Display/Scoreboard Using LED Dot Matrix

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Abstract

Digital display advertisement or scoreboard is the current requirement of the modern business and information world. LED Matrix Display is one of digital displays that displays programmed information. The use of electronic advertising displays is widely used as it is a more creative technology for displaying information on the go and engaging graphic design. This project was created to solve some of the problems that arose with existing usage, including displaying the same display all the time. This project is not only to display advertising but more for general use, as it can be used as a stopwatch and scoreboard for both indoor and outdoor sports or games. Researchers used Bluetooth application software programmed into an Arduino microcontroller. It is being carried out by using Bluetooth Applications to send information to led displays. MIT App Inventor software was used to produce android applications. Besides that, the DS3231RTC also used to transmit time to LED displays. It provides the facility of real time matrix displaying, which means the user can change the message that is to be displayed. The aims of the project are to develop a wireless portable message board that facilitates the user to switch the message content without having to connect the board to a cable and design a phone application that controls the display. The use of Bluetooth makes it easier to customize text in dot matrix views such as time, date, and scoreboard.

Keywords: matrix display, LED, Arduino

1.0   Introduction

LED display is an effective mode of displaying information but the complicated task is to make the message dynamic as users have to change the message content according to these specific requirements. LED display arose for the revolution of the city and digital era, and caught on for its versatile application with several advantages. As compared to other traditional display technology (such as neon light, fluorescent tubes, LCD display) LED display has more benefits; higher brightness, wider viewing angle, lesser energy consumption, longer service life, wet resistance capability, hot and cold resistance capability, and etc. with reasonable cost (Lin, Yang, Li , & Guo, 2010; Liu & Meng, 2012; Popoola, Adu, & Shoneye, 2014; Modi & Vora, 2013; Tunji & OD, 2019; Saini, Devi, Dhankhar, Haque, & Kaur, 2014; Okechukwu & Uche, 2013; Mujumdar, Niranjane, & Sagne, 2014).

Many projects were designed using LED matrix displays. One of the examples is (Modi & Vora, 2013), designed SMS driven automatic electronic display using GSM MODEM. (Babu, Kumar, Jawahar, & Mohan, 2019) developed a wireless scrolling message board where users can update the message content through Bluetooth or Wi-fi. Same goes to (Chakraborty, 2017) they used Bluetooth module, interfaced it to Arduino and an android

development tool with APK application. Another project of LED matrix display was proposed by (Kate, Kharat, Khan, & Yeole, 2020) where they used Google's speech-to-text feature to convert the speech input given by an authorized person, into text which will subsequently be displayed on the LED matrix notice board.

LED panels are also used for general lighting purposes, task lighting and stage lightning. This display unit is efficient in displaying messages in any form, including alphanumeric, number and many more either in static or scrolling formats. Current LED is the most energy efficient example and useful system (Tunji & OD, 2019; Okechukwu & Uche, 2013). The system consists of the red matrix display panel. LEDs provide several advantages over traditional light bulbs or lamps, such as smaller in size and longer lifespan. This innovation is based on the initiative of designing the LED display system for wireless communication between mobile and LED display which is connected by Bluetooth. This project will display as a scoreboard to facilitate the real time matrix displaying where users can change the message at any desired time. In addition, the initial goal of this project is to create a useful and interactive display to catch human attention.

Based on the reviews, some of the shortcomings can be identified such as displaying only the same display. In addition, the new design of led display boards should be enhanced to the next level. A common drawback existed; no design can display more than one message at a time on a larger scale. Another common drawback found in this system was, the function of the display board used only one type of power supply, be it AC power or solar energy. The system can work without having to turn the system on and off manually. It takes manpower to operate the display board. This invention will only be seen as a billboard if it does not have enough power due to the changes of the weather. When two or more different messages appear, it will view the first message again or even longer. This is very complicated for people to get quick information because it takes longer time to repeat the message. Moreover, the size of the LED display board is now huge and not handy. The project aims to provide convenience to all parties through the system created especially for designing a portable LED Matrix display and phone apps for controlling and interfacing between hardware and software.

