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An Optimized Real-Time Wireless Digital Billboard Message Display

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Abstract: This paper presents an optimized Real Time Wireless Digital Billboards Message Display. Displaying information to the public for consumption is done via various means such as newspaper, television, radio, internet, billboards etc. All these methods of passing information are not yet 100% efficient because it can only benefit those seated watching, listening or reading the information. Digital Billboard has recently emerged as a way of improving on the information dissemination across the globe. The emerging technology has facilitated e-message display for commuters and students. This research is aimed at using GSM technology to improve on the message display on wireless digital billboards for commuters and students consumptions within the campus. The digital billboard system comprises of input (text message from mobile phone), control (microcontroller), communication (GSM technology), and output (digital display) units which are hardware-software based. Bottom-up approach was deployed to achieve the targeted system. The system was designed, programmed, and constructed. During testing, a desired text message from a mobile phone is sent to the GSM module located at the remote end digital billboard system, which in no delay, disseminated the message to other digital billboards for display. The reception of the message is acknowledged by blinking small LED and sounds a buzzer connected inside the billboard system, and store the message in the electrically erasable programmable read only memory (EEPROM). The system was tested successfully by varying text messages displayed on the various digital billboards with no latency recorded.

Keywords: GSM, Digital Billboard, SMS, microcontroller, buzzer and LED

I. INTRODUCTION

The advance in technology has made digital billboards and information dissemination possible. Many organizations, colleges, universities, churches, supermarkets, malls, railways stations, etc. have adopted the use of this emerging technology to pass information effectively. Though the existing billboard systems are still not 100% efficient to deliver messages to the viewers, an improvement is still required. It is noticed that there is always latency in delivering and displaying the messages accurately. In [1], it was noted that the existing digital billboard is not easy to update messages instantly which remain a big concern. Mobile and wireless technology have provided mechanism to remotely control and update the content of a display board via SMS and other modern means [2]. Hence, due to the increase in crime and activities in the society, an optimized real-time wireless digital billboard system that would aid information dissemination effective is required. In addition, the existing systems had no security integrated to track the message sent to ensure that the message come from the authorized personnel.

II. RELATED WORKS

In [3], GSM-Based Smart Digital Wireless Electronic Notice Board was developed. Their research work presented a low-cost new concept of digital wireless electronic notice board based on Global System for Mobile communications (GSM) modem whereby the required notice to be displayed would be sent through Short Message Service (SMS). A message or notice is sent to Liquid Crystal Display (LCD), and the message can easily be modified and sent from any part of the world, just by using the SMS facility in GSM cellular devices. An IoT-based Digital Notice Board using ATMEGA 328 Microcontroller, GSM module, LCD, and Buzzer was designed in [4]. In their

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work, a wired connection was established between GSM module, Microcontroller, and LCD. A Buzzer was attached with the Microcontroller to produce a Message Alert. A SIM card was inserted into the GSM Module for calling and sending a message. When the user sends the message from the Mobile phone to the particular SIM Number inserted into the GSM module, it would receive the message and pass it to the Microcontroller which processes and sends to the LCD for display with the Buzzer sound. Multiple users can send a message at a time which would be displayed based on their priority. In [5], Electronic LED Display Board for College and Universities was developed to display day-to-day announcement. Their LED display system consists of a receiver and a display toolkit which was programmed from an Arduino IDE platform. The system receives message via serial port and displays the desired information after necessary code conversion. Being modular design, the LED display is easy to expand and allows the user to add more display units at any time from any location in the campus depending on the requirement of the institution. A Modified SMS-Based Electronic Notice Board was designed and constructed. Their system consists of the power supply, voltage regulators, GSM modules, microcontroller, LED dot matrix display board, counter and subscriber identity module (SIM). Contribution was based on the hardware part of the system to make it more robust. The system was tested successfully [6]. In [7], a dot-matrix moving message display using microcontroller and IOT was developed for information notification to all the students in the campus. Their target is to make sure information keeps updated to students within the period of school hours. A novel smart notice board through GSM and p10 LED was developed and presented in [8]. Their system was implemented using a GSM Module IC controlled by Arduino Mega 2560 and LED display. The GSM module receives the message to be displayed as SMS, then transmits the message through the COM port to the controller to validate the SMS and then displays the message on the LED display. In [9], a wireless notice board that displays messages sent from the user's mobile phone was developed. The user sends a message; it is received by a SIM inserted in GSM modem at the receiver unit. The message received by the GSM is sent to the Arduino Uno that further displays it on an electronic notice board. A dual-face SMSbased LED notice board with an inbuilt GSM feedback and inverter power backup system was developed [10]. Their system's performance was evaluated based on its response time to the input message. Messages are transmitted serially to the notice board in three different communication modes such as USB, Bluetooth, and Wi-Fi. Push buttons were 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 received by ESP32 microcontroller via GSM module was successfully processed and sent to the LED board for display.

