ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

Volume 3, Special Issue 3, March 2014

2014 International Conference on Innovations in Engineering and Technology (ICIET'14)

On 21st&22ndMarch, Organized by

K.L.N. College of Engineering, Madurai, Tamil Nadu, India

Wearable Solution for Visually Impaired Person

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Abstract— The proposed work explores a wearable messaging device that uses embedded technology for visually impaired person. The data input functionalities used in a hand glove based keyboard of existing technologies. The hand –mounted keypad is user friendly to the visually impaired and is easily adaptable. No prior knowledge is required to handle this hand mounted wearable device. The key glove is a prototype that enables users to have total functionality of a keyboard in one hand. Key glove is attached with alpha numeric keypad buttons are mounted in fingers. To generate key press codes by touching combination of buttons. These buttons are mounted in fingers and the combination of two finger can be used to generate character. Compared to existing work that uses multi sensor contacts, the proposed work increases the character set using finger contact combination. The hand mounted keypad can be interfaced with any kind of display device. It can be used for visually impaired person to send message in text format and receive reply from others in voice format using Arduino GSM kit. The efficiency of the proposed work is evaluated with reference to decreased error rate and increased speed of operation.

Index Terms-
Wearable input device, embedded technology, key gloves, alphanumeric keypad, GSM

I. INTRODUCTION

Mobile technology has assumed an important role in everyone's day to day life, yet their complexity and design has often made them difficult for visually impaired people. Visually impaired people can learn science and technology with little effort but they face difficulty in handling this technology at ease. Though technological development has been a blessing to many, visually paired persons are yet to enjoy it with ease. They face many difficulties in experiencing and enjoying technologies to the fullest. Portable devices are usually compactness and light weight. They can be easily carried (but not worn) by the user and require constant hand interact. Mobile phone is not an exception. It has become vital in the lives of almost every individual. But visually impaired person are unable to use it at ease. There are many works being carried out to make their life a breeze. There are about 135 million people around the world who are partially or totally blind. As they lack vision, they face many barriers in their day-to-day life. Braille language helps the blind and visually impaired to gain education. Braille refreshable displays help them to operate systems. Braille keyboard, a portable input device, helps blind people to input the information. Wearable technology is an important developing technology associated to the field of ubiquitous computing and development of computers. Father of wearable computing, Steve Mann, has developed number of wearable computer systems. Following him, half QWERTY hand gloves keyboard has been designed by Scott MacKenzie and William Buxton. It is "Typing with one hand using two hand skills". A keyboard glove is one such invention that allows the blind and visually impaired to input information at ease. Key glove is built to support physically relaxed single-handed operation, which is also perfect for handicapped or disabled users. The glove is powered by Microcontroller Board and features multiple sensors that when activated in different combinations types letters. A microcontroller has a dedicated input device and often has a small LED or LCD display for output. A microcontroller also takes input from the device it is controlling and controls the device by sending signals to different components in the device. Microcontrollers are dedicated to one task and run one specific program.

II. RELATED WORK

A wearable field, new approach of the system is hand mounted keypad in which exploits the skills already developed in two handed typing. It is called Half-QWERTY keypad [2]. It used only half of the QWERTY keyboard. The technique can be used on a standard QWERTY keyboard by implementing Half-QWERTY on a standard keyboard; one can easily switch between this type of input and two-handed typing. In effect, the user has a choice of three keyboards in one, two-handed QWERTY keyboard, and two Half-QWERTY keyboards, one for each hand. By eliminating infrequently used keys.LCD Screen worn on the other wrists, the resulting typing posture allows the user to type and view the display.

The key glove [4] utilizes an interface similar to that of cell phones where several keys are encoded in a single contact. This reduces most of the keys of a 101-key keyboard into 11 contacts only. The purpose of the 16-key encoder is to reduce the number of wires connecting from the glove to the computer. Any connection between a row and a column would then be encoded into a 4-bit output. Each specific encoded output would represent a particular key. The key character assigned and its corresponding output under a specific pair of rows and columns. Here there is no key assigned for the pair C4 and R4.The 4x16 decoder is a TTL device such that if it has no input, it would only send logic low in its 16th bit output. In other words, if no contact is connected with another, the prototype would always send the key assigned for the 16th bit output. To send a high signal from the output, the output from the decoder must pass through inverters.