2.0 Method

This system is divided into two main parts, first is message transmission which is an android phone and another is reception and displaying part. The application shown in Figure 1 is of an android phone, created by MIT app inventor and it will be used to transmit the text message which is to be displayed on LED matrix board. The Android phone (transmitter) generates input to the system. At the receiver, the Bluetooth receiver is used and passed to the Arduino development board. The board is connected to P10 16 rows x 32 columns LED display. The application will send information to the Arduino via the Bluetooth HC-05 application. Arduino will send the information to both matrix and speaker. The buzzer in the speaker will produce a notification sound. The matrix will display date, time and scoreboard as the output.
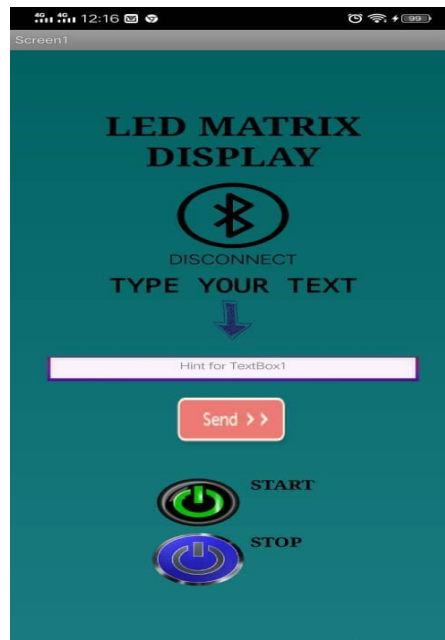
Figure 1: An android application displays as to key in message to LED display
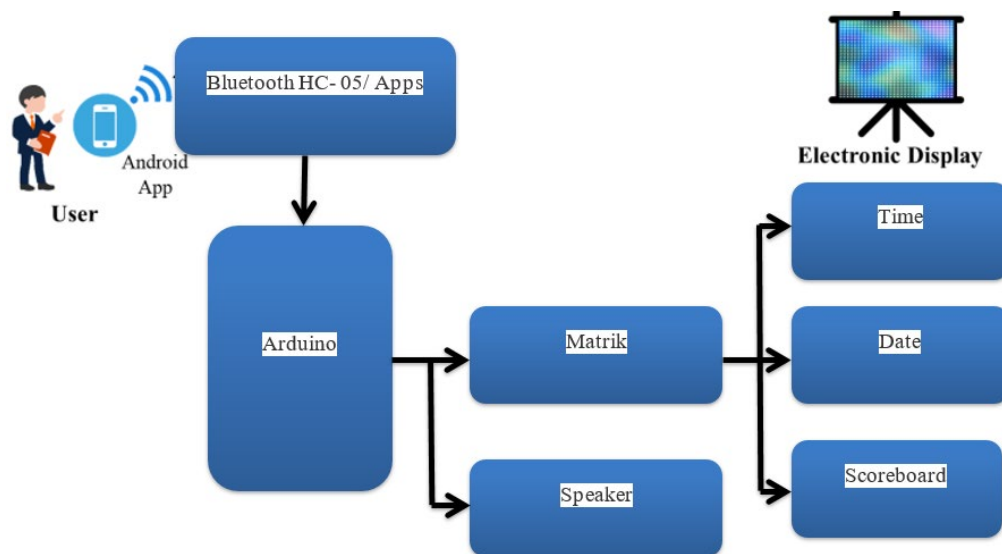
**Figure 2:** Block diagram of LED dot matrix display

