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# Development of IOT Based Digital Display Board for Students' Lectures Update

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

Technology is generally improving the advertisement sector and the use of electronic medium in communication system is on geometric rise due to its flexibility, attractiveness, speed and efficiency. Various methods of information dissemination have been adopted from the use of posters, traditional billboards to electronic billboards. This work presents the development of an IOT (Internet of Things) based display board for Engineering Students in Federal Polytechnic Ile Oluji, Ondo State, Nigeria for lecture update using wireless communication channel (wi-fi); this provides ease and comfort of updating the content from remote location in the wireless network range. The command is sent to the digital display board through the Mobile Application interfaced with the wireless module to give regular update and seamless communication with students.
The digital board basically contains a digital display module, a 5volts DC power pack, a wi-fi card, Microcontroller and Light Emitting Diodes. The administrator sends out message through the mobile led art light application to keep students updated on their lecture information. The text is received through the wireless module connected to the application and transferred to the microcontroller which decodes the message for users. The decoded message will automatically switch ON and OFF appropriate LEDs in order to display respective message sent which scrolls on the display. The display board can accept texts in different modes and styles as provided in the mobile application. The display board is useful in academic environment to regularly update students on lectures and other relevant information.

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## 1. INTRODUCTION

Digital technology has experienced phenomenal growth in the last few years, displaying of information is a way of disseminating information mainly for awareness, advertisements, promotions etc. Digital boards have now taken the center stage in the world of advertisements and promotions because it creates awareness and serves as catalyst for sales.

Wireless communication has become more popular in the digital world today. Man wants to make virtually everything automated, thus remote control of appliances is possible through embedded systems. An embedded system is a combination of hardware and software to perform specialized functions. Display board is a primary device in any institution, or organization such as bus stations, schools, hospitals, railway stations and parks used to display any information to customers and clients [1].

Information dissemination has experienced great transformation in the past decade arising from the static billboard and the mechanical advertising board, this industry has taken another step into the digital advertising. These digital advertising equipment has turned the old-fashioned advertising industry into a fast growing industry. These technologies however, are consuming a great amount of energy due to the requirement of auxiliary components such as computer, wireless, communication unit and cooling equipment. Also, proliferation of the digital advertising will incur recyclability issues. [2]. This development has proffer solution by the use of smart and cost effective standalone component for information dissemination.

## 2. LITERATURE REVIEW

Raymond, Lim and Wong [2] worked on developing a low-cost and low-power consumption flipping advertisement board, the design of the electrical circuit and the controller of the advertisement board was presented. A microcontroller, a Darlington Pair driver and a unipolar stepper motor were used to operate the electrical flipping advertisement board. The designed hardware was tested and it is capable of displaying multiple advertisements in a panel but the information stored on it cannot be changed easily and this might delay its operations.

Ahmad, Ali, Karim and Sultana [3] developed a display element in an embedded system which consume the major portion of the total power required to run the whole system. When large amount of display element is used, power dissipation issue becomes more acute. An FPGA based embedded system implementing scanning technique for low power message display was proposed. The FPGA based intelligent controller scans all the display element continuously at a certain speed to ensure only one display unit is "ON" and others are "OFF" at a given time but human eye cannot detect it due to speedy scanning of the controller. The FPGA based embedded system for "Muslim Calendar" containing date, time and prayer times for five salat was developed using 30 seven segment display units but it has a lower processing speed, lower physical security and high rate of power consumption.

Gai, Gao and Yang [4] designed a solar energy billboard that can stand typhoon, the display screen or display board will be rolled up automatically when the wind becomes strong. The display screen or display board is controlled by electric motor powered by solar energy, there is a three cups style wind sensor that detect wind speed in it. The detected signal is sent to single chip microcomputer MSP430 SCM made by the national semiconductor, when the detected wind speed exceeds the settings threshold, the microcontroller will send signal to motor to roll up the display screen, so there will be hardly any wind pressure on the billboard, so that it can stand firmly in whatever strong wind without being destroyed. The working power of this control system is supplied by solar energy collecting system mounted under the billboards. The billboard is both simple and elegant, it is cost effective but it affects the natural landscape of the city [5-10].

