

Original Research Article

DEVELOPMENT OF IOT BASED DIGITAL DISPLAY BOARD FOR STUDENTS' INFORMATION

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 project present the development of an IOT (Internet of Things) based display board for students' information using a wireless connection to enable ease and comfort of the administrator who determines the content of the display from location in the wireless network range. The input interface is from a mobile application which is linked to the digital board wirelessly to control the digital display board.

The digital board basically contains a digital display module, a 5volts power pack, a wi-fi card, Microcontroller and Light Emitting Diodes. The administrator sends out message through the mobile led art light application for students. The text will be received through the wireless connected application and will be transferred to the microcontroller which decodes the message. The decoded message will automatically switch ON and OFF appropriate LEDs in order to display the SMS received as a scrolling text on the screen of digital display. The billboard can accept texts in different modes and styles as provided in the application for clarity. The billboard is useful in academic environment and industrial areas where information is necessary.

Keywords: IOT, Microcontroller, Light Emitting Diode,

1.1 INTRODUCTION

Digital technology have 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 centre 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. This remote control of appliances is possible through an Embedded Systems. An embedded system is a combination of hardware and software to perform a specialized functions. The value of timely information is quite enormous Notice Board is a primary device in any institution, organization or public utility places like bus stations, railway stations and parks to display any text information. (Akintola, Owadayo and Osuolale, 2019).

Information dissemination has experienced a great transformation in the past decade. From the static billboard and the mechanical advertising board, this industry has taken another step into the digital advertising. These digital outdoor advertising has turned the old-fashioned outdoor 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. (Raymond, Lim & Wong, 2014).

2.1 LITERATURE REVIEW

Raymond, Lim and Wong (2014) works 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 design's 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 a times.

Ahmad, Ali, Karim and Sultana (2011) developed a displayed elements in an embedded system usually consume the major portion of the total power required to run the whole system. When large amount of display element are used, power dissipation issue becomes more acute. An FPGA based embedded system implementing scanning technique for low power message display is proposed in this paper. The FPGA based intelligent

controller scan all the display element continuously at a certain speed to ensure only one display unit is "NO" 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, Du, Gao and Yang (2013) design 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 these control system is supplied by solar energy collecting system mounted under the billboards. The billboard is both simple and elegant, it's money-saving but it affect the natural landscape of the city.

Akintola, Owadayo and Osulale (2019) 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 it's text are very hard to change.

METHODOLOGY

3.1 Equipment Used

A. Wi-Fi Card

A Wi-Fi card connects to your laptop either in your USB (Universal Serial Bus) port or a wider card slot. This card generally is geared to a particular wi-fi network, so to use it you must be in range of a wireless internet signal dedicated to that network. In this way, the wi-fi card acts as both a receiver and transmitter. It receives the wireless signal and communicates with the wireless network, enabling you to access the web with you laptop. The image has been displayed in Fig 3.1

Features of WIFI CARD

- i. High capacity and load balancing
- ii. Scalability
- iii. Network management system
- iv. Role based access controls
- v. Network access control



Fig 1 wifi card

B. 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. The image has been displayed in Fig 3.2. Features of digital display module includes high viewing angle, High contrast ratio, IP65 Waterproof, Voltage Input: DC 5V, Brightness :3500-4500nits, 1W Pixel configuration



Fig 2: Digital Display Module

C. 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 small amount of base current controller both the emitter and collector current. The PNP transistor has two crystal diodes connected back to back. The left side of the diode is known as the emitter-base-diode and the right side of the diode is known as the collector-base diode.

The hole is the majority carriers of the PNP transistors which constitute the current in it. The current inside the transistor is constituted because of the changing position of holes and in the leads of the transistor it is because of the flow of the electrons. The PNP transistor turns on when a small current flows through the base. The direction of current in PNP transistor is from the emitter to collector. Fig 3.3 display the image of the PNP Transistor.