2.1 Working Procedure

The process of replacing text on the LED Matrix display board starts with the user opening the application, then selecting the Bluetooth device in the LED Matrix display board. The user then enters the data and sends it by pressing the "Send" button in the Arduino LED Matrix application. During the data transferring process, the application automatically writes the data entered by the user into the Arduino LED Matrix application database. The Arduino LED Matrix application also processes data transmission via Bluetooth. Wireless signals are spread in the air which are sent, received and

interpreted by antennas (Mujumdar, Niranjane, & Sagne, 2014). Then the Arduino receives the data from the application. Arduino prepares the data to be processed, and to be displayed on the LED Matrix panel. The process is as shown in Figure 3.
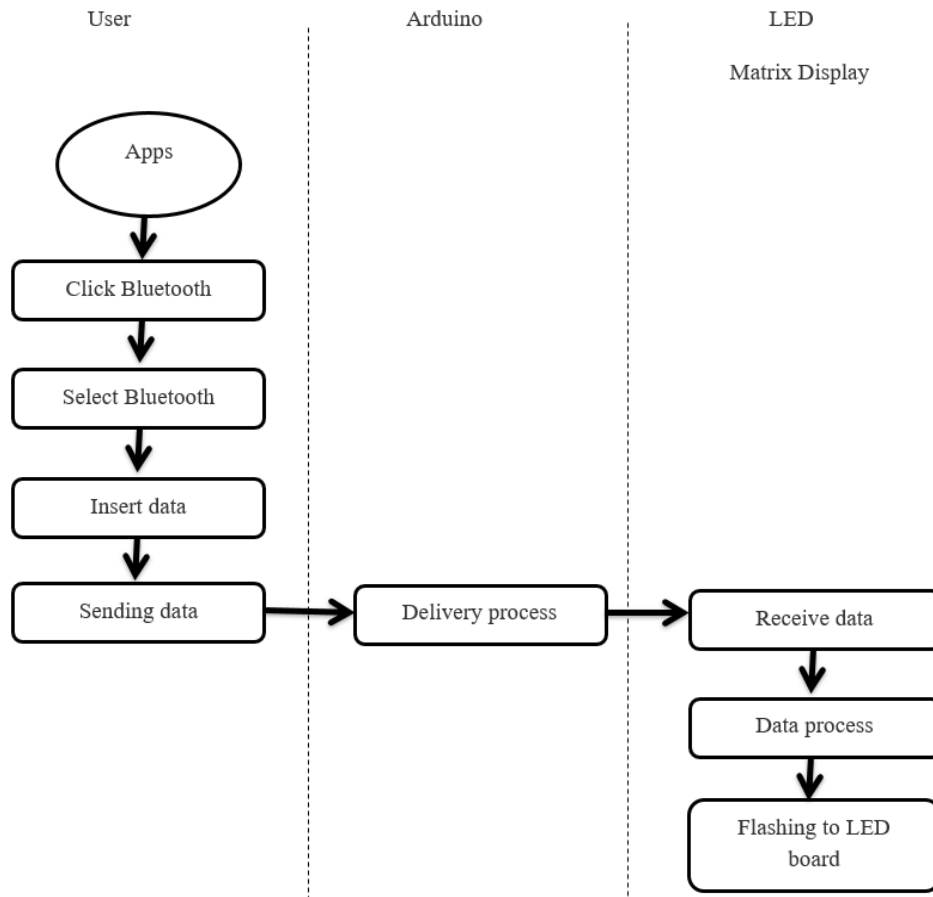

Figure 3: Flowchart of the process of sending message until displaying it on board

The connectivity between android application and the Bluetooth module. The user sends a message that will be received by the Bluetooth module and it will communicate with the microcontroller using the serial communication port. This message is stored in the Arduino which is later used to display the message on the LED dot matrix display. The binary codes, 0 and 1 are used to make the LEDs blink in sequence to display characters. Microcontroller uses ASCII code for characters to be displayed stored in the internal memory that match the pattern. All high (1) LEDs displayed the message that the user sent through the android application. This process is continuous for all rows and columns. An LED Matrix consists of an array of LED's which are interconnected such as the positive terminal (anode) of each LED in the same column are connected together and the negative terminal (cathode) of each LED in the same row are connected together (Ramya, Bavithra, & Priya, 2019).

