



Development of a Dot Matrix Display Billboard for Edo State University Uzairue, Nigeria

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ABSTRACT

The majority of conventional digital display systems are now implemented using individual logic gates, and integrated circuits like microprocessors and microcontroller chips, which contain the circuitry required to create logic functions, which are used to implement digital systems in today's quickly developing technological market. The introduction of new technologies has made information available in the field of advertising and promotion in the form of electronic displays. The LED (Light Emitting Diode) dot matrix display is a display technology designed to disseminate information to a bigger audience in the area where it is located. It is divided into three parts: power, control, and display units. The hardware and software could be divided into two main categories. The controller card, some LED modules, power supply modules, and the framing, which were used by the display system to physically transmit a set of programmed data. The controller card's software portion is where the programmed data that has been received is stored. It employs a volatile memory that supports memory formatting and reprogramming. As a result, a dot matrix display board was created and displayed "WELCOME TO THE FACULTY OF ENGINEERING" using a controller's card and can be updated seamlessly from a mobile device and the WIFI module which is used as a means of communication between the board and the mobile device.

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INTRODUCTION

A fact or proof given or discovered about something or someone that conveys or represents a certain arrangement or sequence of things is referred to as information [1]. There are several ways to communicate information, including sound (audios) and visual (different displays and videos Information displays are used to spread knowledge and or serve as promotional tools [1].

The usage of billboards, signposts, noticeboards, cardboards, various sizes of paper wall-pinned are examples of manual mediums [1]. Electronic displays are a type of automatic medium (displaying videos, static and moving text linked with audio). Since the dawn of time, several display styles have been employed, each serving an important function in the advancement of invention [1]. Signs can be

any visual visuals that are used to display information to a specific audience [1, 2].

Electronic display systems are frequently employed in the field of advertising to promote goods and services [2]. They are also employed in institutions to show information, provide guidance, issue warnings, and serve purely aesthetic functions. Electronics use is now taking on a significant role. It is widely used in practically all of our daily activities [2]. The term "electronic display billboard," as it is used in this project, refers to a sign that displays messages or images to transmit specific information using electronic hardware and software [3].

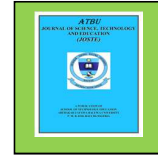
Additionally, a fixed light source may be used to transmit messages in text, images, photographs, or symbols that could appear to move or as on or off signals [3]. The material or substrate to which the copy is typically applied

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is paper, wood, plastic, or a building wall. This is in contrast to traditional (manual) or non-electronic signs where the copy displayed is physically applied to the surface by printing, painting, or other means of attaching it to the sign [3]. Information is now shown electronically in the realm of advertising and marketing thanks to the development of new technologies [3].

A solid-state light source with some appealing qualities for display applications is the Light Emitting Diode (LED) [3]. When a diode is forward-biased, it produces visible light. It is chosen as the primary component of message display since LED is now the most helpful and energy-efficient method [4]. In place of neon signs, LED technology is now extensively utilized in signage; this was first demonstrated in 1910 at the Paris Motor Show [4]. The majority of conventional digital display systems are now being implemented using individual logic gates and integrated circuits, such as microprocessors and microcontroller chips, which contain the circuitry required to create logic functions. This is because the technology market is currently experiencing rapid advancement [5]. By giving it text structure, the LEDs' actions are automatic rather than static. They are also made used in public places such as hospitals, airports, banks, stock exchanges, bus stands, restaurants [3, 4].

A dot matrix display is made up of an LED panel and a row- and column-specific driving circuit with straightforward x-y addressing [5]. The LED matrix is an array of LEDs on a panel that is arranged in the shape of a matrix, with a certain number of LEDs in each row and column. Row scanning, column scanning, and dot-by-dot scanning are the three scanning techniques that can be utilized [5]. These are frequently used in large screens that demand the processing power of sophisticated controllers. Nowadays, data transmission paths and control signal paths in printed circuit board (PCB) layout are made simpler by using Single-

Chip Microcontrollers (SCM), Complex Programmable Logic Devices (CPLD), Field Programmable Gate Arrays (FPGA), and other digital Integrated Circuits like latches and shift registers, among others [5].

