design and construction of a microcontroller based electronic bill board, with editable memory, added scrolling effects, higher lighting intensity and real time clock display. Its dynamism, great but unusual market value is also an added advantage.

Its operation is essentially designed to display the stored data in the 512KB Memory chip.

The use of AT89C52 microcontroller and 74LS138 Address Decoders are employed for multiplexing and to achieve a better display, in terms of the display performance, a 10mm LED is used.

CHAPTER ONE

INTRODUCTION

1.1 About the Project

This century, the 21st century is full of so much advancement in virtually every area of existence, especially in the area of information and communication technology (ICT). We now have a quest for clearer, unlimited and effective display systems. Information is everything, and it is advancing in seconds. Knowing that the effect of good display systems cannot be over-emphasized in the growth of personal effectiveness and the economy of the nation as vital information are passed across through this system. Before now, displays are added to electronics systems almost at the after thought, but today, displays are incorporated into almost all engineering devices even from the conceptual stage. We see them on the elevators, market places, banks, fast food joints, restaurants, insitutions, on machines and electronic devices to mention a few.

Advanced computer systems now have display devices incorporated in them.

Also, its applications are now found in various fields like aeronautic instrumentation, commerce, military device and systems, medicine, camera imaging and computer applications and lots more.

Its dynamism in all these fields has called for constant improvement in size of character, cost efficiency and higher performance of the display device and most importantly clarity.

The following are the basic display technologies in common use:

- Light emitting diode
- CRT based large screen projection

- Cathode ray tube (CRT)
- Plasma display channel (PDC)
- Liquid Crystal Display (LCD)
- Light value based large screen projection
- Electroluminescence (EL)

Electronic bill boards are also instrumental to the development of the earlier above mentioned areas of life. Its aesthetic variance from the non-electronic bill board is wide. Before now, the available electronic bill boards are not editable which limits its functionality and effectiveness. To improve on this, this project incorporates an editable memory device, wireless interface difference, character effects and a real time clock chip technologies. All these features will increase its market value.

The project is microcontroller based, which is used to drive the LED's that are arranged in matrix form on a display board.

1.2 Historical Background

It is discovered that electronic bill boards have been in existence for decades. Those used before now were made from electric lighting devices most commonly, the incandescent lamp, and the various types of arc and electric discharge vapour lamp [1]. In 1862, the England (Dungeness), a lighthouse had the 1st practical arc lamp. The American pioneer in electrical engineering, Charles Francis Brush produced the 1st commercially successful arc lamp in 1878. Also in 1907, tungsten filaments were substituted for carbon filament in incandescent lamps and gas-filled incandescent lamps were developed in 1913 [1]. The fluorescent lamps were introduced in 1938.

The electronic board used before now was very expensive to construct and require high power for their application or operation. It is because of these disadvantages related to it that brought the idea of the electronic bill board that makes use of microcontrollers to control sets of LED's in displaying.

This becomes more preferable in recent years due to its relative low cost of production and they possess an attractive, eye catching quality.

In 1962, at the University of Illinois at Urbana Champaign, a member of faculty of science – Nick Hononyak received the 1975 John Scott award for his inventions leading to the first practical light emitting diode [2].

LED's were first used as indicators, but after his discovery, experts in the fields have also discovered numerous uses for it. It has replaced the earlier technologies as for the purpose of indicators and display boards.

Its uses are stated below;

- Burglar alarms systems
- Dark links and remote controllers
- Field of optical fibred communication systems
- As a grow light to enhance photosynthesis in plant
- Sterilization of water and disinfectant of history
- Numeric displays in calculators
- Image sensing circuits

Of a truth, this project is a contribution to the development of history.

1.3 Types of Board

Display boards are in various types, and are all over the surface of the earth. The dominant ones amongst others are Liquid Crystal Displays (LCD) and the ligh. Emitting Diodes (LED) it is sure that a display is an 'Opto' electric device that shows numbers, a hexadecimal digit display, and also any letter or number i.e. alpha-numeric displays.

LCD's as a newer technology, have advantages over the other displays. These are;

- Customs shapes and symbols displays
- Equipments for use outdoors or in high ambient light level
- Battery operated device due to its very low power dissipation
- Many character display

A single DIP packaging of LED's in such a way that variety of visual characters can be displayed by selectively switching LED's ON and OFF. These packages are commercially available, and are output devices for calculations and other microcontrollers based systems.

A 5×7 dot-matrix and sixteen-segment displays are available in two varieties which are:

- Smart displays that does the hard work of decoding
- Dumb displays that bring out the segments and common LED's just as the same way as with seven-segment displays.

1.4 Microcontroller

A microcontroller is a single chip microcomputer that is used to control processes or events. Any device that measures, calculates, controls, stores or displays information is legible for putting a microcontroller in it.

An application or a required application is what determines our decision on which microcontroller to use. The list made will then be matched to various microcontrollers' description, and the one that best suites could be easily identified.

One of the output devices which are used as light with two states i.e. ON and OFF states is the LED's. They are suitable for use at the output of the microcontrollers because of the following reasons;

- ability to display both numeric and alpha-numeric characters
- produces less heat
- consumes less electric power

Set of LED's are connected together in a single board using a common mode of connection for this project. its packaging is in such a way that a variety of visual character can be displayed by switching the LED's ON and OFF. Microcontroller been embedded to the system is used as the main control either for switching the LED's ON or OFF.

