DESIGN OF A NOVEL PC BASED DIGITAL NOTICE BOARD ON SCROLLING LED

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Abstract

This study presents an alternative design for a notice board known as a PC based digital notice board on scrolling LED. Key features of the project design include availability of a PC interface and scrolling of messages. The PC interface enables the message on display to be changed at will using computer interface software from any computer that has the RS 232 port. The scrolling of messages from right to left enables the notice board to effectively display messages that are longer than its length. The scroll function and changeability of message on display when combined yields a versatile notice board.

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Introduction

Conventional notice boards vary in size and are used in a variety of locations, and the simple functionality they provide is put to a wide range of uses depending on where they are used [8]. Notice boards are very important means of making information available to people in places such as schools, corporate establishments, and the general public at large [9]. Schools for example, rely heavily on notice boards for dissemination of information to their staffs, students, prospective students and the general public. This factor makes the quest for better infrastructure for implementing notice boards to be of high research priority in the university.

The computer age has seen advancements in the field of electronics and computing made possible the development of electronic notice boards. Electrical notice boards followed the invention of the light bulb, and included light bulbs arranged in a pattern where, by lighting some light bulbs and not the others, letters and numerals could be spelled out [7].

With the advent of solid-state circuitry in the early 1970s, digital notice boards with changeable signs became possible. The first of these products were simple text message displays using incandescent lamps. These lamps were very inefficient. They used a great deal of power and had short life expectancies. LED (light emitting diode) technology had been used in displays of electronic notice boards since the mid-1970s. Originally, LEDs were available in three colours: red, green and amber, but were typically used for indoor systems because the light intensity was insufficient for outdoor applications and the durability of the diodes suffered in the changing temperatures and weather conditions. As technology improved, manufacturers were able to produce displays that had the intensity and long life required for outdoor use. However, they were limited in the viewing angle from which they could be effectively seen. Recently, breakthroughs in this field have made available high intensityLEDs in red, green, blue and amber. These LEDs have made it possible to produce notice board displays bright enough for outdoor use with viewing angles that are equal to, or better than, other technologies currently available.

Digital notice boards are known to be energy-efficient, can be programmed and operated remotely, and require little maintenance. In addition, the computer software has evolved such that a broad range of visual effects can be used in digital notice boards and in displaying messages and images[7].

Today, digital notice boards on scrolling LED display constitute an effective and economical means of data distribution to the masses. They have also found application in bus stops, terminals, ferry harbors, car mounted signs, chain stores, square message boards, factories, banks, real estates, stock exchanges, post office, hotels, traffic control, etc., [5].

Research Methodology

The requirements for this design are subdivided broadly into hardware and software requirements.

The hardware design

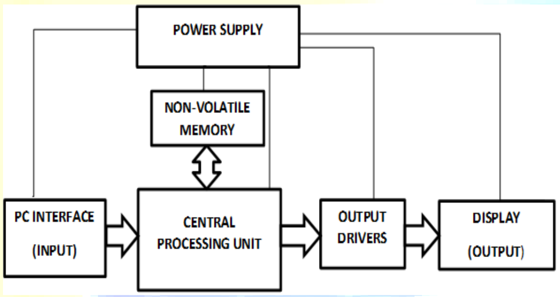

Fig.1. Block diagram of PC based digital noticeboard

The major blocks are shown and the arrows show the direction of the flow of the operation of the complete system. The circuit design is approached through designing the various components differently and at the end to couple them together to realize the finished circuit.

Power Supply

The operation of the circuit requires a well regulated power supply that can supply constant 5V needed for the operation of the circuit. The power supply uses a 5V fixed 1A positive power supply regulator IC (LM7805), silicon rectifier diode (IN4001) and filtering capacitors of 10 and 0.1μF. The power takes in 9V DC to yield a well regulated 5V for the circuit operation.

