SMS Enabled Display Board using Internet of Things

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Abstract:- SMS-enabled display board technology is a novel communication system that integrates mobile devices with display boards. The system enables users to send messages to the display board using Short Message Service technology. The system comprises two primary components, namely the hardware and software. The hardware component includes the display board, a microcontroller, and a Global System for Mobile Communications module. The software component consists of the firmware that controls the microcontroller and the backend system that manages the received messages and displays them on the board. The technology has several applications such as in public places like shopping malls, railway stations, hospitals and schools where it can display emergency messages and notices.

Keywords:- Microcontroller, GSM Module, Display Board, Short Message Service Technology, Novel Communication System, Mobile Devices, Firmware.

I. INTRODUCTION

In the contemporary landscape, advertising is rapidly shifting towards the digital realm, with major stores, malls, trains, and buses adopting digital displays to convey information such as schedules, ticket details, and more. This transition has familiarized people with the notion of accessing the world's information effortlessly. As a result, effective control and communication have gained prominence globally. This has spurred the concept of utilizing mobile phones to receive messages and showcase them on electronic boards. To realize this concept, Global System for Mobile communication technology is harnessed. GSM, with its international roaming capabilities, enables messages to be sent from any corner of the world, facilitated through its Short Message Service system.

The project centers around the creation of a remote display board utilizing a GSM modem at the receiving end. By sending information through SMS, users can update the display board with their desired messages, offering a practical approach to real-time communication. Engineers strive to simplify life through technological advancements, and this initiative represents a stride towards streamlining real-time notifications.

The prototype of this GSM-based display toolkit seamlessly integrates with a display board, ensuring portability. The toolkit not only accepts incoming SMS but also validates and stores the content, subsequently showcasing it on an LED module. This innovation contributes to the evolution of user-friendly, mobile communication systems.

II. RELATED WORK

This section includes some of the existing system papers and their brief description. In [1], M. Ramchandra et al., proposed a system in which message is send from authorized user to GSM module located on the notice board. In [2], S Gladson et al., designed a digital notice board using microcontroller ATMEGA 328 whereas in [3], the authors used credit card sized Raspberry pi. The other GSM based system [4], was developed using HEX codes and in [5], a scrolling LED Display board is designed using some level shifters and voltage regulators.

C Kalaiarasi et al.,[6] developed IoT based notice board which displays message sent through google assistant application. In [7], the authors designed a toolkit that accepts SMS, then stores and validates it and then displays it in the LED module. Each time when the message is read, it is deleted making room for next SMS. The project [8] is designed using ARM-LPC2148 interfaced with Graphical Display. In [9], The authord developed a system which enables an authorized person to send the messages from any corner where internet facility is available. The message is transferred using wireless technology. The paper [10] gives an overview of system implementation on LCD Screen.

III. SYSTEM ARCHITECTURE

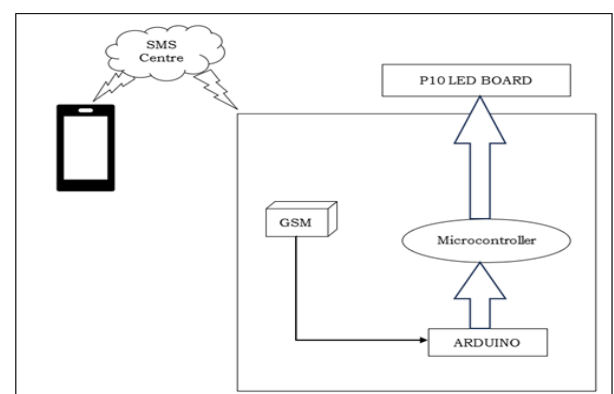➢ *The Architecture of the Proposed System is shown in Fig 1.*

Fig 1 System Architecture

> *Description of the System Architecture:*
The Proposed System is explained in detail below:

- *Mobile:*
The mobile phone plays a key role in this workflow as the source of SMS generator. Through this, any user can send a text message from their mobile phone to a destinated phone number. This destinated phone number is the SIM source for GSM module.

