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DEVELOPMENT OF A DUAL-FACE SMS-BASED LED NOTICE BOARD WITH AN INBUILT GSM FEEDBACK AND INVERTER POWER BACKUP SYSTEM

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Abstract: In recent times, Mobile and wireless technology have provided us with the mechanism to remotely control and update the content of a display board via SMS and other modern means. This work is aimed at developing a display system that fuses the functionality of wired, wireless, and mobile technology into a dual-face, double-layer SMS-based LED notice board capable of displaying memos, announcements, or notices received serially from a smartphone or PC via a terminal application on a P10 SMD LED display as well as forwarding the same information to some selected recipients mobile numbers through an inbuilt GSM feedback system. The system's performance is then evaluated based on its response time to the input message. Messages are transmitted serially to the notice board in three different communication modes (USB, Bluetooth, or Wi-Fi). Push buttons are used by users to alternate between the different working modes, making the system flexible in a variety of scenarios and compatible with wired and wireless communication protocols. The message is received by an ESP32 microcontroller and passed on to the LED board for display and the GSM modem. The notice board is equipped with an inverter power backup system to maintain uninterrupted operation in the event of an AC power outage, eliminating the weakness in the existing display of its kind and offering an alternative to paper for a timely and reliable way to post notices for intended consumers.

keywords: Wi-Fi, Smartphone, GSM, P10 module, LED, Inverter

I. INTRODUCTION

In this era of digitalization, sending or sharing information via mobile and wireless media has tremendously changed the mode of our daily communication. Short or long messages can be sent remotely via a smartphone to an LCD, LED, or other digital display board to advertise or notify people of recent happenings and developments within their immediate environment or community. Users can use the messaging software on their smartphone or any other terminal application at their disposal to modify or change the textual or graphic content of the display for the most precise messaging possible. This is facilitated by the various technological areas in the field of telecommunication (Ngene & Yunus, 2016), such as GSM and other wireless communication technology, that have helped to expand the limits of communication by providing techniques for instantaneous data transmission and information exchange between people and devices at different locations of the world, both in remote and public places, beyond the conventional paper hanging practices that encourage wastage and pollution and non-electronic signs where the information showcased is physically applied to the sign surface by printing, painting, or illumination. Modern notice boards used digital signage innovation, a segment of electronic signage that used digital display technology such as LCD, LED, e-paper, etc. (Wikimedia, 2022), which has a higher and more efficient display quality than incandescent and field emission displays (Gowrishankar et al., 2018), to display a series of changeable, scrolling or static textual messages, graphics, logos, and animation at intervals through the electronic coding of LED matrixes or other equivalent digital display media (Lawinsider, n.d.) to satisfy all purposes, whether for businesses, advertisement, or multi-purpose use, that is sure to capture the attention of any audience. However, the possibility of this lies in their integration with some communication media/devices and protocols that facilitate communication between mobile and wireless devices and a network of LED displays.

A GSM modem, for example, could be used for some of the most cutting-edge applications (Agbeyangi et al., 2017) such as real-time based notice boards, home automation, etc. when allied with a system-on-chip device (SOC) or micro-controller, in addition to providing a medium for conversation exchange for mobile phone users and modems for roaming between mobile phone network operators. Wi-Fi or Bluetooth can also fulfill the same function when quick wireless connections and data transfer are required to transmit messages to an LED matrix display. These technologies also give users the choice to access or control a display device remotely with their mobile phones as desired, without the need for cables or other physical connections.

A similar approach was adopted in this work, where an embedded device that combines the functionality of wired and wireless technology is interfaced with a GSM modem and LED matrix display to develop a dual-power digital display (AC and battery) system that transmits and displays changeable messages using either USB or Wi-Fi or Bluetooth technology via PC or smartphones. The system is built around an ESP-32 microcontroller, which manages operations and coordinates system activities. It can handle multiple simultaneous message displays on two opposing dual-layer LED matrix screens with a GSM feedback system that sends the same messages to a mobile number, as well as an integrated call function that uses the GSM modem to call the authorized user to alert them of any intrusion whenever the system is turned on at any location.

