Design of a GUI and Bluetooth Based Moving Matrix Display System

[1]Tingir T. James , [2]Akuhwa T. David, [3]Awuhe T. Samuel
[1, 2, 3]Department of Electrical and Electronics Engineering, Federal University of Agriculture Makurdi, P.M.B. 2373, Makurdi, Benue State, Nigeria
Email- [1]jaytinter@gmail.com, [2]akuhwagong@gmail.com, [3]samzfrter@gmail.com

Abstract: *In this research, the designed system consists of a microcontroller (ATMEGA 328P), which is programmed using C-programming language, a Bluetooth HC-Module, four Shift Registers (MAX 7219) which are connected to the microcontroller and are used to drive the characters, which are to be displayed on four 8 x 8 LED dot matrix displays. The system also consist of a Graphic User Interface (GUI) , a software that provides an interface that connects the PC and the microcontroller wirelessly. The character is sent to the controller via the GUI and is displayed on a Matrix Display while the registers shifts the characters through the display.*

Key Words: *LED Matrix Display, GUI, Shift Registers, ATMEGA 328P*

1. INTRODUCTION :

Moving matrix displays can be described as an electro-mechanical system for processing information in which the information is represented by physical quantities, which are so constrained to take only discrete values that can be referred to as binary signals.

Traditionally, notice board is all about sticking information, but sticking various notices day-to-day is a difficult process because a person is required separately to take care of this notice board. The moving matrix displays notices through a PC on a notice board where latest information can be displayed. We normally use a simple static LED display screen to convey message, but if we want to display large information we need to change message for every few instances, now scrolling or moving message display is more preferred to static display. This system can be implemented in many important places where latest information can be displayed.

The objective of a Bluetooth in the GUI based moving matrix display is to be able to change the display on a signboard without any cable connection . It makes changing of notices on boards fast, fluid and flexible.

2. LITERATURE REVIEW :

Several Authors have presented some research on the Moving Matrix Display system. [1]Goh and Lau (1991) Designed text layouts for Korean numerals on 10*7 dot matrix displays are presented. A dot matrix approach was chosen because it can display numerals with curvatures that resemble written ones, while a segmented approach will not give satisfactorily readable numerals. [2]Gerwin et al (2004) designed a flexible active-matrix monochrome electrophoretic displays based on solution-processed organic transistors on 25-µm-thick polyimide substrates. The displays could be bent to a radius of 1 cm without significant loss in performance.

[3]Pang et al (2001) designed a novel tricolor dot matrix display system in which all the light-emitting diodes (LEDs) are modulated and encoded with audio information is presented. Besides the LED display, the system concurrently provided audio broadcasting through the visible light rays transmitted by the display panel or assembly. The system is comprised of a tricolor dot matrix display panel with an interface circuit to a computer, an audio signal transmitter, and a receiver. It also comprises an executive program that runs on the computer for the display control of characters, decorative pattern or messages on the display panel.

[4]Zhang Y. et al (2017) designed a Matrix Lighting configuration, which mainly consists of a light-emitting diode matrix and a lens array as an adjustable beam lighting solution. According to the research, it could adjust the light beam and shape freely and timely. An example lighting system which consists of a 32 × 32 × RGB light-emitting diode matrix, and the 8 × 8 Fresnel lens array is demonstrated, which accomplishes a localized lighting with addressable regions for power saving.

3. MATERIALS :

The Design in this research utilizes an PC based GUI (for input), a Bluetooth HC-05 Module, an ATMega 328 Microcontroller, four MAX 7219 shift registers and four 8 x 8 LED Dot Matrix Displays. The Graphical User Interface is used to input the text to be displayed by the Dot Matrix display. The HC-05 Bluetooth Module is connected to the

Microcontroller and receives the text from the GUI installed on Bluetooth enabled PC. The Controller uses the Shift Registers to Light the Dot Matrix display according to the text configuration sent from the GUI, shifting the display as required.

4. METHODS :

The Functional Block diagram, (shown in Figure 1) is separated into three stages. Input, Processing and Output

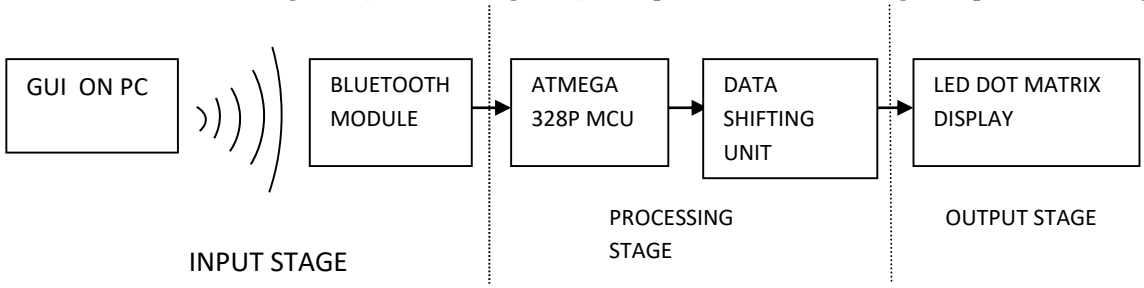

Figure 1:Block Diagram of the Moving Matrix Display

Input Stage.

