



IMPLEMENTATION OF AN SMS AND VOICE-CONTROLLED ELECTRONIC BILLBOARD

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ABSTRACT

The use of electronic medium in communication system is on geometric rise due to its flexibility, attractiveness, speed and efficiency. Various modes have been adapted in the transformation from the use of traditional billboards to electronic billboards in information dissemination. These modes include colour coated glass paper display, reflective mode display method, on-board editing of the content of an electronic billboards etc. with complicated problem of modifying the displayed content. This paper presents an implemented short message service (SMS) Controlled Electronic Billboard with Audio Output to enable ease and comfort of the administrator who determines the content of the billboard from any location. The input can be from a mobile phone or a web-based SMS application, provided the source is linked to a service provider. The billboard basically contains a microcontroller unit (AT89S52), a Subscriber Identity Module (SIM) modem and a matrix of Light Emitting Diodes (LEDs). The input to the display comprises a SIM900 Global System for Mobile communication (GSM) modem that takes care of the SMS and voice call reception for broadcasting any voice call placed on the SIM to the target audience. The text is received by the SIM modem and is transferred to the microcontroller which decodes the message using a set of rules. The decoded message is then used to automatically switch ON and OFF appropriate LEDs in order to display the character received as SMS on the screen of the billboard. Also, Voice call functionality has been incorporated to enable it receive calls and broadcast the audio message with a reasonable sound level to the target audience. It was designed, constructed, tested and found to meet the design specifications.

Keywords: Electronic billboard, microcontroller unit, SMS, SIM, LEDs.

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INTRODUCTION

Display of information is a way of disseminating information mainly for awareness, advertisements, promotions etc. It can be seen as a form of cardboard or tarpaulin at stores or shops, or in form of electronic displays, which have now taken the centre stage especially in the world of advertisements and promotions. As seen in offices, banks, restaurants, shops, airports, bus and railway stations, highways and other private and public places, electronic display of messages plays a central role in easing communication to target audience. The development of information display via electronic based system has covered numerous technologies since its invention. Cathode ray tubes, Liquid Crystal Displays (LCDs), Nixie Tube Displays (NTD) and Light Emitting Diodes (LEDs) have all played an important role in the evolution of electronic display systems [1].

The wide use of global system of mobile communication (GSM) and Web-based SMS application has cut across virtually, if not almost every part of the world. The international roaming of the GSM and its high frequency (850-1900 MHz) has made the use of mobile phone and web-based SMS technology of great importance in various facets of applications. Having explored the various means, by which an efficient, friendly, easy and reliable electronic billboard can be controlled, an SMS based control is being explored and adopted worldwide due to its application in electronic device switching as presented in Dogo *et al.* [2] and for display purposes as presented in these works [2-5] and

some other works [6-12]. The application of SMS for various electronic alert/command control is increasing day by day as it is also being used in many data centre applications including flight queries, railway enquiries, news alert, mobile banking, health care applications, activate/deactivate different kind of services, control of security services, advertisements and much more. Today, text messaging is the most widely used mobile data service [5] despite the advent of the widely used internet based Instant Messaging (IM).

Electronic display devices are mostly controlled by microcontrollers and utilize semiconductors such as LEDs now commonly adopted in new designs. The development of LEDs in mid 1990s with high efficiency, intensity, brightness, low heat emission and power consumption; and long life span gave birth to the increased patronage in various applications [13] as compared to incandescent lamps. A LED emit very little heat and saves a lot of energy, about 98% of the energy used by a traditional incandescent light can be lost as heat energy instead of light energy [1].