Fig 3. PNP Transistor

D. 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. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. The output power can be higher than the input power, a transistor can amplify a signal. The image was displayed in Fig 3.4. Features of a transistor includes: High voltage, High current, Good switching characteristics, High driving power



Fig 4: Transistor

E. 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. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. The image was displayed in Fig 3.5

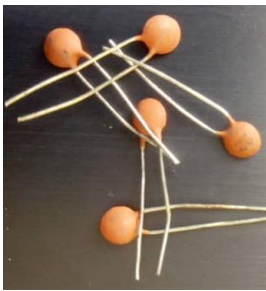


Fig 5: 22pf Capacitor

F. Shift Register

Shift register are digital memory circuitry found in devices such as calculators, computers, and data processing systems. They are basically used to store and transfer data. It is designed to allow the bits of its content to be moved to left or right. More generally, a shift register may be multidimensional, such that its "data in " and stage outputs are themselves bit arrays; this is implemented simply by running several shift registers of the same bit-length in parallel. Shift registers can have both parallel and serial inputs and outputs. Fig 3.6 displays the image of the shift register.



Fig 6 Shift register

G. 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. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. Fig 3.7 displayed the image of the crystal capacitor.



Fig 7 Crystal capacitor

H. 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. A LED is an electric light for use in light fixtures that produces light using one or more light-emitting diodes (LEDs). LED light/lamps have a lifespan many times longer than equivalent incandescent lamp and are significantly more efficient than most fluorescent lamp/light. Fig 3.8 displayed the image of the LED.



Fig8: LED

I. 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 which was originated and developed in the early 1960s by the Electronics Department of Vero Precision Engineering Ltd (VPE). It was introduced as a general-purpose material for use in construction electronic circuits differing from purpose-designed printed circuit boards (PCBs) in that a variety of electronics circuits may be constructed using a standard wiring board. Fig 3.9 display the image of the dotted vero board



Fig 9: Dotted Vero board

3.2 DESIGN

Basically, the system is comprised of integration of hardware and software. The logical communication between the hardware components requires a firmware/software control that enables the message sent through the app 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 3.2 comprises of the circuit diagram which explain the construction of the billboard, also the flowchat in Fig 3.1 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. Fig 3.10 and fig 3.11 comprises of the picture of both LEDs Light and dotted vero board respectively. The block diagram in Fig 3.1 explain the operation of all unit of the billboard.

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 3.10, 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 3.10 and Fig 3.11 respectively; the flow diagram in Fig. 3.12.

