Electronic Table Card Based on Full Color LED Screen

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***Abstract*—Nowadays, the table cards appeared in the meetings are mostly made of paper or copper. They usually lack of beauty and just used once, which not only is a waste of resource but also does bad to environmental protecting. Then an electronic table card that can be reused and easily set is needed. In this design, IAP15W4K58S4 is chosen as the main control chip of the whole system, and MBI5124 is used to drive the full-color 32*64LED screen, and the battery management module and communication module are needed as well. The font and color of characters on the screen can be easily set by a computer or smartphone.**

Keywords—Electronic Table Card; LED Display; MBI5124

I. INTRODUCTION

The current table cards are mostly made of paper or copper, which are not convenient to reuse and difficult to modify the content when facing the emergency. So, it is necessary to design an electronic table card[1]. Not only can it be reusable, but also gives a better appearance of the word, and make the settings of text, font, color etc. easier.

The table card made of full-color LED screen is convenient, beautiful, modern and technological which is a better choice over the traditional one. Thus, IAP15W4K58S4 is used as the main controller in the project, along with MBI5124 which controls the 32*64 full-color LED screen. Finally, an electronic table card is made[2].

II. MAIN DESIGN

The architecture of the design is shown in Fig. 1. It is composed of six parts: Microcontroller, battery management circuit, communication circuit, line-scanned drive circuit, column-scanned drive circuit and 32*64 matrix LED screen. Microcontroller is used to deal with the data for the screen[3]. Drive circuits are designed to light the full-color LED screen. And battery management circuit is for power supply and monitor of the battery level[4]. Communication circuit is for the transport of data from computer to the microcontroller. Besides, 32*64 full-color LED screen is chosen because its size is quit small and still enough for 4 Chinese characters or two lines of English words. To refresh the word on the screen easier, wireless communication is the best choice.

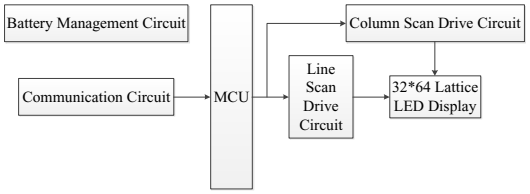

Fig. 1. Overall architecture of the design.

III. HARDWARE DESIGN

The most difficult part of this project is the design of drive circuit of the LED screen. The whole screen is divided into 8 parts, each of which consists 2*64 LED controlled by D4953. The luminance of the three types of LED (red, blue and green) is controlled by 12 units of MBI5124 in every part. MBI5124 is used to receive serial data and takes parallel control of the luminance of 16 monochrome LED (red, blue or green). Different units of MBI5124 are connected in series so as to reduce the IO pins needed from microcontroller. The module structure diagram is shown in Fig. 2.

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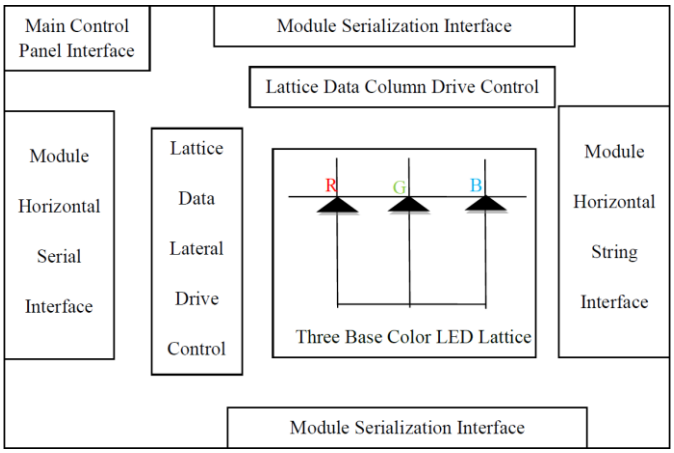

Fig. 2. Diagram of module structure

IV. SOFTWARE DESIGN

A. Software Design for Computer

Main functions of the computer software include three parts: 1. Receive the input words and settings of font, size and color. 2. Generate the data array and show a preview image on the screen. 3. Establish Wi-Fi Connection or Serial Connection with MCU to transmit data.

1) Setting module

The text of name has already preset as 'TJUT'. All the settings can be reset by 'Font set', 'Color set' conveniently. White is the brightest color while red is striking. These two colors are recommended[5].

2) Generate data array and preview image module

This part is about generating the data of the picture and showing a simulate picture, which is the most important part of the computer program. Firstly, receive the words as well as the settings of font, size and color of the words input by the user. Then draw the word on a graphic through GDI and set it at the horizontal and vertical center. After that, generate a bitmap picture and read all the data of that picture into the program by 'filestream', and it will display the data in order, and then read into the three arrays of red, green, and blue. Finally, in the preview module, if the luminance of this point is above 128, draw a circle to show that this point will be lighted. In this way, the preview picture is almost the same as the real screen. The flowchart is shown in Fig. 3.

