



GSM Based Wireless Notice Board Using ARDUINO

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I. INTRODUCTION

1.1. Overview

The GSM based notice board is aimed at the colleges and universities for displaying day-to-day information continuously or at regular intervals during the working hours. Being GSM-based system, it offers flexibility to display flash news or announcements faster than the programmable system. GSM-based campus display system can also be used at other public places like schools, hospitals, railway stations etc.,

A GSM receiver and a display toolkit which can be programmed from an authorized mobile phone. It receives the SMS, and displays the desired information after necessary code conversion. It can serve as a notice board and display the important notices instantaneously thus avoiding the latency. Being wireless, the GSM based is easy to expand and allows the user to add more display units at any time and at any location in the campus depending on the requirement of the institute.

1.2. Objective

- To develop a GSM based notice board whose contents can be updated through an SMS which realized through an embedded system with microcontroller.
- To design a project simple, easy to install, user friendly system, which may receive and display notice in a very specific manner.
- SMS based notice board incorporating the widely used GSM to facilitate the communication of displaying message on notice board via user's mobile phone.
- SIM 800 GSM modem with a SIM card is interfaced to the ports of the Arduino with the help of AT commands.

- SIM 800 is duly interfaced through a level shifter IC MAX232 to the Arduino.
- The messaged is thus fetched into the Arduino.

1.3. Information Transfer

A coordinated sequence of user and telecommunication system actions that causes information present at a source user to become present at a destination user. An information-transfer transaction usually consists of three consecutive phases called the access phase, the information-transfer phase, and the disengagement phase.

1.4. Broadcast

A term to describe communication where a piece of information is sent or transmitted from one point to all other points. One of the most common examples is broadcast through a cellular network service. This serves multiple end users at different locations in a simulcast fashion. Practically every cellular system has some kind of broadcast mechanism. This can be used directly for distributing information to multiple mobiles, the most important use of broadcast information is to set up channels for one to one communication between the mobile Trans-receiver and the base station. This is called paging. The details of the process of paging vary somewhat from network to network, but normally we know a limited number of cells where the phone is located (this group of cells is called a location area in the GSM system). This project aims at integrating the expansiveness of a wireless cellular network and the ease of information transfer through the SMS with the coverage of campus display boards

1.5. Components Overview

This system uses the following components.



1.5.1. Arduino

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. The project's products are distributed as open-source hardware and software, which are licensed. Arduino boards are available commercially in preassembled form, or as do-it-yourself (DIY) kits.

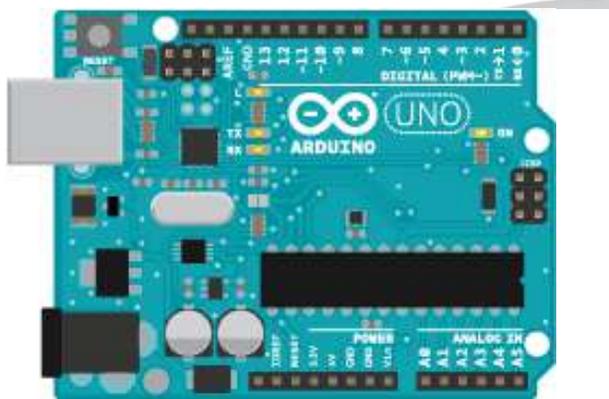


Figure No.1.1.Arduino Board

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

1.5.2. LED Boards

LED – Light Emitting Diode

An LED display is a flat panel display, which use an array of light-emitting diodes as pixels for a video display. Their brightness allows them to be used outdoors where they are visible in the sun for store signs and billboards. LED displays are capable of providing general illumination in addition to visual as when used for stage lighting or other decorative purposes.



Figure No.1.2.LED Display

1.5.3. GSM Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card in order to operate.

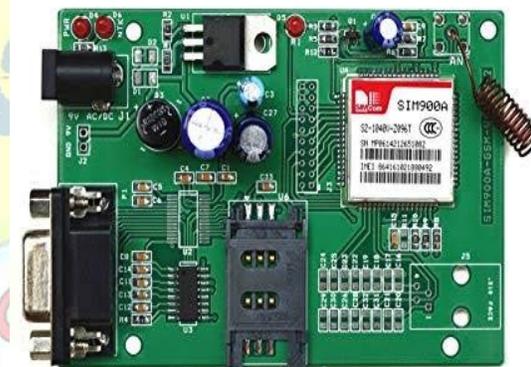


Figure No.1.3.GSM Module

Computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. GSM modem can be used just like a dialup modem. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM.