II. LITERATURE REVIEW

Electronic display boards do not self–generate the content of their display but are either embedded in their media or Microcontrollers or messaged from external sources such as micro-computer, smartphone using USB, Bluetooth or Wi-Fi technology. (Gowrishankar et al., 2018) demonstrated the use of GSM technology in an LED display notice board. The proposed system was a dual-input and dual-powered dot matrix digital display. Messages received from the user through a mobile phone or PC were sent to an LED matrix display using a GSM modem and a USB connection. The system was built around a PIC18F4550, sourced power from the main AC supply and solar system, and automatically turned on or off based on human movement using a motion sensor. When the AC power is cut out, the system switched to solar power and keeps the system running. The work proves highly efficient in terms of ensuring a continuous power supply. (Pro. Gaurav S et al., 2020) They incorporate the 16 x 64 P10 LED matrix display, ATmega328 microprocessor, and HC-05 Bluetooth modem into their design. By connecting the HC-05 and the phone's Bluetooth device, users can engage with the proposed system via their mobile devices. With an Android Bluetooth interface application, messages from the smartphone are delivered to the LED display. The message is received by the HC-05, which then converts it into a serial stream. The microcontroller reads the serial stream and passes it on to the LED display. The system is powered by a solar system and an AC source. A wireless notice board that integrated the capabilities of Bluetooth and GSM technologies was proposed by (Aliya et al., 2019). In the design, a Bluetooth modem (HC-05) was interfaced with a smartphone via a Bluetooth terminal application. The message received by the HC-05 was read by the microcontroller, an ATmega 328p, displayed on a 2 x 16 LCD board, and also forwarded to a few registered mobile phones using a Sim 900 GSM modem. A novel technique for electronic notice boards was introduced by the research work. (Savan, 2015) utilized a methodology similar as (Aliya et al., 2019) except the media were used independently and their performance was assessed. An 8051 microprocessor, Bluetooth, and a GSM modem were used to construct the system. In order to convert RS232 voltage levels to TTL voltage levels, the microcontroller is connected to the GSM modem through a MAX232 level converter. The message was received from the modem by the 8051 microcontrollers, who then displayed it on a 16 x 2 LCD board. (Rahul & Preeti, 2013) used a Sim 300 GSM modem and an AT89S52 microcontroller to send real-time messages to multiple LED display boards. The work proved to be cost-effective and secure as the microcontroller had to authenticate the sending mobile numbers with the EEPROM registered number before messages can be displayed.

III. METHODOLOGY

The proposed notice board is a dual-face, double-layer, two-way power system (AC supply and inverter power backup) that applies the wired and wireless-based serial data communication techniques in a digital display by integrating an ESP32 micro-controller, a Sim800I GSM modem, and networks of P10 SMD LED displays into an embedded system capable of displaying real-time messages as per updated at the user's discretion and dictation in continuous scrolling mode and evaluating the performance of the system in each operating mode based on response time. The response time is calculated using the below formula

$$\text{Response time } = Message\ Sending\ time - system\ feedback\ time \qquad (1)$$

Messages to be displayed are transmitted remotely as SMS from a Bluetooth or Wi-Fi-compatible device that interfaces with the microcontroller using a wireless communication protocol. A personal area network (PAN) is established by pairing the smartphone to an ESP32 Bluetooth controller or Wi-Fi network. The intended message is then sent via an android Bluetooth or web console application. The application enables interfacing between the notice board and the user. The microcontroller validates the MAC address of the transmitting device, and forwards the message to the network of P10 LED matrix for display and SIM800l modem which further forwards the message to some mobile number programmed into the microcontroller. For every new sms message successfully received by the microcontroller a notification sound is heard from a buzzer connected to the control circuit and the message remains on the EEPROM where it is fetched and scrolled repeatedly on the LED display until a new message is received that overwrites it.

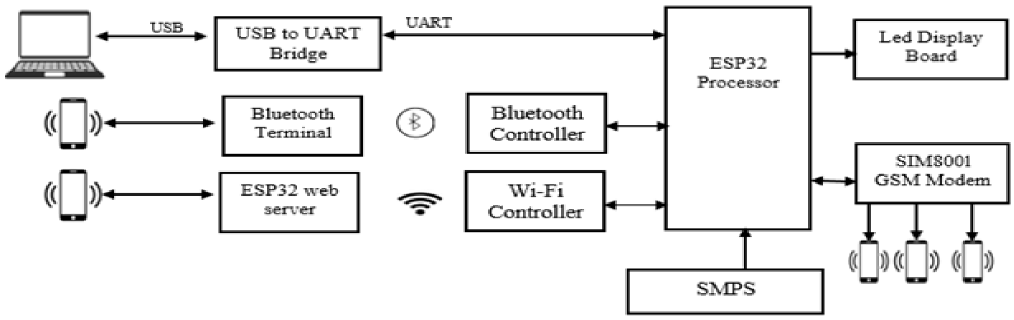

Figure 1: System Block Diagram

IV. HARDWARE DESIGN

The proposed system consists of four units: the display, power supply, control and the feedback units. The units are constructed using the following components.

i. P10 LED Matrix
ii. SMPS Power supply
iii. ESP WROOM 32 Microcontroller
iv. SIM800L
v. 1000W Solar Inverter
vi. MA1210A Intelligent Charger
vii. 70mAH Battery
viii. Relay

1. Display Unit

The display unit consists of twenty (20) single-colored, 32 x 16 P10 SMD2835 semi-outdoor LED modules that are separated into two faces of ten P10 modules and organized in the order of RGB. Each face has two rows of five P10 LED cascade panels (Figure 1). With 512 highly luminous LEDs mounted on a plastic housing frame with 32 LEDs in each row and 16 LEDs in each column, the panels are cascaded through the output HUB 12 connector and offer a luminosity of 1600 CD/m2 at a viewing distance of 10 meters. Each panel contains eight (8) cascaded 74HC595 ICs, an 8-bit serial in parallel out shift and storage register to drive the column, and four (4) current source drivers to drive the rows of the display at a scan rate of ¼ (Shenhzen Xuyang Technology, 2022). The P10 modules display high-quality characters and symbols as received from the microcontroller.