In the design of LED display, control system based on Advanced Reduced instruction set computing (RISC) Machines (ARM) and Field Programmable Gate Arrays (FPGA) are utilised. According to the system, a module structure characteristic of Red, Green and Blue (RGB) three colours LED display and the LED display through dynamic scanning display [14] is adopted. This paper is focused on developing a LED display electronics billboard capable of receiving a Short Message Service (SMS) from a mobile phone and/or web-based SMS application source with a designated

access from anywhere, provided there is availability of Mobile Service Network (MSN) or Internet Service Provider (ISP), and display the message as a scrolling text on a 5×7 dot matrix display. Dot matrix LED display technique was adopted with an embedded circuit where an AT89S52, recommended for new designs and an 8-bit Main Control Unit (MCU) with 8 KB in-System Programmable Flash is the centre of the processing unit [15]. The data communication between the MCU and mobile phones help the microcontroller in using SMS-related AT commands to control remote switching of home appliances as well as being able to modify the

contents of short message from mobile phone and deleting the short message [16]. Similar approach of using the AT commands has been employed [6] for a developed car security system; Figure 1 shows the basic architecture of the SMS and Voice-Controlled Electronic Billboard.

When a new recognized SMS arrives, the previous message is overwritten and the new message is displayed. Also, this billboard is capable of receiving a voice call and broadcast the audio message with a reasonable sound level to the target audience.

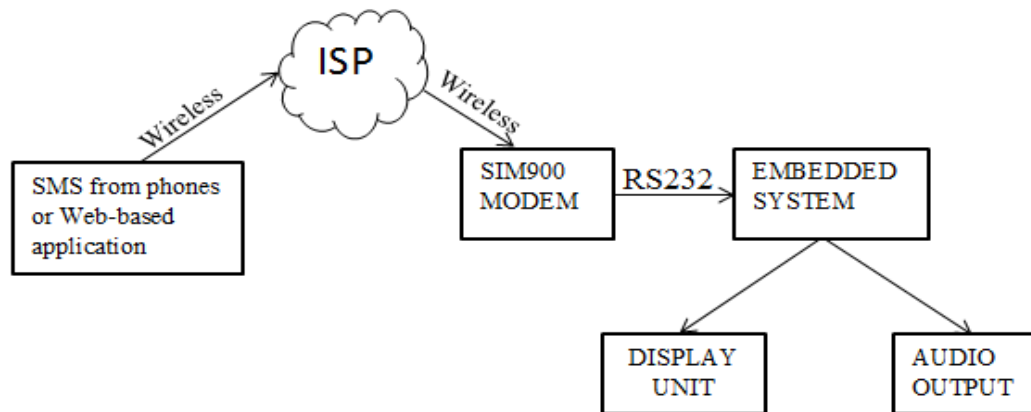


Figure1: Block diagram of SMS and voice-controlled transmission and reception

RELATED WORKS

Various approaches have been explored in the development of electronically controlled notice or billboard which includes Bluetooth control technique, use of android application software and SMS controlled techniques. The SMS controlled technique is adopted in this work with emphasis on improving the convenience of operation and its security. In some cases, mechanical control was implemented [7], here, 8051 series microcontroller was utilised in exploring the principle of Space Multiplexing. While in some other recent designs, the texts are modified through On-Board Editing (OBE) by altering the programme section containing the text to be displayed, thus requiring high technical know-how which most end users may obviously lack. Also, the cable connection between PC and Microcontroller for editing (the OBE) amount to a more complex and costly system whose disadvantages also encapsulate the difficulty in text editing as a result of lack of remote editing and the possibility of data loss in case of power failure during transmission [17].

Gowtham *et al.* [3] designed a real time digital notice board implemented using ATMEGA328P but the design was limited to Bluetooth connection where such messages can only emanate from connected/registered smart phones at close range, hence, causing the problem of conveniently modifying the content from any location and delegating assignment, although with the advantage of enabled monitoring of registered users where an administrator is kept in charge. Similar security levels

were also incorporated which allowed access only for authorised users by means of registered access codes as used earlier [2, 4, 8, 18, 19] in order to eliminate security breach by individuals or unsolicited messages from network providers from being displayed.