1.5.4. Bluetooth

Bluetooth is a wireless technology standard for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial scientific and medical radio bands, from 2.400 to 2.485 GHz, and building personal area networks (PANs). It was originally conceived as a wireless alternative to RS-232 data cables. Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 30,000 member



companies in the areas of telecommunication, computing, networking, and consumer electronics. The IEEE standardized Bluetooth as IEEE 802.15.1, but no longer maintains the standard. The Bluetooth SIG oversees development of the specification, manages the qualification program, and protects the trademarks. A manufacturer must meet Bluetooth SIG standards to market it as a Bluetooth



device.

Figure No.1.4. Bluetooth

1.5.5. Power Supply

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).



Figure No.1.5. Power Supply

1.6. System Operation

The operation of the system is very simple. It sends message from any of the remote area to the distant located e-notice board using GSM mobile. For sending the text message from remote area we need to interface the mobile phone with GSM Modem. For developing some of GSM based applications we need to have some common peripherals including GSM MODEM, SIM, microcontroller, LED (Light Emitting Diode), power supply and also some connecting wires.

II. LITERATURE SURVEY

Author: Dharmendra Kumar Sharma and Vineet Tiwari, IEEE 2015[1] introduces a low cost, handheld, wireless electronic notice board by using Atmel's ATmega32 microcontroller and different wireless technologies (Bluetooth and) and their performance analysis based on the parameter such as range, BER (bit error rate), RSSI (Received signal strength indicator), signal attenuation and power consumption. The board receives serial information from wireless module receiver and shows it on the graphical liquid display. It has a common communication receiver hardware for notice board having compatibility with both wireless modules i.e. Bluetooth and GSM. KS0108 based 128x64 graphical LED 32x16 as display element are used.

Author: Neeraj Khara and Divya Shukla, IEEE 2016[2] It has developed a simple and low cost Android based wireless notice board. They proposed system uses either Bluetooth or Wi-Fi based wireless serial data communication. The developed system aims in wirelessly sharing the information with intended users and also helps in saving the time and the cost for paper and printing hardware.

Author: Aniket Pramanik, Rishikesh and Vikash Nagar, IEEE 2016[3] this project, a hardware capable of controlling home appliances and displaying notices electronically using an android application has been built. So, the hardware can perform broadly two functions. In order to display notices, a user can use the same application to type a notice and click on the send button to get it displayed. The hardware consists of an 8051 microcontroller that communicates to the application through a GSM mobile communication network module which uses a SIM card to receive messages itself retrieves message.



Author: Kruthika Simha, Shreya and Chethan Kumar, displayed is sent through an SMS from an authorized IEEE 2017[4] It has been developed as a wireless electronic transmitter. The toolkit receives the SMS, Validates the board, that offers the flexibleness to manage data display sending Mobile Identification Number (MIN) and displays within a given range on multiple displays. Human the desired information after necessary code conversions.

intervention, though it offers selection, ability and **2.2 GSM Based Data Acquisition System:**

interactivity, could lead on to errors, as it is a natural and GSM based data acquisition is a process control system that inevitable results of this variability. Hence, automation of a enables a site operator to monitor and control processes that system is an accepted means that to attenuate human error are distributed among various remote sites. This project is and its impact.

Author: S. Rubin Bose and J. Jasper Prem IJRIER rainfall, wind direction, temperature, light intensity, etc. This 2017[5] In GSM based LED scrolling display board, GSM system saves time and money by eliminating the need for modem communicates with the microcontroller through service personnel to visit each site for inspection and data asynchronous serial communication. The microcontroller collection. They are used in all types of industries, from transmits a set of AT commands to read the message sent by electrical distribution systems, to food processing, to facility the user. The quick display of message using wireless data security alarms.

transfer in smart notice board. The paper titled as design and

implementation of multiple LED notice boards by using **2.3 Development Of SMS Based Teaching And Learning ZIGBEE Technology** states that the proposed system is **System:**

handled by numerous transmissions and the message feeds on The Short Message Service (SMS) technology is one the most only one receiver.

