Secured Multi-User Short Message Service Based Scrolling Display Board

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***Abstract*--Notice Board plays an important role to share information in variety of places like share-market, restaurants, colleges, railway stations, hospitals and shopping malls. The Light Emitting Diode (LED) scrolling display board in educational institutions is becoming an effective mode of communication for providing information to the people. In the existing work, the message display is static and the message cannot be changed from wherever or whenever. The display board cannot be placed anywhere because of complex and delicate wiring. The enhanced work proposes a secured Multi-user Short Message Service (SMS) based LED Scrolling Display Board, which is a model for displaying notices/messages at places that require real-time noticing, by sending information in the form of SMS through mobile. The information can be send to the display board only by the authenticated users. The display board need not be reprogrammed to display every new message because, it is wireless. In this system, a GSM modem SIM 300 is used for communication and LED panel for advertising. The project aims to develop a digital notice board which empowers multiple authenticated users to update the scrolling message using SMS service even from a remote distant.**

***Key Terms*--PIC Microcontroller, LED display, MAX 232 Voltage Converter, GSM SIM 300.**

1 INTRODUCTION

GSM (Global System for Mobile Communication) network is the most widely used wireless communication networks today for SMS (Short Message Service). The remote control appliance is possible using Embedded System which is responsible to give rise to many interesting applications that ensures comfort and safety to human life. A Notice Board is a very essential device in any institution/ organization that requires real time noticing. The main aim of the project is to design an SMS driven display which reduces manual operation. The information can be updated instantly from any desired location.

The message to be displayed is sent via SMS to the GSM modem. The message is received by the Microcontroller that validates the user and displays the desired information. Also, the messages are stored in the EEPROM memory of the microcontroller that helps the user to retrieve the stored messages. Only authorized users are permitted to send or update the messages. The main components of the toolkit contain PIC Microcontroller 16F877A which is interfaced with GSM modem SIM 300 via MAX232 convertor. MAX232 voltage convertor is used to convert RS232 voltage to TTL voltage level or vice versa. Microcontroller validates the users and controls the entire operation. The output is viewed in the LED dot matrix display that has longer life time at low power consumption.

The key contributions of this work are organized as follows:

- Chapter two shows the papers related to the work.
- Chapter three deals with the features, advantages and drawbacks of the existing system.
- Chapter four explains the overview and advantages of the proposed system.
- Chapter five gives how to assemble the collected hardware that make up the proposed system.
- Chapter six implements the Multi-user SMS based LED Scrolling Display Board and discuss the detailed description about the hardware.
- Chapter seven concludes the work and discusses the future work.

2 RELATED WORKS

Number of methodologies are proposed for GSM based LED scrolling display board. This chapter discusses the methodologies used in the digital notice board. Buzzer [1] is controlled by the microcontroller using a single pin. The use of memory device is to store the data for off line process. The PIC controller provides 2048 bits of serial electrically erasable and programmable read only memory. The device is optimized for use in many industrial and commercial applications where low power and low voltage operations are essential.

Wireless communication is one of the effective modes of communication today. GSM MODEM SIM300 [5] is used to update information from remote distance. EEPROM [1] is communicating with the microcontroller using 12c communication i.e., it contains one data pin and clock pin, these device are connected as slave to microcontroller. LED display with the useful messages via SMS to SIM embedded in design circuitry is proposed. The KEIL software c programming is carried out for the support of the hardware. The proposed work has ample of application potency in public places. This proposed unit is not just exploited by any intruder.

MAX232 voltage converter [7] is to play safe. MAX 232 voltage converter converts modem voltage to microcontroller voltage. MAX232 is used to convert from GSM voltage levels to RS-232 voltage levels and vice versa. The MAX232 [6] is a dual driver/receiver that includes a capacitive voltage generator to supply appropriate voltage levels. Vital role of MAX232 converter [1] is that it is a chip to convert TTL voltage levels into RS232 level and vice versa. In this system GSM modem communicates with the

microcontroller using RS232 serial data format. In order to make the MODEM serial port compatible with microcontroller serial port the MAX232 converter is used. Microcontroller AT89S52 [7], allow users to display real-time messages. Vital notice takes time to be displayed on the boards. This aims in developing a system that will display the messages received by the GSM modem. The system contains two sections where the mobile from which the user sends the message acts as a transmitter and the GSM modem acts as a receiver.

