Braille Based SMS System for the Visually Challenged

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Abstract : Telecommunication technology has become an integral part of our life. There have been innumerable advancements in the field of mobile communication and has improved the standard of living. But unfortunately, these are not exclusively developed for the visually challenged people and they cannot utilize the developing technologies. This paper explains the design and implementation of an SMS system which uses the conventional Braille language as the basis. The two major tasks involved are SMS send and SMS receive. Initially an SMS can be sent to the desired mobile number, using a Braille keypad which is interfaced with the ARM microcontroller and GSM module. At the receiving end, a buzzer alerts the blind user about the reception of a message. Each of the characters in the message are decoded by ARM controller and sent to the vibration motors. These vibrations help the user decipher the message, character by character. This design is implemented using an embedded kit with various modules assembled on one board. The system thus designed is easy to use, and cost effective.

IndexTerms **- ARM, Braille, GSM Module, Vibration motors**

I. INTRODUCTION

THIS SMS system uses the Braille language as the basis since the visually impaired people are well versed in using it. Braille which is named after its creator Louis Braille, is the conventional reading and writing system used by blind people. According to the statistics, there are around 37 million blind people across the globe among which over 15 million are from India.

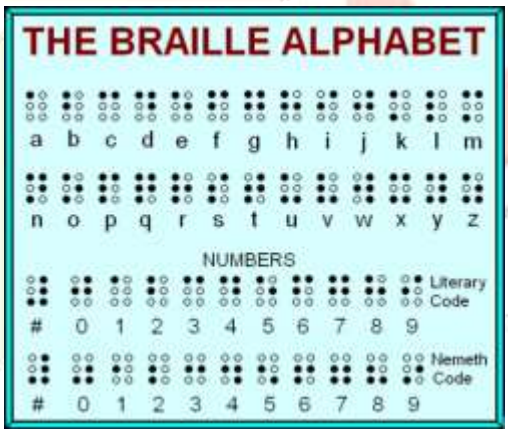

Fig. 1.1 Braille Alphabet Table

And only about 1 lakh people in them receive formal education. Braille characters have rectangular clocks known as cells, which have small raised dots. These dots are arranged in a 3*2 matrix format. Each of the English alphabets i.e., a to z, numbers i.e., 0 to 9 and special characters have specific Braille patterns based on the number and arrangement of the dots. Thus, distinguishing one character from another. Blind people utilize these to read and write.

This system is designed by interfacing various modules like Braille keypad, LCD, GSM, vibration motors with the ARM microcontroller to perform two major tasks, i.e SMS send and SMS receive.

II. LITERATURE SURVEY

The literature survey was aimed at finding the existing solutions that help the visually impaired to communicate through their mobile phones effectively and the problems faced while using such applications. In one paper, two blind persons demonstrated their usual interaction with social applications and stressed their difficulties and strategies. Take away from the paper were the inconsistencies between their mobile and

desktop versions. And text entry in touch screen is a demanding task. Another paper proposed a software application called "New Vision", which was used to make calling and messaging easier for the visually challenged people. However, due to absence of hardware keys, a modified android accessibility had been formulated to ease the use of smart phones. Various analysis and surveys of the blind people, have evaluated the usability issues of different android & iPhone applications. These reveal the importance of usability to software and provide guideline for improving the usability and accessibility of smart phone application.

Touch gesture based performance on smart phones, the differences and preferences among the visually challenged people are investigated in one of the papers. Conclusion drawn from the paper is that, more research is needed regarding accessible and mobile touch-based interaction. Although there are various tools like Voice over, talk back, etc. included in the existing mobile applications, the user interface is designed by keeping sighted people in mind and this may not address all the difficulties of the visually impaired. Thus, there is need to design application specifically for the blind instead of adding an extra accessibility features in the app for sighted people.