Akintola, Owadayo and Osuolale [1] also developed a digital billboard which can be controlled and operated by GSM titled " A Mobile System for Information Dissemination via GSM-Technologies Microcontroller in Technologies", their design is energy saving and time saving, GSM takes full control of the system and it is environmental friendly. However, their research lacks security and the text is not simple to modify [11-21].

## 3. METHODOLOGY

### 3.1 Equipment Used

**Fig. 1. Wi-Fi Card**

The wi-fi card acts as both a receiver and transmitter. It receives the wireless signal and communicates with the wireless network.

**Fig. 3. PNP Transistor**

The transistor in which one n-type material is doped with two p-type materials such type of transistor. It is a current controller device. The PNP transistor turns ON when a small current flows through the base.

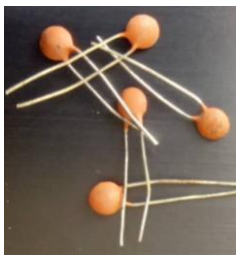

**Fig. 5. Capacitor**

Capacitor is a device that stores electrical energy in an electrical field. It is a passive electronic component with two terminals. The effect of a capacitor is known as capacitance.


**Fig. 2. Digital Display Module**

Digital display module is a digital output device for presentation of information in a visual or tactile form. When the input information is supplied it will display it. Voltage Input: DC 5V, Brightness: 3500-4500nits, 1W Pixel configuration.

**Fig. 4. Transistor**

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit.

**Fig. 6. Shift register**

Shift register are digital memory circuitry basically used to store and transfer data. It is designed to allow the bits of its content to be moved to left or right.

**Fig. 7. Crystal capacitor**

A Crystal capacitor is an electronic oscillator circuit that uses the mechanical resonance of a vibration crystal of piezoelectric material to create an electrical signal with a precise frequency.

**Fig. 9. Dotted vero board**

A dotted vero board is a brand of strip board, a pre-formed circuit board material of copper strips on an insulating bonded paper board.

**Fig. 8. LED**

A LED is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons.

## 3.2 Design

Basically, the system is embedded; comprising the integration of hardware and software. The logical communication between the hardware component requires a firmware/software control that enables the message sent through the mobile application to be processed by the embedded system (which comprises of data cable, a wifi card and Shift register 74LS164) and then to the display board where the text can be displayed as a scrolling text. The Input Unit is comprised of the wifi card and data cable which the text is emanated. The text is sent via the app after the source is connected with the board's wifi which are then sent or driven by the embedded system, the embedded system (microcontroller). The texts are then displayed on an LED dot matrix 56x8 of the display board as a scrolling text. The Main Controller Unit senses arrival of new message, sends the message to the memory unit provided the message is recognized in the set format, and then drives the display unit. Fig. 10 comprises of the circuit diagram which explain the construction of the billboard, also the flowchart in Fig. 12 explain the movement of information between all unit.

The display is a LED dot matrix display whose addressing and multiplexing method in controlling the OFF and ON of the LEDs is at given instants. The units consist of 56 row and 8 column. A single character is 56x8 Blue LEDs dot matrix. All the LEDs on the same row are connected to have a common anode while all the LEDs on the same column are connected to be the same or common cathode. The LEDs light were arranged 56 by 8 on a dotted vero board.

The power stage comprises of a 16MHz crystal capacitor, 22pF capacitor, PNP transistor, NPN transistor and 7805 regulator. The step down reduced the alternative current to desire 6v using centre tap transformer, it then pass through the bridge rectifier as shown in Fig 10, 1000uF/50volt capacitor was used for smoothing an unwanted AC.

Regulator 7805 was used to produce stable 5v for Atmega328p microcontroller to work perfectly.

Also 100nF capacitor was used for stability and LED was used as indicator and resist by 220ohms resistor. A circuit diagram of the power stage and the digital display board is displayed in Fig. 10 and Fig. 11 respectively; the flow diagram in Fig. 12.