M. Arun, P. Monika and G. Lavanya IJCAT 2017[6] The students carry mobile phones with SMS facilities and can be GSM system acts as the central server of the proposed system used for teaching and learning. The system is capable of and also the notice boards are accessible only by logging in supporting administrative teaching and learning activities via with the proper credentials within the server. GSM acts as the the SMS technology.

server for this e-Notice board system. With the help of the **2.4 Multiple Unit GSM Controlled Devices:**

Ethernet shield the display node is connected to the computer The human mind always needs information of interest to network. In school area two, the Arduino is connected with a control systems of his/her choice. In this study authors have Wi-Fi shield and a LED Display and this node is also developed an interface which is a phone based home/office connected to the intranet through Wi-Fi. These devices will remote controller equipped with power to turn ON/OFF and also have a valid IP address assigned towards them. For receive STATUS of electrical appliances remotely located. developing some of GSM based applications Moreover GSM The display system in school area one will be having an based applications could be easily developed and enhanced Arduino board with an Ethernet Shield and a LED Display due to easily accessibility of components in local markets at hooked up with it. The hardware consists of an 8051 very pocket friendly prices.

2.1 GSM Based Display Toolkit:

Presently, the wireless communication has announced its arrival on big stage and the world is going mobile. We want to control everything and without moving an inch. This remote of appliances is possible through Embedded Systems. The main aim of this project will be to design a SMS driven automatic display toolkit which can replace the currently used programmable electronic display. The message to be

The human mind always needs information of interest to network. In school area two, the Arduino is connected with a control systems of his/her choice. In this study authors have Wi-Fi shield and a LED Display and this node is also developed an interface which is a phone based home/office connected to the intranet through Wi-Fi. These devices will remote controller equipped with power to turn ON/OFF and also have a valid IP address assigned towards them. For receive STATUS of electrical appliances remotely located. developing some of GSM based applications Moreover GSM The display system in school area one will be having an based applications could be easily developed and enhanced Arduino board with an Ethernet Shield and a LED Display due to easily accessibility of components in local markets at hooked up with it. The hardware consists of an 8051 microcontroller that communicates to the application through a GSM mobile communication network module which uses a SIM card to receive messages itself retrieves message.

III. SYSTEM REQUIREMENTS

The two major kinds of system requirements are hardware and software requirements.

3.1. Hardware Requirements:

- Arduino UNO R3
- LED display



- Jumper Wires
- GSM module
- Power Supply
- DMD

3.1.1. LED display:

One of the most common devices attached to an 8051 is an LED display. Some of the most common LEDs connected to the 8051 are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. In recent years the LED is finding widespread use replacing LED's.

This is due to the following reasons:

1. Declining prices
2. Ability to display numbers, characters and graphics.
3. Incorporation of a refreshing controller into the LED.
4. Ease of programming.

3.1.2. Microcontroller:

A microcontroller (MCU for microcontroller unit, or UC for μ -controller) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip (SoC); an SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes.

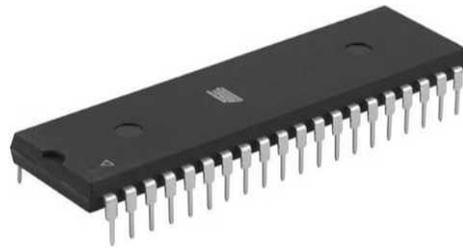


Figure No.3.1.Microcontroller

Features:

- Compatible with MCS-51® Products
- 8K Bytes of In-System Programmable (ISP) Flash Memory
- Endurance: 1000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watchdog Timer
- Dual Data Pointer
- Power-off Flag

3.3.1.3. Jumper Wires:

A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.



Figure No.3.2.Jumper Wires

3.3.1.4. DMD:

Dot Matrix Display is a matrix of LED connected in 16x32 pattern. We can wirelessly transfer messages over mobile to DMD using Bluetooth. Light emitting diodes aligned in a form of matrix constitute a dot matrix display. It is commonly used to display time, temperature, news updates and many more on digital billboards. Dot Matrix Display is manufactured in various dimensions like 5x7, 8x9, 128x16, 128x32 and 128x64 where the numbers represent LEDs in rows and columns, respectively. Arrangement of the LEDs in the matrix pattern is made in either of the two ways: row anode-column cathode or row cathode-column anode. In row anode-column cathode pattern, the entire row is anode while all columns serve as cathode and vice-versa pattern is there in row cathode-column anode.