The Inputs for this design include the GUI and the HC-05 Bluetooth Module

Graphical User Interface (GUI)

The design uses a simple PC based Graphical user interface. The GUI is designed such that the PC searches for the Bluetooth Device and pairs with it, once that is done, the icon on the CONNECT and DISCONNECT buttons turns green. The CONNECT button links activates the text box. The user can type the text to be displayed and send it to the HC-05 Bluetooth module. The screenshot of the GUI is shown in Figure 2.

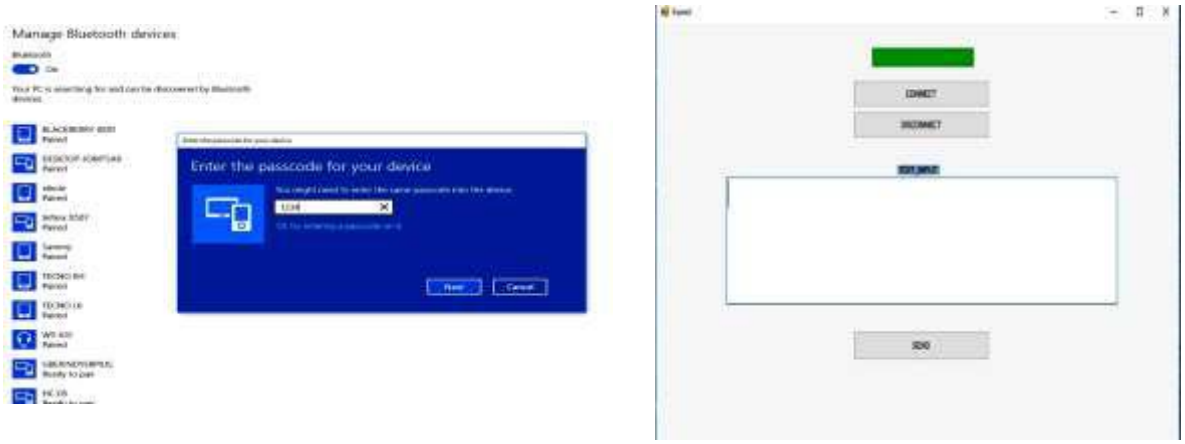

Figure 2. Screenshot of the Graphical User Interface

Bluetooth HC-05 Module

HC-05 Bluetooth module is a wireless Bluetooth device that is compatible with microcontrollers. The HC-05 is cheap, fast, s and low powered. It operates within a 10 meter radius . It uses a short wave length, ultra high frequency (UHF) radio waves in the industrial scientific and medium radio band (ISM) from 2.4 to 2.485 GHZ from fixed and mobile devices. It is used in this design to link the GUI and the ATMEGA 328P microcontroller. The equation for calculating the Value of resistors is thus

$$V_{out} = \frac{R_1}{R_1 + R_3} V_{in} \quad (1)$$

$$V_{out}(R_1 + R_3) = (R_1)V_{in} \quad (2)$$

$$V_{out}R_1 + V_{out}R_3 = V_{in}R_1 \quad (3)$$

$$V = IR \text{ hence } I = \frac{V}{R} \quad (4)$$

$$R = R_1 + R_3 \quad (5)$$

$$I = \frac{V}{R_1 + R_3} \quad (6)$$

Processing Stage

This stage is composed of the ATMEGA 328P and the Data Shifting Unit

The ATMEGA 328P Microcontroller

The ATMEGA328P, is a single chip microcontroller created by Atmel and belongs to the mega AVR series. The Atmel 8-bit AVR DISC- based microcontroller combines 32KB ISP flash memory with read-while- write capabilities, 1KB EEPROM, 2KB SRAM 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, SPI serial port, 6- channel, 10 bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watch dog timer with internal oscillator, and five software selectable power saving modes. The ATMEGA 328P receives the text sent from the GUI through the HC05 Bluetooth Module. It sends the received text to the Data Shifting Unit which is connected to the Microcontroller. The connection of the ATMEGA 328P microcontroller with other peripherals is shown in Figure 3.