- *SMS Centre:*
The SMS Centre receives the message from the user's mobile device. It acts as a gateway between the mobile network and the receiving device It is responsible for storing, routing, and forwarding SMS messages to their intended recipients. In this case, the recipient is the SMS-enabled display board. It processes the incoming message and forwards it to the system managing the SMS-enabled display board.

- *GSM:*
GSM (Global System for Mobile Communications) technology enables wireless communication between the SMS Center and the Arduino system. A GSM module is connected to the Arduino, allowing communication with it through UART protocol. This protocol is used for serial communication between GSM and Arduino Uno.

- *Arduino:*
Arduino serves as the microcontroller that processes incoming SMS messages and controls the display board. It receives messages from the GSM module (Transmitter) by acting as a receiver, interprets the content, and sends it to LED Display board through SPI protocol. Serial Peripheral Interface Protocol provides communication between P10 LED board and Arduino uno.

- *P10 LED Board:*
P10 LED board is the output display device. It consists of a grid of LED modules that can display text, graphics, and animations. Arduino uses software libraries such as SPI, DMD and TimerOne libraries for creating desired effects. The Arduino sends commands or data to the P10 LED board to control the content displayed on it.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

> *Hardware Requirements*
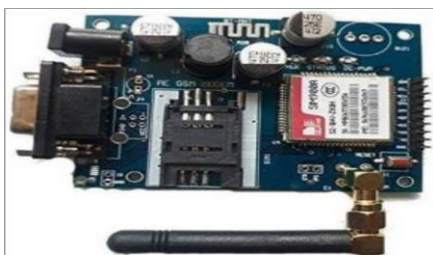
- *SIM 900A GSM Module:*

Fig 2 SIM900A GSM Module

The SIM900A stands as a comprehensive SMT module, offering a fully integrated solution for Dual-band GSM/GPRS functionality. It is designed to seamlessly integrate into various customer applications. With its standardized interface, the SIM900A ensures reliable performance at GSM/GPRS 900/1800MHz frequencies. This performance covers a range of functions including voice communication, SMS, data transmission, and fax capabilities. Despite its compact size, the module maintains efficiency with minimal power consumption. Fig 2 is the image of SIM 900A GSM module.
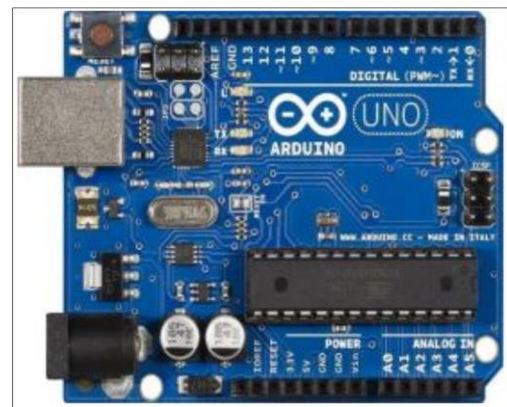
- *Arduino Uno:*

Fig 3 Arduino Uno

The Arduino Uno R3 ATmega328P stands as a microcontroller board centered around the Atmega328P microcontroller. It incorporates 14 pins for digital input and output functions, with 6 of these offering Pulse Width Modulation (PWM) capabilities. Alongside, there are 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The board is equipped with all the necessary components to fully support the microcontroller. All you need to do to begin is link it to a computer using a USB cable or power it using an AC-to-DC adapter or battery. The board is compatible with most shields and can be powered via USB or an external power supply. The board can be programmed using the Arduino IDE or other compatible software. The Arduino Uno R3 Atmega328P supports a variety of programming languages, including C/C++, Python, and Java. It can be used to control various electronic projects, such as robots, home automation systems, and more. The above Fig 3 represents Arduino Uno.
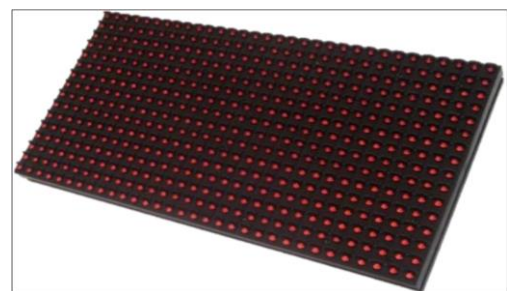
- *P10 LED Board:*