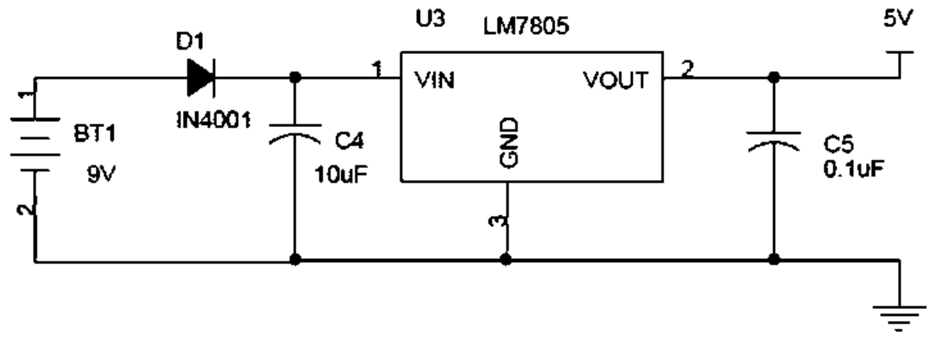

Fig.2. Circuit diagram showing thePower Supply Module [Drawn with Microsoft office Visio 10 for Windows]

Input PC Interface

The RS 232 to TTL voltage level converter IC (MAX233) handles the task of converting the voltage level of RS 232 port of the PC which is -18V to -3V for high and 3V to 18V for low into the standard TTL voltage level which is the acceptable level of the microcontroller. The pin 14 and 13 of the level converter IC is connected to pin 2 and 3 of the RS 232 port. While the 11 and 12 of the level converter IC is connected toTx and Rx pins of the controller.

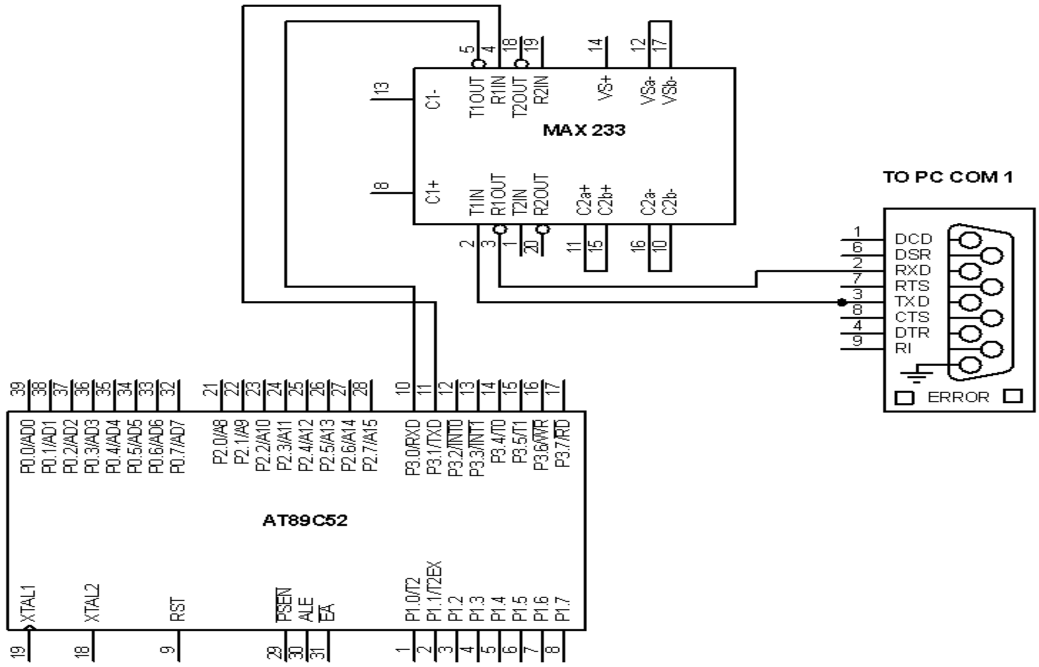

Fig.3.Circuit diagram showing the input circuit [Drawn with Proteus version 7.8 for Windows]

The memory circuit

A non-volatile serial EEPROM memory IC (24C02C) provides a means of saving characters to be displayed. The EEPROM is interfaced with the microcontroller using two wires as shownbelow.