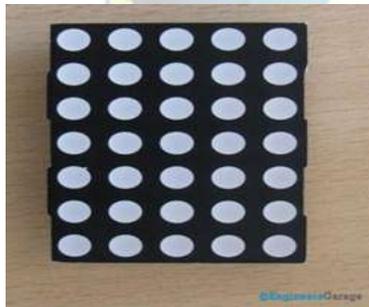


Figure No.3.3.DMD

3.2. SOFTWARE REQUIREMENTS

3.2.1. Arduino IDE

The **Arduino integrated development environment (IDE)** is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports also the languages C and C++ using special rules of code network, a list of the services the user has access to, and two

structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

IV. SYSTEM DESIGN

An embedded system is a combination of hardware and software and perhaps other mechanical parts designed to perform a specific function. Theoretically an SMS sent from a mobile phone to GSM modem is received by the GSM and stores it through AT commands. Using microcontroller it is possible to retrieve the stored message in GSM and display it on a LED display using embedded programming languages. Short information can be sent from a mobile phone as SMS and made display until the next one.

4.1 METHODOLOGY

4.1.1. GSM Modem

The GSM Modem, works by accepting any GSM network operator SIM card acts just like a mobile phone with its own unique phone number. The advantage of this modem is that its RS232 pin can be used to communicate and develop embedded application. The main operation of the modem is to send or receive calls or SMS. For this purpose it can be connected to a PC port directly or to any other microcontroller. The GSM modem acts as a highly flexible plug and its direct and easy integration to RS232 applications plays a significant role.

4.1.2. SIM:

SIM stands for Subscriber Identity Module. It is a chip-on small card which consists of user's information and phone book. The SIM is inserted in a slot available on the GSM Modem. A SIM card contains a unique serial number (ICCID), international mobile subscriber identity (IMSI) number, security authentication and ciphering information. It stores temporary information related to the local network, a list of the services the user has access to, and two



passwords: a personal identification number (PIN) for ordinary use, and a personal unblocking code (PUK) for PIN unlocking. The SIM used in this project is SIM.

4.1.3. Arduino:

The microcontroller used in this proposed system is Arduino Uno, shown in Figure 3, which is based on ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs and a 16 MHz quartz crystal. It also consists of a USB connection, a power jack, an ICSP header and a reset button. The main operation of the Arduino is to read the SMS received from the GSM module, extract the main message from the received string and store it in another string.

4.2 LED PIN SYMBOL I/O DESCRIPTION

Pin Identification:

Table No.4.1 LED Pin I/O Description

No	Symbol	Function
2-5. 37-39	PC ₀ -PC ₅	6- bit I/O port or Control Lines
3	TIMER IN	Timer clock input
4	RESET	Reset input
6	TIMER OUT	Timer counter output
7	IO/ M	I/O or memory select input
8	CE/CE	Chip enabled input
9	RD	Read strobe input
10	WR	Write strobe input
No	Symbol	Function
11	ALE	Address low enabled input
12-19	AD ₀ -AD ₇	Low address/Data bus I/O
20	V _{SS}	Ground

21-28	PA ₀ -PA ₇	8-bit I/O port A
29-36	PB ₀ -PB ₇	8-bit I/O port B
40	V _{CC}	+5v power supply

As explained in the introduction chapter, the realization of complete potential of the display boards and the wireless medium in information transfer is the major issue that the following thesis of the following project deals with.

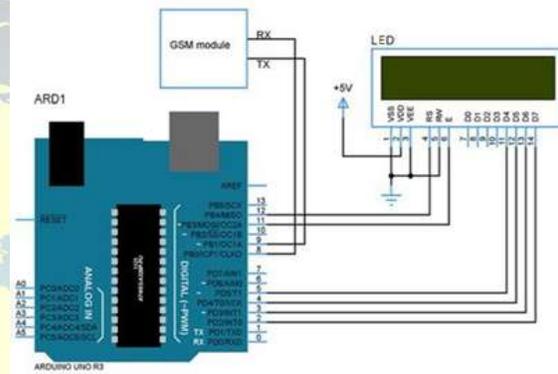


Figure No.4.1.Connection Diagram

As we see in the above figure, the setup has Arduino with Microcontroller, LED display with microcontroller, and Arduino with GSM MODEM. It is not a hidden fact that interfacing a MODEM with a normal PC is quite easy with the help of the AT commands sent to it from the Hyper Terminal window. The complexity of coding substantially increases, but once programmed the module works at its robust best since it is a dedicated embedded system and not a general purpose computer. The design procedure involves identifying and assembling all the required hardware and ensuring fail safe interfacing between all the components.