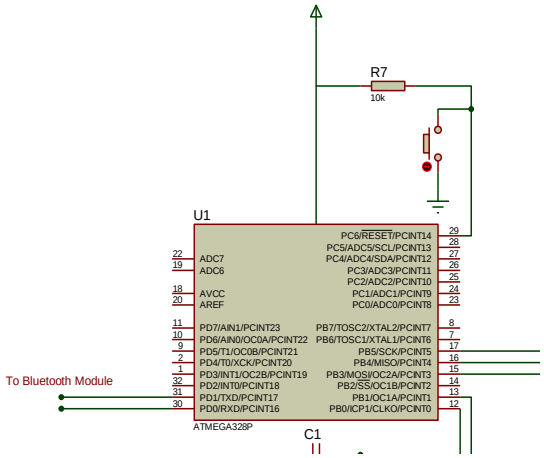

Figure 3 : Connection of the ATMEGA 328P to other peripherals

The Data Shifting Unit.

This unit is comprised of four MAX 7219 shift registers, each one is made up of cascaded flip- flops, sharing the same clock in which the output of everyone is connected to the data. This 8-bit shift register has gated serial inputs and CLEAR, each register bit is a D-type master/slave flip-flop. A low at either or both inputs inhibits entry of new data and resets the first flip-flop to the low level at the next clock pulse. A HIGH level on one input enables the other input which will then determine the state of the first flip-flop. Data at the serial inputs may be changed while the clock is HIGH or LOW, but only information meeting the set up and hold time requirements will be entered. Data is serially shifted in and out of an 8-bit register during the positive going transition of the clock pulse. Clear is independent of the clock and accompanied by a low level at the input. The arrangement of the shift registers can be seen in the complete circuit shown in Figure 6.

Output

Display Unit

The display unit consists of a dot-matrix display. A matrix consists of an array of elements capable of being individually addressed. Principally, a matrix display finds its use in the fact that the array of LEDs can be individually addressed. Thus, a combination of LEDs within the matrix can be to produce any form of alphanumeric sign and symbol.

The elements of a matrix have a grid structure with an X-Y arrangement. Each LED has one of its two electrode connected to a row and the other connected to a column, with this arrangement it is possible to select any LED by energizing a right combination of row and column. In this research, four 8×8 matrix displays are used, each connected via a shift register in the Data shifting Unit..

2.6 Software Design and Flow Charts

The GUI for the Moving Matrix Display was written in C - sharp programming language using [5]Visual Studio 2015 IDE (Microsoft Corporation, 2017).. The hardware design was simulated using [6]Proteus 8.4 (Labcenter Electronics, 2015). The programming for the ATMEG328P microcontroller was written using embedded "C" language in the [7]Atmel Studio Environment. The flow chart for the program of the system is shown in Figure 4.

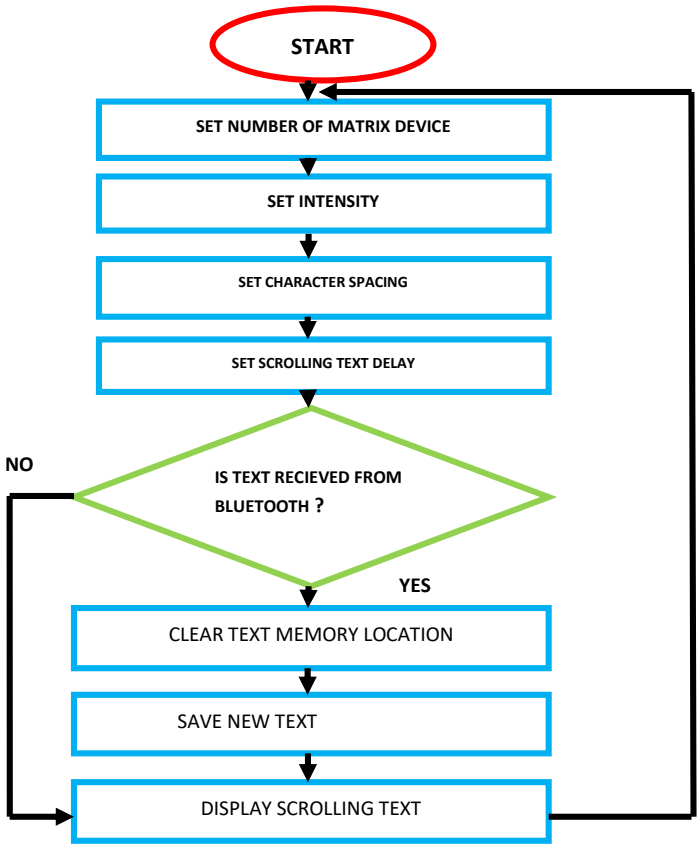

Figure 4: Flow Chart of the Moving Matrix Display

5. RESULTS:

The system was simulated. The GUI was installed on a Windows 7 operating system and linked with the HC-05 Module. A text "WELCOME TO ELECTRICAL/ELECTRONICS ENGINEERING DEPARTMENT" was sent from the GUI and was displayed successfully on the Matrix Display. The displayed text is shown in Figure 5.