1.5 Aims and Objectives

This project is aimed at achieving the following:

- The designing and construction of a microcontroller based bill board in an improved way, editable memory, higher lightening intensity and real time clock display.
- Microcontroller based bill board of great market value.
- Unlimited display ability, which can be edited i.e. information can be changed overtime without having to destroy the board.
- Longer lasting display board

1.6 Methodology

Materials are gathered at each stages of the implementation of the design and construction. Also, library materials, internet browsing was not left out which serves as updates on the topic.

Laboratory works are then carried out and some past projects in the department were also consulted. With the assistance of the laboratory technologists and group discussions, the work was made easier.

1.6 Scope Of Study

The design is a microcontroller based one and uses LED`s as the display unit and not seven-segment LED to aid the simplicity of the project design. Also address decoders are used for the movement of the data; right from the first column to the last column of the display LED`s and it aid stability of the performance and reliability.

CHAPTER TWO

LITERATURE REVIEW

2.1 Historical Background of the Bill Board.

2.1.1 A Brief History of Major Components

In simple terms, LED's are light emitting semiconductor diodes, only when electric current is applied in forward direction of the device, as in the simple LED circuit. The effect is a form of electroluminescence where incoherent and narrow spectrum light is emitted from the P-N.

This has caused the light output and the efficiency to increase exponentially, with a doubling approximately every 36 months since the 1960s, in a very similar way to Moore's Law. The advances are generally attributed to the parallel development of other semiconductor technologies and advances in optics and material science. This trend is normally called Haitz's law after Dr Roland Haitz [3]. The LED hottest competition flourished in 1970s and 1980s for consumer goods which came from vacuum fluorescent displays (VFD), whose bright blue-green display offered high intensity and high contrast when viewed through a green or blue filter.

Monochrome LCDs competed strongly with LEDs and VFDs for consumer services, instrumentation, and the automotive panels with the advantages of lower power and easy customization in the 1980's. LCDs became the obvious choice of battery operated application. Although LCDs do not emit light, there are many applications where ambient can be guaranteed.

Around four billion (4 billion) units of LEDs are produced worldwide in a month. Ten years ago, Japan was the principal LED producers and Taiwan's output was a little over 10% of the world demand. According to ITIS (Industrial Technology Information Services) of Taiwan, they now produce around half the world`s demand from its more than 30 LED manufactures.

Microcontroller. This is a very major component used in this project. This is a microprocessor integrator with varying mix of memory and peripherals on a single chip. Microcontrollers are almost always found embedded in all system. It obviously means many things to different people. In general, a microcontroller contains an inexpensive microprocessor core with a complement of the on board peripherals that enable a very compact yet complete computing system either on a single chip or relatively few chips.

Intel began the manufacturing of these microcontrollers in the 1976 with the introduction of the 8048 family. Motivated by the popularity of the 8048, they introduced the 8051 microcontrollers in 1980, which is substantially more powerful and flexible. It contains 128 bytes of RAM, 4KB of ROM, two 16-bit timer/counters, and a serial port. Registers within the microprocessors are 8 bits wide except for the 16 bit data pointer (DPTR) and program counter (PC). With the Atmel 8051 microcontroller, it is easy to get totally engrossed in the programming of the device and not understanding any of the hardware consideration. We have different types of microcontrollers with respect to this family:

- AT89C5: This is a low power high performance CMOS 8-bit microcontroller with 4KB of flash programmable and Erasable Read Only Memory (PEROM). Under this class we have AT89C51, AT89C52, and AT89C53.
- AT89S5: This is a low power, high performance CMOS 8-bit microcontroller with 8KB of in system programmable flash memory. Under this class we have AT89S52,

AT89S53 and AT89S8252. The AT89C52 was employed in this project. The device is manufactured using Atmel's high density nonvolatile memory technology and is compactable with the industry standard 80C51 and 80C52 instruction set and pinout. The on- chip Flash allows the program memory to be reprogrammed in- system or by a conventional nonvolatile memory programmer. By combining a versatile 8- bit CPU with Flash on a monolithic chip, Atmel AT89C52 is a powerful microcomputer which provides a highly- flexible and cost- effective solution to many embedded control applications [4].

- Also, the shift register is one of the most important components. Shift registers are type of a logic circuit, mainly for storage of digital data. They area group of flip-flops connected in a chain so that the output from one flip-flop becomes the input of the next flip-flop. Most of the registers possess no characteristics internal sequence of states. All the flip-flop are driven by a common clock and all are set or reset simultaneously. We have various types which are:

- Serial in Serial out
- Serial in Parallel out
- Bi directional

We have verious applications of the registers

- To produce time delay
- To simplify combinational logic
- To convert Serial data to parallel

The ability of the shift register or address decoders to convert serial data to parallel one is highly employed in this project. This is achieved through the use of a type of address decoders known as 74LS138 decoders.

2.2 Theoretical Background

2.2.1 Static And Multiplex Driving LEDs

It has been discovered that the easiest method to drive multiple LEDs, such as a display digital segment, is to drive each LED separately with a resistor or current source setting the forward current.

This technique is called the Static Drive because the LED current is continuous. Static drive is useful when relatively few LEDs are driven, sensibly limited to about 7-segment digits. High frequency LEDs can be driven to high brightness with 2mA, which is from the output of most microcontrollers. Even when driving more segments, Static drive demands a larger number of drive outputs, one per LED. Multiplex Drive (or pulse drive) reduces the drive connections by strobing only a small number of segments (typically a complete digit) at the time. The strobing is done at a high enough repetition rates that the eyes experience a continuous illumination. However, the LEDs require a higher current to compensate for the reduced duty cycle.