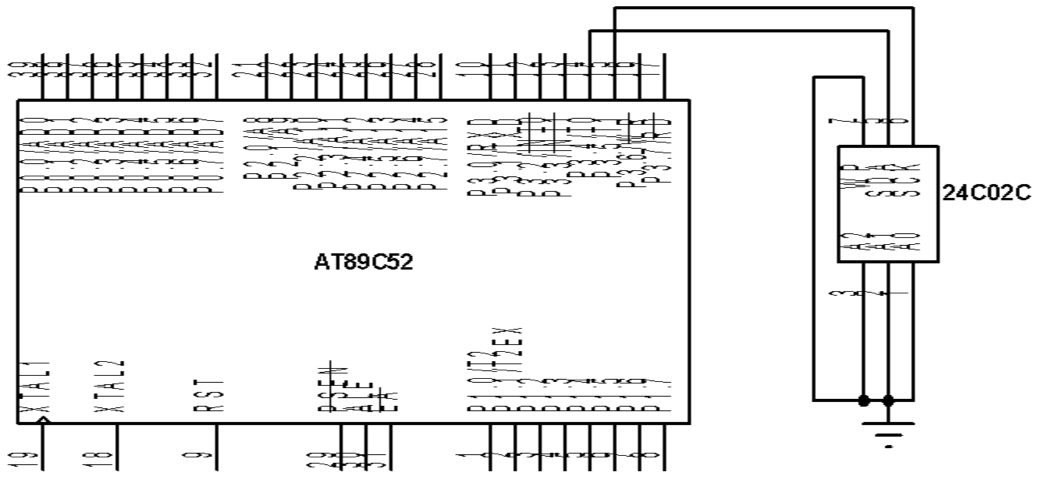

Fig.4. Circuit diagram showing the interface of the EEPROM IC and the Microcontroller [Drawn with Proteus version 7.8 for Windows]

Microcontroller

The program that controls the operation of the whole circuit is written in assembly language and stored in the code ROM of the microcontroller. The microcontroller uses the instructions of the program and with the help of its input and output pins carry out the task of receiving character data from the PC, saving them in external memory device first, and then generate a pattern appropriate for displaying the characters and continuously output them to the display. The circuit is designed around two identical microcontrollers: AT89C52. The two microcontrollers are clocked at speeds. One is clocked at 11 MHz and the other at 32 MHz and they together control and coordinate the functioning of the various paths of the circuit. The connection between the two controllers is illustrated below.

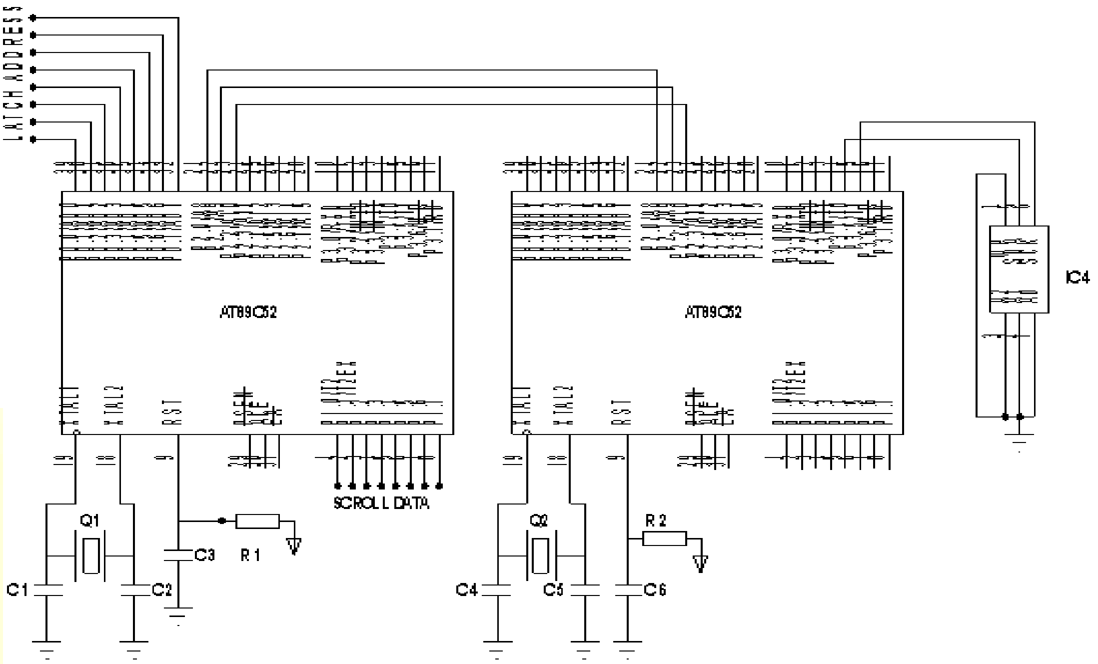

Fig.5.Circuit diagram showing the connection of the microcontrollers[Drawn with Proteus version 7.8 for Windows]

The display

A 64 x 7 matrix of 5mm LEDs is formed in such a way that all the positive terminals of the 64 LEDs in given row are connected together while the negative terminals of all the seven in each column are connected together as shown in figure below.