III. IMPLEMENTATION

3.1 System Architecture

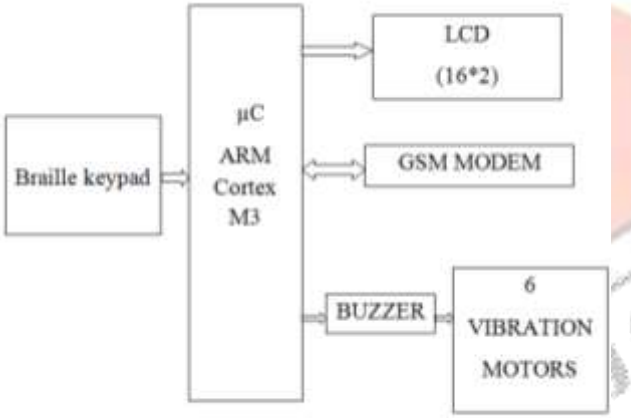

Fig3.1 Block diagram of the proposed SMS system

The proposed design consists of :

- ARM Cortex M-3 microcontroller
- Braille Keypad
- 16x2 LCD
- GSM SIM 808 module
- Vibration Motors
- Buzzer

3.2 Open Lab Kit

The OpenLab kit developed by Etiq Technologies is a self learning embedded application development platform which can be used by students and techno enthusiasts to experiment and design a vast range of circuits, ranging from basic to highly complex circuits.

This sophisticated platform contains all the necessary electronic control modules, circuit making devices and ports which are all arranged on a base board in a modular structure. The kit also gives the flexibility to connect other functional modules and also supports arduino shields thus making it compatible with most of the available modules in the market.

Thus the Openlab kit was used to develop a proof of concept for the proposed SMS system design.

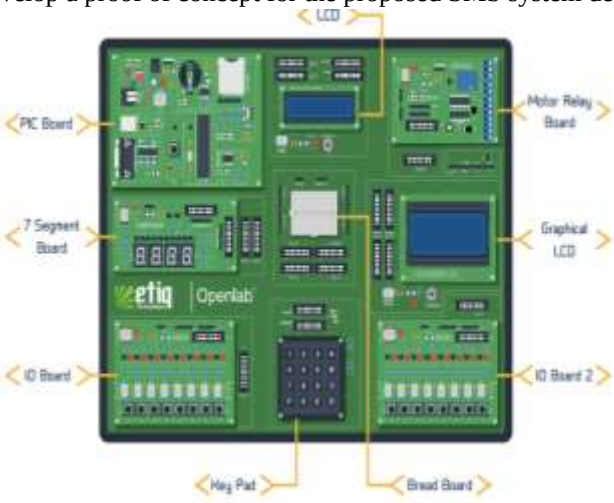

Fig 3.2 OpenLab architecture

IV. SYSTEM OVERVIEW

4.1 ARM Cortex M-3

The Arm Cortex M-3 is a 32 bit microprocessor which provides excellent performance at low gate count , greater performance efficiency with the processor running at frequencies up to 100MHz, low power consumption which facilitates longer battery life and enhanced determinism enabling the critical tasks and interrupts to be serviced as fast as possible within a known number of clock cycles.

The Arm Cortex M-3 CPU is designed according to the Harvard Architecture with separate instruction and data buses as well as a third bus for peripherals. The CPU incorporates a 3- stage pipeline, which increases the amount of work that can be executed in a single clock cycle and follows the RISC (Reduced Instruction Set Computer) principles which is much simpler than the CISC(Complex Instruction Set Computer) architecture.

The microcontroller (lpc1768) which incorporates the Cortex M-3 processor is interfaced with 512kB of Flash memory and 64kB of RAM , Ethernet MAC, USB interface, 8 channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, I2C bus interface, 8 channel 12-bit ADC, 10 bit-DAC, motor control PWM, 4 general purpose timers, ultra-low power real time clock(RTC),and up to 70 GPIO (General Purpose Input/ Output pins).

Thus the microcontroller suits the requirements to perfectly run all the components of the proposed system effectively.

4.2 Braille Keypad

The Braille keypad is made up of six push buttons arranged in a 3x2 matrix form which resembles the conventional Braille pattern.