2.2.2 Background Persistence of Vision (POV)

The television images persist on the retina of the eye which the brain will interpret as a continuous image over the whole screen. A visual experience of a movie always revealed how badly the illustrated screen flickers. This is as a result of the fact that a television picture is never at the ON state all the time, otherwise it is being re- written 50 times per seconds by a moving trace. It is based on the scanning effect or principle.

This principle or effect of scanning as applied to LED display of complex patterns like moving message is employed in this project. The LED display will appear as if all the LEDs are ON at the same time and at all time. It is actually not so! It is just like a "pseudo-ON". It is only turned on for just 0.5 micro-seconds at every 250 micro-seconds (duty cycle =3% i.e. pulse width/period). This technique is known as the multiplex as discussed earlier. It makes use of persistence if vision effect to allow the display of complex message, hence there is no need of turning all the LED ON continuously since when ON for only 3% of the time. The same output effect can be accomplished.

2.3 Difficulties that Limit Performance

The static drive display or messaging board has the following limitations;

1. It produces only one message.
2. Displaying many messages means it has to be bulky
3. Re-designing of the whole system is the only means of changing messages to be displayed.

The advances in the Integrated Circuit (IC) technology has made it possible to include all the logics necessary to operate a multi digit multiplex LED displayed in a single chip. An example is the 8279 programmed keyboard or a displayed controller (Intel, 1981) which is an input/output circuit in the 8080/8085 family. The HP 5082-7340, which is an example of smart display with a built in latch, decoders and driver.

Also, some limitations are related to the choice of LEDs and their reliability after design, such as:

1. Mean time between possible failures (MTBF) for precision optical performance devices.
2. The effect of overheating of the precision optical performance LED lamps.
3. The effect of exposure to long time high humidity and condensing moisture
4. LED light output degradation
5. Extreme temperature effect on the precision optical performance of the LED lamps.

2.4 Improvement against the Limitations

The LED failure modes mentioned above are prevented by:

- Providing adequate over voltage surge protection, thereby reducing the possibility of a high current transient that exceeds the maximum allowable LED drive current.
- PC board designed for low thermal resistance to ambient air, thus reducing the LED junction temperature rise to minimum.
- The housing designed to provide sufficient protection from long term exposure to condensing moisture.

Most recent designers use Microcontroller to drive the sets of LEDs arranged in Matrix form using multiplexing or scanning technique. The approach is adopted in this very project work to solve the limitations to;

- Bulky messages can be displayed. This is solved since the microcontroller fetches the messages on the board from memory that supports up to 1000 characters.

- Static messaging by the fact that since the controller can continuously alternate the messages on the screen given dynamic messages.
- Reconstruction of the whole design when editing the messages on the board is solved since editing can be done using software programming.

This project has provided solutions to the limitations outlined above.

CHAPTER THREE

SYSTEM DESIGN AND CONSTRUCTION

3.1 System Design

The electronic messaging board is designed around the following sub systems;

- Power Supply
- A 24L08 1KB Non Volatile Memory
- 89C52 8- bit microcontroller
- 7- bit row drivers
- RS232 Logic Level Translator
- 13- bit address generator

Based on the concept, project design and its operation, the message to be displayed by the screen made of 700 LED's [5 x 7 dot matrix] is "WELCOME TO ELECTRICAL LABORATORY FEDERAL UNIVERSITY OF TECHNOLOGY MINNA". Other messages depend on what is desired to be displayed and written into the NVM.

3.2 Anatomy of the Project

The project is divided basically into two Sections namely:

- The hardware design section
- The software design section

3.3 The Hardware Unit

The following units of the implementation are further explained below in details.

3.3.1 The Power Supply Unit

A regulated 5- Volt dc supply is required for the system operation. The voltage is derived from a 12V, 1A step down transformer, a bridge rectifiers and two 6- Volts regulators as depicted in fig 3.1

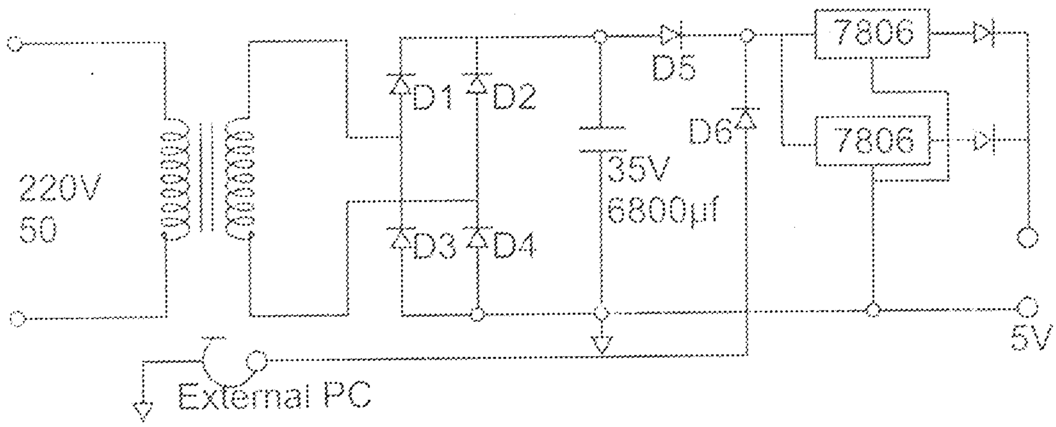

Fig 3.1: System Power Supply

The low- voltage AC was converted to a DC voltage of amplitude

$$V_{dc} = V_{AC}\sqrt{2} - 1.4$$
$$= 12\sqrt{2} - 1.4 \qquad (1)$$
$$= 15.5V$$

The DC voltage was smoothened by a capacitance of value deduced from:

$$C = \frac{It}{V} \qquad (2)$$

Where;