Figure 5. Implementation of Moving Matrix Display

6. RECOMENDATION :

The moving Matrix could incorporate a GSM module instead of Bluetooth to increase the range.

7. CONCLUSION :

The research is the design and implementation of a GUI/ Bluetooth Moving Matrix Display System. This was executed, several Texts were sent from the system the texts were displayed successfully on the Matrix display. The Objectives of the research were achieved.

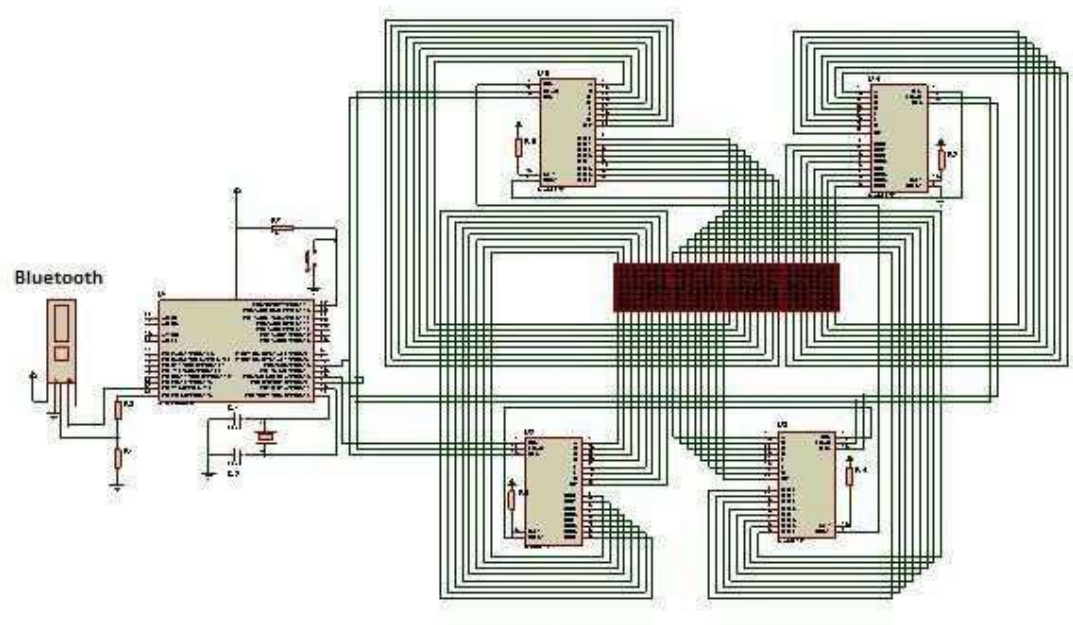

Figure 6: Complete Circuit of the Moving Matrix Display.

REFERENCES :

1. Goh W. L., Lau K. T. (1991): Dot Matrix Display for Korean Numerals. *IEEE Transactions on Consumer Electronics*. 37(4) , 892-896.
2. Gerwin, H. G., Edzer H., Huitema A., Van Veenendaal E., Cantatore, E., Schrijnemakers L., Jan, B., Van der Putten P. H., Geuns C. T. T., Beenhakkers M., Giesbers J. B., Huisman B. H., Meijer, E. J., Benito, E. M., Touwslager, F. J.,. Marsman A.W,. Van Rens, B. J., De leeuw D. M. (2004): Flexible Active-Matrix Displays and Shift Registers Based on Solution-Processed Organic Transistors. *Nature Materials* 3(1), 103 -110.
3. Pang, G. K., Chan C. H., Kwan T. T. O. (2001): Tricolor Light-Emitting Diode Dot Matrix Display System With Audio Output. *IEEE transactions on Industry*, 37(4), 534-540
4. Zhang, Y., Tang, J., Wang, J., Liu N., Wang F., Geng, D. (2017): An Adjustable Beam Lighting Solution. *Journal of the Society for Information Displays*. 25(4), pp: 496-503.
5. Microsoft Corporation (2017) "Visual Studio 2017" www.visualstudio.com [accessed June, 2018]
6. Proteus Design Suite 8.4, Release 8.4 SP0 (build 21079) with Advanced Simulation. © Labcenter Electronics, 2015.
7. Atmel Studio 7 (Version:7.0.1188). © Atmel Corporation, 2015.

.