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Smart LED Display Boards

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Abstract:

Everything around us is becoming smart such as smart phones, smart televisions, smart refrigerators, so why not smart displays boards for advertisements and notices. Display boards are primary thing in any institute, organization, public utility places like bus stops, railway stations, parks, shopping malls to display information regarding platforms, various advertisements about the products, or important notices. People are now adapted to the idea of the world at its fingertips. The old -wired display boards are controlled by microcontroller. To change message, we need to change the microcontroller program code again and again. By adding GSM wireless communication interface, we can overcome these limitations. It is a start to the era of smart and real–time displaying of messages on display boards. This paper explains the development of GSM based Smart LED Display Boards using Short Message Service (SMS).

Keywords: Design on Paper, GSM, Hardware Profile, ICMAX232, LED, SIM, Software.

1. Introduction:

The led Display System 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 display system can also be used at other public places like schools, hospitals, railway stations, gardens etc. It presents an SMS based display board incorporating the widely used GSM to facilitate the communication of displaying message on display board via user's mobile phone from any part of the world. This project is built around the AT89S51

microcontroller from Atmel. This microcontroller provides all the functionality of the display and wireless control. The led display system mainly consists of a GSM receiver and a display toolkit which can be programmed from an authorized mobile phone. It receives the SMS, validates the sending Mobile Identification Number (MIN) and displays the desired information after necessary code conversion. The system is easy, robust, to use in normal life by anyone at anyplace with less errors and maintenance. As engineer's main aim is to make life simple with help of technology, this is one step to simplify real time noticing.

2. GSM

GSM (Global System for Mobile Communications, originally Group Special Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It is the de facto global standard for mobile communications with over 90% market share, and is available in over 219 countries and territories. The GSM standard was developed as a replacement for first generation (1G) analog cellular networks, and originally described a digital, circuit-switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit-switched transport, then packet data transport via GPRS and EDGE. "GSM" is a trademark owned by the GSM Association. It may also refer to the initially most common voice codec used, Full Rate. Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots (or burst periods) are grouped into a TDMA frame. Half-rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270. 833 Kbit/s, and the frame duration is 4. 615 ms. the transmission power in the handset is limited to a maximum of 2 watts in GSM 850/900 and 1 watt in GSM 1800/1900.

3. Subscriber Identity Module (SIM)

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM card. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them; this practice is known as SIM locking.

4. LED

A light-emitting diode (LED) is a two-lead semiconductor light source that resembles a basic pin-junction diode, except that an LED also emits light. When an LED's anode lead has a voltage that is more positive than its cathode lead by at least the LED's

forward voltage drop, current flows. Electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. An LED is often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity, and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness. Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays, and were commonly seen in digital clocks. Recent developments in LEDs permit them to be used in environmental and task lighting. LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are now used in applications as diverse as aviation lighting, automotive headlamps, advertising, general, traffic signals, and camera flashes. However, LEDs powerful enough for room lighting are still relatively expensive, and require more precise current and heat management than compact fluorescent lamp sources of comparable output. LEDs have allowed new text, video displays, and sensors to be developed, while their high switching rates are also useful in advanced communications technology.

5. Design on Paper

This is a Scrolling (Moving) Message Electronic Display Board which displays the messages received as SMS or GPRS Packets. The main aim of this project will be to design a SMS driven automatic display board which can replace the currently used programmable electronic display. It is proposed to design receiver cum display board which can be programmed from an authorized mobile phone. The message to be displayed is sent through a SMS from an authorized transmitter. The microcontroller receives the SMS, validates the sending Mobile Identification Number (MIN) and displays the desired information. Started off as an instantaneous News display unit, we have improved upon it and tried to take advantage of the computing capabilities of microcontroller.