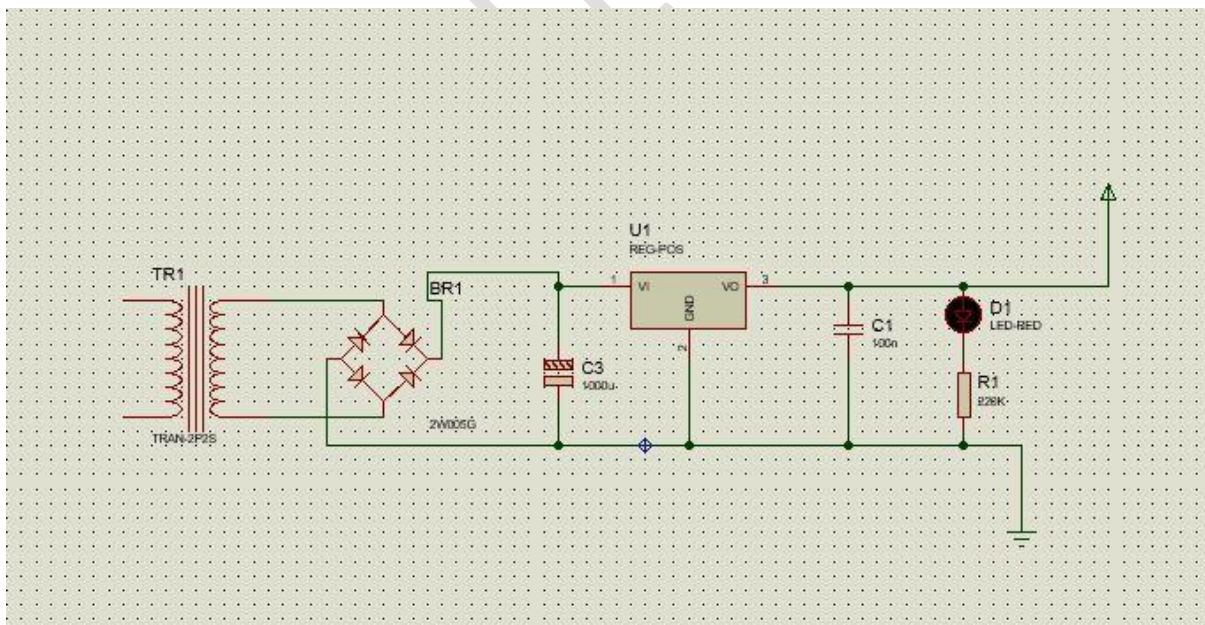


Fig 10: Circuit diagram of the power stage using Proteus

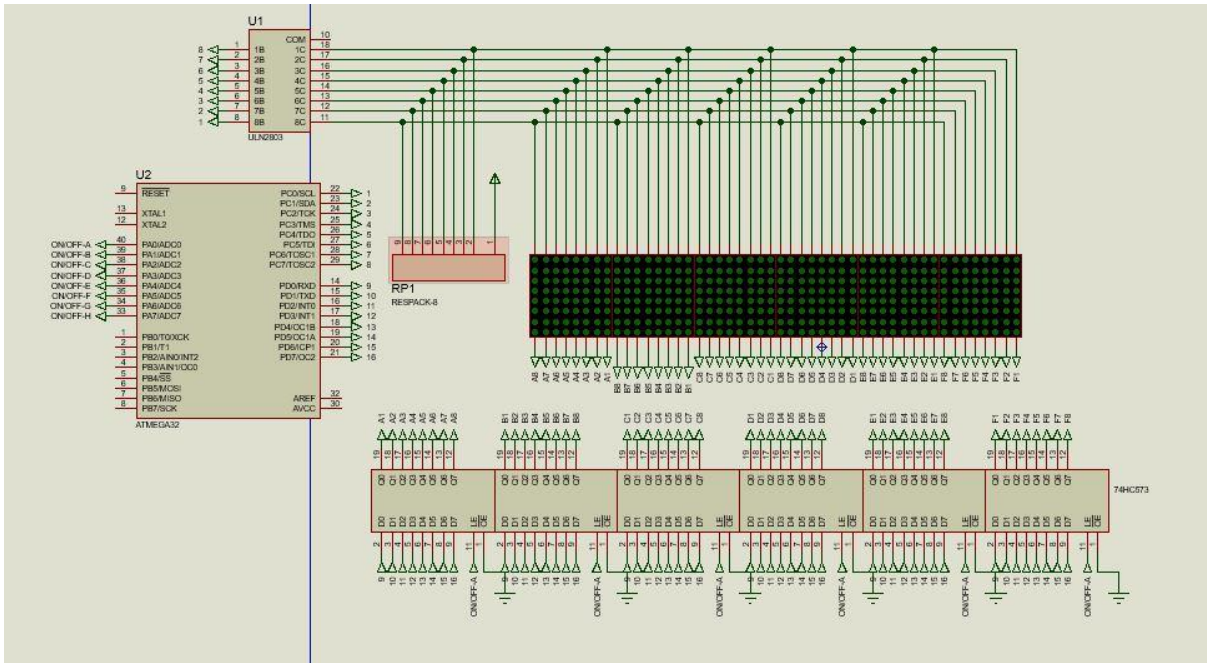


Fig 11: Circuit diagram of the billboard using Proteus

3.3 Operation Flow Diagram

Chart 1 : The system operation flow diagram is displayed below;