The issue of flickering and reduced light intensity becomes more problematic when a huge dot matrix is being designed [6]. Frame rate and refresh rate must be increased in both the horizontal and vertical directions as sizes rise to avoid flickering [6].

Different varieties of microcontrollers are utilized depending on the amount of information to be kept on them and the kind of instructions that will be put into them to regulate their activities. Since the dot matrix display uses less energy to operate and has low maintenance costs, experts have established that it aids in energy conservation [6]. Hence, the objectives of this study are to develop a dot matrix display billboard that is capable of displaying "Welcome to Faculty of Engineering" by using an interface P10 LED Board Shift register with RHX8-32W512.

The rest of this article is structured as follows; section one introduces the research domain, while section two elaborates on the materials used for developing the dot matrix billboard while section three analyses the results obtained from the analysis conducted. Finally, the conclusion and recommendation is given in section four.

MATERIAL AND METHODS

In this section, the detailed procedure of how the prototype was developed and achieved is discussed. This model is widely used when customers are unclear about their requirements. The initial requirements are gathered from the customers followed by a quick design. A prototype is developed and shown to the customer for evaluation. Once the customer is satisfied, full-fledged systems development will be done as shown in Figure 1.

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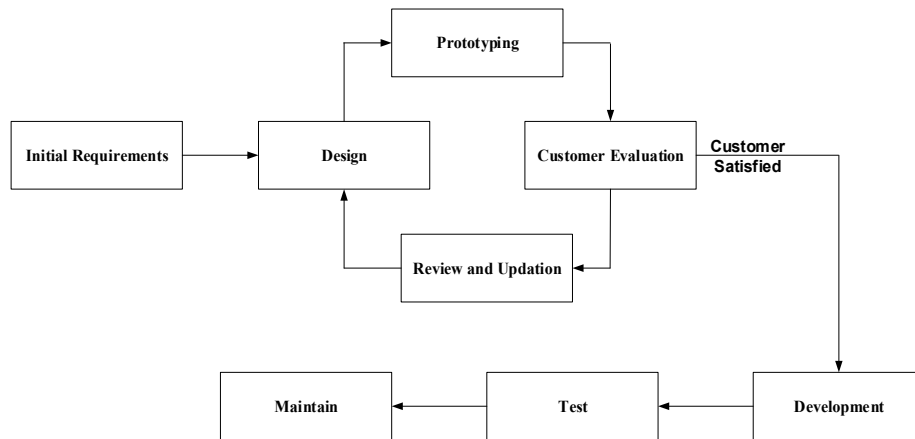


Figure 1: Diagram of the Developed Prototype Model

The prototype developed is of two types – Throwing and Evolutionary. If the prototype is developed only to get acceptance from the customer and discarded further, then it is known as a 'Throwaway Prototype'. The Prototype which will be further developed as the actual system is referred to as the 'Evolutionary Prototype'.

Using this model one stage has to be completed before another stage can start. So, the first stage is the initial requirement stage where we find materials based on the research made. The second stage is the design of the work which the circuit diagram was introduced and how the work should be connected.

The third stage is the prototyping where the work is created and tried implementing the design to see if it's going to work and if it's not going to work.

The next stage is the evaluation by the customer to check if the prototype meets its initial design which was intended if it does not correspond or do not meet customer evaluation, it is then reviewed and updated if it does, then the developmental stage is next, and try to assemble the work then after this stage, the next stage is the testing stage and then the last which is the maintenance stage. This is further explained in Table 1, Figure 2 and Figure 3 respectively.