III. SYSTEM DESIGN METHODOLOGY

The System design method adopted is bottom-up approach in which the complete system was developed starting with the components part. The digital billboard system comprises of the power supply, controller, GSM module, shifters and LED display units. The block diagram of the system is as shown in fig.1.

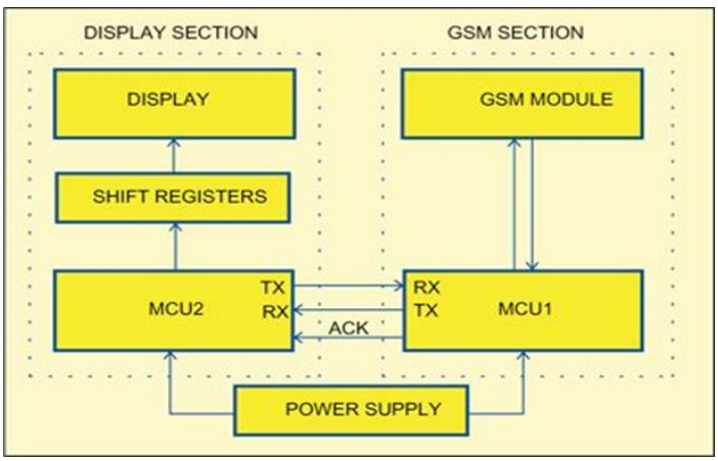

Fig.1. The block of the digital billboard display system

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A. Hardware Components

Power Supply: This unit provides the +5v DC power to the system. The solar panel was used to constantly supply power to the system.

Microcontroller: ATMEGA328P was used as a controller that processes the message sent from the mobile phone and sends to the display unit.

GSM Module: SIM 800L Global System for Mobile communication (GSM) modem was integrated in the system to receive the SMS sent from the mobile phone.

Dot Matrix Display (DMD): The display panel consists of Matrix of LEDs connected in 16 x 32 to display two hundred (200) characters at a time.

B. Hardware Circuit Diagram and operation

The system was designed to use two microcontrollers to display and update messages on the digital billboard. When the user sends message from mobile phone, example (*Department of Electrical/Electronic Engineering#) to the SIM card inside the GSM modem, the GSM Modem would receive the message. The microcontroller reads the message from the serial port and validates it and then activates sound which signifies the reception of the message. The controller processes the message and sends to be displayed on the matrix of LEDs connected to it. If the incoming message is in the correct format, message would be displayed but if not, message would be discarded and the existing messages would continue to display. The circuit diagram was simulated in PROTEUS as shown in fig.2.