Fig 4 P10 LED Display Board

The P10 series presents a collection of dot matrix displays characterized by a LED spacing of 10mm. These displays are available in a standard single-screen configuration, featuring a 16x32 LED array. The arrangement and composition of the P10 LED Board can be understood from Fig 4. Notably, each LED within this display holds independent controllability. By controlling specific LEDs, we can display text, shapes, and graphics as required. We can chain these displays together (both vertically and horizontally) to create a display of any desired height and length. They run on a 5V voltage supply at 20W power supply. They can be controlled using ATMEGA 2560, and ESP8266 controllers.

- *Push Button:*

Fig 5 Push Button

A push button is a simple mechanical or electrical switch that is designed to be activated by pressing it. It is one of the most common types of switches used in various applications to control the flow of electricity, signal a device or system, or initiate a specific action. Push buttons are used in everyday objects and industrial systems alike. An image of Push Button is shown in Fig 5.

- *Jumper Wires:*

Fig 6 Male to Female Jumper Wires

A Jumper wire is an electrical wire or group of them in a cable with pin at each end. Jumper wires are also called as connector wires. Used to connect the test circuits, components of breadboard or other prototypes, internally or

without soldering with other equipment and other hardware components. Even though they come in different colors, such colors mean nothing. That means a black jumper wire is functionally same as the blue one. Indeed, the colors can be used for your convenience to identify the type of connections such as ground, input pins and power. Jumper wires are inexpensive and one can make our own jumper wires as well. Usually, jumper wires are in three forms: male to male, female to female, and male to female. The difference between them is the end point of the wire. Male to male jumper wires have connector pins at both ends of the electrical wire and these are used to plug into things.

Female to female jumper wires has header pins at both ends and are used to plug things into. Male to female jumper wires has one end connector pin used to plug into things and other end header pin used to plug things into. The Fig 6 denotes Male to Female jumper wires.

- *Adapter:*

Fig 7 Adapter

Adapter is a software or hardware that enables two or more otherwise incompatible devices to communicate with each other. It acts as a translator between two devices, allowing them to exchange data and interact. Adapters are commonly used to connect computers to peripheral devices, such as keyboards, printers, and scanners, as well as to connect different types of computers such as PCs and Macs. Adapters are also used in networking to allow different types of networks to interconnect. Here, we use 5V 1A adapter. Fig 7 defines the picture of Adapter.

5V 1A adapter is a type of power adapter that converts a 5volt DC input to a 1 ampere output. It is commonly used to power a wide range of electronic devices, such as computers, TVs, phones, tablets, and other small appliances. The 5V 1A adapter is also known as a wall wart, as it plugs directly into a wall outlet. The adapter is a very cost-effective and versatile solution for powering a wide range of devices.

- *SIM:*

Fig 8 SIM Card

It is recommended to use a prepaid plan or a plan with unlimited SMS for testing purposes. In this project, a prepaid plan with unlimited SMS is used. Here, Airtel SIM card is used as it is capable to bend to lower generations like 2G, 3G depending on network conditions. Fig 8 represents the icon of a SIM.

- *USB Cable:*

USB (Universal Serial Bus) is a serial bus standard for connecting devices to a computer. It is used to connect computer peripherals, such as keyboards, mice, printers, external hard drives, and other devices. It is backward compatible with older versions of USB. USB cables come in various types, including A-A, A-B, Micro-B, and Mini-B.