I = Maximum Load Current

The load current was fixed at 2A. The maximum ripple voltage was determined by the minimum regulator input voltage. Two 7806 regulators were connected in parallel, and their output diode isolated to source the required load current. The minimum regulated input voltage is 8V (for the 7806 regulators, as specified in the device data sheet). On a 15.5V DC supply, this corresponds to a peak to peak ripple voltage of

$$(15.5-8)V = 7.5V$$

Evaluating C required in the process is:

$$C = \frac{1 \times \frac{1}{2} \times 50}{7.5}$$
$$= \frac{0.001}{7.5} F \quad (3)$$
$$= 1333 \mu F$$

The calculated value of the capacitance is the maximum smoothing capacitance required across the supply to meet system worst case performance requirements. It was increased to 6800 for improved system performance.

The smoothened DC voltage was regulated down to about 5.4V (due to diode sink) by two 7806 regulators as shown in Fig 3.2

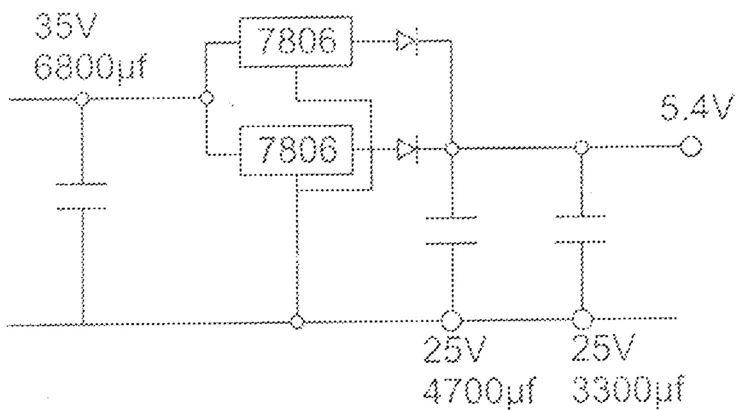

Fig 3.2: 7806 Regulators

The regulators are in parallel to reduce the dissipation that would result if a single regulator was used. The regulated 5.4V was stabilized by a parallel combination of 7806 regulators.

3.3.2 8-bits Controller

An 89C52 device was used for system control. It is a low power, high – performance CMOS 8 –bit microcontroller. The device was programmed to execute the following operations;

- Provide a real time clock function
- Respond to user input keys
- Interface the display board with the host system via the serial port.

The controller interface with other system component a shown in Fig 3.3

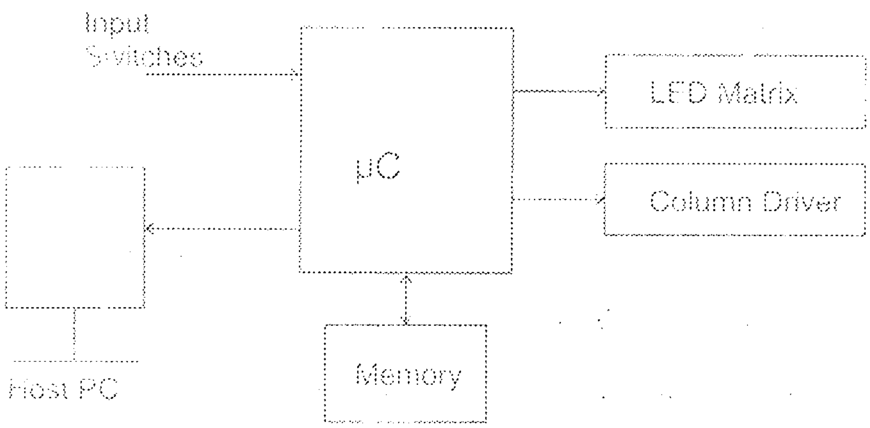

Fig 3.3: Computer Interfacing with other System Components

A 7-bits row driver designed around 25A1015GR PNP transistors was interfaced with the controller over P 0. The 13 –bit address generator for individually selecting the columns was interfaced over P.2. The Non – Volatile Memory was interfaced via the two - wire software emulated IIC Bus interface over P 3.6 and P 3.7.

Four user keys to provide Time and Speed adjustments were connected to P1.0 – P1.3. The microcontroller also interfaced with the host computer over the serial port Via a CMOS/TTL – 232 Logic Level Converter.

3.3.3 Controller-Row Driver Interface

Seven PNP transistors were used to switch current through the Seven (7) rows. They were connected over P.0 as shown in Fig 3.4