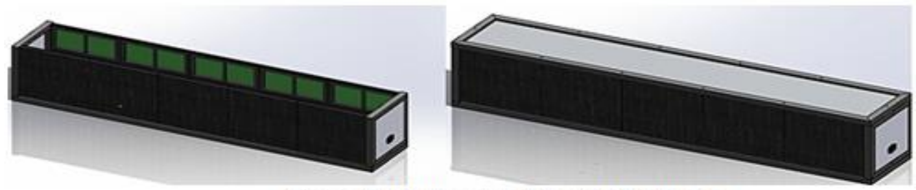

Figure 2: 3D Diagram of the Display Board

2. Module Interface

The HUB-12 DMD connector was used to link the panels to the microcontroller (Figure 4). The data pin (R) of the connector is used to serially feed the input signal from the ESP32 into the DS pin of the first 74HC595 register, where it latches at the transition of the ST CP input and shifts at each positive transition of the SH CP input (Diode, 2018). The serial input of the second shift register is coupled with the serial output of the first shift register, and the trend follows until the last shift register, after which the signal is transferred to the R output pin of the HUB 12 connector for the subsequent panels. The columns of the display are driven by the shift registers' concurrent data outputs. However, since the columns are all connected to the cathode pin of the LEDs, they do not possess enough current to illuminate the LEDs on the display. To illuminate the display, the current source (row drivers) will drive the rows of the display, thereby controlling the state of each individual LED in the display by adjusting the current through the rows. This means that the number of rows of LED that can be lit per frame is also determined by the drivers based on the logic states of Pin 2 (A) and Pin (B), the scan mode of the panels, as well as the intensity and brightness of the display. At a scan rate of ¼ with 512 LED per panel;

$$1\ frame = \frac{512}{4} = 128 \text{ LEDs,}$$

So the panel required 128 bits signal from the micro controller to control/Light 128 LEDs per frame. ¼ of the total images in one frame another ¼ in the next frame till the fourth frame. A complete image is formed by four (4) frames switching at a very fast rate base on technique of persistence of vision.(Maio, 2020),(Wikipedia, 2022) .

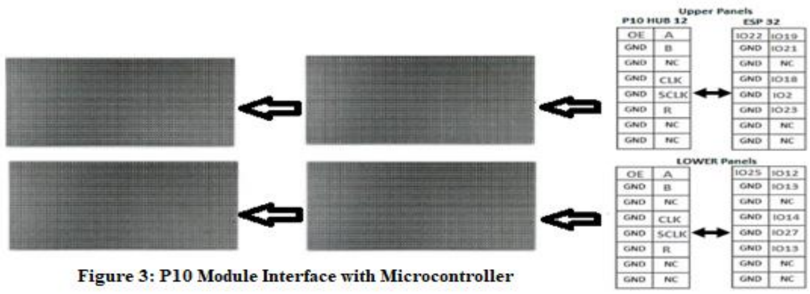

Figure 3: P10 Module Interface with Microcontroller

2.1 Module Power Consumption

Each module contains 512 LEDs with each tested at 20mA, if all the LEDs are to be on at the same time total consumption will be: $512 \times 0.02 = \ 10.24$.
The LEDs are all connected in parallel to 5 V DC

$$P = IV\ watts \qquad (2)$$

$I = 10.24\ A$ Current for a single module
$V = 5\ V$
$P = 10.24\ \times 5 = 51.2$ W for a single P10 module
Therefore Power consumed by 20 modules: $51.2\ \times 20 = 1024\ W$
Current consumed by 20 module: $10.24\ \times 20 = 204.8\ A$
Consider the scan mode which is ¼
Hence, Consider the scan mode which is ¼
Total power = $\frac{1}{4} \times 1024\ W = 256\ W$
Total Current = $\frac{1}{4} \times 204.8 = 51.2\ A$
Additional information about the modules specified 20 W, 5V power supply per module, that is each P10 module in the display required 5 V, 20 W power supply to operating. If all the twenty modules are considered, then the total consumption is
Voltage Per Module: 5 V
Current per Module: 4A
Power consumption per module: $P = IV\ watts = 5\ \times\ 4 = 20\ W$
Hence total power required by the 20 modules: $20\ \times\ 20 = 400\ watt$
Total current required: $4\ \times\ 20 = 80\ A$
Hence to generate sufficient power to drive the system we make use of a 400 W, 80 A switch mode power supply

3. Power Supply Unit

Two sources of power (an AC power source and an inverter backup) were used to power the system, and they were both connected to the display through a switch-over circuit. When there is electricity, the system uses the AC supply, but when the AC supply is turned off, it switches to the inverter backup. A 400 W 5 V 80 A switching power supply steps down the 220V from the main AC supply to a 5V DC voltage (Xiamen Chantop, n.d.). The 5V DC output is used to power the microcontroller, the P10 LED matrix display, and the passive components.