Fig 9 USB Cable

Here, Arduino USB Cable type A-B is used. Utilized for linking any Arduino board to computer, this cable also serves as a connection for USB printer, scanner, and other devices. The cable facilitates rapid data transmission with a high-speed, flawless performance, ensuring error-free and efficient data transfer. Fig 9 represents the USB Cable of Type A-B.

➢ *Software Requirements*

- *Arduino IDE Software:*

Arduino IDE is an open-source platform. It is a software used for electronic projects. By using Arduino IDE, we can upload code into microcontroller boards. It has additional libraries and serial monitor to communicate with. The code is developed by using Embedded C.

- *Embedded C Language:*

Embedded C is a C language extension with additional header files. These files can be altered from controller to controller. It is the most popular programming language used to program the microcontroller. Previously several embedded applications using assembly level programming have been developed. Indeed, they won't offer portability. To overcome this, the extended C language for embedded systems is approved. The advantage of being the code written in C is much easier to understand and is portable.

➢ *Libraries used in the Program are:*

- *SPI Library:*

The SPI (Serial Peripheral Interface) library in Arduino provides functions and tools to facilitate communication over the SPI bus. SPI is a synchronous communication protocol used to exchange data between a microcontroller and peripheral devices, such as sensors, displays, memory chips, and other microcontrollers. It is widely used for connecting devices that require high-speed data transfer and is supported by many microcontrollers, including those used in Arduino boards.

- *DMD Library:*

The DMD (Dot Matrix Display) library for Arduino provides a convenient way to control and manage dot matrix displays. Dot matrix displays consist of an array of LEDs or other display elements arranged in a grid, allowing you to display text, graphics, animations, and patterns.

The DMD library simplifies the process of working with dot matrix displays by providing functions for drawing pixels, characters, and graphics on the display. This is particularly useful when creating scrolling text, animations, or custom patterns on the display.

- *Timer One Library:*

The Timer One library for Arduino provides an easy-to-use interface for working with timers and interrupts on AVR-based Arduino boards. Timers are essential hardware components that allow you to generate precise time intervals, schedule events, and execute tasks at specific time intervals. The TimerOne library simplifies the configuration and usage of timers, making it easier to incorporate time-dependent functionalities into your Arduino projects.

➢ *Expenditure of Hardware Components*

The total expenditure for implementing this project is tabulated in below table:

Table 1 Expenditure of Hardware Components

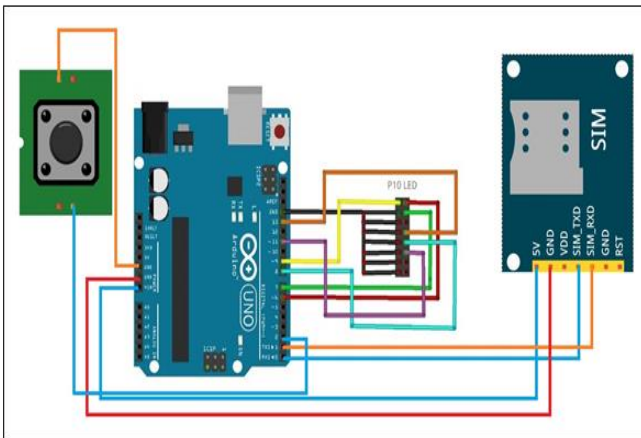| COMPONENT	COST
SIM 900A GSM Module	₹ 1250
Arduino Uno R3 ATmega328P with USB Cable	₹ 1200
P10 LED Board	₹ 1000
Connecting wires & other components	₹ 250
5V 1A Adapter	200
SIM	₹ 150

V.   CIRCUIT DIAGRAM

Fig 10 Circuit Diagram

Fig10 represents the complete circuit diagram of the Proposed System. The diagram represents the connections between the Arduino Uno and P10 LED, Arduino Uno and GSM Module, Arduino Uno and Push Button.