The main functions of the GSM based E-Notice board is that using GSM mobile user can send message to any distant located e-notice board from any remote area. As the components required for the application of E-Notice board are available at pocket friendly prices, there is an ease of accessibility enhanced GSM based applications. SMS based wireless e-notice board [4] explains how to establish an effective and reliable communication between a mobile phone and a microcontroller using GSM modem.

3 EXISTING WORK

In the existing work Matrix SIM AD0 is used as the modem that receives the message from the users. The received message goes to the AT89C52 microcontroller for verification and validation of the user and the message is displayed in the LCD 16 X 2. Here, 16 X 2 that means 2 rows and 16 characters can be displayed in the LCD. The memory used for storing the message and numbers in the EEPROM. Also, this system facilitates multiple users to send and update messages. Multiple users can send messages after providing authentication.

The system is basically divided into two sections: Transmitting and Receiving. Transmitting section consists of just a mobile. Any type of user (SIM number) can be used, as users are assigned password for accessing the system. Authorized users send the message that they want to display on the notice board to the receiving section's mobile number and the message will be displayed only if the users have the authentication password. Receiving section on the other hand consists of a GSM modem to receive message. Received SMS is then extracted by PC with help of a VB program using AT commands. SMS are then sent to microcontroller using MAX 232 IC and PC's serial port. Microcontroller finally displays it on LCD display.

Embedded C is used for microcontroller programming. The GSM modem requires a SIM card to operate which receives the message from the authorized user. PCs use AT commands to control the modems. The message is then sent to the microcontroller which is programmed to read the data and further uses it to program the LCD module through which the message is displayed. Multiple users are assigned a common password to access the system, i.e. they can update messages on notice board. For security, password is provided to authorize users.

Before sending message, a user needs to authenticate itself with the system by sending the assigned password to the receiver section's modem SIM number. The receiving section verifies password, sends response to the user and tells them to send the message. Password can be periodically changed by the administrator of PC to avoid threat to system security due to password leakage.

The drawback of the proposed system is that LCD display is used to display the message sent by the user. Also AT89C51 microcontroller is used in which external devices like buzzer is difficult to interface. This system uses Keil software for interfacing modem with the controller. There is no provision to view the already stored message in the existing system. Even though it supports multi user it cause insecurity to the system through authentication. This authentication system uses a common password that causes a threat.

4 PROPOSED WORK

SMS application has been used in education to send notification using paperless environment to a group of students in campus pertaining to class cancellation, class postponements without passing information using paper. The advantages of the work includes that the information could be received quickly and it reduces the number of non-notified students. This presents a new way of online communication through mobile to notice board that helps students to be aware of appointments. This also helps to reduce manual work. Here, it provides security by authentication technique.

Authentication technique is that only authorized numbers are given activation to send message. The whole system is divided into two sections: Input obtained from the user via GSM modem and Output is displayed in the LED display board. The user sends message from the mobile that is received in the GSM modem. The modem sends the message to the PIC Microcontroller that verifies whether the message is sent only by the authenticated user. After validating, the microcontroller displays the message in the LED display.

4.1.1 GSM MODEM SIM 300

A GSM modem is a wireless modem that works on wireless network. Generally, computers use AT commands to control modems. Reading of message from SIM card inserted into the modem is done by appropriate AT command. In addition to the standard AT commands, GSM modem support an extended set of AT commands. These extended AT commands are defined in the GSM standards. This modem is a wireless modem that works with GSM wireless network.

The main difference between a dial-up modem and a GSM modem 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 from a wireless carrier to operate. Here SIM 300 module is used which is an advanced and low cost modem for communication. SIM 300 GSM modem operates at voltages from 3.6V to 4.5V. Most of the microcontrollers we use operate on +5V power supply and hence the IO signals also swing from 0 to 5V. To have safe operation, we can use MAX232 to convert from GSM voltage. This chip converts RS232 signal voltage levels to TTL voltage levels and vice-versa.