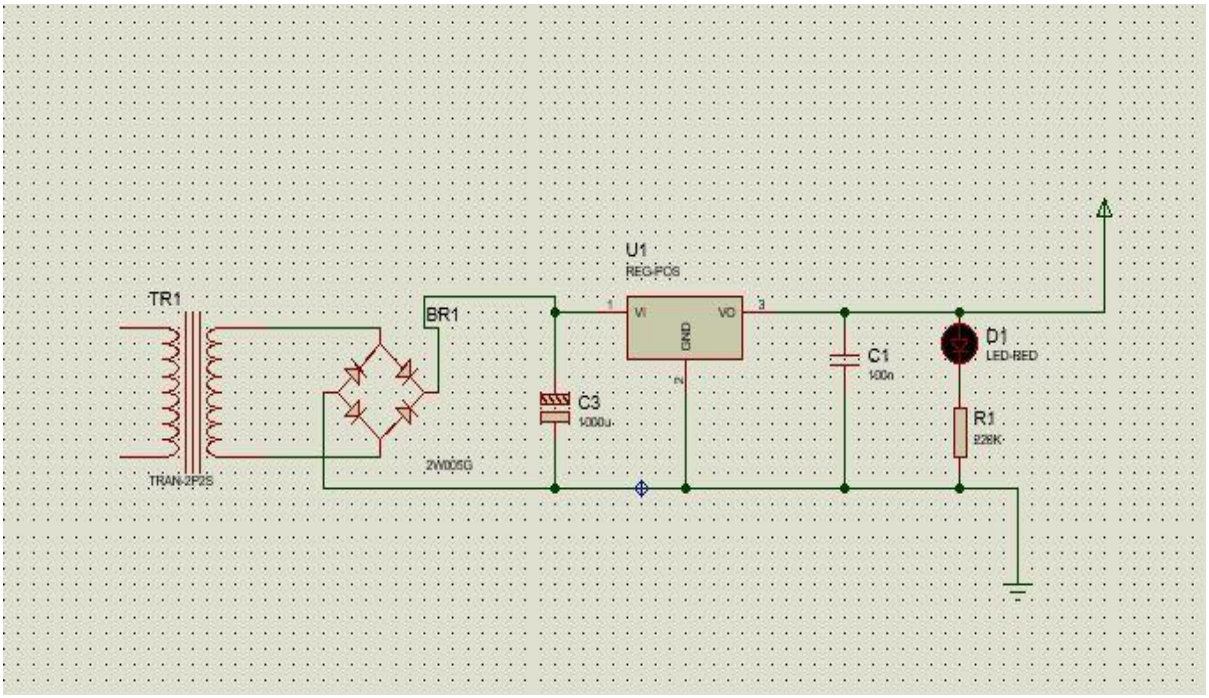


**Fig. 10. Circuit diagram of the power stage using Proteus**

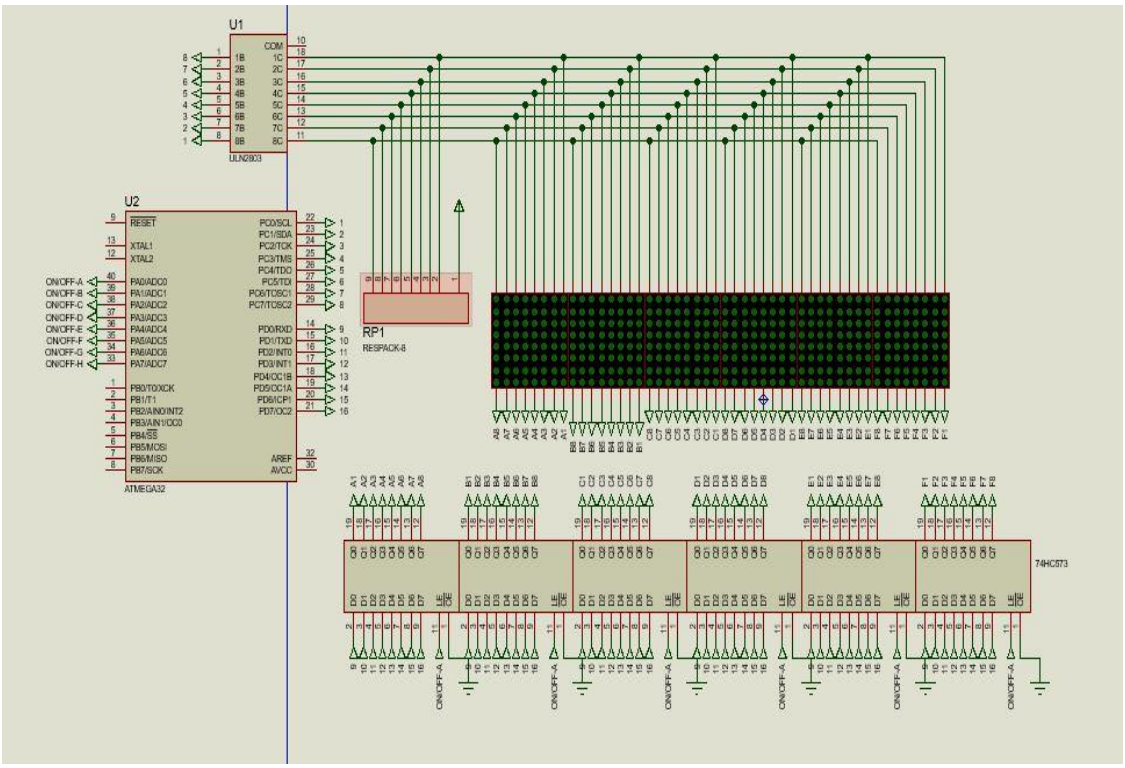


**Fig. 11. Circuit diagram of the billboard using Proteus**

### 3.3 Operation Flow Diagram

The system operation flow diagram is displayed below;