VI.   HARDWARE ASSEMBLY

Connect the components as per the circuit diagram with proper precautionary measures.

Connect the Arduino Uno to Computer using USB cable to observe the results on serial monitor. Fig11 shows the Hardware Assembly.
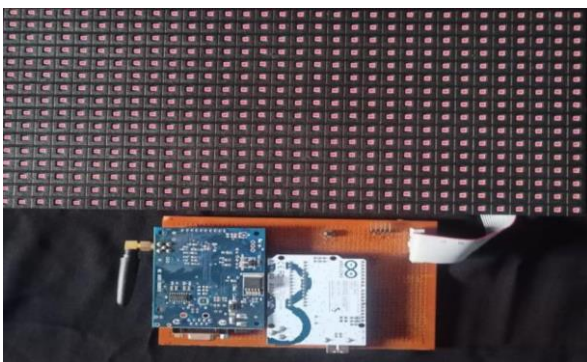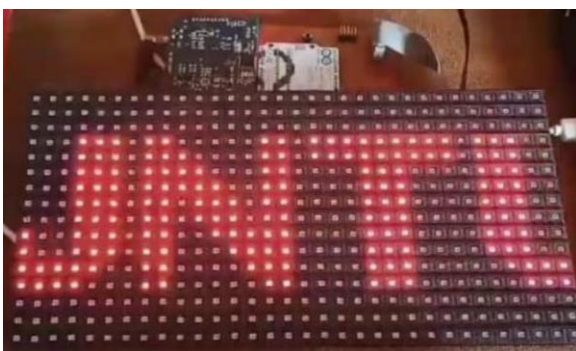

Fig 11 Hardware Assembly

VII.   RESULTS

Fig 12 Experimental Results

Fig12 shows a part of implementation results of the work "SMS enabled display board". It includes displaying scrolling message which is sent to the mobile number associated with the GSM module.
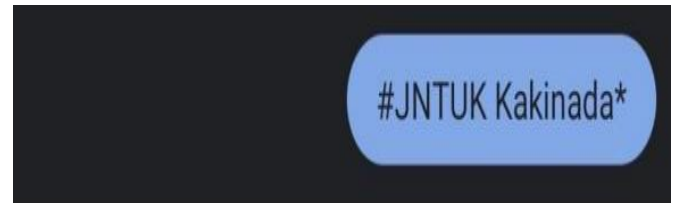

Fig 13 Message Sent

When a SMS is sent to the SIM embedded GSM Module, the module receives it and resends it to the micro controller. The micro controller interprets and transfers it to LED board.

Fig13 shows the screenshot of SMS sent to the GSM module. As soon as message is received by the module, it redirects it to micro controller, which is responsible for displaying message over the LED screen.
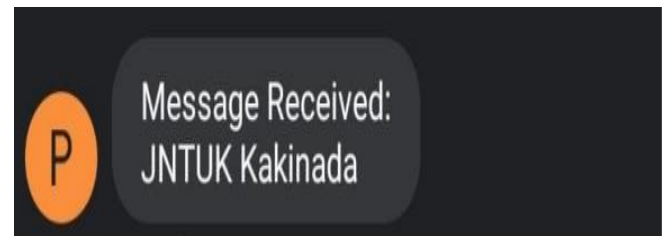

Fig 14 Confirmation Message

The Fig14 represents the proof of confirmation message send to a particular number whenever the received message is successfully projected on the LED screen.

The system has a button feature. Whenever the button is pressed, last recent message starts scrolling over the LED Board.

VIII.   CONCLUSION

This paper explains how we can develop as well as modify display board using GSM module with the SMS feature. Whenever new message is received, old message gets replaced by new. Also, the system can be controlled using push button. In addition to this, the system can send acknowledgement after successful receiving of message.

FUTURE SCOPE

The future scope of SMS enabled display board using IoT technology is the ability to use different colors for displaying text message and expand the message length.

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