A Multiuser SMS based wireless electronic notice board was developed by Jiang [9], again, with restriction of users, just as given by Gupta *et al.* [4], to the use of password and as presented by Kamdar *et al.* [18], with incorporation of a PC for monitoring purposes.

Comprehensive works detailing GSM based designs for electronic board was presented by Saxena and Chaudhari [2], Nivetha *et al* [10] and Kadam *et al.* [20] but are limited only to SMS control with no simple mode of security. A design by Dogo *et al.* [2] incorporates a feedback mechanism from a remote display board to ascertain the display of sent messages by the users, although with no voice output for urgent alert. An improvement was made by Kamdar *et al.* [18] by incorporating a speaker for announcement purpose and also a PC for the sole purpose of viewing and keeping records of incoming messages but that on the other hand increased the complexity and cost greatly though with the advantage of storing sent messages.

An android based wireless notice board was presented by Zahariah *et al.* [11] and Avhad Jyoti *et al.* [21] with obvious limitation to only devices on which the application is installed and availability of internet services which cannot be guaranteed in various locations of the world becomes a major concern. Similar work was

presented in form of a hybrid system [12] where the control is done via the developed android app and the command is executed via SMS.

Electronic billboards have been presented in various designs and are used in so many areas and fields in the present day world. An improvement is therefore sought in this work to provide for ease of operation by improving the security level by adopting a pre-set identifier for acceptable messages rather than users going through the complications of having to register and create access codes or using an application for the modification of texts to be displayed which may further require availability of internet services. Also, a voice call function for emergency announcement has been incorporated for ease of dissemination though to target audience within the range.

MATERIALS AND METHODS

Basically, the system is comprised of integration of hardware and software. The various units of the

hardware and its components are shown in the block diagram of Figure 2a and 2b. The logical communication between the hardware components requires a firmware/software control that enables the SMS sent to the SIM modem to be processed by the embedded system (which comprises the microcontroller AT89S52 decoder, EEPROM memory and oscillating circuits) and then to the display board where short message SMS can be displayed as a scrolling text. The interaction between the end user and the system's architecture has been depicted in Figure 1. The Input Unit is comprised of the mobile phones or web based app from which the SMS/Call is emanated. The texts/call is sent via this unit to a SIM card in the modem which are then sent or driven to by the embedded system. The texts are then displayed on an LED dot matrix of the display unit while the audio output is processed through the amplifier to the speaker.