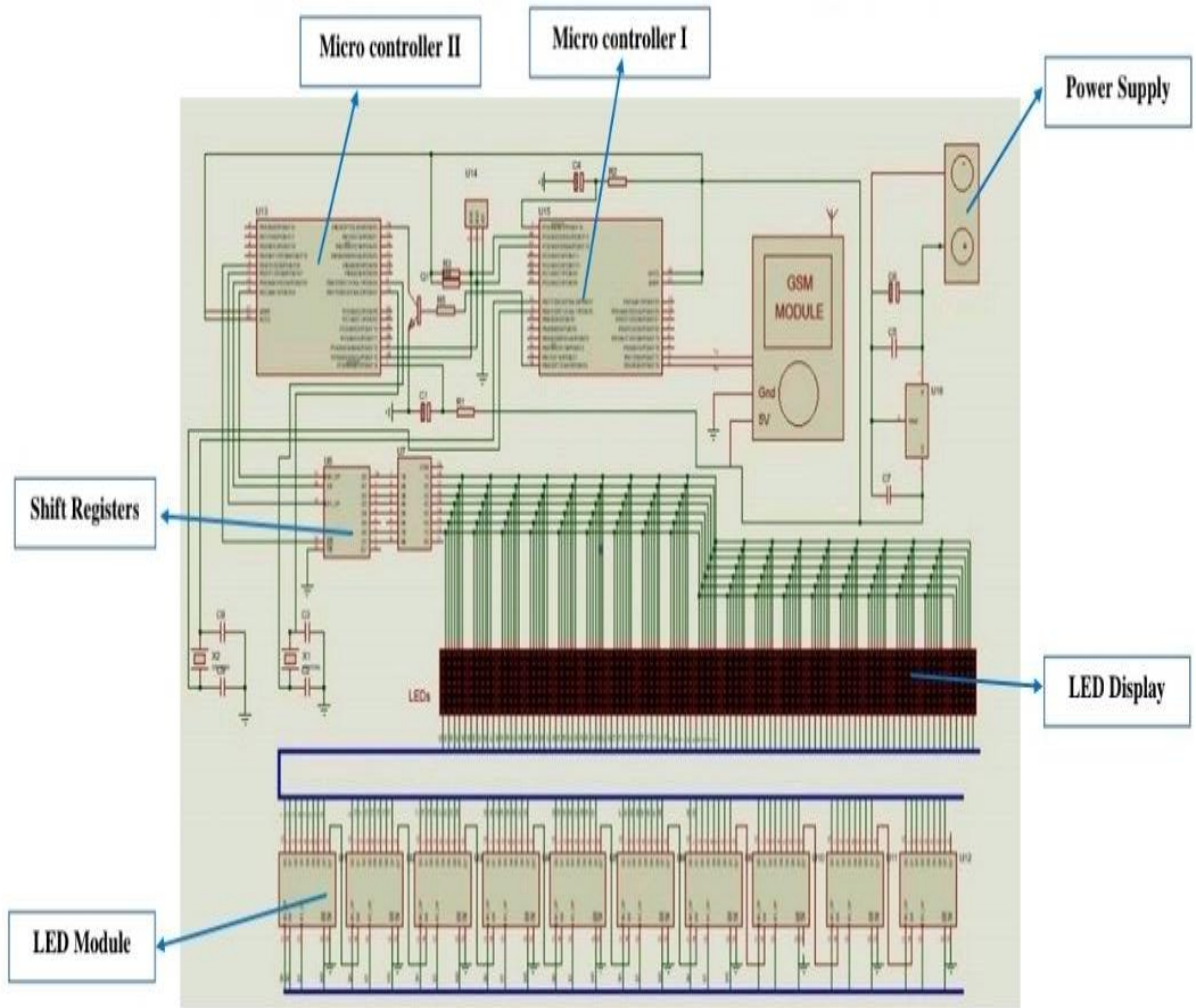

Fig.2: Circuit diagram of the Digital billboard message display

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C. System Algorithm and Flowchart

The system algorithm developed to handle the message received and displayed is as follows:

Step 1: Start and initialize the System
Step 2: Send message to the billboard
Step 3: Receive any Message from mobile phone?
Step 4: yes, Check SMS with code "()" and goto step 5
Step 5: Does the code match?
Step 6: yes, save to EEPROM and goto 8
Step 7: No, go back to step 3
Step 8: Fetch the message from EEPROM
Step 9: Check if the message is valid
Step 10: if yes, check if the message starts with * and end with
and goto step 12
Step 11: if no, goto step 13
Step 12: if yes, replace Old Message with New Message.
Step 13: Keep displaying the old message
Step 14: Stop

The flow chart for the algorithm is shown in fig.3.