The GSM operates in the 900MHz and 1.8GHz bands GSM supports data transfer speeds up to 9.6 kbps, allowing the transmission of basic data services such as SMS. This will become a good transferring tool of messages quickly and create awareness of any situation in the public. This is a plug and play GSM Modem

with a simple to interface serial interface. It uses the highly popular SIM300 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to micro controllers and computers.

The modem consists of all the required external circuitry required to start experimenting with the SIM300 module like the power regulation, external antenna, SIM Holder, etc. The following are the features of the GSM Modem SIM 300: Provides the industry standard serial RS232 interface for easy connection to computers and other devices; Provides serial TTL interface for easy and direct interface to microcontrollers; Can be used for GSM based Voice communications, Data/Fax, SMS, GPRS and TCP/IP stack; Can be controlled through standard AT commands and Modem a low power consumption of 0.25 A during normal operations and around 1 A during transmission.

4.1.2 PIC MICROCONTROLLER 16F877A

PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC 16F877 features all the components which modern microcontrollers normally have.

The PIC 16F877 features all the components which modern microcontrollers normally have. Up to 368×8bit of RAM (data memory), 256×8 of EEPROM (data memory), 8k×14 of flash memory. 100000 times erase/write cycle enhanced memory. 1000000 times erase/write cycle data EEPROM memory. Microchip's PIC (PIC16F877A), PIC16F/18F Primer Kit is proposed to smooth the progress of developing and debugging of various designs encompassing of High speed 8-bit Microcontrollers. The general features of PIC MICROCONTROLLER 16F877A are: High performance RISC CPU; Operating speed; 256×8 of EEPROM (data memory), Low power- high speed CMOS flash/EEPROM; Wide operating voltage range (2.0 – 5.56) volts.

4.1.3 MEMORY

Program memory contains the programs that are written by the user. The program counter (PC) executes these stored commands one by one. Usually PIC16F877 devices have a 13 bit wide program counter that is capable of addressing 8K×14 bit program memory space. This memory is primarily used for storing the programs that are written (burned) to be used by the PIC. These devices also have 8K*14 bits of flash memory that can be electrically erasable /reprogrammed. Each time we write a new program to the controller, we must delete the old one at that time.

The data memory of PIC16F877 is separated into multiple banks which contain the general purpose registers (GPR) and special function registers (SPR). According to the type of the microcontroller, these banks may vary. The PIC16F877 chip only has four banks (BANK 0, BANK 1, BANK 2, and BANK4). Each bank holds 128 bytes of addressable memory. The data EEPROM and Flash program memory is readable and writable during normal operation (over the full VDD range). The EEPROM data memory allows single-byte read and writes.

The Flash program memory allows single-word reads and four-word block writes. There are six SFRs used to read and write this memory. They are: EECON1, EECON2, EEDATA, EEDATH, EEADR and EEADRH. The EEPROM data memory allows single-byte read and writes. The Flash program memory allows single-word reads and four-word block writes. Program memory write operations automatically perform an erase-before write on blocks of four words. A byte write in data EEPROM memory automatically erases the location and writes the new data (erase-before-write).

The write time is controlled by an on-chip timer. The write/erase voltages are generated by an on-chip charge pump, rated to operate over the voltage range of the device for byte or word operations. Program memory write operations automatically perform an erase-before write on blocks of four words. A byte write in data EEPROM memory automatically erases the location and writes the new data (erase-before-write). The write time is controlled by an on-chip timer.

4.1.4 MAX232 VOLTAGE CONVERTOR

The MAX232 has two receivers (converts from RS-232 to TTL voltage levels), and two drivers (converts from TTL logic to RS-232 voltage levels). This means only two of the RS-232 signals can be converted in each direction. Typically, a pair of a driver/receiver of the MAX232 is used for TX and RX signals, and the second one for CTS and RTS signals. There are not enough drivers/receivers in the MAX232 to also connect the DTR, DSR, and DCD signals. Usually these signals can be omitted when e.g. communicating with a PC's serial interface. If the DTE really requires these signals, either a second MAX232 is needed, or some other IC from the MAX232 family can be used. Also, it is possible to directly wire DTR (DB9 pin #4) to DSR (DB9 pin #6) without going through any circuitry. This gives automatic (brain dead) DSR acknowledgment of an incoming DTR signal.