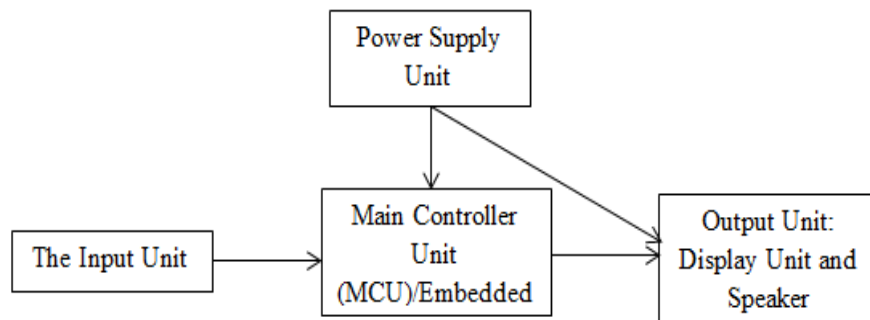


Figure 2a: Block diagram of the hardware units

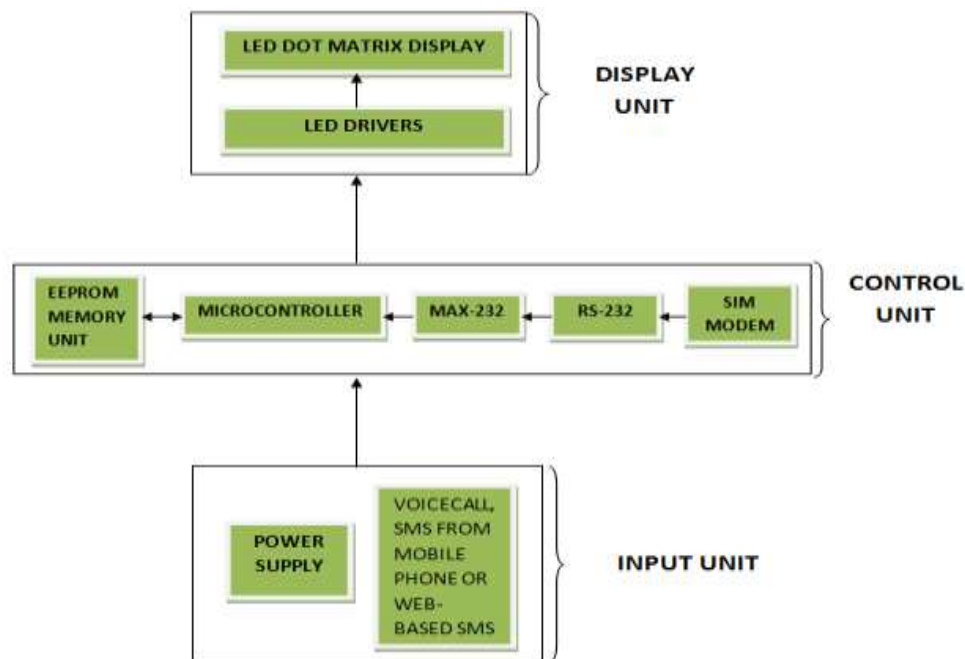


Fig. 2b Block diagram of the hardware design

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. AT 89S52 microcontroller, Source driver (ULN2803), AT24C16B (EEPROM), Shift registers (74HC595) and LEDs Drivers are key components utilised. The Microcontroller programme is written in C and is executed using keil embedded development tool for ARM.

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 one row of 42 characters per row. A single character is of 8x8 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 have the same or common cathode.

The audio unit consists of an amplifying chip [22] interfaced with the audio command port of the SIM modem and a loud speaker. TDA2003 is a cheap audio amplifier that is designed to run on single rail power supplies (unipolar). It provides a high output current capability, output power of about 10 W, very low harmonic and cross-over distortion [22]. The implemented procedural steps for the executorial commands are as summed up in the given developed flowchart given in Figure 3.