The keys of a chord keyboard [5] that are mounted on the fingers of a glove. A chord can be made by pressing the fingers against any surface. Shift button placed on the index finger enable the glove to enter the full ASCII character set. The chording gloves is designed as a text input device for wearable computers and virtual environments. For beginning and moderate users, a chord keyboard should be fast or faster than a QWERTY keyboard. The average overall speed was 8.9 1.4 words/min. The error rate has been calculated as the ratio of chording errors to the total number of characters. This is shown to be 27 2.5% after tutorial. The chording speed has been found to be increased over the sessions with no signs of leveling off. The average Chording speed of the final session is 16.8 2.5 words/min. The final error rate has fallen to 17.4 0.6% with some signs of leveling off. The authors have implemented keyboard keys in both hands.

The hand mounted keypad device [1] provides multiple contacts on each finger that are only activated when the appropriate finger and thumb contacts are combined. Two different key maps have been proposed, one is wired prototype and another one is wireless prototype. Finger contacts 1-8 are located on the palm-side of the user's hand near the tops of the fingers or the fingertips. There is one finger contact on the pinky, ring, middle and index finger of each hand (1- 8). Also, there are six contacts A-F, A0-F0 on each thumb; three contacts on each inner thumb and three contacts on each outer thumb. As described in more detail below, signals for letters A-Z are generated by contacting one of the finger contacts 1-8 with one of the six thumb contacts A-F, A0-F0 on the same hand. Character Input is connected in analog pin of microcontroller. Wireless keyboard mapping based on four thumb contacts (T1-T4) and six finger contacts (LP, LR, LM, LI1-LI3) placed on the pinky, ring, middle and index fingers as shown in Contact T1 is placed on the thumb nail, T2 on the thumb pad, T3 on the center of the thumb pad and T4 on the bottom of the thumb pad. As for the prototype key-map described in finger-contacts represent rows and thumb-contacts represent columns on a standard keyboard. Bluetooth wireless technology is being used extensively in wireless and portable devices like cell phones and PDA's, and has become a wireless standard. It provides plug and play type connectivity between any two or more Bluetooth devices.

The inbuilt ADC [6]receives analog data from sensors and converts it to digital data and passes it to the microcontroller. The sensors continuously send data from the distant site. This system is interfaced with a GSM modem. this system senses the conditions continuously and a message is sent to a mobile no. using SMS on LCD every 10 minutes. Using this system, the operator can monitor the signals from anywhere. The GSM modem is connected to microcontroller using RS232 interface. Whenever an SMS is sent to the GSM modem, the GSM modem receives the data and sends to microcontroller. After receiving the signal from the microcontroller it processes the data and sends the read data to mobile number through GSM modem.

III. PROPOSED WORK

A. System Architecture

The block diagram in Fig 1 shows the methodology of the proposed system architecture. The proposed Hand mounted glove based keypad can be worn in any hand (left or right). Key buttons are attached with Glove.

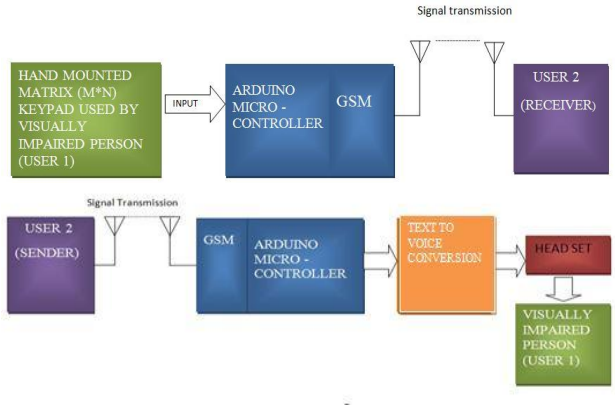

Fig 1 Communications between Two Users
a) User1 to User 2 Communication
b) User2 to User 1 Communication

Basically this keypad is a matrix type keypad (M* N). Combination of two fingers shows a Character which can be displayed in LCD. Pressing two buttons generate a signal that can be passed to Arduino Microcontroller. In the proposed system, GSM interface with Arduino Microcontroller is used. Thus the one user can type and send a message to any other user. With the help of cellular network the receiver can received the Call/SMS.