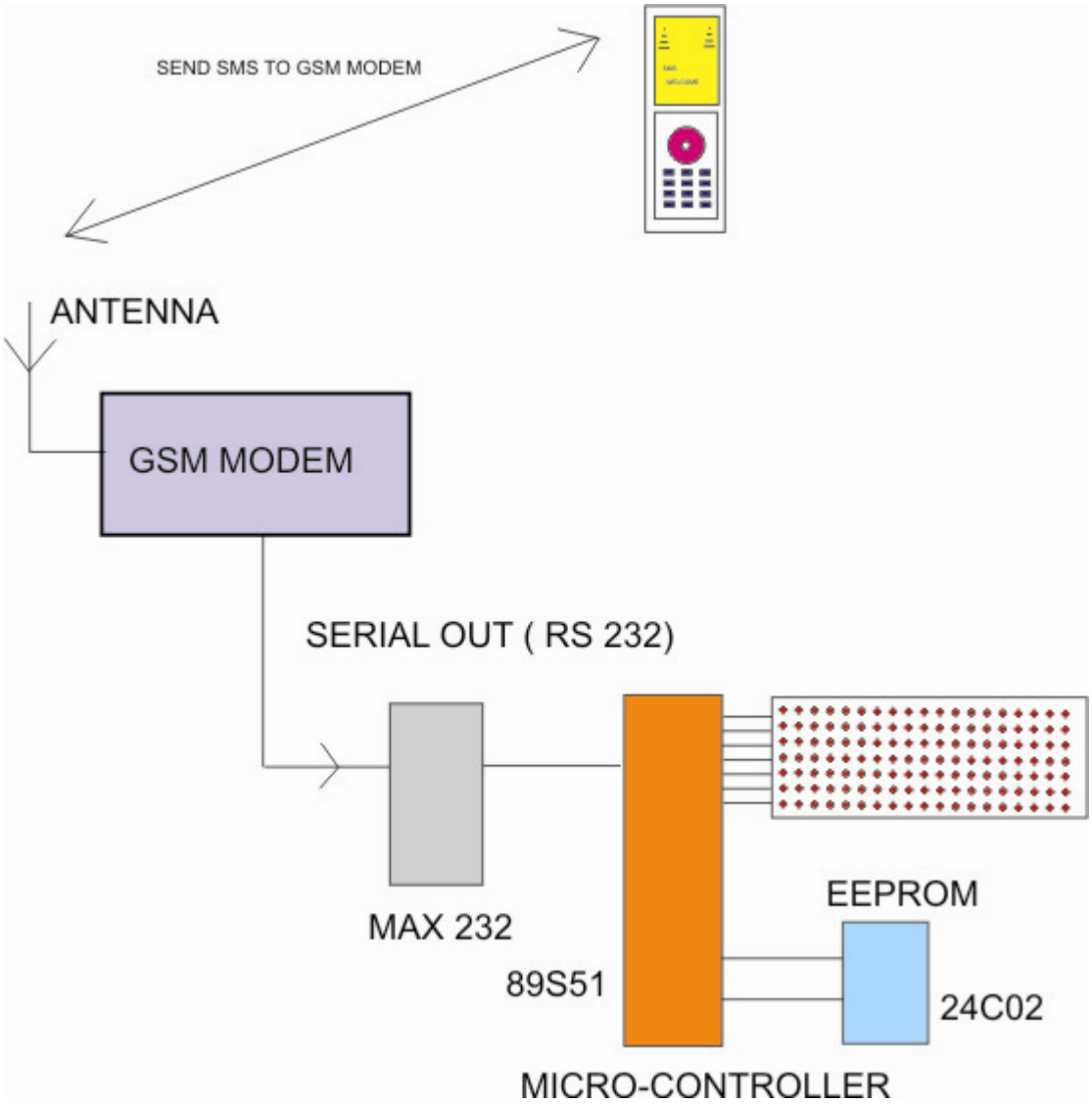

Fig 1: Block Diagram

6. Circuit Diagram

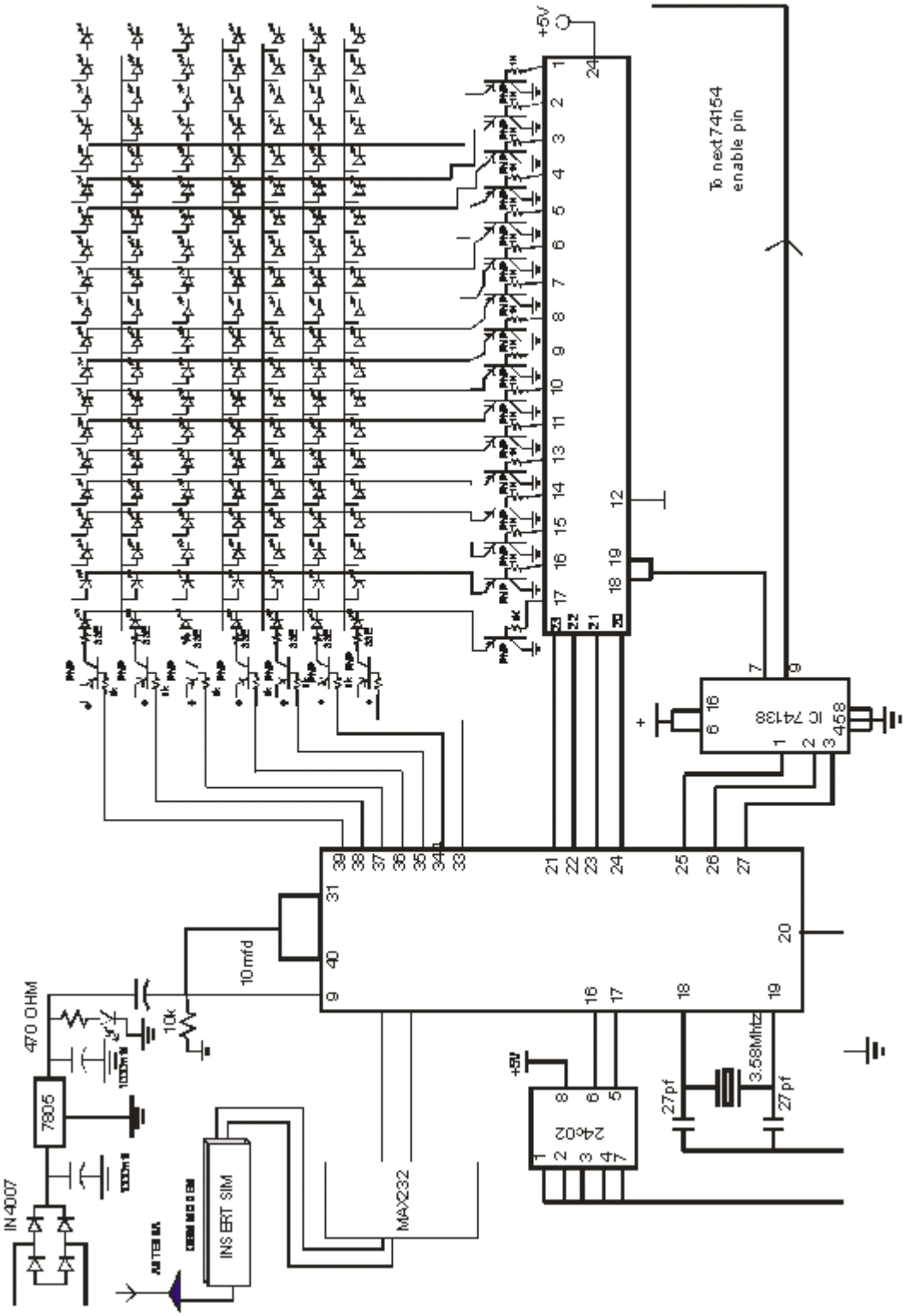

Fig 2: Circuit Diagram

7. Power Supply

In this project firstly we have used one step down transformer. Step down transformer steps down the voltage from 220 volt AC to 12 volt AC. This AC voltage is further converted into DC with the help of rectifier circuit. In rectifier circuit we have used four diode. All the diodes are arranged as a bridge rectifier circuit. Output of this rectifier is pulsating DC. To convert this pulsating DC into smooth DC we have used one capacitor as a filter component. Capacitor converts the pulsating Dc into smooth DC with the help of its charging and discharging effect.