Dot Matrix Display (DMD) was used in this project. P10 is a 32 X 16 LED Matrix module which is popular for displaying big advertisements used in this project. There are 512 LEDs in each unit of the P10 LED Module which consists, 32 LEDs in each row and 16 LEDs in each column. There are two ports in a P10 which is an input port used for the incoming data from the Arduino side and the output port is used to connect the module to another LED P10 module.

2.2 Hardware Design

The schematic circuit is an initial design before it becomes a circuit. This schematic (Figure 4 - Figure 7) circuit must be connected properly because it can facilitate the layout of the PCB circuit to find the components easily.
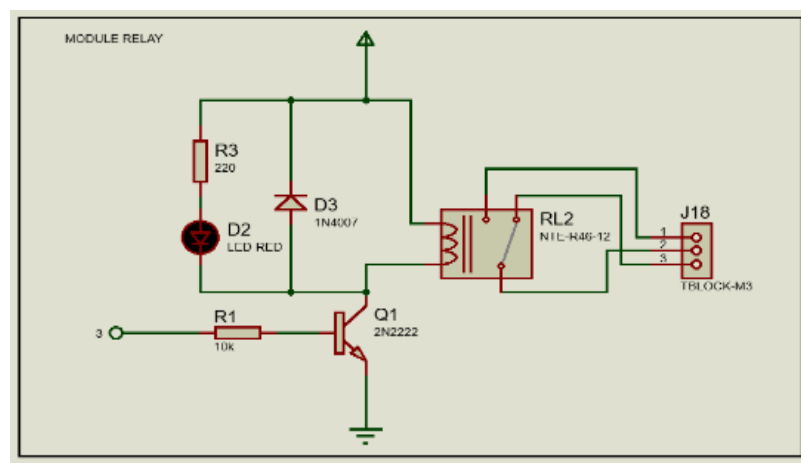
Figure 4: Relay schematic
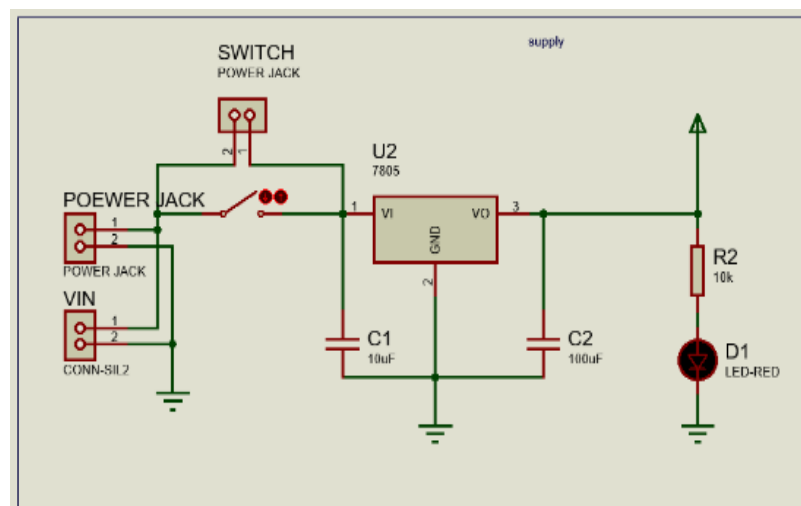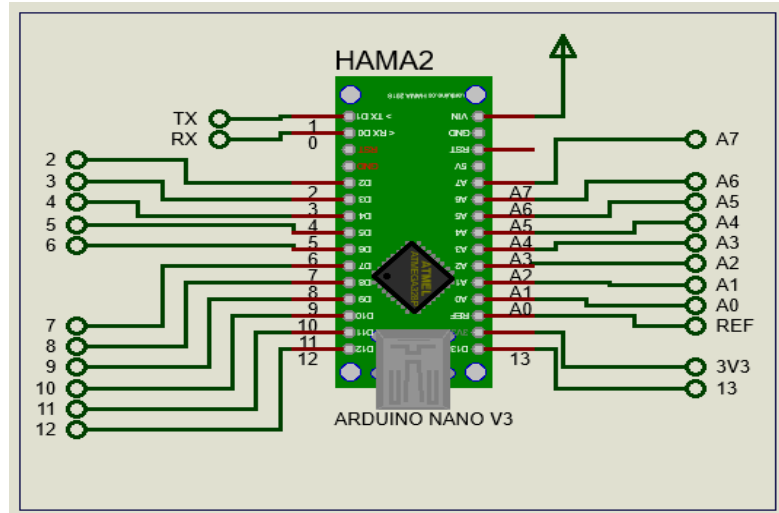