The received user's reply message will be received by GSM modem. And the control message is sent to Arduino microcontroller board. Finally the message will be received by the visually impaired people. Text message is converted into Audio message using speak jet IC. Visually Impaired person hearing the reply message and can reply in text format. Thus wearable device can be used as Mobile phone as well as act as keyboard of PC or other devices.

The Sequence diagram for the model is shown in Fig.2

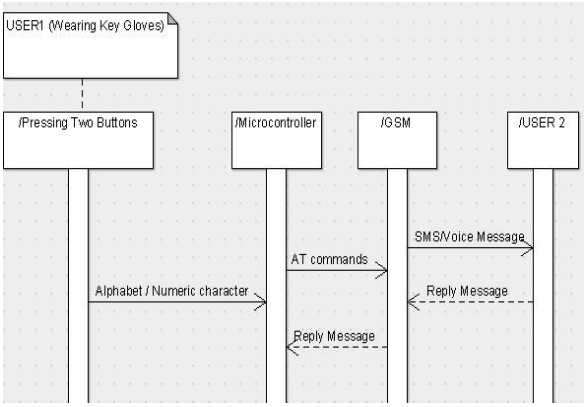

Fig 2 Sequence Diagram

B. Key mapping

Key mapping design is an important role in the proposed work. Key mapping design is flexible to type the character. Keys are arranged in Alphabetical order. The user however, needs prior knowledge of key position. Two main keys Alpha and Numeric are placed in the thumb finger on hand. Alphabetic, Numeric, Arithmetic operators, Backspace, Enter keys are placed on the remaining four fingers. ASCII values 65, 48 are placed inside of Alpha and numeric keys respectively. In the same manner remaining ASCII values are placed inside of other keys. (A-Z, 0-9, Arithmetic Operation, symbols).

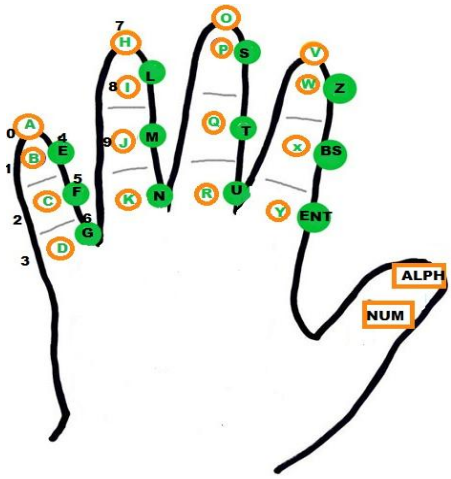

Fig 3 Gloves Design

Combination of alpha and any other keys except control will produce the alphabets. Combination of Numeric and any other keys except Alpha will produce the Numeric. In the existing technology, the input will be given by using Analog pin. In result; it produced the Ambient Noise which may affect the accuracy of the system. To avoid this error the new system is proposed. Alphanumeric keyboard is used instead of QWERTY keyboard. It is easier to type letters alternating between hands. QWERTY keyboard has been designed for the machine, to improve the performance of the machine not the typist. In the proposed methodology, instead of analog pins Digital pins have been used for getting input. As a result, it completely avoids the ambient noises which exist in the existing systems.

C. Arduino Mega 2560 Microcontroller

In this study, Arduino (single board microcontroller) is used to make electronic circuits in multi-disciplinary projects. It consists of an open source hardware board designed around an 8-bit Atmel AVR microcontroller. Some shields communicate with the Arduino board directly, and in, allowing many shields to be stacked and used in Switch consists of four pin which are vertically connected to the bread Board. A Right side pair of vertical pin is connected to ground (black wire).Similarly, Left side pair of vertical pin is connected to Digital pin (blue wire) and Vin (red wire).Resistance is connected between two side, one end is connected in Vin (left pair of the switch) and another end of the resistance is connected in Switch. Similarly, all switches are connected in same way. Press Left side switch (0, 1, 2) and Right side switch (Alphabetical, Numeric) at a time to display the Character in the output screen. GSM module is interfaced using the serial port of the Arduino board.