4. Inverter Power Backup

The backup provides an alternative power supply to the notice board to maintain continuous operation after AC power outage. It comprises a 1000VA inverter, MA-1210A intelligent battery charger, and a 12V, 70AH battery (figure 5) The choice of this specification was derived from the calculation:

Power consumed by the 20 P10 modules: 400 W
Total Power: $= 400$
Inverter rating: $= \frac{load}{powerfactor} = \frac{402}{0.8} = 502.5\ W$
Inverter used: 1000 W
Backup Time: $= 2\ hours$
Battery: $l\ \times \frac{H}{V} = 400\ \times \frac{2}{12} = 67 \sim 70Ah$
Battery Charging Current: $= 10\%\ of\ 70Ah = 7A$
If we consider charging losses of 2A then:
Charging Current: $= 9A$

The battery was polarity-conformingly connected to the battery charger and the inverter, respectively. The input of the battery charger was then connected to an AC power source. The battery charger has two indicator lights to indicate charge and discharge. when the green light is on the battery is fully charged else the red light which indicates discharge. When AC power is out the inverter converts the 12 V DC supply from the battery to 220 V AC output. The 220 V AC output is connected to the switch mode power supply which steps it down to 5 V and powers the loads. The interconnection of the power unit is shown in (figure 5).

5. Switch Over Circuit

The switchover automatically alternates power between the inverter and the primary AC power supply. It includes components like relays, transistors, resistors, and diodes. The inverter backup was connected to the normally closed (NC) terminal of the relay and the main AC power source to the usually open (NO) terminal. The relay's control terminal was wired to the microcontroller. The normally closed (NC) terminal of the relay will close in the presence of AC power, allowing the main power to reach the load. When the primary power supply fails, the microcontroller activates the relay by sending a signal to its normally open (NO) terminal, which supplies power to the load from the inverter's backup power source. The transistors are used to amplify the signal from the microcontroller to the relay to activate it and also switch the relay on and off. See figure 5 for the circuit design.

6. GSM FEEDBACK UNIT

The GSM feedback unit makes use of a SIM800I GSM modem to relay messages received from the microcontroller to a few mobile numbers programmed into the microcontroller to provide feedback to the user and also relate the sms message to some recipients The module supports SMS messaging, voice calls, and data transmission using the GPRS network. The modem is interfaced with the microcontroller on the UART pins and powered by the 5 V DC supply through a voltage divider circuit. This reduces the 5 V to 4 V, which is the working voltage of the modem.

$$Vout = \frac{5V(40k\Omega)}{(40k\Omega + 10\text{k}\Omega)} = \frac{200}{50} = 4\,V$$

7. RTC (Real Time Clock)

A real-time device is also embedded in the system to provide continuous and accurate timekeeping of date and time. The unit consists of an RTC module and a 3 V lithium battery. It operates independently of the control unit and keeps track of time and date even when the system is powered off.

8. Control Unit

This unit consists of a low-power, low-cost ESP32 microcontroller. The ESP32 Wroom 32u is equipped with 2.4 GHz Wi-Fi and Bluetooth connectivity support, a USB-to-UART Bridge Controller for bidirectional communication with the PC, a dual-core processor, and a large number of input/output(I/O) pins for connecting various sensors, (Espressif, 2023) making it a perfect choice for IOT projects that require wireless communication. For storing data and executing code, it also features 8MB of PSRAM and 4MB of flash memory. The microcontroller interfaced with other units via its UART, PWM, SPI, and I/O interface and received inputs from sensors, controls actuators and communicates with other units to perform the desired operation. It was programmed in the Arduino IDE platform using C programming with all relevant libraries for the ESP32, and the displayed installed. The interconnection of the control unit with other units in the system is shown in the circuit diagram in (figure 5).