Figure 5: Power supply
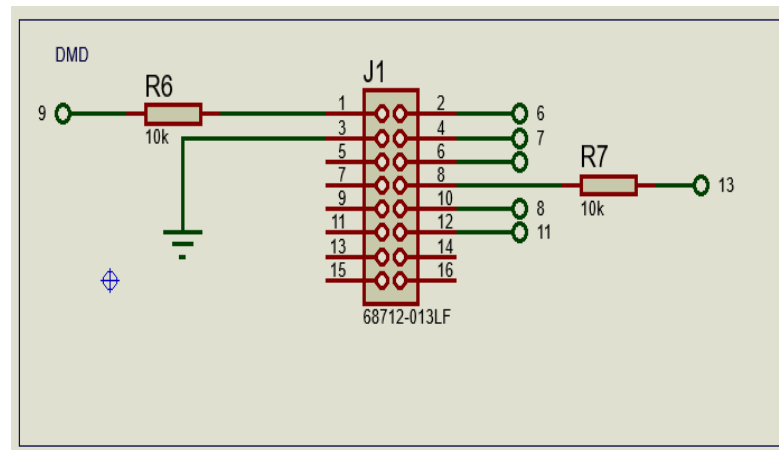
Figure 6: Schematic of Arduino Nano
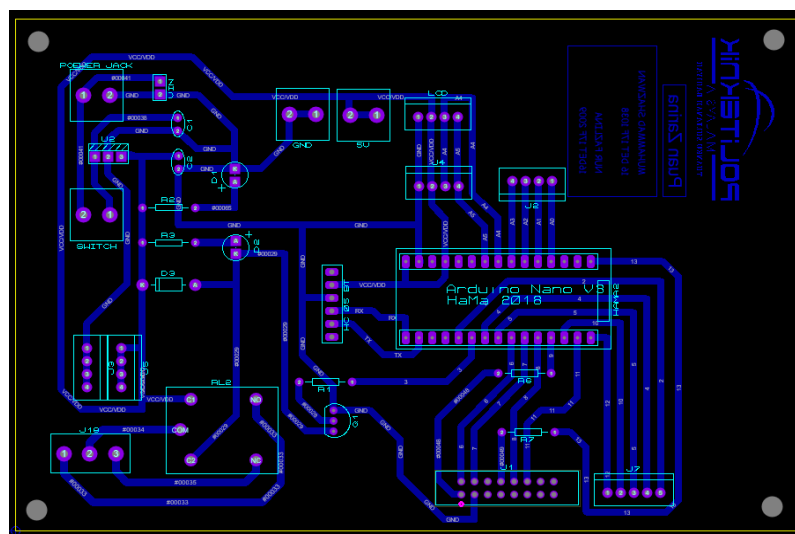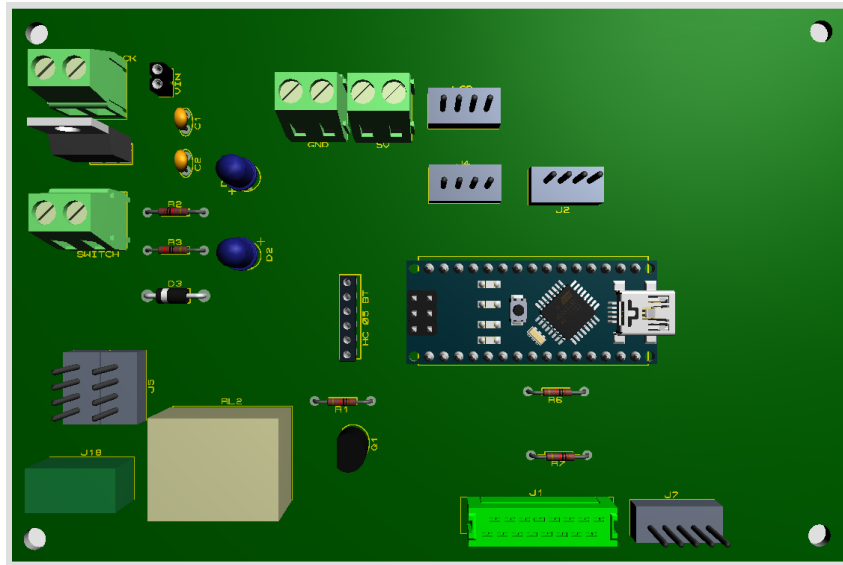