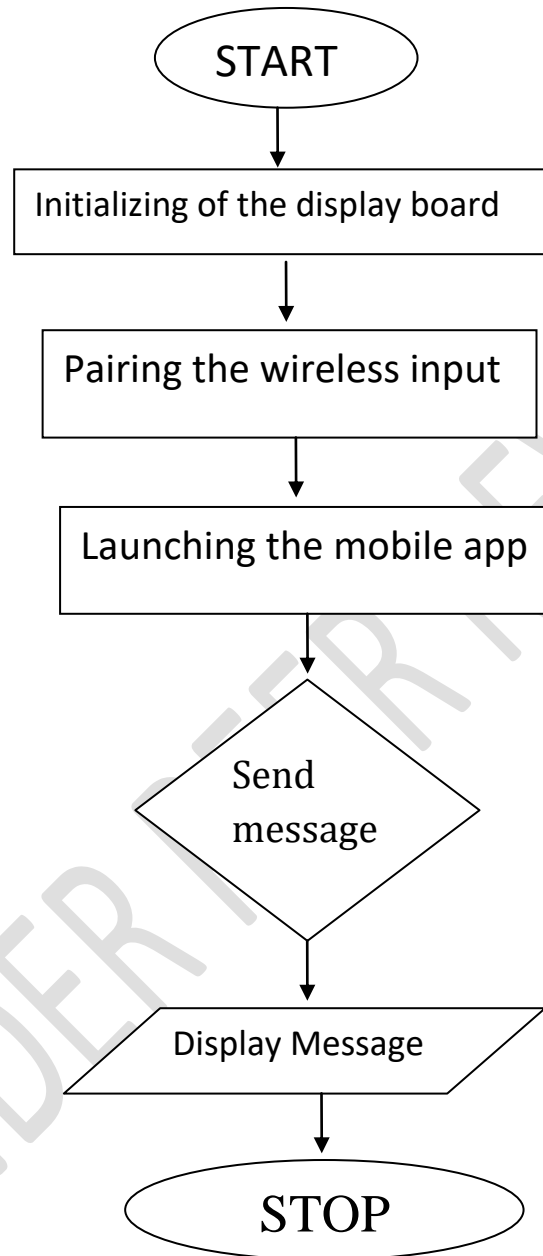


Fig. 3.12: Flow Chart

4. RESULT AND DISCUSSIONS

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 project.

In preparation for the final execution of the project, a picture of the final view of the display board is displayed in Fig. 4.1, after the digital display is plugged in and as been connected to the to a phone a text will be sent to the billboard through sms input as shown in fig 4.2 after reading and processing it for some time it will display it on the board as shown in fig 4.3.



Fig 12 Project first view

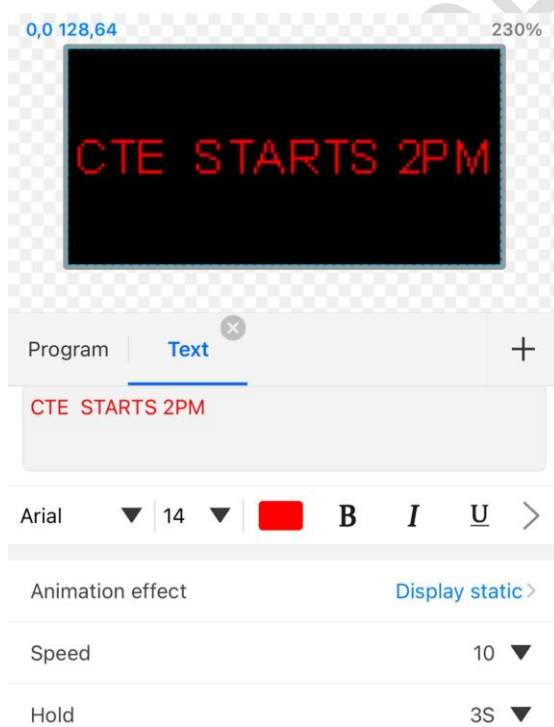


Fig 4.2 SMS input to the Digital Display



Fig.13: SMS output on the billboard

4.2 Result and Discussions

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 present format and display the received text as a scrolling text.

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

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 help students to be updated

CONCLUSION AND RECOMMENDATION

5.1 Summary

The zeal to make information dissemination easier and effective to students has to this great project. Since technology has taken over all section therefore there's a 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 the targeted audience. The new design is expected to benefit targeted audience due to its fastness and brighter led which enables an easy dissemination of information, the text will be displayed as a scrolling text for the targeted audience. The new system is also expected to benefit sender of information due to the fact that information can be inputted into the billboard from any distance/location in as much as the sender is connected to the billboard's wifi.

5.2 Recommendations

For further research work to be carried out on this project, 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. Voice recognition techniques can be incorporated as a means of verifying callers since mobile service providers are fond of placing some unsolicited promotional calls through to their customers, hence, a verification mode similar to the pre-set codes used in the elimination of the network providers' messages in this work can be adopted as improvement.

iii. **COMPETING INTERESTS DISCLAIMER:**

iv.