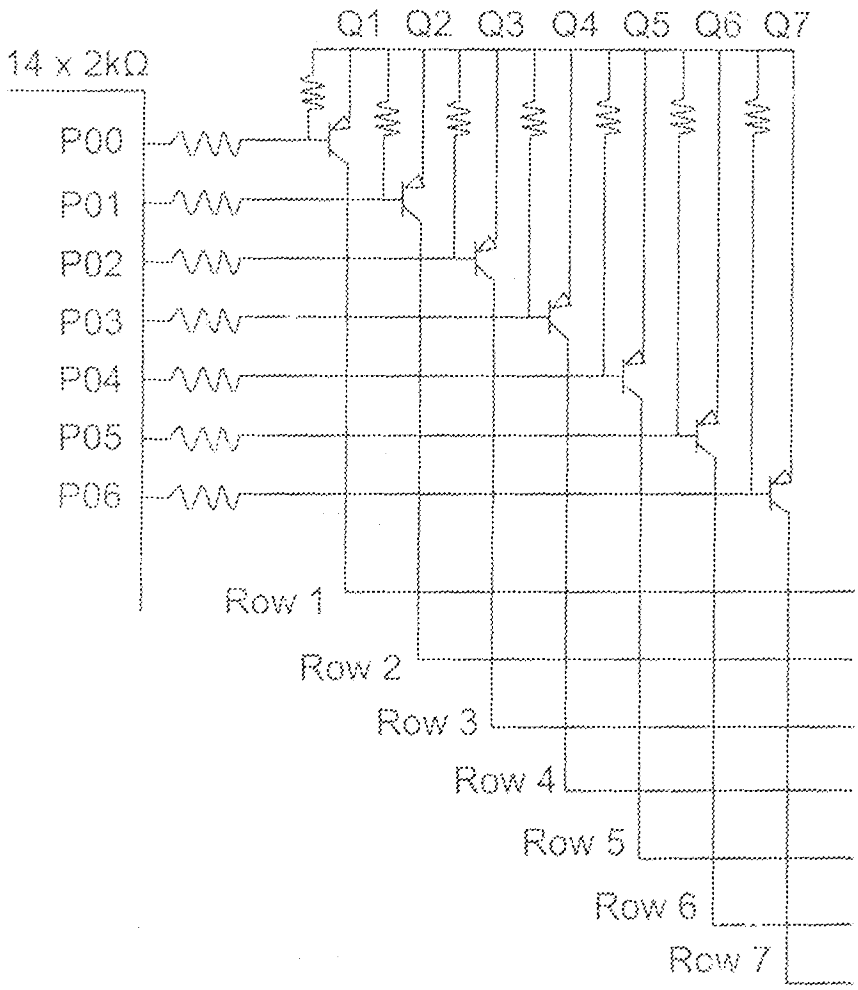

Fig 3.4: Row Driver Interface

A 5×7 font face was used. A 5×7 display uses 5 bytes of 7–bits each to represent a character. The 7–bits are written to the display at once, while only one column of the five is strobe low. An anode row display was used, hence the cathode links the LED current to the ground to illuminate.

The transistors were chosen because their moderately large gain which is approximately 200, and 150mA peak continuous current. Each transistor was biased by a two – resistor network shown in fig 3.5;

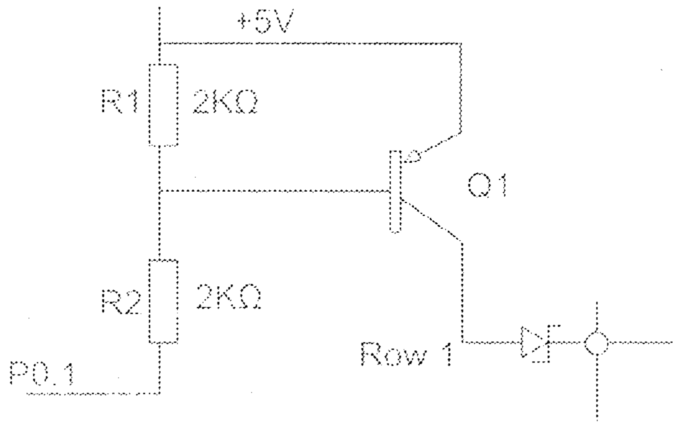

Fig 3.5: Transistor Biasing

To display twenty characters at once, 100 columns were needed. The average current through each LED is given by the equation;

$$n \propto I/I \qquad (4)$$
$$\text{Where } n = \text{number of columns} = 100$$

A continuous current of 10mA was chosen for each LED. The peak LED current therefore is $100 \times 0.01 = 1A$. This therefore corresponds to the peak collector current for each transistor. The transistor has a DC gain of about 200.

Evaluating I_B;

$$I_B = \frac{I_C}{200} = \frac{0.1}{200} = 5mA \qquad (5)$$

The current through the base resistance is chosen to be;

$$\frac{V}{R} = \left(\frac{5}{2000}\right)\Omega = 2.5mA \qquad (6)$$

Since no current limiting resistance was used to limit the current through the LED's, 2.5mA was considered. The current were grounded through column drivers as shown in fig 3.6:

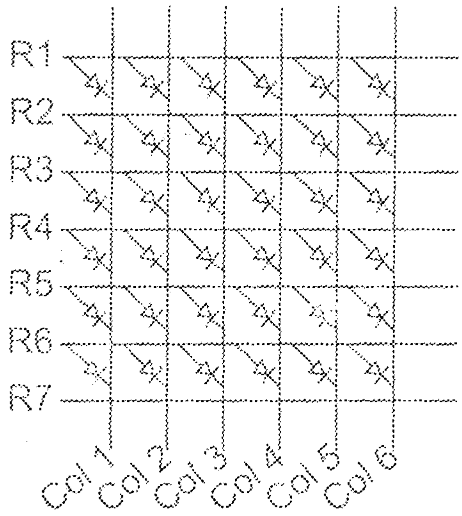

Fig 3.6: Diode Matrix

A total of 700 LED's were used i.e. 7 LED's in 100 columns. Therefore 100 separate column driver output were required to switch the LED current to ground. The display was multiplexed at about 200Hz to prevent display flickering.