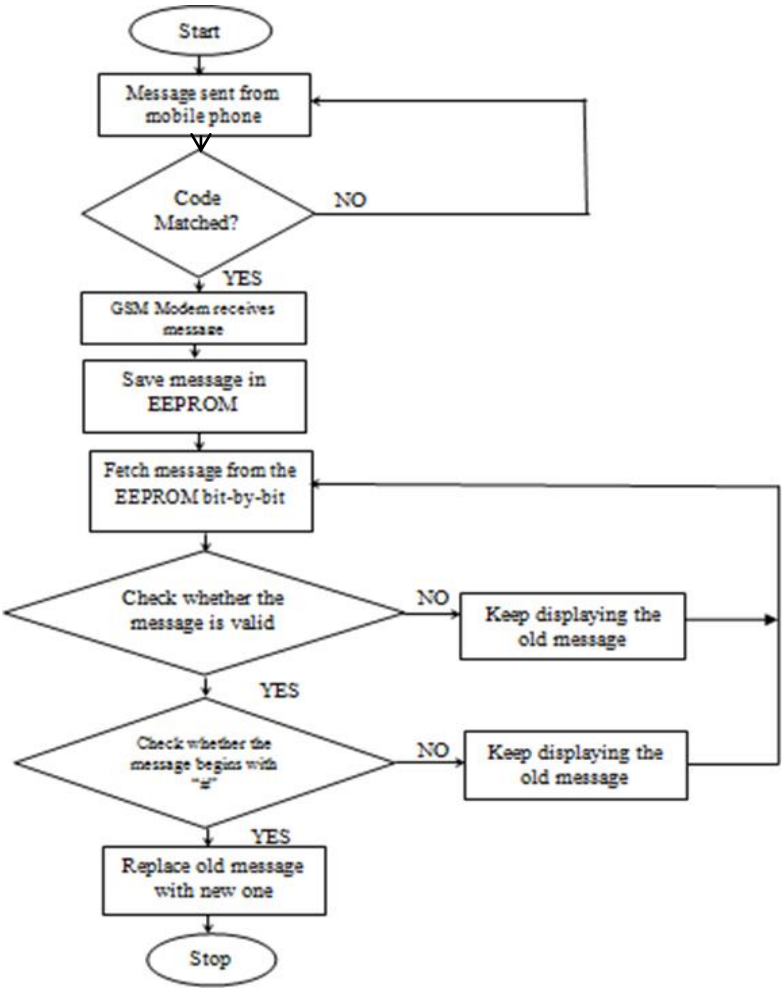

Fig.3. System flowchart for receiving and displaying message

D. System Software

The programming language used to develop codes for the controller is C language in Arduino Integrated Development Environment. The language was chosen because it is simple and easy to code. The symmetric encryption and decryption approach was deployed to checkmate the message being sent for display before flashing on the display board via written codes.

E. Prototype System

The Prototype system (fig.4.) is made up of hardware and software. The construction of the system casing was based on the aluminium material with dimension of 69.0cm x 18.0cm x 18.0cm. The construction of the digital billboard Message Display was achieved with the aid of various components such as Microcontroller, GSM Module, Shift Register, matrix of LEDs, and Max232 IC.