Table 1: Specifications of P10 Monochrome LED Display

Product Name	P10 1R	P10 1G	P10 1B	P10 1W	P10 1Y
Pixel Pitch	10 mm	10 mm	10 mm	10 mm	10 mm
Pixel Density	10000 pixel/m ²	10000 pixel/m ²	10000 pixel/m ²	10000 pixel/m ²	10000 pixel/m ²
Type	Red	Green	Blue	White	Yellow
Module Resolution (dots)	32*16	32*16	32*16	32*16	32*16
Module Size (mm)	320*160	320*160	320*160	320*160	320*160
Lamp Type	DIP546	DIP546	DIP546	DIP546	DIP546
Scan Mode	1/4S	1/4S	1/4S	1/4S	1/4S
Drive Mode	Constant voltage 2400 cd/m ²	Constant voltage 1800 cd/m ²	Constant voltage 1800 cd/m ²	200 5500 cd/m ²	200 cd/2400 m ²

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Dot Matrix Display Billboard Design

In this subsection, the detailed design procedure is discussed, which are given as follows:

Block Diagram of the Billboard

The various building blocks that make up the block diagram of the billboard are the LED control card, WiFi module, GSM module, antennas and LED matrix. This is shown in Figure 2.

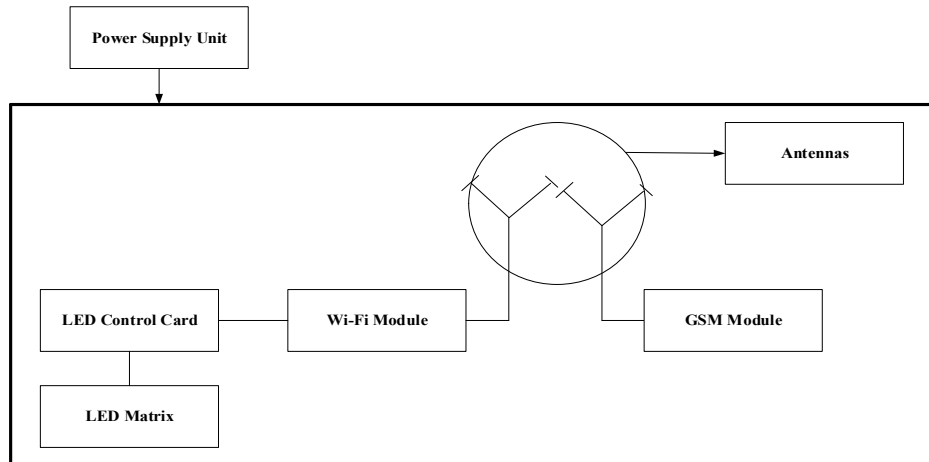


Figure 2: Block diagram for the system

However, the Led dot display matrix is shown in Figure 3.

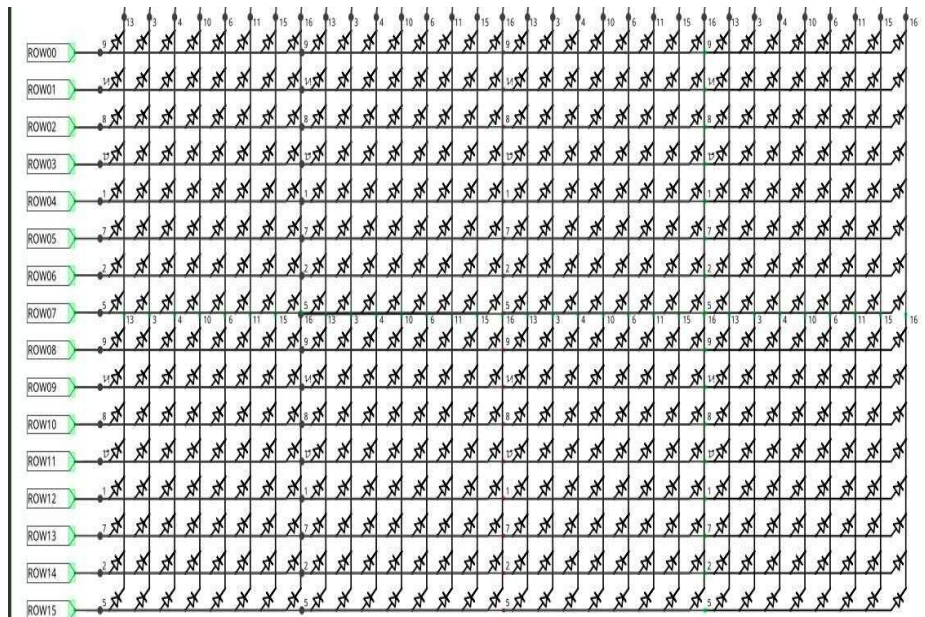


Figure 3: Circuit Diagram for a 16x32 Led Dot Matrix Display

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From Figure 3, the LED dot matrix used is a single-color dot matrix display with the color white and the dimension for the dot matrix display is a 16 x 32 dot matrix display which comprises 512 LEDs.