Figure 7: DMD schematic

Figure 8: PCB design for LED dot matrix display
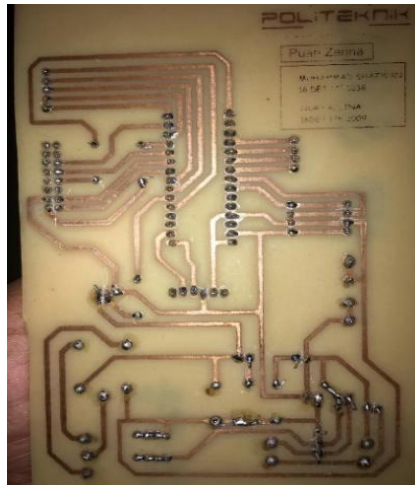
Figure 9: 3D displays of the PCB design for LED dot matrix Display.

Figure 10: Bottom view of PCB board

3.0   Results & Discussion

Figure 10 shows the display from the LED dot matrix P10 16 x 32. This is an example where a message number was uploaded in the android application and LED DMD will display it.


Figure 10: LED dot matrix display with number input.

Figure 11 shows the display where the input from the android application is a timer and when it is set at a certain time, the buzzer will be sounded if the time is up. This display is in static mode.

Figure 11: LED dot matrix display with timer; minute and second.

From Figure 12, this is the result from the scrolling format, where the input is 'NAZIHAH'. The text 'Nazihah' will scroll along the display.
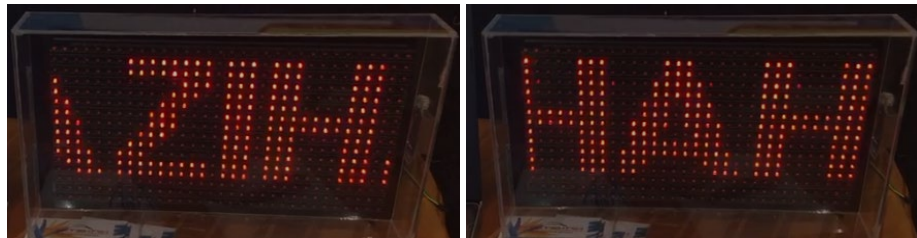
Figure 12: LED dot matrix displays a scrolling text.

Completed projects will be tested to see the functionality. The results will show the functionality of the project and the content of use. Among the items tested are: -

i.   Project functionality testing process: The main purpose of this test is to ensure that each component used works well and is done manually or automatically.
ii. Bluetooth distance testing process: The main purpose of this test is to ensure that every distance used works well. The Result of this testing as shown in Table 1 below.