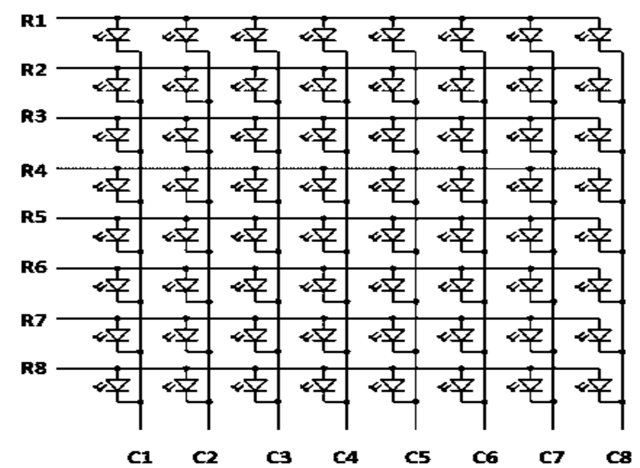

Fig.6.Circuit diagram showing theconnection of the Dot matrix arrays of LEDs[Drawn with Microsoft office Visio 10 for Windows]

The complete circuit

The components are assembled on a Vero board using electric soldering iron. Jumper wires are used to establish connection between components on a common node but separated by a reasonable distance. The schematic diagram of the complete circuit is shown in Fig. 7which shows the complete circuit diagram of the PC based digital notice board.

IC 1, IC 2 - AT89C52 Microcontroller

IC 4 - 24C02C (2 Kbit EEPROM MEMORY)

IC 5 - IC 12 - 74HC573 (OCTAL D-TYPE TRANSPARENT LATCH)

T 1 - BC 337 NPN BJT

Q 1, Q2 - QUART CRYSTAL

C 1 - C6 - 30 pF Ceramic Capacitors

R 1, R2 - 10 K Resistors

R 3 - 1K Resistor

Operational flow chart

The flow chart for receiving and displaying data are shown below

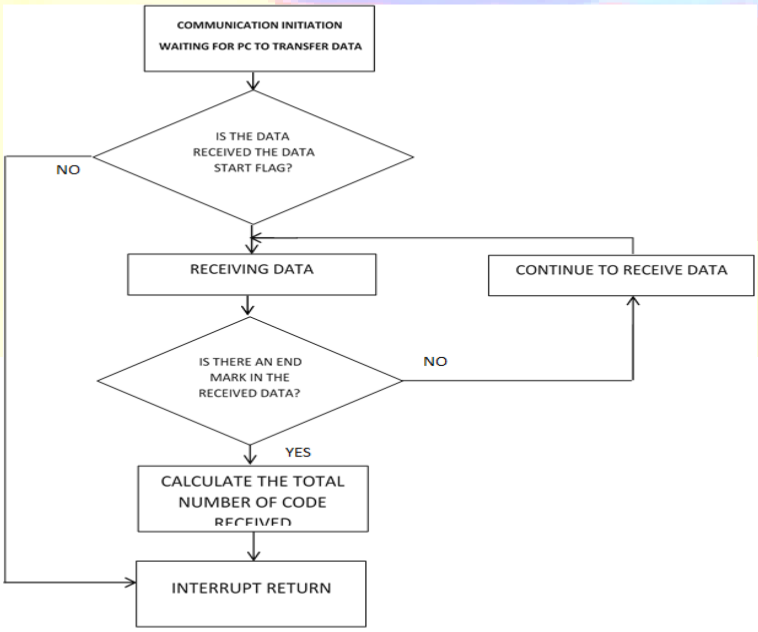

Fig.7. Flowchart of the program for receiving data from PC

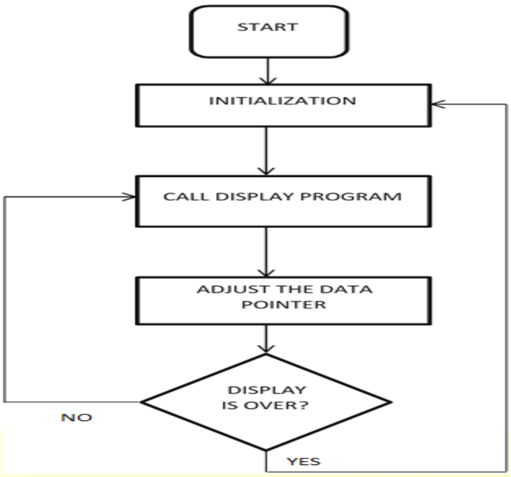

Fig.8. Flowchart of the display program

Program source code: Software

The two flow charts that have been presented above are converted into executable computer programs using the assembly language. The complete source code of the programis available on request. The programs are compiled and burnt into the appropriate microcontrollers.

