A LOW COST A Low Cost PC-Controlled Electronic-Display Board

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***Abstract*— This paper describes the development of a computer controlled electronic display-board by using a low cost older personal computer (PC) that has become almost unusable otherwise. This display system is capable to display the information as an independent system in the manner that can be dynamically programmed by the computer. A local control system, memory-subsystem has been developed to make it to work as an independent system.**

I. INTRODUCTION

An electronic-display board is a two-dimensional LED-array system in which each LED [1] acts as a pixel, therefore, any text or image can be displayed on that board. In the modern days, this type electronic-display boards are being used widely for different type of applications, for example, just for displaying fixed contents for advertising or information delivery. These first types of electronic-display board are static in the sense that once these boards are programmed to display some contents; it will continue to display those contents until it is reprogrammed. On the other hand, some electronic display-board are said to be dynamic in the sense that it displays the contents those are changed frequently or dynamically, for example, electronic score board or flight information displaying board. In general, a computer is employed for this second type of display-board. However, in this case, the computer should be always busy, even if for displaying a fixed content, engagements for sending data continuously to one column-LED after another of the LED-array in order to display any information. Therefore, it will hardly be possible to have the computer free to do any other job. In addition to this, to provide this type of electronic display board at low cost is a great industrial challenge in these days. From this viewpoint, in this work, a system has been developed for a PC controlled electronic display board by employing a low cost old-dated 386 series computer and necessary software has been developed too to drive that system. The main features of the system are, it uses software controlled synchronous serial data communication between PC and display-unit, in the display-unit, there is also a memory subsystem which holds the information that are received from the PC for displaying, for displaying that information there is also a local controller which controls displaying mode whatever it is still or moving text or image and finally this system can work independently without help of PC. This software is capable of controlling still or moving text or images.

II. DESIGN CONSIDERATION

The block diagram of the proposed hardware is shown in Fig. 1. The design part of main hardware is divided into the following sub-circuits:

A. PC Interface circuit,
B. Serial to Parallel converter circuit,
C. Memory sub system,
D. Display unit circuit,
E. Device control circuit.

A. PC Interface circuit

The interfacing circuit [2~5] can interface between the display board and PC. Following the address decoding part, this circuit accepts lines from PC: one data line, one clock pulse line and another common ground line. The computer program can transmit data via data line serially along with programmed-clock pulse for every single data bit.

B. Serial to Parallel ConverterCcircuit

The serial to parallel converter circuit converts the serial data come from the computer into parallel format. The data is shifted into the sift register (SR) at every clock pulse, at the same time, the clock line is fed to a counter via an inverter. This causes a half cycle delay between data shifting in shift register and counting the counter. This was done in order to prevent the loss of data. When 8 bit data are shifted into the shift register completely, at that time the counter value is 7. At

this time the temporary data register (TDR), which is connected to the parallel output of the shift register, is enabled by the counter, thus the contents of the shift register are loaded in the TDR as parallel data. Only this data will be available in the data bus of the designed system. The next byte serial data in the shift register will be available to a 3-to-8-line decoder (DR) through a tri-state buffer when the terminal count occurs in the counter. The second byte data is used for addressing various register/tri-state buffer and generates various control signals in the designed system for data-load operations or data-transfer operations. So, there are two bytes data are necessary for loading or transferring in parallel form. For example,

1st byte	2nd byte	Equivalent operation
XXH	00H	Load device control register (DCR)
XXH	02H	Load last count register (LCR)
XXH	03H	Load memory address register (MAR)
XXH	04H	Load memory via data line (MDR)

C. Memory Subsystem Unit

The memory subsystem consists of a 2048X8 bits memory package 6116 [6] for storing data that will be displayed to the LED monitor. A local control-circuit places the proper address at Memory Address Register (MAR) that should contain the data to be displayed on the LED monitor; in this way desired portion of the memory can be selected for displaying data. Therefore, the function of the local controller is to read the appropriate column-data of the LED monitor as well as to control whatever the contents for displaying should be static or moving.

This local controller consists of a counter, comparator and register. However, during this write operation that local controller is disabled. For memory-write operation, at first, the address is sent and following that data is sent. After write operation the MAR and the memory buffer (MB) is disabled and the local controller is enabled by the device control register.

If the content column-data are equal or less than the number of columns of display units then the contents are displayed on the monitor will be static or still. In this case, after displaying a complete set of data, again data-reading should be stared from same initial memory location. In order to display moving contents, two set of same data are stored consecutively, .and starting memory location for read operation is shifted one step advance or back after finishing of displaying one set of data.

D. Display Unit Circuit

The display unit circuit has been built with 8X16 LEDs. The row LEDs are connected commonly for data that are available for any column. The column LEDs are connected commonly for displaying the data of a selected column. The column data are primarily stored in a latch and a 1-to-16-line decoder selects the desired column. The column decoder uses decoding by a counter, which counts continually with the clock pulse comes form the main circuit.

E. Device control circuit

The system has a control register, which can be used to control the device. The control word of the status register is shown in figure-2.