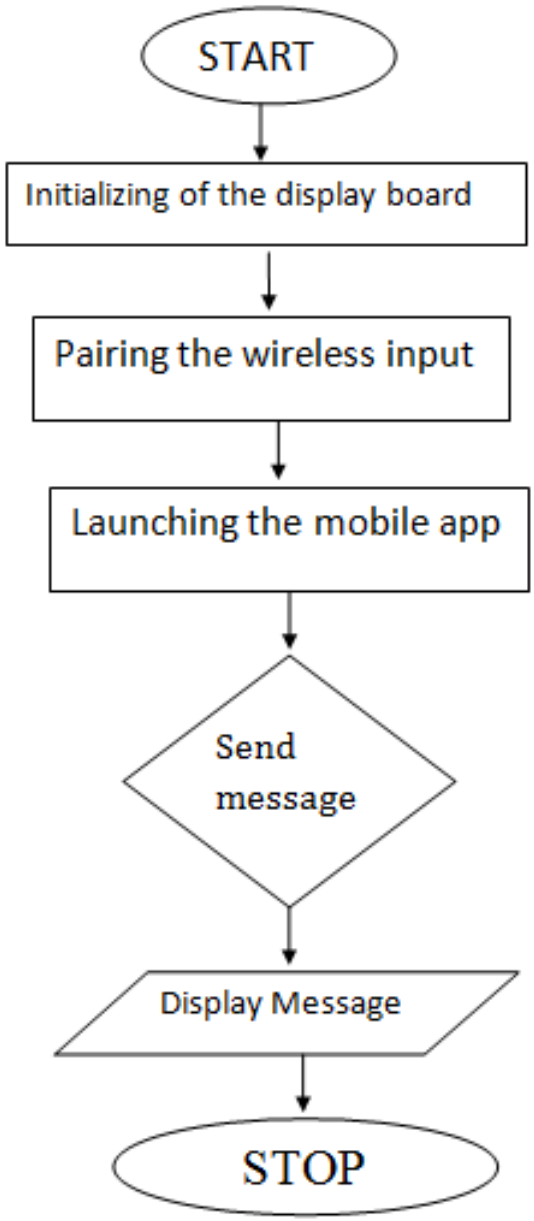


**Fig. 12. Flow chart**

## 4. RESULTS AND DISCUSSION

### 4.1 Performance Test

The entire performance test carried out on the digital display to show that the system is performing desired result and it justifies the aim and objectives of the work.