Table 1: Bluetooth distance testing process

Distance	Function	Not Function
5 Meter	✔	
10 Meter	✔	
15 Meter	✔	
16 Meter	✔	
17 Meter		✔
18 Meter		✔

After testing and analysing, the project has the potential to be developed to be used by the community. That is why the invention of this system is more user-friendly, environment friendly and does not involve too much capital or cost so that market development is not stunted. Among the advantages of this project are:

i. Able to display messages of any shape, including alphanumeric, number etc.
ii. Can be used as a stopwatch and scoreboard for sports use and "Indoor" or "Outdoor" games and the next example is that it can be used as hazard signage and directional signage.
iii. The proposed system uses Bluetooth technology to communicate from an android phone to a matrix display led display board.

4.0   Conclusion

In conclusion, the display board was satisfactorily designed, constructed, and tested. It was designed from inexpensive components. It is also a cost-efficient system and user friendly. The introduction of wireless technology using Bluetooth makes our communication more efficient and even faster. The display message without any connectivity through cable wire is successfully done with less error and maintenance. This made it possible to pass out information digitally using logical devices like microcontrollers to display on the scoreboard. Our aim is achieved successfully not just to display advertising only, but it is more for general use, as it can be used as a stopwatch and scoreboard for both indoor and outdoor sports or games. Thus, we hope that this design can serve as a starting point for other researchers and educators who are interested in developing more complex LED matrix displays.

References

Babu, B. N., Kumar, G. S., Jawahar, i., & Mohan, T. K. (2019). Wireless Based LED Dot Matrix Message Display. *International Journal of Research and Analytical Reviews (IJRAR)*, 220-226.

Chakraborty, D., Yadav, S., Rathore, S., Kumar, S., Agrawal, R., & Chandrakar, P. (2017). Smart Rolling LED Display using Arduino and Bluetooth. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT)*, 322-324.

Kate, A., Kharat, A., Khan, M. A., & Yeole, M. (2020). Notice Board using LED Matrix Display. *International Research Journal of Engineering and Technology (IRJET)* , 852-855.

Lin, K., Yang, T., Li , L., & Guo, D. (2010). A new algorithm of dynamic display for the large led screen of multi-scanning-beam. In Anti-Counterfeiting Security and Identification in Communication (ASID). *Anti-Counterfeiting Security and Identification in Communication (ASID)* (pp. 142-145). Chengdu: IEEE.

Liu, J., & Meng, Z. (2012). System design and simulation of led dot-matrix screen displaying chinese characters based on proteus. *International Conference on Computer* (pp. 2106-2108). Nanjing: IEEE.

Modi, D. J., & Vora, P. S. (2013). Advertising display system using led and graphical led. *International Journal for Scientific Research & Development,* 153-157.

Mujumdar, A., Niranjane, V., & Sagne, D. (2014). Scrolling Led Display Using Wireless Transmission. *International Journal of Engineering Development and Research, 2*(1), 475-478.

Okechukwu, O. F., & Uche, O. V. (2013). Design and construction of a dot matrix information display for the office of. *Advances in Applied Science Research, 4*(1), pp. 515-522.

Popoola, O. R., Adu, M., & Shoneye, S. D. (2014). Design and construction of multi-coloured led scrolling display using pic microcontrollers. *Journal of Environmental Science, Computer Science and Engineering & Technology, 3,* 1619-1630.

Ramya, R., Bavithra, N., & Priya, M. (2019). Wireless E-Notice Board Using Bluetooth. *International Journal of Engineering Research & Technology (IJERT), 6*(7), 1-6.

Saini, B., Devi, R., Dhankhar, S., Haque, M. z., & Kaur, J. (2014). Smart LED Display Boards. *International Journal of Electronic and Electrical Engineering,* 1057-1067.

Tunji, O. T., & OD, I. (2019, April 25). Design and Implementation of Dot Matrix Display System. *Journal of Telecommunications System & Management, 8*(1), 178.