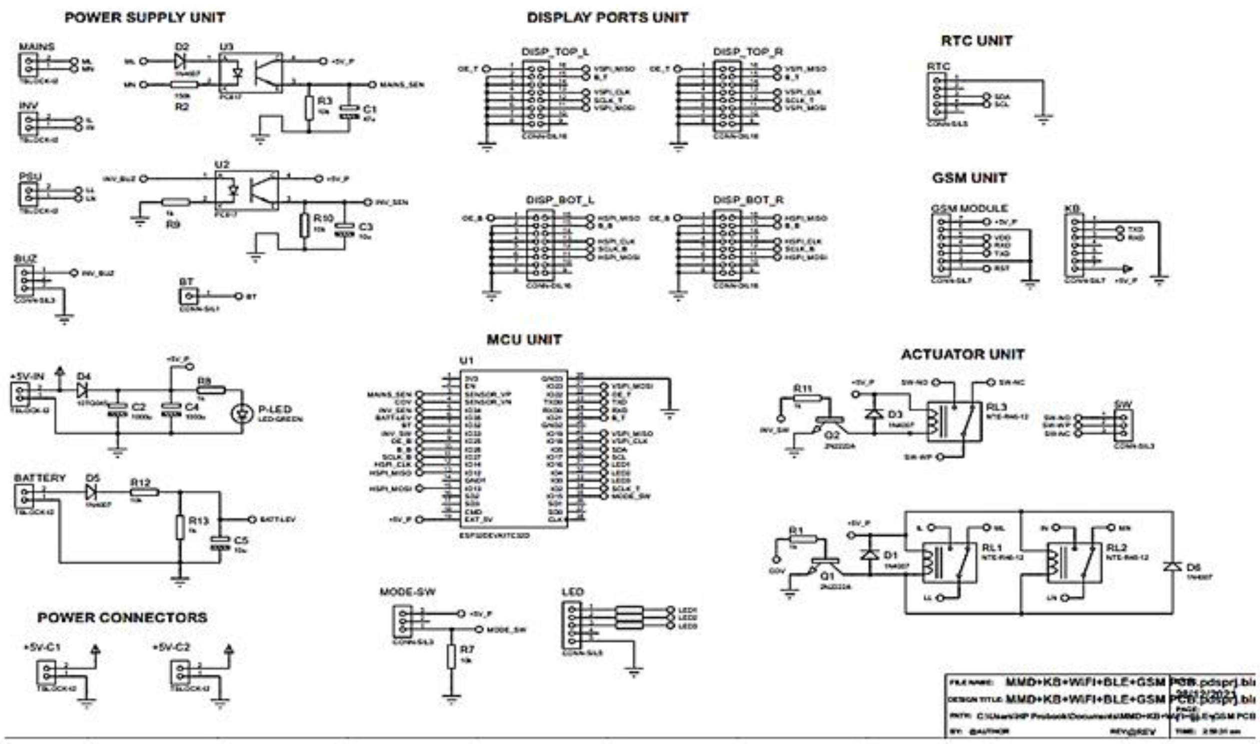

Figure 5: Schematic Diagram of the System

V. SYSTEM IMPLEMENTATION AND TESTING

The system was constructed as shown in the schematic diagram in (figure 6). The circuit layout was designed in Proteus 8.13 design suite and the microcontroller was programmed in the Arduino IDE platform using C programming with all relevant libraries installed. The code was loaded on the microcontroller through its micro USB connector. ESP32 microcontroller was interfaced with P10 modules using the SPI and I/O pins. The microcontroller's clock and data pins were connected to those of the P10 modules, and the data is transmitted through the R pin to the shift register. The switch mode power supply provides energy to the system. The 5 V DC output of the SMPS was used to power the circuitry and the P10 Displays, while the AC Input of the SMPS was connected to a 220 V AC wall outlet and the inverter output. The system automatically switched to the backup power source provided by the inverter when the AC supply failed or is disconnected. The relay switches back to the primary power source once it is restored. This ensures that the load is always powered and that the switchover happens smoothly and without an interruption. Between the main AC input and the inverter, two relays were wired in series. The usually Open (NO) terminal of the first relay was wired with the live wire of the main power source, and the normally closed (NO) terminal was wired with the live wire of the inverter. Similarly, the ordinarily open (NO) and usually closed (NC) connections of the second relay were connected to the negative of the main power supply and the negative of the inverter power backup, respectively. The SMPS was coupled to the common terminal of the relays, enabling it to draw power from either the inverter backup or the main power source depending on the signal from the microcontroller. The control terminal of the relay was wired via a transistor to one of the microcontroller's output pins. Through this, the microcontroller controls the switching between the main power source and the inverter backup.

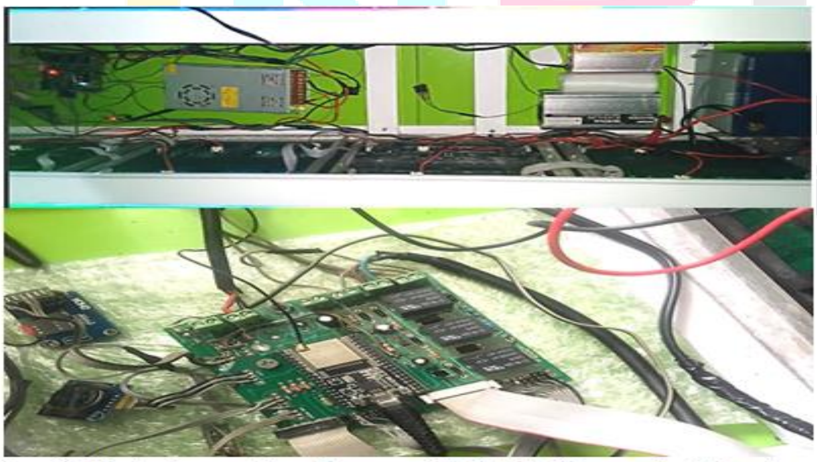

Figure 6. Physical connection of the power Unit to Switchover circuit showing the GSM Modem &RTC

VI. POWERING AND TESTING THE SYSTEM

An SPST switch is used to turn the system on and off. When the switch is turned ON, the system locates the authorized user's mobile number and dials it for three (3) seconds before automatically terminating the call. This notified the authorized user information. The board then shows the default message as a result of this operation. On both sides of the notice board, there are two tiers. The top layer shows imbedded scrolling messages with dates, mottos, and greetings. The RTC module controls and maintains the time and date. The bottom layer displays and scroll messages that have received from external devices. The microcontroller was interfaced with the external devices (Smartphone or PC) via USB, Bluetooth, and Wi-Fi. Messages were sent from the medium, stored, and displayed by the microcontroller on the P10 display board.