GSM modem, which works at RS232 voltage levels, logic 1 varies from -3 to -15 volts and logic 0 from +3 to +15 volts. The microcontroller which works on TTL logic levels, logic 1 is +5volts and logic 0 is 0 volts. Therefore to interface, the two MAX232 drivers IC is used. This is the model for displaying notices in colleges on electronic notice board by sending messages in form of SMS through the mobile; it is a wireless transmission system which has very less errors and maintenance. The hardware board contains microcontroller AT89C52 level converter. It is used to convert RS232 voltage levels to TTL voltage levels and vices versa. The hardware also has a 64k EEPROM chip AT24cs64.This EEPROM is used to store the timings and messages. Microcontroller coding will be done using embedded c.

The MAX232 is a wonderful component that solves those signal conversion problems. The MAX232 is an IC that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 package provides two inputs and two outputs. Most of the time only half is used. The capacitors C4 and C3 are used for the internal voltage inverter that creates the negative voltage level for the serial communication. C1 and C2 are used for the voltage double to raise the TTL (5v) level.

4.1.5 SWITCHED-MODE POWER SUPPLY (SMPS)

Switched-mode PSUs in domestic products such as personal computers often have universal inputs, meaning that they can accept power from most mains electricity throughout the world, with rated frequencies in the 50 - 60 Hz range and a voltage range between 100V - 240V AC (although a manual voltage range switch may be required). In practice they will operate from a much wider frequency range and often from a DC supply as well.

Most modern desktop and laptop computers also have a voltage regulator module which is a DC-DC converter on the motherboard that step down the voltage from the power supply or the battery to the CPU core voltage, which may need to be as low as 0.8 V for a low voltage CPU to 1.2 - 1.5 V for a desktop CPU as of 2007. Some motherboards have a setting in the BIOS that allows over clockers to set a new CPU core voltage; other motherboards support dynamic voltage scaling which constantly adjust the CPU core voltage. Most laptop computers also have a DC-AC converter to step up the voltage from the battery to drive the cold cathode backlight in the flat-screen monitor, which typically requires around 1000 V_{RMS}.

4.1.6 STEP DOWN TRANSFORMER

Step down transformers are designed to reduce electrical voltage. Their primary voltage is greater than their secondary voltage. This kind of transformer "steps down" the voltage applied to it. For instance, a step down transformer is needed to use a 110v product in a country with a 220v supply. Step down transformers convert electrical voltage from one level or phase configuration usually down to a lower level. They can include features for electrical isolation, power distribution, and control and instrumentation applications. Step down transformers typically rely on the principle of magnetic induction between coils to convert voltage and/or current levels.

Step down transformers are made from two or more coils of insulated wire wound around a core made of iron. When voltage is applied to one coil (frequently called the primary or input) it magnetizes the iron core, which induces a voltage in the other coil, (frequently called the secondary or output). The turn's ratio of the two sets of windings determines the amount of voltage transformation. Step down transformers can be considered nothing more than a voltage ratio device.

4.1.7 DISPLAY UNIT

LED is connected to the microcontroller for displaying the message sent by the user. It has to be initialized by the microcontroller before displaying. The scrolling is displayed in the 8*8 LED dot matrix. The running speed of the message can be increased or decreased and clock signal is used for scrolling message display. The number of characters displayed at a time can be as 20 as possible.

Dot matrix units typically come in either a 5x7 or 8x8 matrices LED's. The LED's are wired in the matrix such that either the anode or cathode of each LED is common in each row. In other words, in a common anode LED dot matrix unit, each row of LEDs would have all of their anodes in that row wired together. The cathodes of the LEDs would all be wired together in each column. Typical single color 8x8 dot matrix units will have 16 pins, 8 for each row and 8 for each column. The reason the rows and columns are all wired together is to minimize the number of pins required. If this were not the case, a single color 8x8 dot matrix unit would need 65 pins, one for each LED and a common anode or cathode connector. By wiring the rows and columns together, only 16 pins are required.