Output of the rectifier is regulated with the help of IC regulator circuit. In this project we have used positive voltage regulator circuit. Here we have used three pin regulators. Output of this regulator is regulated voltage. If we have used 7805 regulator then it is 5 volt regulator and if we have used 7808 regulator then that it is 8 volt regulator circuit. In this project we have used 5 volt DC regulated power supply for the complete circuit. Separate 9 volt DC power supply is used for the relay coil.

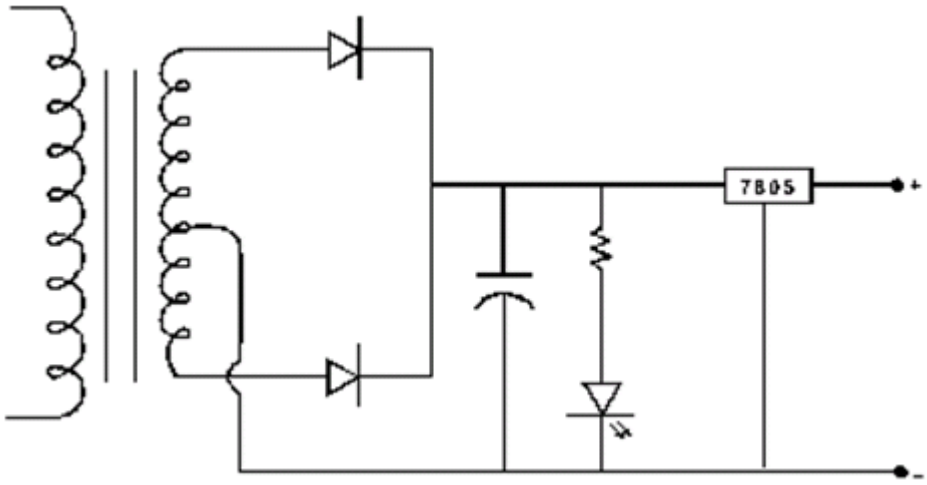

Fig 3: Power Supply Circuit

8. Hardware Profile

8. 1. AT89S51 Microcontroller.