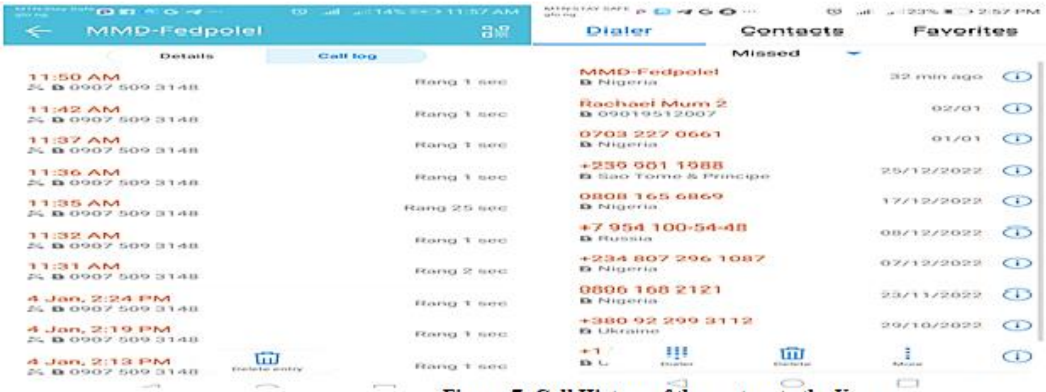

Figure 7: Call History of the system to the User

Figure 8: The SMS based notices board in operation

A. TESTING THE NOTICE BOARD USING WIRED CONNECTION

In the USB mode, a micro USB cable was used to establish a serial connection between the ESP32 and PC, which was controlled by a USB-to-UART bridge controller. The ESP32 microcontroller is connected to the bridge using UART, and the bridge is connected to the Computer via USB. Serial communication was set up between the PC and the microcontroller on COM-PORT 4 at a baud rate of 115200 using the Arduino serial monitor. The serial terminal was used as a terminal emulator to send SMS messages to the microcontroller. As soon as the message is received, the microcontroller processes it and sends it to the LED matrix displays and SIM 800l GSM modem for further communication to some selected mobile numbers. These enable recipients at remote location to get the notice or message. In this work six (6) mobile number were programmed into the system.

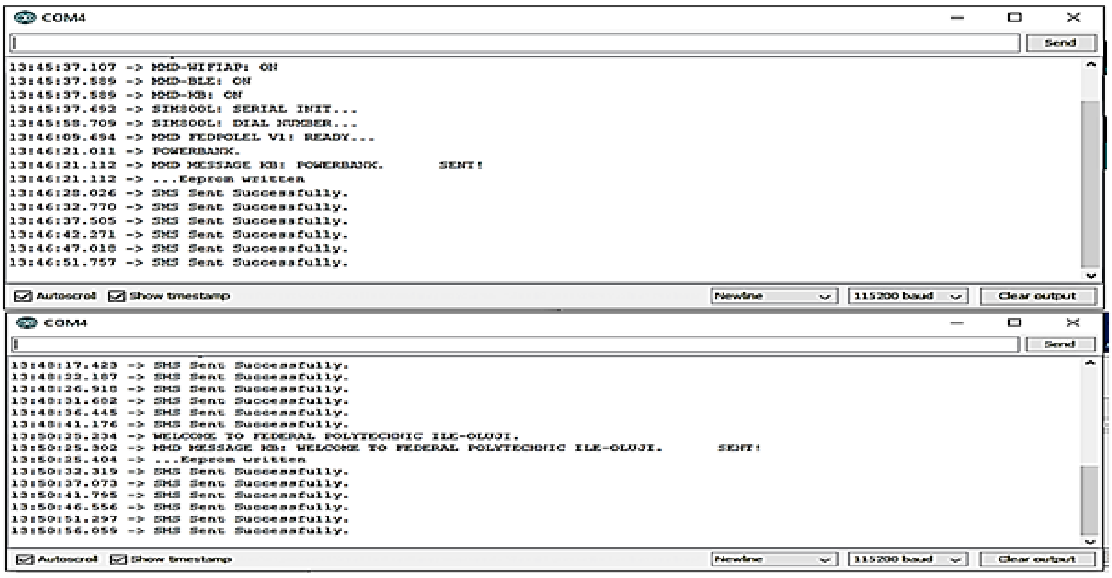

Figure 9: The serial monitor interface for Wired Communication showing the Elapse Time and Message status

B. TESTING THE NOTICE BOARD USING WIRELESS COMMUNICATION

The microcontroller already has a built-in Bluetooth and Wi-Fi controller that are responsible for both Bluetooth communication interface and Wi-Fi connectivity and data transmission. This means that any external device that is Wi-Fi and Bluetooth-compliant can connect directly to it.