The columns were driven by the active low output of 74LS138 decoders driven by software over P2 as shown in Fig 3.7

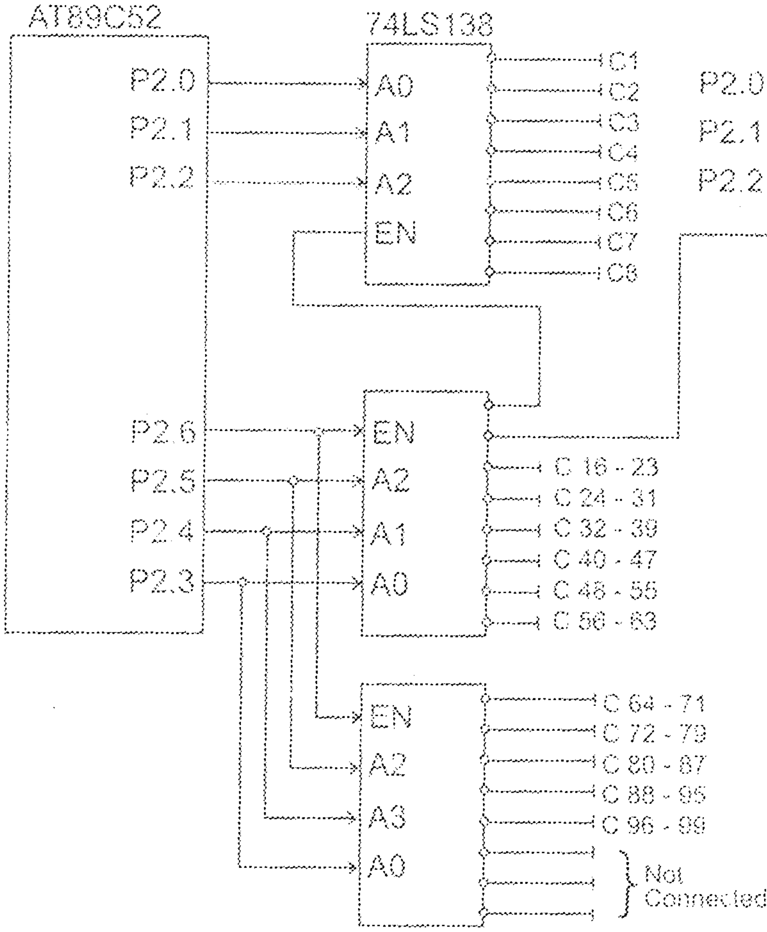

Fig 3.7: 13-bit Address Generator Decoder

Port P2 was run in software as an up counter to successively generate a walking address output. Since 74LS138 decoders were used, the address bits were split into the high range and low range. The low address range handles column outputs 0 – 63 while the high address range handles 64 – 99. Whenever an address is placed on P2, the corresponding decoder output goes low.

At the same time, current through the rows is returned to the ground via the LED's, causing the LED's to glow.

The lower bits of P2 [P2.0 – P 2.2] were connected to the A0, A1 and A2 of the decoders. The ENABLE inputs of each decoder was then connected to the output of 1– of -16 decoders formed out of two 8-bit decoders as shown in Fig 3.8

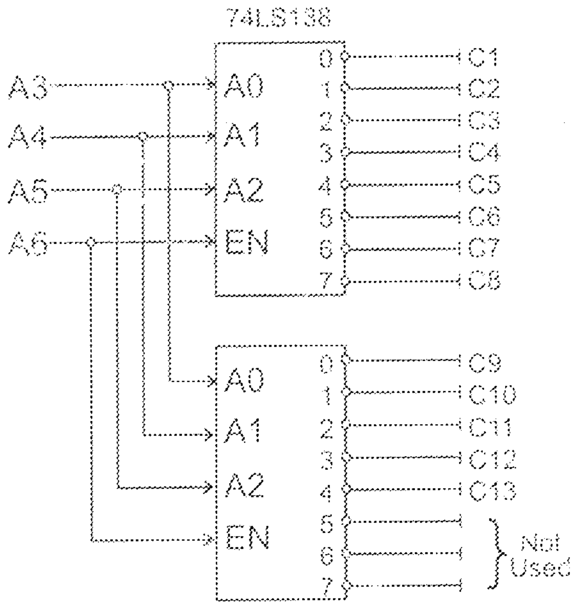

Fig 3.8: 1-of-16 Decoder

The address bus data was synchronized with the buffer address in RAM. By writing the bit pattern in the RAM buffer to the data port [P0] and setting the appropriate address on P2, the binary equivalent of the RAM buffer data is displayed on the LED array. The 74LS138 device is capable of sinking about 40mA on each output.

3.3.4 Controller – PC Interface

To enable programming of the embedded IIC (bus protocol) EEPROM, via a system, a serial communication link was required. The link was established via a Logic Level Translator shown in fig 3.9;