4.1.8 WORKING PROCEDURE

The proposed work contain a moving LED message display with the message count as static which is the latest technology used for communication between the mobile and the embedded devices. System will work like when the user wants to send the message from the mobile defining the message to the number of the SIM inserted in the GSM modem. The modem connected to the microcontroller will receive the SMS and programmed in such a way that when the modem receives any message the microcontroller verifies whether the message is from the authenticated user. Once verified by the controller the message is displayed in the LED Display Board.

Embedded System has many applications and user can update information from remote distance. Also the administrator of the notice board has the control to view the already stored messages using codes given from mobile to microcontroller. When the code is matched with the microcontroller the stored message gets displayed. The enhanced work of the proposed system is that it reduces manual work to a great extent. The users can send and update the messages from remote distances. For every new message, an alert sound is produced by the Buzzer. Also, the users are having the provision to view the already stored messages.

5 EXPERIMENTAL EVALUATIONS

Embedded C is as the microcontroller programming language. There is a large and growing international demand for programmers with embedded skills, and many desktop developers are starting to move into this important area. Because most of the embedded systems have severe cost constraints, they tend to use low-cost processors like PIC devices.

Embedded C is small and reasonably simpler to learn, understand, program and debug; Compared to assembly language, C Code written is more reliable and scalable, more portable between different platforms; C Compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers; Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/ microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems; As C combines functionality of assembly language and features of high level languages, C is treated as a 'middle-level computer language' or 'high level assembly language'; It is fairly efficient; It supports access to I/O and provides ease of management of large embedded projects.

5.1 HARDWARE ASSEMBLY

8*5 LED dot matrix display is grouped into a cardboard as 10 modules which acts as an output device. This display is wholly controlled by PIC Microcontroller, which consists of shift registers and EEPROM memory for storage. GSM Modem is

interfaced to a microcontroller, where there is an inbuilt voltage converter. Buzzer is external device used as an alert for arrival of new message.

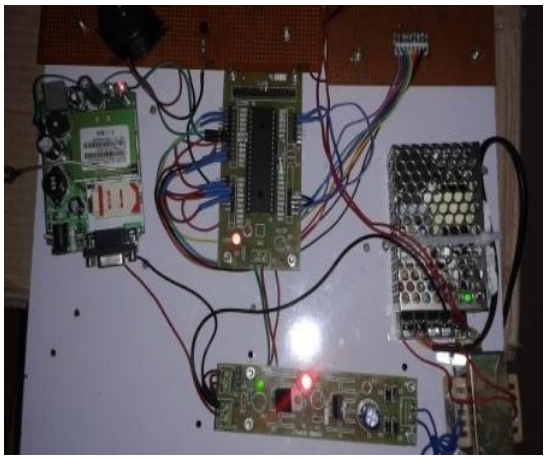

Figure 5.1 Hardware Assembly

5.2 AUTHENTICATION FOR USERS

A common SIM is given for all the departments to handle the notice board. That number is verified stored in the microcontroller. Only those authorized users can send or update the message**.** Also the entire set up is controlled by an admin who is also an authenticated user. The admin is allowed to view the earlier stored messages in the EEPROM.

Figure 5.2 Authentication to users

5.3 BUZZER WITH SNOOZING

Buzzer is an electrical device, which is similar to a bell that makes a buzzing noise and is used for signaling. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. The buzzer can be disconnected by removing jumper JP5, and this is also the default position for this jumper since the buzzer sound can be quite annoying if always left on.

The buzzer subsystem produces a 2 KHz audible tone when powered. The buzzer will sound when the signal coming into the driver is high. The buzzer is connected between the supply rail (+V) and the input signal. This acts as load on the driver. When the input signal coming into the buzzer subsystem is low, the potential difference across the buzzer causes the current to flow. This flow of current causes the buzzer to sound. Buzzer is connected to microcontroller port pin, so microcontroller will give high or low to switch on/off buzzer. This system is used to define the arrival of every new message sent by user to the GSM modem.