Calculations of the LED on the Billboard

The calculation done towards achieving the required voltage rating for a single white light-emitting diode is 3.6 volts and the current rating for a single white light-emitting diode (LEDs) is 20 mA. However, to calculate the resistor used for a single white LED. Using the formular for the ohms law, which is given in equation (1).

$$V = IR \quad (1)$$

Where V, I and R are the voltage, current and resistance that is required to lights

up the LED. The voltage value used is 5V with a current of 3A.

The reistance of each row of the LED is given as:

$$R = V - (V_{sat} + V_{drops}) / I \quad (2)$$

Where V_{sat} used is 0.6V, while V_{drops} is 3.5V. substituting these values into equation (2) gives a resistance of 0.9 ohms. So, for each row, the resistance is 0.9 ohms, this shows that there is little or no resistance for each row. A single LED board measures around 12 inches in length from the top view, and it has connectors on the back for connecting more P10 boards as well as a port for a 5 volts power source for dc power supplies. The P10 board is a highly integrated LED board that includes digital signal amplifiers and shift registers to prevent signal loss throughout the LED network this is shown in Figures 4, 5 and 6 respectively.

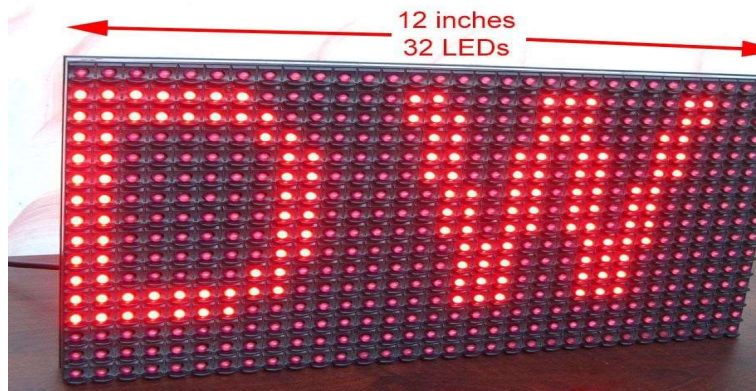


Figure 4: Front view of the Prototype

Figure 4 shows the front view of the prototype. Also, the back view of the prototype is shown in Figure 5.

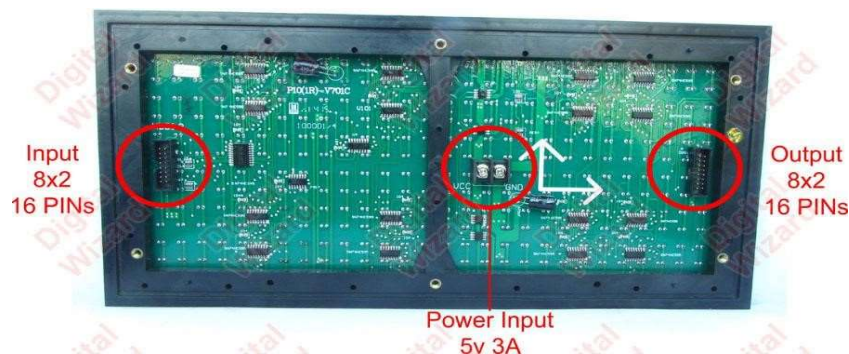


Figure 5: Back view

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Figure 5 shows the back view of the prototype. It can be seen how the various LEDs were connected to achieve the lightning up of

the LED. Also, the image of the LED controller is shown in Figure 6.



Figure 6: Image of the led controller

The robustly constructed printed circuit board layout eliminates problems like interference, overheating of the LEDs, misaligned LEDs, and loose contacts that are frequently present in hand-soldered led boards, hence enhancing longevity, precision, and brightness. P10 LED modules was used for this project. [7].