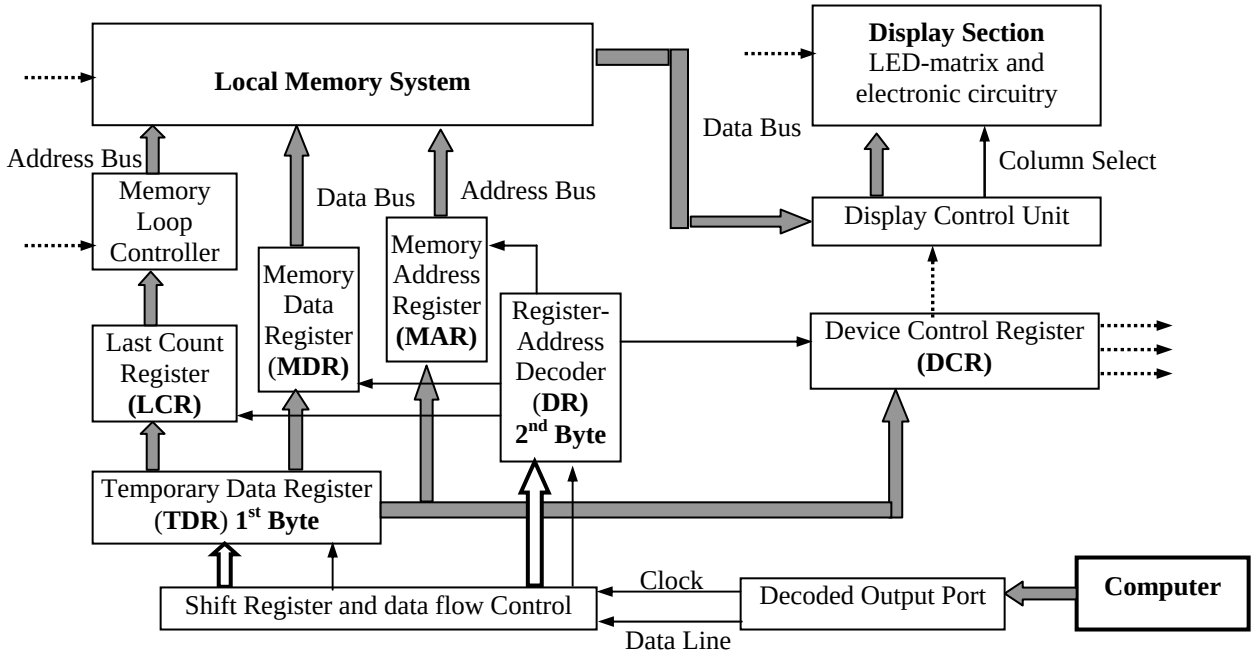

Figure 1. Block diagram of PC-controlled electronic display board

The D_0 bit can be used for switching to clock pulse line. The D_1 bit can be used to enable or disable the address lines and counter lines. The D_2 bit is used to turn on or turn off the data sending line for the display unit.

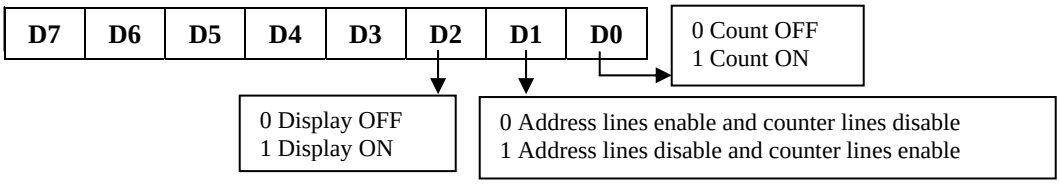

Figure .2. Device control word

III. SOFTWARE DESIGN

The program of the device, that can control its all operation, is written in C [7] programming language. The algorithm is given below.

A. Program Algorithm

All characters are formatted by 8X8 matrix of square array. For example character 'A' has the following format. All 0's represent no power present and all 1's represent that power supply is present.

```
A = { 0 1 1 1 1 1 1 0
      1 0 0 0 0 0 0 1
      1 0 0 0 0 0 0 1
      1 0 0 0 0 0 0 1
      1 1 1 1 1 1 1 1
      1 0 0 0 0 0 0 1
      1 0 0 0 0 0 0 1
      1 0 0 0 0 0 0 1 };
```

Therefore, the column values are sent one after another to the LED-array so that it looks like 'A'. In this way all characters and any other picture or images can be formatted compatible for this system. The program takes the value of each column and represents its corresponding integer value and transmits the value to store in the memory of the memory sub-system. Then, the device an display the contents of the memory according to its data values. The flow chart of the software is shown in Fig. 3.

IV. CONCLUSION

The project has been developed to show something in large-view. The total cost of this hardware is about 12 USD, this design involves some old-dated computers those are unusable otherwise, but those will have some industrial value. Therefore this low-cost displaying system can be sued as information displaying at different rail-station, airport etc, particularly for third world countries.

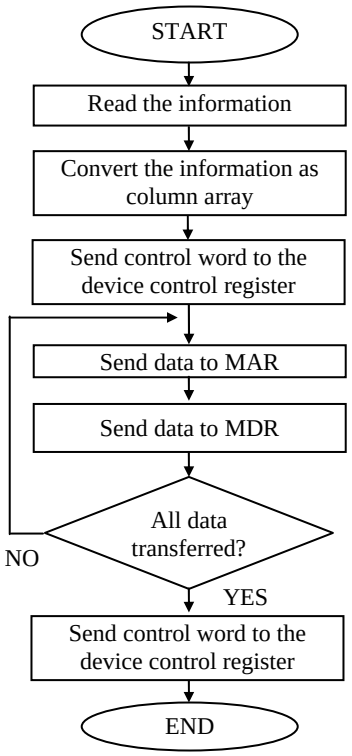

Figure 3. Flow cart of the program.

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