D. Integrated Development Environment

The board and development tool have been connected through the serial port communication. For establishing the connection, the designer has to select the board model and port number.

E. EEPROM

In this proposed methodology, the two kind of memories are used namely chip (IC), board. The memory requirement for storing and retrieving a data is exceed the total memory space of IC. Hence the EEPROM (internal memory) is required for storage. It had a lookup table which stores the equivalent ASCII value for a character. If required, the IC will access the data from the EEPROM.

IV. EXPERIMENTAL RESULT

The connection between Bread Board and the Arduino Board are showed in Fig 4

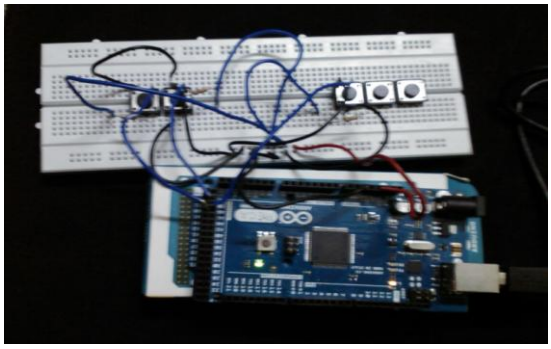

Fig 4 Bread Board Connections with Arduino Board

The Characters being displayed on the screen when both the switches are pressed simultaneously as shown in Fig 5

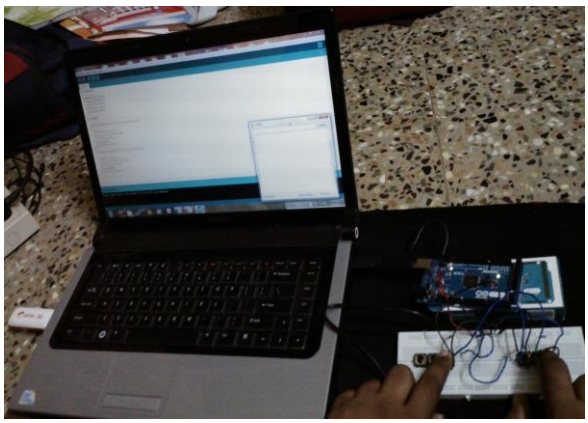

Fig 5 Working in Breadboard

For establishing a communication, the GSM modem is used as an interface with Arduino board as shown in the Fig 6

Fig 6 GSM connected with Arduino

In Arduino IDE displayed the output through the serial port monitor shown in Fig 7

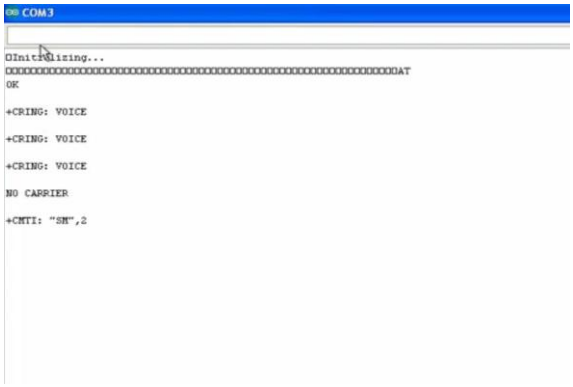

Fig 7 Text/Voice Communications

Message and voice can be received successfully using Arduino 2560 microcontroller and GSM modem.

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IV.CONCLUSION

The concept of wearable computing used for this work implementation is learnt in detail. Literature related to the problem proposed is reviewed and a deeper insight of the need for this wearable device application is justified. A detailed design flow for the entire project is formulated which is used during the design and implementation of this project. Ambient noise is minimized using digital pins. Key mapping is done for two key combinations and the output was displayed in Arduino IDE. Further enhancement will be implementation using the hand gloves and gloves can be integrated with GSM modem. Communication can be achieved from the hand glove to any mobile devices using GSM. In future work Speak Jet is integrated with Arduino mega 2560 Microcontroller and it converts reply message from text to audio.

ACKNOWLEDGMENT

The authors gratefully acknowledge the Knowledge shared by Jeff Rowberg, Senior Field Application at Bluegiga Technologies, Roanoke, Virginia, USA, Pertaining to the project work.

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