Led Control Card

LED control cards are devices that allow users to control LED displays. They are usually small, black boxes with a series of buttons, knobs, and sliders that allow users to change the color, brightness, and speed of their LEDs. LED control cards can be used for a variety of applications, including stage lighting, advertising, and automotive lighting. They are popular among stage technicians and lighting designers because they offer a high level of control and flexibility.

RHX8-32W512 was the model of the LED controller used. There are some advantages of using an LED control card. One of the it is that it allows the designer to have more control over the LED lighting. The colors, brightness, and even the patterns of the lights can be changed with the push of a button. An LED control card, quite simply, is a card that regulates LED lights. It tells the light what to do—turn on, turn off, change color, change brightness, and more.

There are a few different ways that an LED control card can work. In some cases, the card is inserted into the light fixture and controls the light directly. In other cases, a wireless transmitter sends signals to a receiver that is embedded in the light fixture, telling it what to do.

The RHX8-32W512 Model used has a WiFi module that is used to communicate with the device module it supports dual and mono colors, and it is supported on both Windows, Android, and iOS systems. It also has two HUB12 ports and a single HUB08 port.

P10 LED Board Interface

The P10 LED interface has various pin which are used for the connection. There functions are summarized as follows:

- a Enable: By sending a PWM pulse to the LED panel, this pin is utilized to regulate the brightness of the LED display.
- b These are referred to as multiplex select pins. To choose any multiplex row, they require digital input.
- c Data, Store Clock (SCLK), and Shift Clock (CLK): These are the standard shift register control pins

These functions are depicted in Figure 7.

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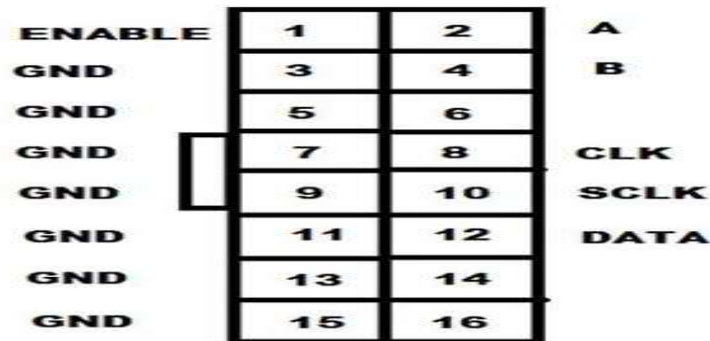


Figure 7: P10 Module Pinout

The P10 modules display is made up of 16 74HC595 8-bit shift registers, or one-fourth of it. The A and B lines choose one of four groups of 128 LEDs for the display. The Shift Clock and Data lines are used to write 128 bits of ON/OFF data to the display shift register input for each quarter of the display, and the Store Clock is then strobed to latch the data onto the display. The A and B lines, as depicted in the datasheet, determine which quarter of the display is lighted. You can shift the 128 bits for the following group of LEDs while that data is being displayed. Until you choose A and B for

the following group, the LEDs will not change and strobe the store clock once more [8].

Control Hardware

The control hardware used is the RHX plus application which controls the matrix display (v8.0.67) connections and cables. They are connectors used to end current or data signals as well as electrical cables used to transmit electrical signals in a circuit or system cable. There are four different cable kinds, which can be divided into two groups and were used for the research construction [9]. This is shown in Figure 8.



Figure 8: WiFi Connection

The sequence in which the program transmission for the display of the bill of engineering management and evaluation (BEME) is given as [10]:

- Disable the phone's mobile data and Bluetooth, activate the phone's WLAN setting, and establish a Wi-Fi connection with the card.
- Verify the device's online status.

- When you click "Device," you can view the device's information and check that it's online [11].
 - Make a fresh screen (program)
 - Select "Program" and "New Display" "Add" After selecting the device set the screen's width and height
 - "OK" Edit the software, then send it
- However, the materials used in achieving the BEME is summarized in Table 2.