In Bluetooth Mode, a personal area network was created in the range of 15 meters by pairing a smartphone with the ESP32 Bluetooth LE. Bluetooth communication is then established between the two devices using a Bluetooth terminal application, which facilitates serial communication between them over the Bluetooth connection. In this case, an android serial Bluetooth terminal application was used. The ESP32 was configured as a Bluetooth server and the smartphone was paired and connected to it using the serial Bluetooth application, the intended message is sent from the smartphone via the application to the microcontroller. The microcontroller receives the message from the authorized transmitter validating the Media Access Control address and displays the information on the P10 digital displays which serve as the notice board and also transmit the message to the feedback unit for some mobile numbers (Figure 10) shows the implementation of the notice board using Bluetooth connection.

Figure 10: The Bluetooth terminal Interface

In the Wifi mode, the ESP32 was configured as an access point (SoftAp) that is as a Wi-Fi network hub for other devices to connect. The smartphone was paired and connected to the ESP32 Wi-Fi network from the phone Wi-Fi setup. A serial communication link was established between the phone and ESP32 microcontroller via a standalone ESP32 web server. The server was built into the code and accessed on a web browser using the IP address 192.168.1.1. The server contains a webpage for controlling and updating the content of the notice board. The notice board Date, time, and messages are set and updated from this application (figure 10). Messages are sent from the smartphone to the microcontroller via the web page to the microcontroller which forwards it to the display and Sim800l modem. To eliminate conflict in connection and transmission each of the modes is used independently of the other by switching between them using an SPST push button. A buzzer, attached to the microcontroller provides a double buzz notification for every new notice or sms message from either of the message sources to the micro-Controller and the message remains on the EEPROM where it is being fetched and scrolled repeatedly on the LED display until a new message is received that overwrite the initial message.

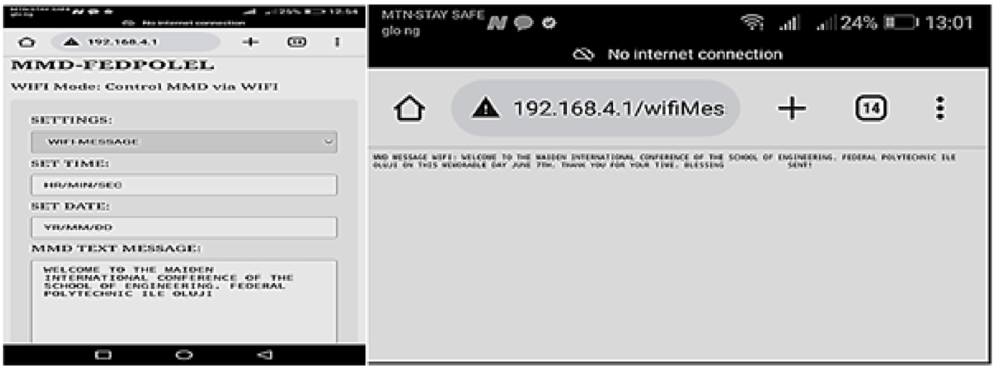

Figure 11: The Wi-Fi webpage Interface

C. TESTING THE FEEDBACK UNIT

The feedback unit received the message from the microcontroller and forward it some recipients whose mobile number had been embedded into the microcontroller code. Six (6) mobile number of different networks was embedded into microcontroller. figure 10 shows the transmitted messages.