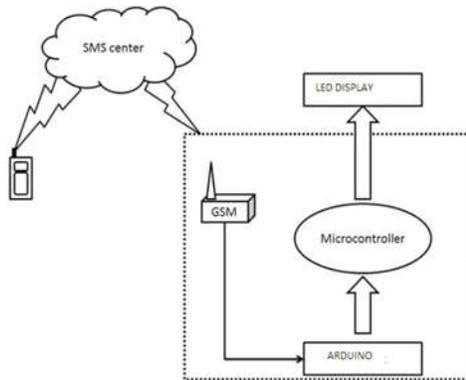


Figure No.4.2. Block Diagram

Then we have the coding process which has to take care of the delays between two successive transmissions and most importantly the validation of the sender's number. The number of valid mobile numbers can be more than one. The limiting constraint is the RAM of the microcontroller rather than the coding-complexities.

V. SYSTEM IMPLEMENTATION

5.1 SOFTWARE TOOLS

Software tools helps in building the project as per the aim. Following are the software tools used for the project.

5.2 ARDUINO PROGRAMMING

Arduino Programming is a low-cost computing platform. The goal is to make computing available to everyone globally to help them to learn programming. A program for Arduino hardware may be written in any programming language with compilers that produce binary machine code for the target processor. Atmel provides a development environment for their 8-bit AVR and 32-bit ARM Cortex-M based microcontrollers: AVR Studio (older) and Atmel Studio (newer).

5.3. IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. The Arduino IDE supplies a

software library from the Wiring project, which provides many common input and output procedures. A program written with the Arduino IDE is called a sketch. Sketches are saved on the development computer as text files with the file extension .ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde. A minimal Arduino C/C++ program consist of only two functions: setup(): This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch. loop(): After setup() has been called, function loop() is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

V. EXPERIMENTAL SET UP

This system is set up with 2 arduino boards, LED board, GSM module and 2 power supply. An Arduino board controls the LED display and other Arduino board is connected to GSM module. GSM Modem is used to receive message from the authorized user. This GSM modem requires a SIM card from a wireless carrier in order to operate. The messages sent from the mobile phone is transferred to LED display through 2 arduino kits. The notices sent through the mobile scrolls in the Display unit.



Fig.No. A.1 Experimental setup

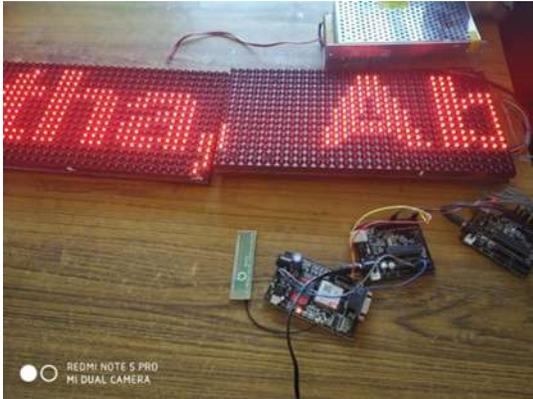


Fig.No. A.2 Message Display

VI. CONCLUSION AND FUTURE ENHANCEMENTS

The prototype of the GSM based display toolkit was efficiently designed. The SMS is deleted from the SIM each time it is read, thus making room for the next SMS. The major constraints incorporated are the use of * as the termination character of the SMS and the display of one SMS as a time. These limitations can be removed by the use of higher end microcontrollers and extended RAM. The prototype can be implemented using commercial display boards. In this case, it can solve the problem of instant information transfer in the campus. Multilingual display can be another added variation of the project.. This feature can be added by programming the microcontroller to use different encoding decoding schemes in different areas as per the local language. This will ensure the increase in the number of informed users.

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