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Table 2: Bill of Engineering Management and Evaluation (BEME)

S/N	ITEM	DESCRIPTION	QTY	UNIT PRICE (₦)	COST PRICE (₦)
1.	P10 LED dot matrix display.	This display module is used for the project.	30	10,000	300,000
2.	Power supply unit (5v and 12v 50A)	The module used for supplying power to the other subsystems	6	15000	90000
3.	15cm data cable	For the transmission of data in the system.	30	350	10500
4.	60cm data cable	For the transmission of data in the system	10	750	7500
5.	100cm data cable	For the transmission of data in the system	10	1000	10000
6.	RHX8-32W512	The controlled card for the p10 board	3	10000	30000
TOTAL					448,000

RESULTS AND DISCUSSION

This subsection presents the results that was achieved in the implementation of the dot matrix billboard display. The P10 module was subjected to testing which was done by isolating the units one by one and testing them according to their stages following the block diagram of the circuit. The different units were cascaded together and then a performance test of the entire system was carried out. The main parameters measured at the output side are the output voltage, current, and output power. Finally, the P10 module was also tested to determine if the single P10 module can display anything and the various module was subjected to different testing.

Component Testing

This project stage is crucial because it allows the assessment of every component that was purchased and testing them to ensure they function properly. The components and

module readings were checked using a multimeter. Ensure that the components operate properly in the circuit and that the components operate based on the rated specification and help prevent errors while working or damage to working components.

Power Supply Unit

The first module tested from the work was the power supply unit because it was used to supply power for all other sub-components in this work. So, two wires one for the live and the other for the neutral are both connected to AC power which is 220V AC and the power supply then has two terminals which is either a 5V output or a 12V output. Then the output of the power supply was tested with the use of a multimeter to ensure the output voltage was exactly 5V when the power supply unit was powered a green LED indicator was also on to show the power supply was on. This is shown in Figure 9.

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Figure 9: Picture of Testing the Voltage of the Power Supply with a Multimeter

Rhx8-32w512 LED Control Card (Testing the WiFi)

The Rhx8-32w512 was first connected to the power which required a voltage for working 5V and there was an LED indicator to see if the control card was put on

and then a multi-meter was used to check if the input voltage for the card was the appropriate voltage coming from the power supply unit. Then, the WIFI module was tested when the card was put on, and the WiFi also came on automatically. This is shown in Figure 10.

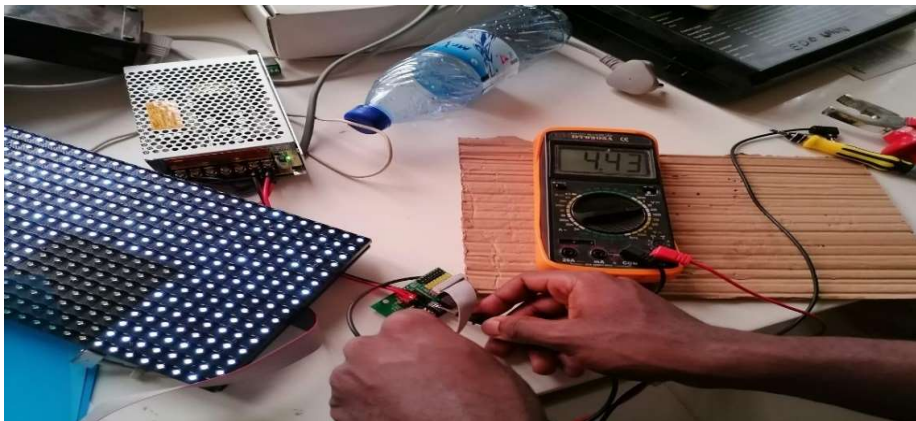


Figure 10: Image of Checking the Input Voltage into the Rhx8-32w512 LED Control Card.

6x32 P10 Dot Matrix Display Module

The P10 led dot matrix display is the display module used for this project, the voltage rating for this display module was the 5V and the current rating for this module was 3A, so the voltage entering the LED board has to be 5V and the current of 3A as any voltage higher than the allocated rating was going to destroy the

board and using the data cable was also connected to the display module and to the control card to ensure be able to check if the display module was going to work as it is supposed to display any form of light to ascertain the board still works properly. This is shown in Figures 11, 12 and 13.