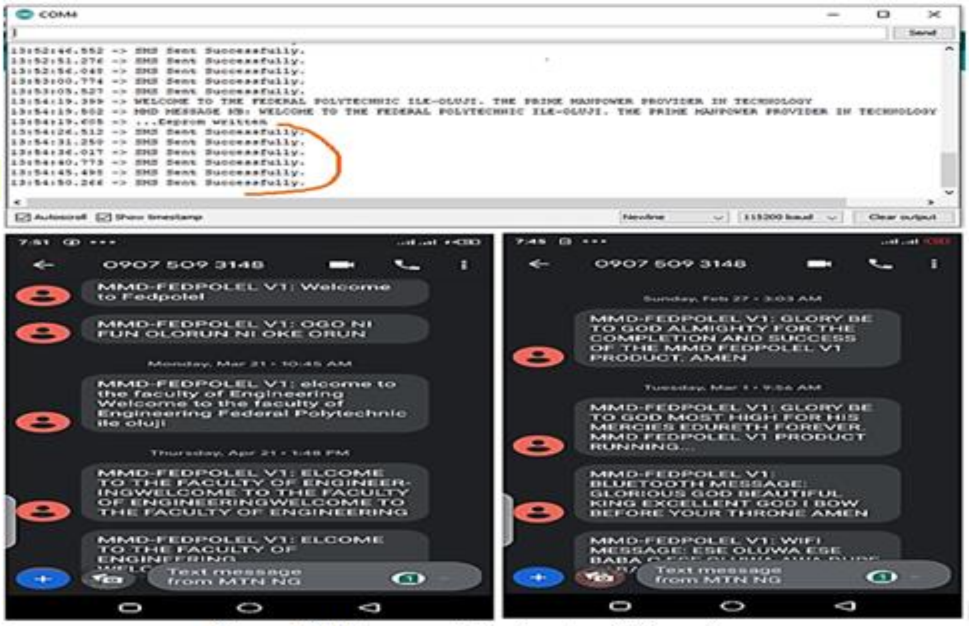

Figure 12: Messages delivering to mobile numbers

VII. RESULT AND DISCUSSION

The notice board was tested with different sizes of messages in the three operating modes. The system was programmed to accommodate 300 characters that is the system can scroll up 300 bytes of information at a time, beyond this the system triggers the buzzer. The system was tested with a minimum of 10 bytes and a maximum of 160 bytes of messages which is the equivalent of one page of sms and the response time was measured using a stopwatch and the serial monitor timestamp (figure 8). The result of the measurement is shown in Table 1 below.

Table 1: Duration of Message transmission per Device (in seconds)

Message Size	RESPONSE TIME IN SECONDS (S)					
	Cable (USB)	Bluetooth	Wi-Fi	GSM (cable Mode)	GSM(Bluetooth mode)	GSM (Wi-Fi mode)
10 Bytes	0.101	1.134	0.892	30.645	30.964	30.846
20 Bytes	0.103	1.135	0.984	30.655	31.131	30.955
40 Bytes	0.102	1.138	1.124	30.655	31.309	31.652
60 Bytes	0.103	1.124	1.252	30.359	31.006	31.750
80 Byte	0.103	1.158	1.102	30.661	31.198	31.265
100 Bytes	0.102	1.147	1.082	30.667	31.056	31.153
140 Bytes	0.105	1.140	1.095	30.833	31.209	31.285
160 Byte	0.105	1.177	1.290	30.926	32.089	31.562
AVERAGE RESPONSE TIME IN SECONDS (S)						
				5.15	5.34	5.29

The table displays the response time for each byte of data transferred from the three transmitting media to the notice board at various times. By calculating the difference between the time it takes to send a message and the time it takes for the system to respond, the response time for the GSM feedback system was also recorded for each of the operating modes. If the total bytes of information sent are considered in relation to time, then the transfer speed can be calculated as thus:

$$Total\ byte\ size = 610 = \frac{610}{1024} = 0.595KB$$

In USB mode: $Total\ elapse\ Time = 0.824s$

$Speed = \frac{0.595}{0.824} =)$ 0.72KB/s

In Bluetooth Mode : $Total\ elapse\ Time = 9.153s$

$$Speed = \frac{0.595}{9.153} = 0.065KB/s$$

In Wi-Fi mode: $Total\ elapse\ Time = 8.821$

$$Speed = \frac{0.595}{8.821} = 0.067KB/s$$

It was discovered that the system operates more efficiently in the USB mode than in the other two operating modes. The fastest transmission speed and shortest response time are produced by this setting. As Contrary to the other modes, which had transfer rates of 0.065KB/s and 0.67KB/s, respectively, which are slower than cable, the majority of the messages were transmitted at milliseconds (ms) with a transfer rate of 0.72 KB/s and an average response time of 0.103s. In the wireless mode, the system performance is slightly better with Wi-Fi than with Bluetooth. it has a transfer speed of 0.067KB/s at an average response time of 1.102s while Bluetooth has an average response time of 1.144s at a transfer speed of 0.065KB/s. Both connections lag the USB connections in response time and speed, which may be because cable connections provide higher bandwidth and more reliable connections that are not limited by interference or signal attenuation, resulting in faster and more reliable data transfer and lower response time than Bluetooth and Wi-Fi, which use radio frequency signals to transfer data and can be impacted by environmental factors like distance, obstacles, and other factors. Additionally, wireless communication protocols such as Bluetooth and Wi-Fi have additional overhead and latency compared to cable or wired connections. In the feedback unit, the system recorded an average of 5 seconds in response time per SMS message forwarded by the SIM800l to the six (6) mobile numbers embedded into the system. The response time was recorded per SMS delivered to each of the six mobile numbers. This was done in the three operating modes and the summation is shown in table 1. Since the system is tested with message size within the range of one page of SMS, we can find the average response time by dividing the highest response time in each mode by the number of mobile numbers. From the table, we discovered that in each operating mode, the system delivered the SMS messages across the six mobile numbers in 5 seconds which matches the SMS delivery time displayed on the recipient's mobile phone.

VIII. CONCLUSION

In conclusion, the dual power, dual face scrolling P10 display notices offers a versatile and efficient solution for displaying information in a dynamic and eye-catching way. By utilizing both AC and DC power sources, the board can operate seamlessly in various settings and environments. The dual-face feature enables the board to display messages in two directions, maximizing its visibility and impact. The scrolling feature also adds an interactive element to the display, enabling users to convey information in a dynamic and engaging way. With the added features of security that notifies the authorized user of any intrusion and remote control via Bluetooth or Wi-Fi, it is easy to update and manage the content displayed on the notice board. Overall, the dual power, dual face scrolling P10 display notice board is a reliable and effective tool for conveying important information to a wide audience.

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