- v. Authors have declared that no competing interests exist. 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.

REFERENCES

Abalos M. A., Beldad R. R., Deximo P. M., Gruta D. J. and Kristoffer L. C. (2014). Wind Sensitive Auto-controlled Poster Billboard. *Countryside Development Research Journal*, 2(01), 61-68, 2014.

Ahmad S.M. T., Ali Md. L., Karim M. B. and Sultana T. (2011). Development of an FPGA based low power system for displaying muslim prayer time. *Institute of Information and Communication Technology* 4(2), 3201-3206.

- Akintola G.K., Owadayo, I.O., & Osuolale, A.F. (2019). A Mobile System for Information Dissemination via GSM-Microcontroller Technologies. *Global Scientific Journal*, 5(2), 2320-9186.
- Chen L. (2011). Shallow Analysis of Simple LED Electronic Billboards Design. *The Guide of Science & Education* 5,2011.
- Chen C., Hoa G. and Qian L. A bridge crane anticollision system based on STC MCU [J]. (2010). *Information Technology* 10, 2010.
- Gai Z., Du Y., Gao S., & Yang D. (2013). Design of Solar Energy Billboards that can Stand Typhoon. *Journal of Applied Sciences*, 13(16), 3196 -3202.
- Gidion J. and Zyl V. (2012). Display screen system and components thereof. *US Patent App.* 13/100,616,2012.
- Jebisha N., Shiny J. J. and Jasmine S. (2017). E-Mail based Notice Board Using Raspberry-Pi. *I-Manager's Journal on wireless Communication Network* 6 (3), 1, 2017.
- Jin C., Yuan P. W., Yao M. L., Li C. L, Jing l., Duan W. & Tong Z. (2012). Design of Intelligent Control Billboards Based on MCU. *Applied Mechanics and Materials* 229,2205-2208,2012.
- Judi D., Darrel W. P. and Eric S. (2005). Creating innovative curricula: Developing new programs with new paradigms. *International Journal of Engineering Education* 21 (2), 233-238, 2005.
- Kimura T. and Kakehi Y. (2014). MOSS-xels: slow changing pixels using the shape of racomitrium canescens. *ACM SIGGRAPH 2014 Posters*, 1-1, 2014.
- Li C., Wang Y. and Zhang J. (1999). Research on Cylindrical Threeturn Advertising Machine. *Journal of Shandong Institute of Building Materials* 2,1999.
- Liu J., Wang X., Feng H. and Wang C. (2009). Tower Garage Control System Design Based on the Mitsubishi PLC. *Computer Engineering of China*, S4, 2009.
- Lukasik K. and Puto A. (2016). Internet Of Things (Iot) In A Retail Environment. The New Strategy For Firm's Development. *2nd PAN-AMERICAN INTERDISCIPLINARY CONFERENCE, PIC 2016 24-26 February, Buenos Aires Argentina*, 345, 2016.

- Raymond Y. K.W., Lim P. Y. and Wong F. (2014). Design and Development of an Innovative Advertisement Display with Flipping Mechanism. *International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering* Vol;8, 4, 2014.
- Rerkratn A. and Kaewpoonsuk A. (2017). Real-time fault notification for billboard lighting system. *Proceedings of the 3rd International Conference on Communication and Information Processing*, 495-498, 2017.
- Wally B., Ferscha A. and Lenger M. (2009). Presence Sensing Billboard. *Pervasive Advertising*, 112, 2009.
- Wu A., Jog J., Mendenhall S. and Mazalek A. (2011). A framework interweaving tangible objects, surfaces and spaces. *International Conference on Human-Computer Interaction*, 148, 2011.
- Xiang L. J. H. (2010). Design of sound impulse generator based on single-chip microcontroller. *Applied Acoustics* 4, 2010.
- Yuan H. (2011). Development of Billboard Control System Based on PIC16F73. *Automation & Instrumentation*, 2011-07.
- Yu B., Li W. and Wu Z. (2012). Design of a kind of IC Tester with Speech Function [J]. *Journal of Sichuan College of Education* 11, 2012.