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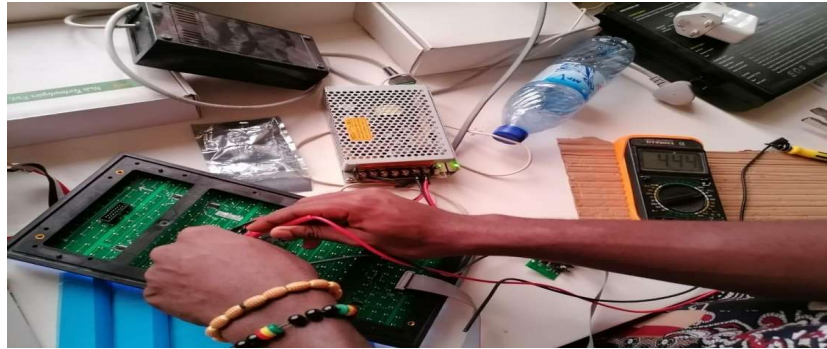


Figure 11: Image of Checking the Input Voltage into the 16x32 p10 Dot Matrix Display

Figure 11 shows the verification of the input voltage that was fed to the dot matrix

billboard, while for the connections, it is shown in Figure 12.

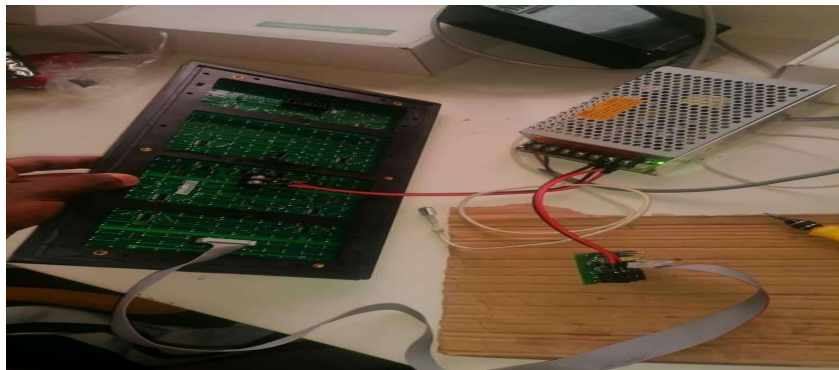


Figure 12: Image of the Connection to Test the Display Module

The connection for testing the displaying if it is working in the proper condition is shown in Figure 12. However, the image

showing the displayed content for the billboard is shown in Figure 13.

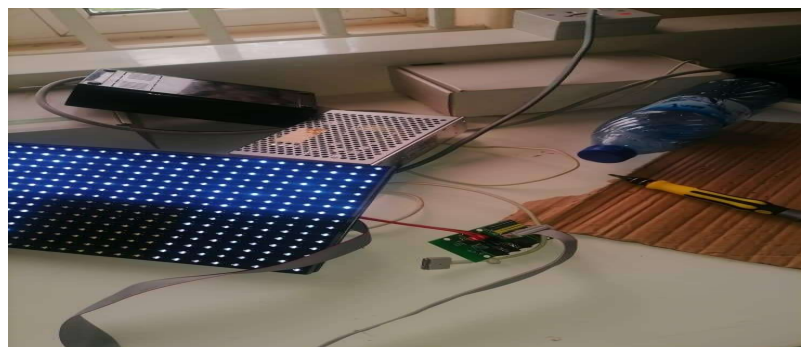


Figure 13: Image Showing the Display Module Working

Figure 13 shows the image of the displayed content of the billboard, and the

verification of the content that was sent to the billboard.

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Billboard System Implementation

There were thirty P10 display modules present which were arranged in 5 rows and 6 columns and forming a width of 96cm and length of 160cm with a thickness of the boarder is 5cm and there are 15360 LEDs present among the 30 boards. The data from one P10 display module to another flows in series and the data cables were connected in series, with two rows connected to a single control card which is the Rhx8-32w512 which has two hub 12 ports one for the input and the other for the output. However, the power supply

in the board was connected in parallel and for each column there is a power supply supplying the full column as shown in Figures 14, 15 and 16. Also, for the display, each of the two rows was connected using the WiFi module and are all updated seamlessly to display any information needed to be displayed. In this case, the "WELCOME TO THE FACULTY OF ENGINEERING, DEPARTMENT OF COMPUTER ENGINEERING" was displayed on the display board as shown in Figures 17, 18 and 19.