This keypad serves as the input section and is used by the visually impaired person to type his message character by character. There are two extra buttons which are used one for space and the other as an enter key.

The figure below shows the Braille keypad of the system:

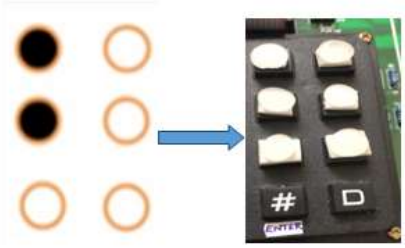

Fig 4.1 Braille keypad 3*2 matrix

4.3 Liquid Crystal Display

The LCD is used to display the message keyed in by the user as well as display the message received on the users device. The display operates on 5V dc and is composed of 16 columns and two rows and can display 16 characters in each line.

So a total of 32 characters can be displayed on the LCD. The microcontroller decodes each Braille pattern entered by the user on the keypad using the look up table and displays the corresponding letter on the LCD. It can also be used to check the output of different modules interfaced with the microcontroller. Hence the LCD forms a vital part of the system which is used to visualize the message to be sent as well as the message received and helps to debug the system in case of errors and rectify them easily.

4.3 GSM Module

GSM (Global System for mobile communication) is a digital mobile telephony system that can be used to send short text message to the desired number and also to receive message from any number.

Tthe iot section of the kit was interfaced with a GSM module which uses SIM 808. It is a quad- band GSM module that works on GSM frequency of 850MHz.The SIM808 uses power saving technique that brings down the power consumption to as low as 1mA in the sleep mode. TCP/IP protocol and extended TCP/IP AT commands are used for data transfer applications.

Thus the module works on power ranging from 3.4 to 4.4v DC and AT commands are used to interact with module to send a message and also to receive a message.

4.3 Vibration Motors

The vibration motors are used in the system for Haptic feedback which would enable the blind person to read the received message.

These motors are arranged in a 3x2 matrix , the received message is decoded by the microcontroller using the look up table and the corresponding pattern is feed to the vibration motors where the user can decipher the message character by character.

Since the microcontroller drives the motor it is necessary to connect a diode in reverse bias in parallel to the motor to eliminate the voltage spikes produced by the windings of the motor as it rotates otherwise these spikes could easily destroy the microcontroller. A capacitor of 0.1µF is used to absorb the voltage spikes produced by the brushes. 75mA of current is required to drive the vibration motor thus an n-p-n transistor is used to amplify the current output from the microcontroller.

The figure below shows the schematic used to interface the motor with the microcontroller:

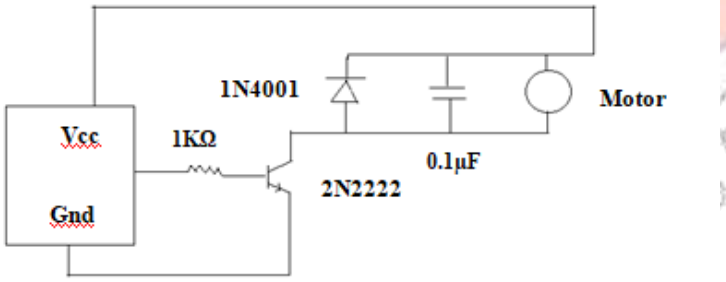

Fig 4.2 The schematic used to interface the motor with the microcontroller.