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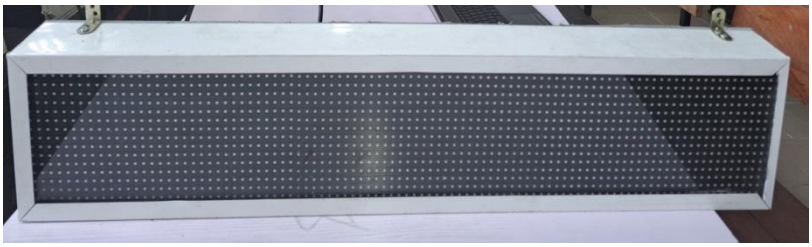

Fig. 4: Constructed Digital Billboard Prototype

III. RESULTS

A. SMS Test for Valid and Invalid messages

For Valid message, the system was tested by sending the SMS message with * and #. It was noticed that the system received the message, processed and displayed the same on the display unit without missing words. The message 'Hello, my people' was sent and the display shown in fig.5. For invalid message, the system was tested by sending the SMS message with only *Heloooo and not including # at the end. It was sent but not displayed instead the digital billboard kept displaying the same message previously sent.

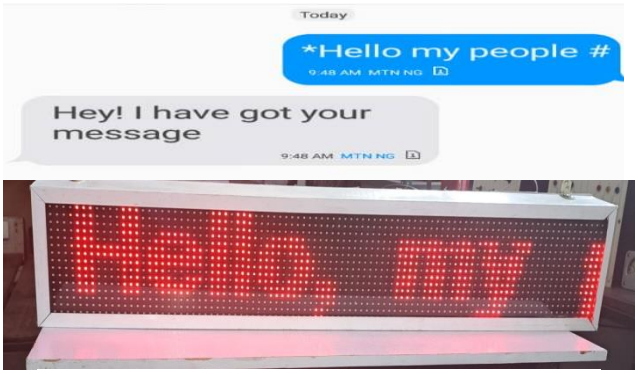

Fig.5. Valid message and its display

B. SMS length test

This test is to determine the numbers of characters that can be reliably received and stored in the micro-controller hardware serial buffer. The test revealed that, the buffer can reliably store up to 200 characters without truncation or some other unexpected behaviour while receiving text. This is not possible without updating the buffer size to 256 in the hardware serial configuration file. It is clearly indicated that the highest number of characters to be received, acknowledged, updated and displayed is 200 characters. Table 1 shows the SMS length Test conducted with their results.

TABLE 1: SMS length test

S/N	Message	Number characters	Received by GSM module
1	*Hello my people#	17	Yes
2	*We are pleased to inform you that the registration fee has been slashed by 30%#	80	Yes
3	*We are pleased to inform you that the registration fee has been slashed by 30%. We are pleased to inform you that the registration fee has been slashed by 30%#	160	Yes
4	*We are pleased to inform you that the registration fee has been slashed by 30%. We are pleased to inform you that the	240	No

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	registration fee has been slashed by 30%. We are pleased to inform you that the registration fee has been slashed by 30%#		

C. 160 Characters SMS Sent and Displayed

160 character SMS was sent to the designated mobile number which was received, acknowledged, updated, and displayed as shown in fig.6.