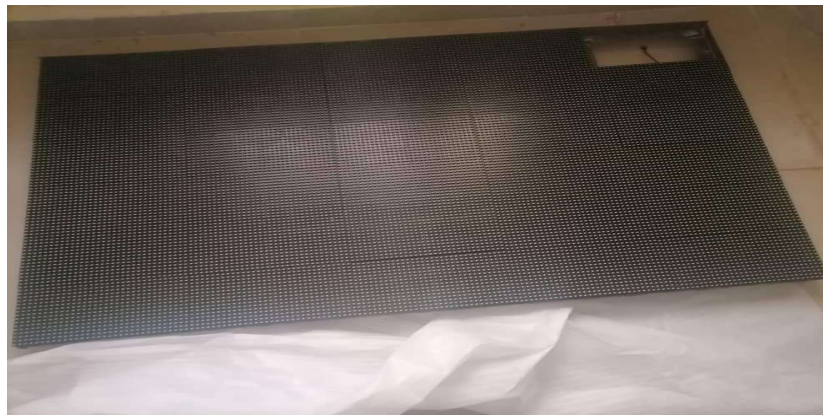


Figure 14: Arrangement of the Board 5 Columns and 6 Rows

Figure 14 shows the arrangement of the board into five (5) columns and six (6) rows respectively. Also, the pattern of the

arrangement of the cables is shown in Figure 15.



Figure 15: Cables Being Arranged in Series from one Board to Another Board

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Figure 15 shows the arrangement pattern of the cables in the series format. Figure

16 shows the cable arrangement in the parallel format.



Figure 16: Cables Arranged in Parallel from One Board to Another

From Figure 16, it shows the cable arrangement of the dot matrix billboard which was used for displaying of the contents that is

been supplied to it. The P10 LED board displaying text is shown in Figure 17.



Figure 17: The P10 Led Board Displaying Text

Figure 17 shows the P10 LED board displaying text for the actualization of the intended task on the system. Lastly, the pictorial

representation of the implemented dot matrix billboard display is shown in Figure 18.



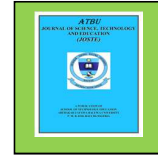
Figure 18: Picture of the Implementation of the Dot Matrix Display Board

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From Figure 18, the dot matrix billboard display is shown in Figure 18, which has come into reality.

CONCLUSION AND RECOMMENDATION

This research presented a dot matrix display billboard for Edo state university, Uzairue, Nigeria. The aim of this article was to demonstrate how shift registers on P10 LED board operates, which are used to connect LED boards to the RHX8 display card controller, which was utilized to create a dot matrix display billboard. The interface was effectively implemented, and eventually, the project's aim was met. The design and development of a dot matrix display billboard is a gradual process that involves building a frame large enough to house 30 LED modules, using a power supply module to power the LEDs and other circuits, and using a controller card to store and transmit the information needed to be displayed. By producing a physical electrical device, this article has allowed students to put their theoretical classroom knowledge into practice, bridging the gap between classroom theory and its practical application. The article will also enhance the beauty of the environment and advance technology in the area of information transmission via display boards. Considering its attractiveness, viewing angle, and viewing distance, it will enhance the proportion of people who get information. Applications for this system include banking, schools, restaurants, workplaces, hospitals, scoreboards for sporting events. This article can be concluded that the article planned goal of designing and developing a dot matrix display billboard that can display "WELCOME TO FACULTY OF ENGINEERING, DEPARTMENT OF COMPUTER ENGINEERING" was realized. There are some ways the research may be improved, by adding a receiver's card which will enable the work to display video animation and assist with board interaction, also by including a *raspberry pi* which can function as the sender's card and a color light card is needed to operate as the receiver's card, which helps to interact with the boards.

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