Buzzer is used to indicate that a button has been pressed are a click, a ring or a beep. When the input port pin from microcontroller is changed, the sound wave is changed in Buzzer. By pulling pin PORTB.0 low, the alternative INT feature of pin PORTB.0 (the INT signal) can be used to modulate the buzzer to oscillate around different frequencies. Then the volume of the sound will be changed by alternating the pulse width. When a student fail to notice the arrival of new message, a snooze option is used to give a buzzer sound again once in 50 minutes.

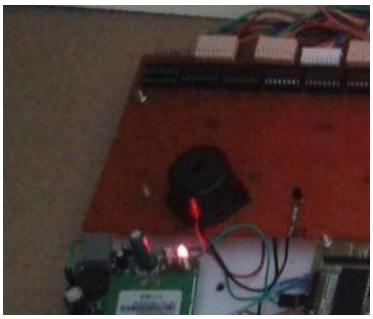

Figure 5.3 Buzzer

5.4 STATIC MESSAGE DISPLAY

The message count will be static whereas, the message keeps scrolling. Initially the message sent by the user will be static for a period of time and then it scrolls by using time delay. Static screen is corresponding to the scan screen, static screen is the LED display in the display text, images, video, LED lights on display is lighted at the same time; it is not like the scan screen to use the person eye's temporary characteristics, Scan screen instead of using the human eye as the visual characteristics of temporary stay, to light each line of Led screen separately.

LED display is derived by room ratio; the brightness is related to the light time. So, if the same brightness of Led, the brightness of static screen is more than scan screen. Therefore, a static screen is used for high-brightness and outdoor display, and scan screen commonly used for scanning screen which do not need the high brightness to save the driver cost. However, with the LED materials technology is developed continuously, brightness of LED is improved continuously. In order to save the cost, outdoor display also use scan driver. Of course, the high request for the control and driver when use scan driver for outdoor led display, also request the very high performance chips.

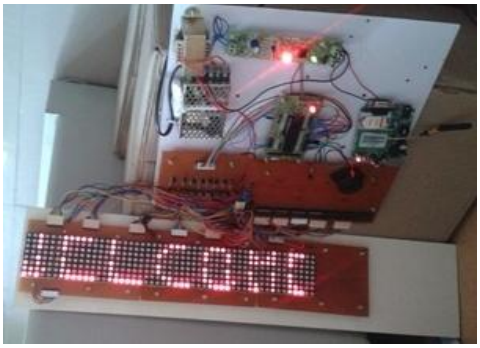

Figure 5.4 Static Message Display

5.5 DYNAMIC MESSAGE DISPLAY

The user gives the code followed by a space and gives the message count of the stored message to be viewed. The PIC microcontroller is programmed in such a way that when the code is received it first verifies whether the message is from the valid users. Then it checks with the code. If the code is matched the controller retrieves the message stored in the EEPROM and displays in the LED Dot matrix display.

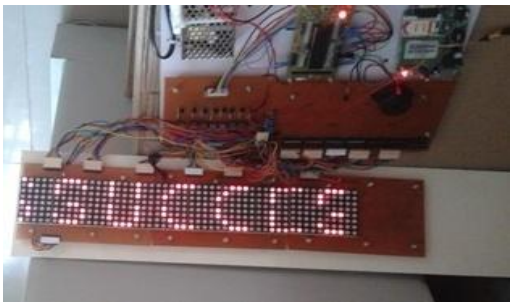

Figure 5.5 Dynamic Message Display

6 CONCLUSIONS

By introducing the concept of wireless technology in the field of communication there is a great efficiency to display messages with less errors and repairs. Latency involved in using papers in displaying notices is avoided and the information can be updated by the authorized persons. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Moreover this is secured in terms of providing authentication for sending and updating messages. The future work is to implement the Multi-lingual display.

Multi-lingual display can be another variation added in this project. One - many displays can be implemented in which one GSM modem can be operated to display messages in various places using sensors. The numbers stored in the EEPROM can be edited by providing a keypad interfaced with the PIC microcontroller. Additional RAM or EEPROM can be interfaced to view the history of messages by authorized persons.

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