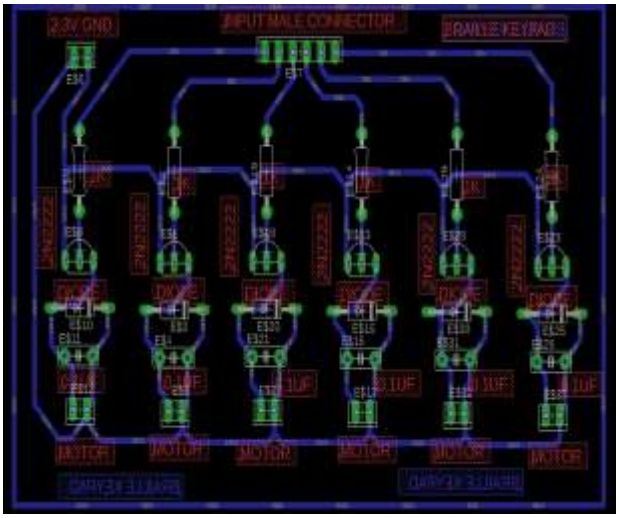

Fig 4.3 The schematic was designed on a PCB layout and connected to the microcontroller. PCB design on EagleCAD.

4.3 Buzzer

The buzzer is used to alert the user that a message was received . On reception of the buzzer alert the user can read the message with the help of the vibration motors. Buzzer connection is shown in the figure below:

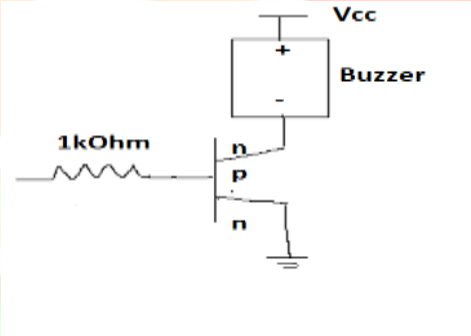

Fig 4.4 Circuit diagram for buzzer connection.

V. SOFTWARE ALGORITHMS

5.1 SMS Send

Here the blind person can type the SMS using the Braille keypad interfaced to the microcontroller. The microcontroller then converts the Braille pattern to the English alphabets using the look up table. After the message is translated into alphanumeric English letters the microcontroller sends the typed SMS to the desired number via the GSM module.

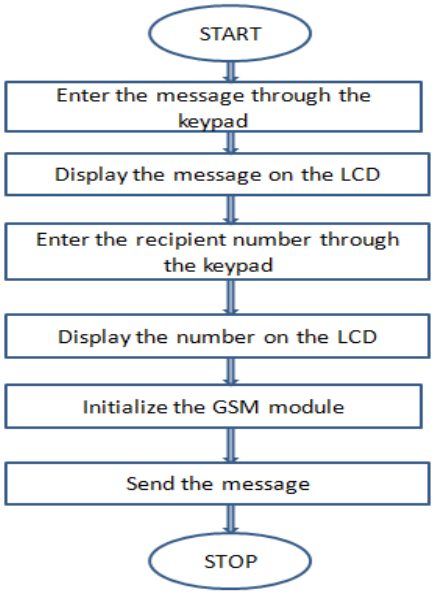

Fig 5.1 Flowchart for SMS send

5.2 SMS Read

Once the user has received a message an alert is given through the buzzer. The microcontroller converts the message received through the GSM to their respective Braille pattern using the look up table which allows the user to read the message with the help of the vibration motors.