Low-power, high-performance CMOS 8-bit microcontroller with 4KB of ISP flashes memory. The device uses Atmel high-density, non-volatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin-out. On-chip flash allows program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer.

8. 1. 1 Features

- Compatible with MCS®-51 Products
- 4K Bytes of In-System Programmable (ISP) Flash Memory
- Endurance: 10, 000 Write/Erase Cycles
- 4. 0V to 5. 5V Operating Range

- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six 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
- Fast Programming Time
- Flexible ISP Programming (Byte and Page Mode)

8. 2. GSM Module.

It is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such modules. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

- Receive, send or delete SMS messages in a SIM.
- Read, add, search phonebook entries of the SIM.
- Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

A GSM/GPRS module assembles a GSM/GPRS modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microprocessor / microcontroller based system. The power supply circuit is also built in the module that can be activated by using a suitable adaptor.

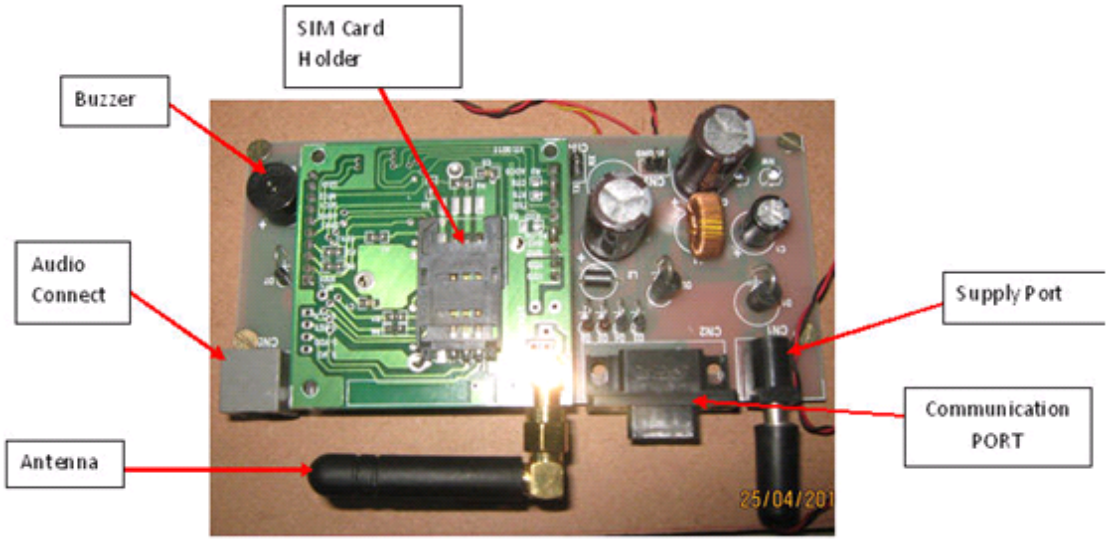

Fig 4: GSM Module

8. 3. LED Display.

Main logic of the moving display is the scanning process. In the scanning process first of all, we transfer the data on the microcontroller output (port p0) and then switch on the first line of the 32 lines matrix. Switching of LED lines from right to left is very fast, approx 50 ms speed. With the help of this great speed LEDs lines are on/off step by step. Due to persistence of vision, it is not possible to detect the on/off period of LED lines with the help of naked eyes.

8. 4. DM74154

4-Line to 16-Line Decoders/De-multiplexers. Each or these 4-line-to-16-line decoders utilize TTL circuitry to decode four binary-coded inputs into one of sixteen mutually exclusive outputs when both the strobe inputs, G1 and G2, are low. The de-multiplexing function is performed by using the 4 input lines to address the output line, passing data from one of the strobe inputs with the other strobe input low. When either strobe input is high, all outputs are high. These de-multiplexers are ideally suited for implementing high-performance memory decoders. All inputs are buffered and input clamping diodes are provided to minimize transmission line effects and thereby simplify system design.

8. 5. EEPROM.

These memory devices are used to store the data for off line process. The AT24C02 provides 2048 bits of serial electrically erasable and programmable read only memory (EEPROM) organized as 8192 words of 8 bits each.

9. Software

9. 1. Operational Flowchart.