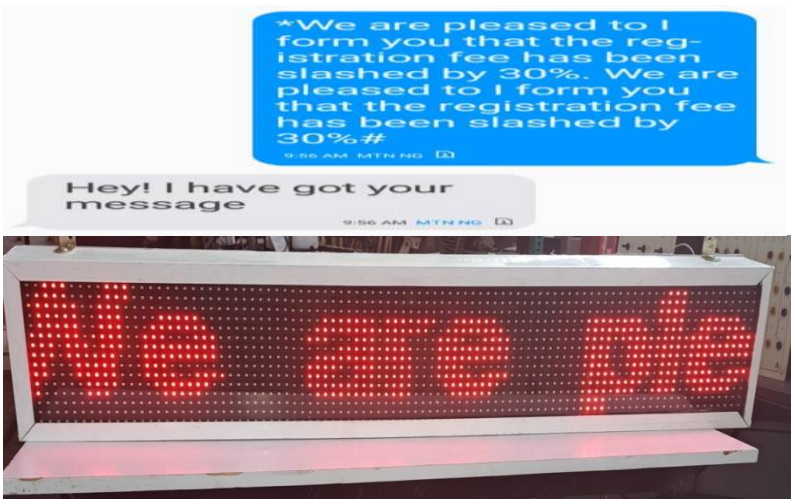

Fig.6: Displaying of the 160 character sent to the billboard display

III. CONCLUSION

The Optimized Real-Time Wireless Digital Billboard Message Display has been successfully designed and implemented. The system could display message sent from authorized personnel only from mobile phone that has the SIM card number of the digital billboard without delay. This would help the students in the higher learning, staff in organizations and industries; commuters etc. to be keenly get updated with recent happenings in their environments. The GSM technology with Nano microcontrollers and program codes made this a reality. The Digital Billboard is security conscious because it does not display message sent by the unauthorized user who happen to get the SIM card number. For future enhancement, researchers are encouraged to apply artificial intelligence (AI) to predict the daily display of information based on its self-learned approach.

REFERENCES

[1]. P.R. Kuraganti, V. V. Muppalla, K. M. Busiraju, S. Velagaturi, U. Chirumamilla. "Design and implementation of novel smart notice board through GSM and p10 led," International Journal for Advanced Research in Science and Technology. Vol. 13, Issue 03, pp. 142-147, May 2023.

[2]. O.I. Mudasiru, A. M. Ilupeju, A. B. Aliyu. "Development of a dual-face SMSbased led notice board with an inbuilt GSM feedback and inverter power backup system," International Journal of Novel Research and Development (IJNRD). Vol. 8, Issue 3, pp 285-295, March 2023.

[3]. A. Arun , R. Kishan, K.P. Biplab, K.Vishaka. "GSM Based Smart Digital Wireless Electronic Notice Board," Journal of Information Technology and Digital World. Vol. 4 Issue 3, Sept. 2022.

[4]. S. Mariammal, A. Sapna, and K. Rajkumar. "Digital notice board. *AIP Conf.Proc.*Vol.2444,Issue1,March2022.https://doi.org/10.1063/5.0078342

[5]. K. Dileep, T. Gopichand, V. Jaswanth, V. Jayanthkumardr, and P. Sekhar-Babu. "Electronic Display Board for College," ZKG International, Vol. VIII Issue I, pp 1600-1606, June 2023.

[6]. I. Z. Yahaya, I. O. Madiu , M. W. Ibrahim. "Design and Construction of a Modified SMS-Based Electronic Notice Board," Path of Science. Vol. 9. No 4, 2023

[7]. B. Sunil Manikanta Kumar, G. Chitti Kalyan and Ch. Rama Krishna. "LED Advertising Board based on IoT for E-Circular Notification for Students through Wi-Fi," International Journal for Recent Development in Science & Technology. Vol. 07, Issue 02, pp. 172-178, May 2023.

[8]. P.R. Kuraganti, V. V. Muppalla, K. M. Busiraju, S. Velagaturi, U. Chirumamilla. "Design and implementation of novel smart notice board through GSM and p10 led," International Journal for Advanced Research in Science and Technology. Vol. 13, Issue 03, pp. 142-147, May 2023

[9]. K.D.Todkari, A.D.Tawale, R.N.Pawar and S.S. Chorage. "GSM Based Wireless E-Notice Board," International Research Journal of Modernization in Engineering Technology and Science. Vol. 05 Issue 03, pp. 4375-4379, March 2023.

[10]. M. O. Ibrahim, I. A. Mojeeb, A. A. Bello. "Development of a Dual-Face SMS Based LED Notice Board with an Inbuilt GSM Feedback and Inverter Power Backup System," International Journal of Novel Research and Development (IJNRD). Vol. 8, Issue 3, pp. 285-295, March 2023.