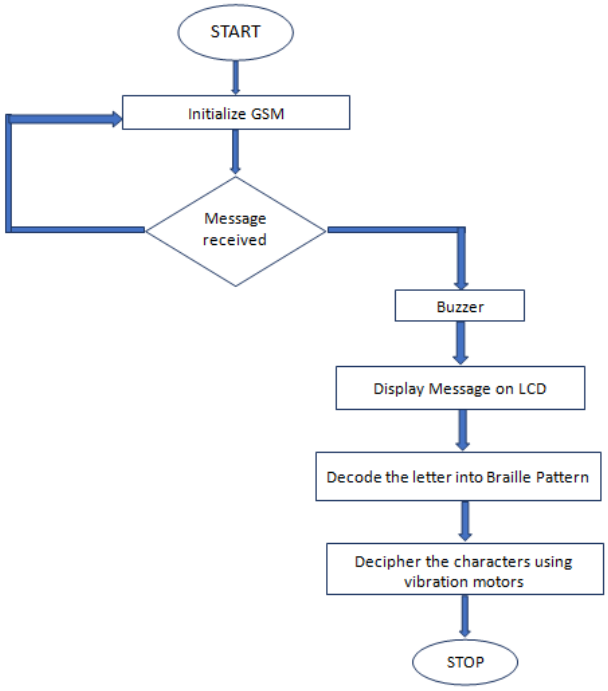

Fig 5.2 Flowchart for SMS receive

VI. RESULTS

6.1 SMS Transmission

Fig 6.1.1 Message to be sent to the recipient

Fig 6.1.2 Entering the mobile number of the recipient

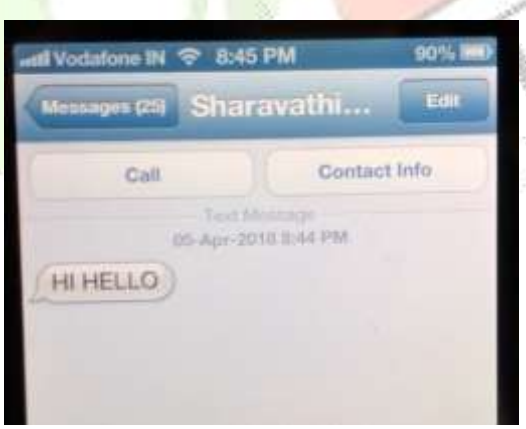

Fig 6.1.3 Output of SMS to the required person.

6.2 SMS Reception

Fig 6.2.1 Replying to the SMS received.

Fig 6.2.2 Receiving the message and display on the LCD

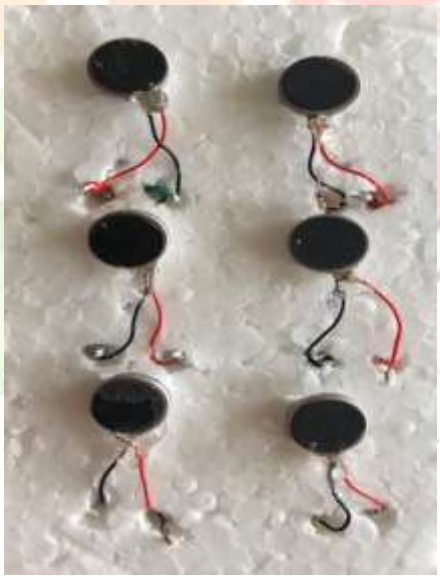

Fig 6.2.3 Vibration Motors arranged in 3*2 matrix format to decipher the characters.

VII. CONCLUSION

The proposed Braille based SMS system has been implemented successfully using the OpenLab Kit by interfacing the various modules with ARM. Thus, the user can send the desired SMS to the required person using Braille keypad and read the received SMS, character by character through the vibrations on the vibration motors.

The system helps in overcoming the difficulties faced by the visually challenged and provides an effective way of communication. It also increases the ease of use for the people since it does not require any additional training to use it.

VIII. ACKNOWLEDGEMENT

The authors like to acknowledge the guidance from project guide for execution of the work, Etiq technologies for providing the Open Lab embedded kit and Department of Medical Electronics, B M S College of Engineering (BMSCE), Bangalore, India for providing necessary infrastructure for successful execution of the work. We would also express our gratitude to Technical Education Quality Improvement Programme (TEQIP-III) of MHRD, Government of India for the support through BMSCE.

IX. FUTURE SCOPE

- Voice output can be given for the input as well the output sections for each of the character entered thus enabling the user to effectively utilize the system.
- The device apart from being used as a stand alone system for SMS communication it can also be used as an I/O device.
- The system can be designed to operate in two modes. One mode could make the device work as an SMS system and the device could be used as an I/O device which can be interfaced with computer.
- It is often seen that the computer systems used in the work environment of visually challenged people are laborious to use ,thus the idea proposed above would make life easier for them.
- However, to make such a system, driver software needs to be designed and incorporated on to the system, also a serial communication port needs to provided which would enable our device to get physically connected to the computer and interact with the same.

X. **References**

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