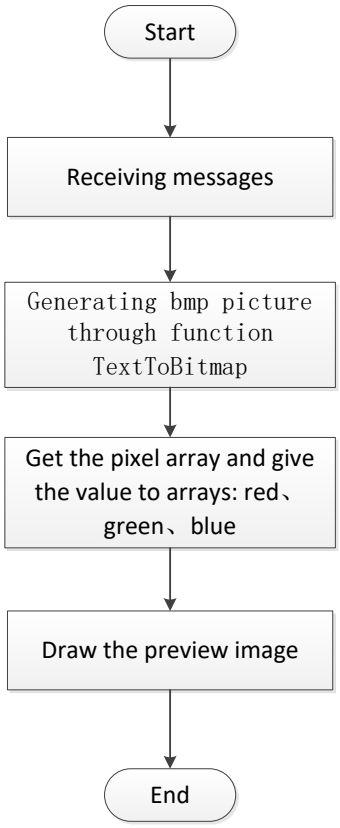

Fig. 3. Flowchart of generating data and preview

a) Function: TextToBitmap

This part of program is to transform word into bmp picture. Firstly, the format of the picture, the size of the picture, the position and layout of the words are set in the program. Next, get the parameter of text content, background color, text color and so on, and draw the text in GDI, then save it as a BMP file.

b) Data section

In this part, the message of bmp picture is read in the program through 'filestream'. Skip the file header and information header by changing the location of the pointer and put the pixel array into 'bydata' array. Then, the data is assigned to red, green and blue arrays by cyclic assignment. Normally pixels are stored "upside-down" with respect to normal image raster scan order, starting in the lower left corner, going from left to right, and then row by row from the bottom to the top of the image. For example, the first pixel actually stays in [31][0], and the second one stays in [31][1].

c) Previewing part

In order to give the user a visual view of the display on the

LED screen, a preview picture (as shown in figure 4) is given by drawing individual dots on a black square which is almost the same effect of the real screen. The area is divided into 32*64 parts, and each dot represents a lighting LED.

Fig. 4. Diagram of software preview area

GDI is also used in this part. Firstly, the background color is set to black. Then by 'Brush Ledbrush = new SolidBrush(LedColor);', the brush color and the words' color are the same. When the value in the array red, blue or green is above 128, there will be a dot in this pixel.

3) Communication Module

The ESP8266 chip is used for Wi-Fi connection as the server, which transmits Wi-Fi signals, and connects the computer to its Wi-Fi as the client. In the beginning, a socket and a thread for watching the request from server are created. At the same time, the IP address and the port are also preinstalled. When getting a click on the 'connecting to the server', the thread starts working. After the initialization of the microcontroller is complete, the data in the array will be sent.

B. software program of Microcontrollers

This part consists of main-program and communication-program. The 32 rows of the screen are divided into 4 parts. The first and third parts are lighted up early and given some time to improve the luminance. Then the second and forth parts are lighted. Interrupt service routine is used to receive the data and command from the computer.

The core of the main-program is the cyclic assignment, whose flowchart is shown as Fig. 5.

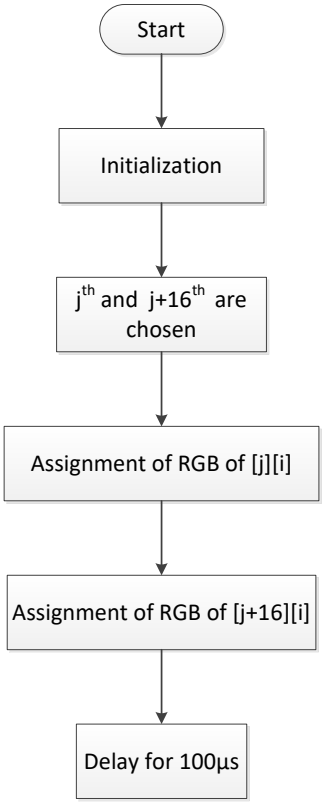

Fig. 5. Flowchart of cyclic assignment

The program is based on nested loop. Every time when the number of row—j is refreshed, OE is set high level and MBI5124 stops outputting to avoid lighting wrong LED during refresh. At the same time LE is set low level to lock all the data in the 16-bit output latch. Then function of row choosing 'enableline()'is called to choose D4953 and jth along with j+16th will be chosen at the same time. When R1 is assigned, the red LED of jth will be lighted; which R2 is assigned, the red LED of j+16th will be lighted. Therefore, the lighting efficient is higher than before.

V.DEBUGGING OF THE SYSTEM

The control board of the system is shown in Fig. 6. In the debugging process, three tests are needed. First, the electrical test: the system powered by USB through the power conversion circuit; second, MCU program download test; third, LED screen display test. As shown in Fig. 7, after programming, the full-color screen is working well.

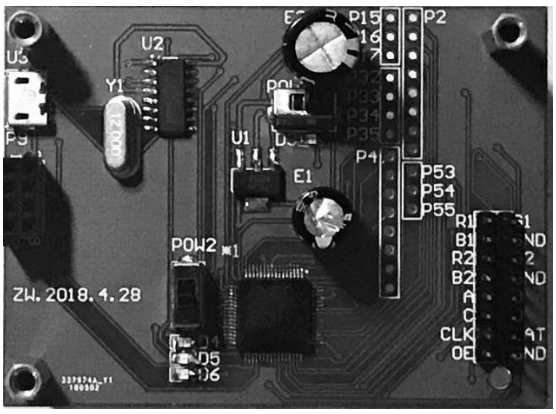

Fig. 6. PCB of control circuit

Fig. 7. The photo of the working-screen

VI. CONCLUSION

The electronic table card was realized with full-color LED screen in this design.

The IAP15W4K58S4 is used as the main control chip which can receive data and command from computer or smart cellphone. On the computer, C# program is adopted to transform words into a bmp picture and Pixel Array is read into three data arrays for transportation. Wi-Fi connection or serial port connection is established for microcontroller, which lights the LED to show the words on the screen. This electronic table card will be accepted by the market and has a bright future because of its beauty, cheap and convenience.

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