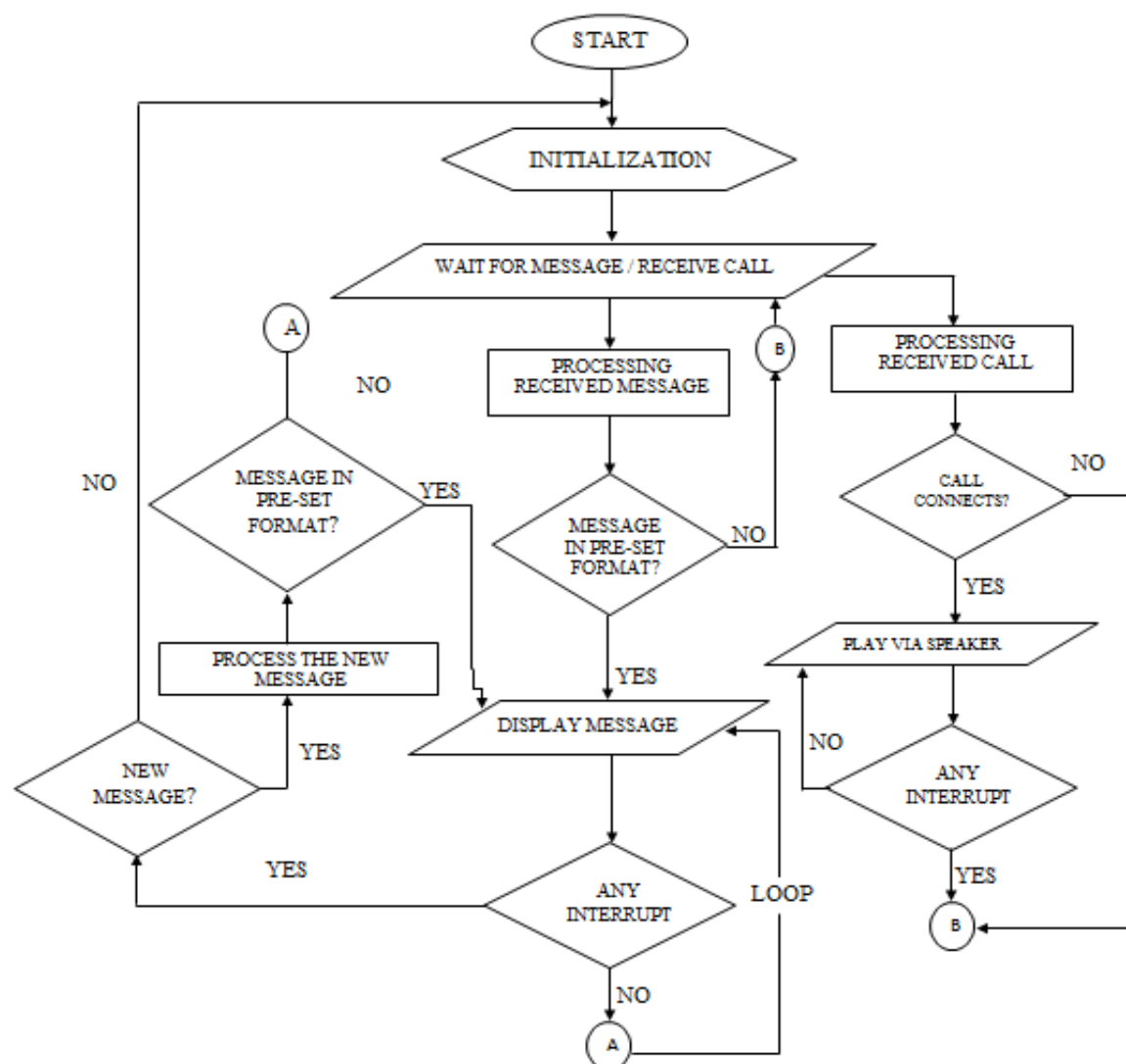


Figure. 3: The developed flowchart for the system

TESTING AND RESULTS

The system implemented is capable of displaying 16 alphanumerical characters at a time and displays content as soon as SMS is received. The number of characters must not exceed 160 per message. The text displayed on the billboard can be changed in two steps:

- Turn ON the power switch and wait for 45 seconds for microcontroller to initialize
- Send a text message to the SIM number using the format “%message#;”

In Table 1, the instruction set for sending SMS to be displayed and the results for the implemented billboard is shown. This helps eliminate unsolicited messages

from Network Providers. Also, any call placed to the number on the SIM is automatically picked after two beeps, and the amplifying circuit amplifies the call and

broadcast the audio message to the target audience. Figure 4 shows the developed prototype.



Figure 4 Developed prototype of the system

Table 1: Test results for the implemented billboard

S/No.	Instruction set	Message displayed
1.	%WELCOME#;	WELCOME
2.	% UNILORIN BETTER BY FAR#;	UNILORIN BETTER BY FAR
3.	% ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT#;	Electrical and Eletronics Engineering department

CONCLUSION AND RECOMMENDATION

Electronic billboards generally are simply fascinating for displaying text messages. However, their cost as well as power consumption and interruption are of great concern as compared to traditional billboards. A system capable of receiving SMS and thus, displays the message as a scrolling text on the system display unit, and as well receives voice call and broadcast it as an audio message in a reasonable sound level has been achieved. Tests were carried out and the displayed outputs are as depicted in Figures 4.

Efforts can be made for the 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. Also, 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.

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