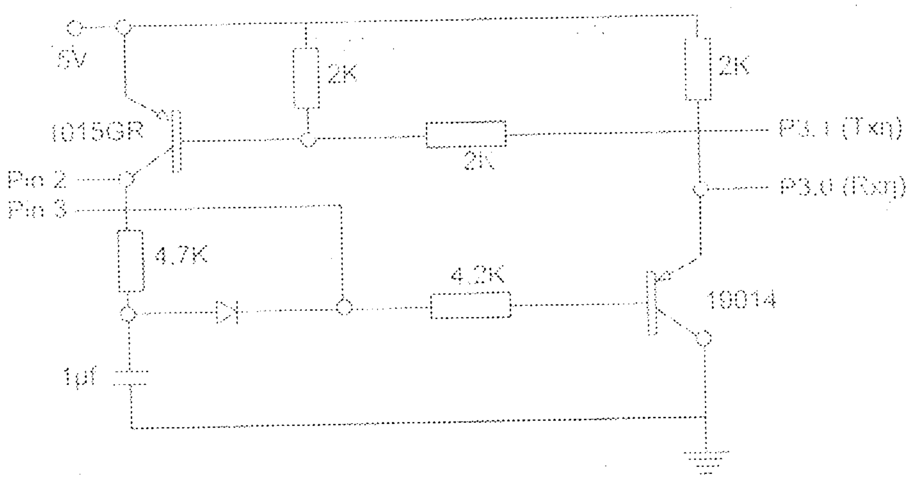

Fig 3.9: Logic Level Translator

The microcontroller utilizes single-polarity signaling, while the IBM PC motherboard utilizes a bipolarity signaling convention. To translating between the two different signaling conventions, a Logic Level Translator translates the 0 – 5V Logic Level on the microcontroller to the -3V to +3V logic level required by the motherboard logic for communication. A complementary transistor pair was used in the translator. The PNP transistor inverts the logic level on the Transport Data (TD) pin, while the NPN transistor inverts the RS232 voltages to generate the 0V – 5V levels required by the controller. The translator was adapted from an IBM (International Business Machine) [6] application.

3.3.5 24C08 EEPROM

A 1 Kilobyte EEPROM was interfaced with the microcontroller. The memory was divided into 8 pages of 128 bytes each. Each page was addressed via software, reading and writing of the EEPROM memory was done over the two-wire bit-banged IIC interface. The device was configured for read/write address 1010 0001, and write at 1010 0000. Communicating with the memory device involves sending the Read/write address.

then the 8- bit data (in the case of write operation), or reading the 8- bit data (in the case of read operation).

The memory was configured as shown in fig 3.10;

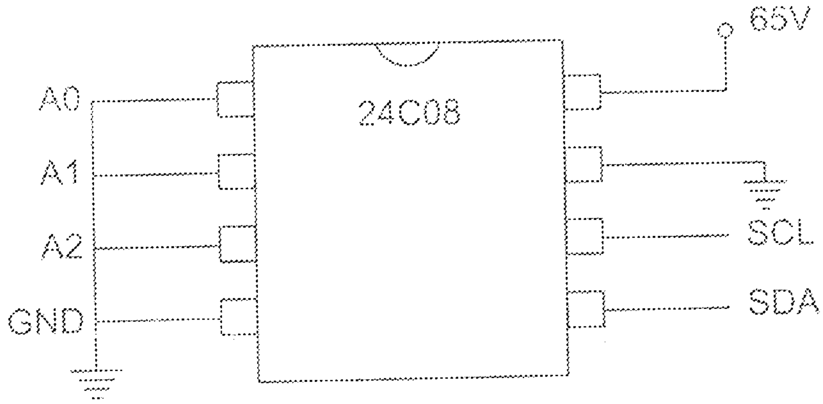

Fig 3.10: 24C08 Hardware Configuration

The A2 and A1 pins were not connected inside of the chip, leaving only A0 to act as the device select input.

3.3.6 User Program Key

Four push buttons were interfaced with Port 1 to control the Hour/Minute/Speed plus and Speed minus of the system.

A 24 - hour software clock was run in software. The software approach was adopted due to the non- availability of dedicated real time clock chips (RTCG) designed for hardware time keeping purposes. The speed was also made adjustable via two normally open buttons.

3.3.7 System Control Software

The control software executed the following in a loop:

Step 1- Display start up message and serial port for data

Step 2- Read memory and display memory data

Step3- Return to step 1

Interrupts were enabled (Serial, T0, and T1) to enable time keeping, keypad scanning and serial port for transmission and reception remotely. A standard screen writes routine beginning with the software reading a character processing the data to access a look up table, reading the 5 byte making up the character, and writing the bytes to the RAM buffer before writing to the screen.

Different display effects were provided, examples of which include

- Screen shift (right to left)
- Top – down display build up
- Down – top display build up
- Reverse data display (Right to left)
- Adjacent character shift (up/down for adjacent character) etc.

Two hundred bytes of RAM were used for the effects since two buffers of 100 bytes each were used. 25 bytes of RAM were used for time display. Five bytes were used for data masks, thus necessitating the utilization of an 89C52 part with 256 bytes of RAM.

The microcontroller was configured for 9600 bits per seconds using an 11.0592 MHz crystal.

CHAPTER FOUR

TESTING AND DISCUSSION OF RESULT

4.1. Testing

Every stage of this design has one form of test or the other carried out. A test is an experiment to discover whether or how well something works, or to find out more information about it. [7].

Each component was tested for continuity and corresponding outcome was noted.

4.1.1 Power Supply Unit

An AC means (220V) is used to secure the power unit of this project. After all the components were rightly designed, the output voltage from the regulators is 5.4V. Also, each component was tested before they are used.

4.1.2 Address Decoder Output

Care is taken in handling and implementing the 74LS138ICs to avoid bridging which will burn the decoders. The generated output will be incorrect if the proper pins configurations at the output of the AT89C52UC are not correctly inputted in the decoders.

4.1.3 Display Unit

Some LEDs are burnt in the process of soldering on the board. It was discovered that the soldering iron temperature was too high, therefore regulated. Every form of short circuiting was avoided, and it is also ensured that 100μA is feed into each Row of the display board from the microcontroller through the 2S101GR transistors acting as switches. Testing the output of the display board, each column showed that the LEDs were properly aligned, no form of short circuiting.