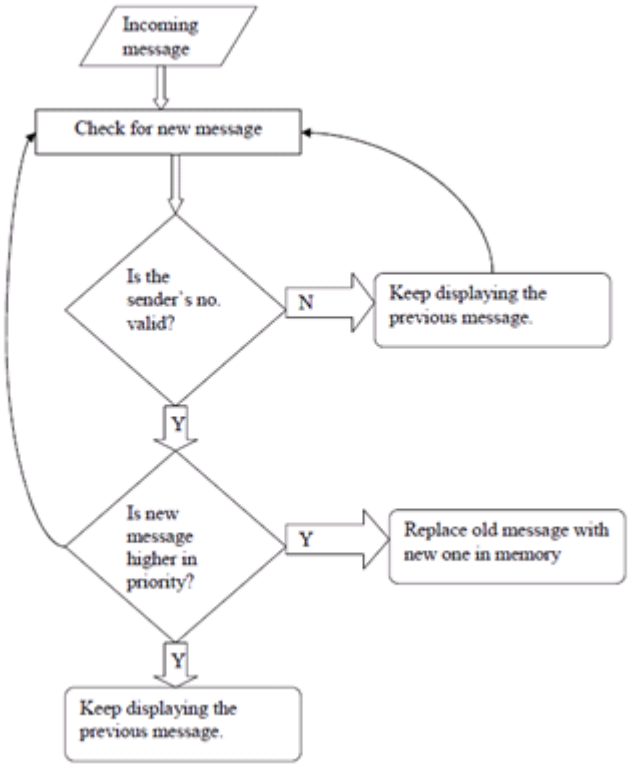

Fig 5: Operational Flowchart

9. 2. Programming

Kiel. The Kiel C51 C Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today. The C51 Compiler allows you to write 8051 microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Language extensions in the C51 Compiler give you full access to all resources of the 8051. The C51 Compiler translates C source files into reloadable object modules which contain full symbolic information for debugging with the µVision Debugger or an in-circuit emulator. In addition to the object file, the compiler generates a listing file which may optionally include symbol table and cross reference information.

9. 3. Simulation

Proteus. Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. It is developed by Lab center Electronics. The X Game Station Micro Edition was designed using Lab center's Proteus schematic entry and PCB layout tools. Proteus PCB design combines the ISIS schematic capture and

ARES PCB layout programs to provide a powerful, integrated and easy to use suite of tools for professional PCB Design.. All Proteus PCB design products include an integrated shape based auto router and a basic SPICE simulation capability as standard. More advanced routing modes are included in Proteus PCB Design Level 2 and higher whilst simulation capabilities can be enhanced by purchasing the Advanced Simulation option and/or micro-controller simulation capabilities. The products are offered at a number of levels which offer increasing levels of functionality and design capacity.

10. Microcontroller – MODEM Interfacing-ICMAX232

The MAX232 is an IC, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7. 5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1. 3 V, and a typical hysteresis of 0. 5 V. The MAX232 (A) 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.

11. Conclusion

The prototype of the GSM based display was efficiently designed. This prototype has facilities to be integrated with a display board thus making it truly mobile. It accepts the SMS, stores it, validates it and then displays it in the LED module. The SMS is deleted from the SIM each time it is read, thus making room for the next SMS. Only one SMS can be displayed at 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.

12. Future Work

The use of microcontroller in place of a general purpose computer allows us to theorize on many further improvements on this project prototype. Temperature display during periods wherein no message buffers are empty is one such theoretical improvement that is very possible. The ideal state of the microcontroller is when the indices or storage space in the SIM memory are empty and no new message is there to

display. With proper use of interrupt routines the incoming message acts as an interrupt, the temperature display is halted and the control flow jumps over to the specific interrupt service routine which first validates the sender's number and then displays the information field.

Another very interesting and significant improvement would be to accommodate multiple receiver MODEMS at the different positions in a geographical area carrying duplicate SIM cards. With the help of principles of TDMA technique, we can choose to simulcast and broadcast important notifications. After a display board receives the valid message through the MODEM and displays it, it withdraws its identification from the network and synchronously another nearby MODEM signs itself into the network and starts to receive the message. The message is broadcast by the mobile switching centre for a continuous time period during which as many possible display board MODEMS "catch" the message and display it as per the constraint of validation.

Multilingual display can be another added variation of the project. The display boards are one of the single most important media for information transfer to the maximum number of end users. This feature can be added by programming the 40 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. Graphical display can also be considered as a long term but achievable and target able output. MMS technology along with relatively high end microcontrollers to carry on the tasks of graphics encoding and decoding along with a more expansive bank of usable memory can make this task a walk in the park.

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