Theory of operation

On power up, the microcontroller labelled MIC1 which is clocked at 11.0592 MHz will start retrieving ASCII character data stored in the internal memory chip with the help of program instructions stored in its code ROM. As the data is being retrieved, the program also enables the microcontroller to be alert for new incoming data. If there is a new incoming data, an interrupt occurs and retrieval stops as the microcontroller readies to receive new data from the PC using RS232 serial port protocol. The microcontroller first erases the old character data in the external memory, receives the incoming data and stores them in the external memory. When the reception and storage operation is complete, the retrieval of character data from the external memory continues again till another incoming data causes an interrupt. The second microcontroller labelled MIC2 is clocked at 32 MHz, on power up it starts requesting for data from the microcontroller MIC1. MIC1 respond to this request by retrieving the ASCII character data from the external memory and convert them into the appropriate pattern and send them to MIC2. In the code rom of MIC1 are embedded the patterns for the ASCII codes in six bytes array. At the receipt of an ASCII code MIC1 downloads the corresponding six bytes of character pattern using the routine/procedure “downloadptn”. The first row (r0) of the downloaded pattern are fed into the latches and r0 of the LED matrix is set high followed by two milliseconds delay and r0 is pulled low. Now, replacing r0 (as stated above) with r1, r2…r6, the successive rows are scanned one after the other. After r6 is scanned, the operation starts afresh. Since this operation is carried out fast enough, the result is that the images of the selected characters persist on the screen as a result persistence of vision.

Scrolling of the characters is simulated by manipulating the columns of the first character on the screen. Initially scanning starts with the first column of the first character. After a delay (¼ sec) the starting point for scanning the first character becomes the second column. After another ¼ sec delay the starting point becomes the third column, and so on till the sixth column, after which the second ASCII code in the buffer is shifted into the first character position using "shiftLeft" procedure/routine. In other words the second ASCII code overwrites the first, till the 11th replaces the tenth after which MIC1 requests for another ASCII code from MIC2, receives another ASCII if any, and replaces the 11th character with the just received character code. Thus a column-wise shift to the left is simulated.

Result and Discussion

The assembled circuit was tested by plugging it to a 220V AC/12V 5A/ DC travel adapter. On doing so the device powered on. It was monitored for about five minutes with the power supply maintained and the device kept working on properly. A serial DB9 cable was connected on the RS 232 port of the device while the other end was plugged into the corresponding port of Pentium 4 desktop computer booted on, and on which was installed the Toochiosoft Display Interface. From Start/All programs/Toochiosoft Display, the interface program was launched and "Hello World" was typed into the textbox and the SEND button was clicked. The device responded by lighting up the correct character pattern and scrolling them from right to left. The scroll was observed for some seconds. The test was repeated four more times respectively replacing "Hello World" with other characters and the result was that each word pattern was replicated correctly by the notice board display.

Costing

The cost of constructing the project is presented in a table 1below.

Table 1. Items and their cost

S/N	QTY	Description of items	Rating	Unit Cost (NGN)	Amount (NGN)
1	4	Capacitor	30pf	30.00	120.00

2	4	Capacitor	10uf/16v	50.00	200.00
3	4	Resistor (1/4 watts)	3k	5.00	20.00
4	7	Resistor (1/4 watts)	1k	5.00	35.00
5	7	Transistor	BC337	50.00	350.00
6	2	Crystal Oscillator	11.059MHz, 32MHz	150.00	300.00
7	5	Voltage regulator	7805	50.00	250.00
8	2	Microcontroller	AT89C52	200.00	400.00
9	6	IN4001		10.00	60.00
10	2	Vero board	Dotted	150.00	300.00
11	11	Connecting wire		30.00	330.00
12	8	Latch	AT89C52	80	640.00
12	500cm	Soldering Lead		5.00	250.00
13	1	RED LED panel	64 × 7	250	250
14	1	DB 9 RS 232 socket		100	100
		Total			**3,585**

Conclusion and Recommendation

The major advantage of this design is thatthe PC interface enables the message on display to be changed at will using computer interface software from any computer that has the RS 232 port. Also, the power consumption of the digital notice board is considerably minimal at about 24 W. However display are limited to only the ASCII characters and therefore not all messages can be put to display. Further research on display of non ASCII character is recommended.

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