4.2. Discussion of Result

On completion of the circuit on the board, testing the design, gave the output display that was coded in the flash memory of microcontroller which is "WELCOME TO ELECTRICAL LABORATORY FEDERAL UNIVERSITY OF TECHNOLOGY MINNA"

Some components were burnt due to over current, LEDs, capacitors. Some were faulty and replaced due to undesired output results. Also a major challenge with the LEDs is short circuiting.

The prototype used for this project was derived after some errors were discovered in the program and re-written.

CHAPTER FIVE

CONCLUSION

5.1 Summary

The aim of this project design is to put together both the theoretical and technical aspect of the design and construction of a microcontroller based modern display board that is more economical, user friendly and has wider application.

5.2 Result

The LED display board was a success from the conceptualization to the final stage, a well constructed microcontroller based LED display board with an editable NVM attached for wider display of information. It is going to be used at the Laboratory of this great department.

5.3 Limitation of This Design

One major limitation of this project is the construction of the standard LED. It characters are not visible enough when displayed in an outdoor location. For subsequent projects, the use of an ultra bright LED would be advised.

5.4 Recommendation

A wireless interface could be attached to the design. This will enhance the quality of the design and will make transfer of information into the non volatile memory less stressful.

Also, the character display size should be larger to enhance clarity.

5.5 Conclusion

An opportunity to be major part of the design, construction and intensive study of this project has really enhanced my knowledge and practice of what has been learnt in class.

Also, working with my colleague has been full of learning's in the area of teamwork which is a vital area of human existence.

From the conception stage to the implementation of this project, it has been challenging but a huge success. I hope it will be used for the purpose it has been designed and constructed by the department.

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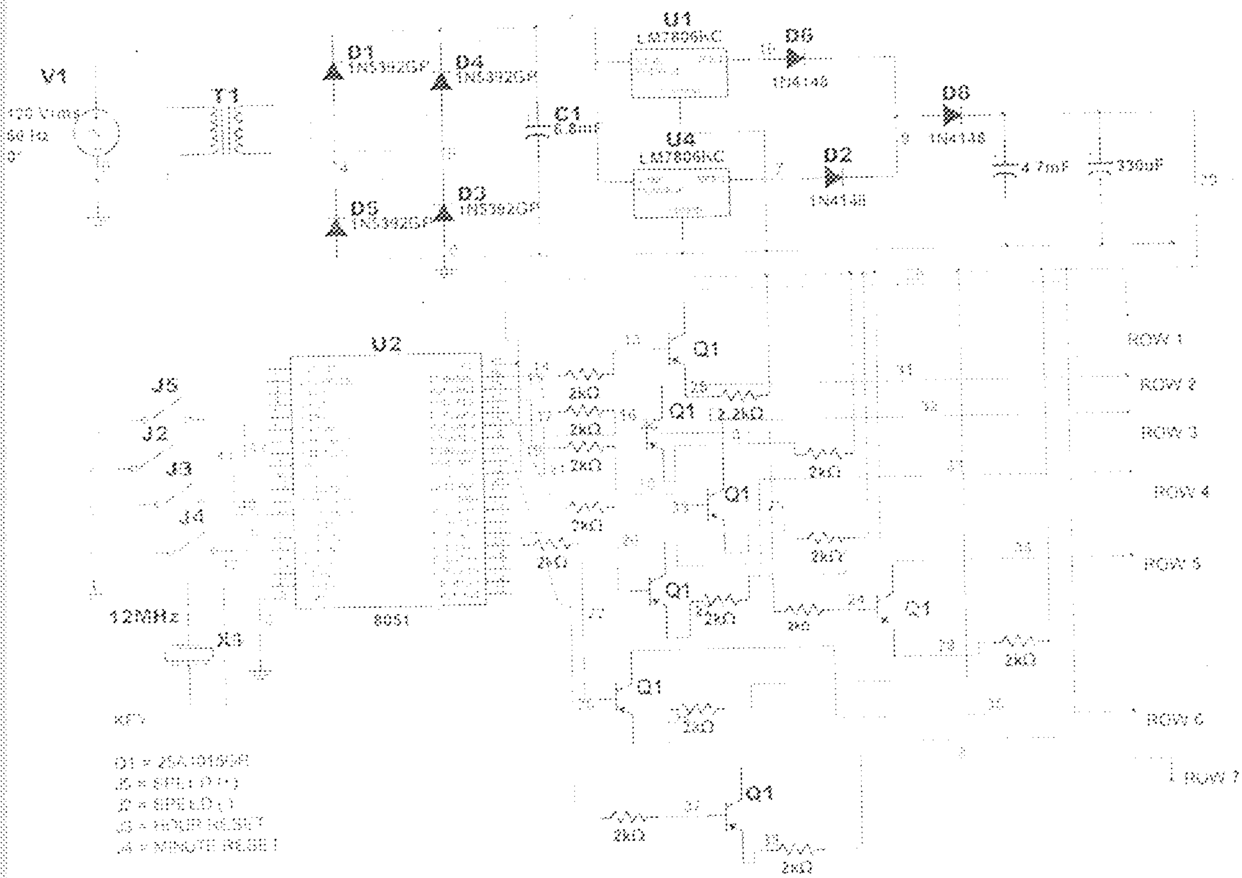

The circuit diagram of the microcontroller based billboard.