In preparation for the final execution, a picture of the final view of the display board is displayed in Fig. 13, after the digital display is pluged in and connected to the to a phone wirelessly, a text will be sent to the billboard through application as input as shown in Fig. 14 after reading and processing it for some time it will display it on the board as shown in Fig. 15.

**Fig. 13. Digital display board first view**

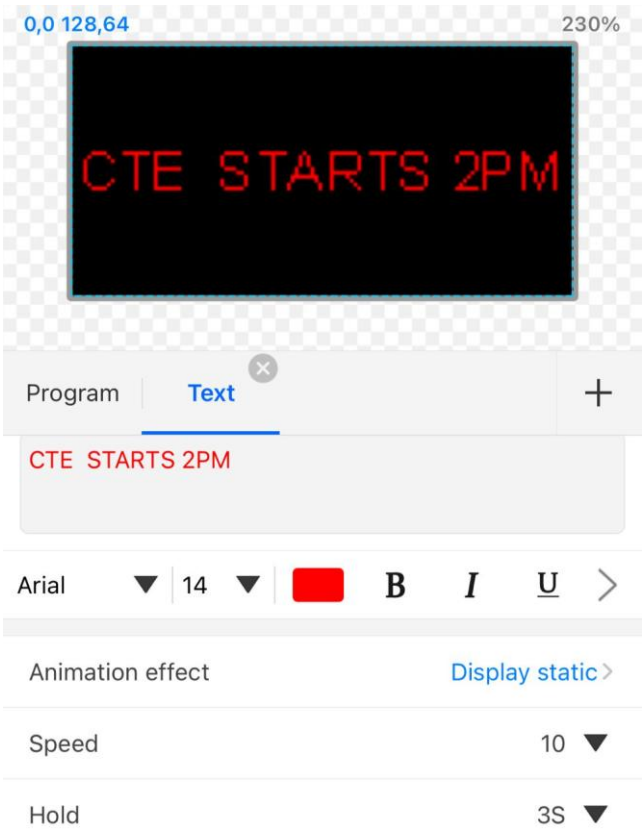


**Fig. 14. SMS input to the digital display**

**Fig. 15. Output on the display board**

### 4.2 Using Software

The codes were written using C-programming, and implemented, the code was to first extract the information sent to the app, process the information and accept the information in pre-sent format and display the received text as a scrolling text.

While testing the working principle of the display board, a text was sent to the board, the microcontroller was able to extract and process the text from the mobile app and display it as a scrolling text for students.

### 4.3 Contribution to Knowledge

The system is aimed towards an effective means of information dissemination. Other positive impact of the system includes:

i. It is efficient in passing information to Students
ii. Information can be sent or stored on it regardless of the distance.
iii. Information can be easily conveyed without stress s
iv. It helps students to be updated about Lecture schedules.

## 5. CONCLUSION AND RECOMMENDA-TION

### 5.1 Conclusion

The zeal to make information dissemination as regard lectures easier and effective to students was accomplished. Since technology has taken over all section therefore there is need to invent a more advance way of disseminating information which will make it more effective, user friendly and time saving.

This digital display was able to receive text, and display the message as a scrolling text for students. The new design is expected to benefit targeted audience due to brighter led which enables an easy dissemination of information, the text will be display as a scrolling text for the targeted students. The new system is also expected to benefit the sender due to the fact that information can be sent remotely from any distance/location in as much as the sender is connected to the board's wifi network.

### 5.2 Recommendations

For further research work to be carried out on this work, the following suggestions are recommended:

i. Inclusion of the display of environmental temperature, the current time of the day and any other information as may be needed in the environment where it is intended for installation.
ii. Personalized messaging can be incorporated; this will make the digital board to be smart by displaying information to only intended receiver.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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