BRAILLE HAND GLOVE - A REAL TIME TRANSLATION AND COMMUNICATION DEVICE

Project report submitted in partial fulfillment of the requirements for the Degree of

BACHELORS OF TECHNOLOGY
IN
ELECTRONICS & COMMUNICATION ENGINEERING

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TABLE OF CONTENTS

DECLARATION BY THE SCHOLAR

We hereby declare that the work reported in the B-Tech project work entitled **"Braille hand glove - a real time translation and communication device"** submitted at **Jaypee University of Information Technology, Waknaghat** is an authentic record of our work carried out under the supervision of **DR. MEENAKSHI SOOD**. We have not submitted this work elsewhere for any other degree or diploma.

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SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the B-Tech. thesis entitled **"Braille hand glove - a real time translation and communication device"**, submitted by **Rahul Saxena, Pragya Sharma and Tarunam Mahajan** at **Jaypee University of Information Technology, Waknaghat** is a bonafide record of their original work carried out under my supervision. This work has not been submitted elsewhere for any other degree or diploma.

Dr. Meenakshi Sood

Date: 25-05-2016

ACKNOWLEDGEMENT

"EXPRESSION OF FEELINGS BY WORDS MAKES THEM LESS SIGNIFICANT WHEN IT COMES TO STATEMENT OF GRATITUDE"

The joy and sense of fulfillment that comes along the successful completion of any task is incomplete without thanking all those people who made it possible with their guidance and constant word of encouragement. We especially thank **Dr. Meenakshi Sood**, our **project guide** for giving extremely valuable guidance and support throughout the course of the project. We would also like to express sincere appreciation to our **Head of Department**, **Prof. S.V.Bhooshan** for having extended all department facilities without hesitation. We thank almighty for giving us such excellent facilities and support through the way of **JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY**, for giving us the opportunity for completion of this project. We would also like to extend our heartfelt gratitude to our lab incharge Mr. Mohan whose constant encouragement and help and support made this project a fun-to-do activity. Last but far from least, we thank all the staff members of **Electronics and Communication Engineering Department** for their kind co-operation and timely help.

ABSTRACT

Visually impaired people are excluded from most forms of communication and information. These are the ones who have the inability to see to a degree that causes problems not fixable by usual means and the people with complete vision loss are termed to be blind. With the exponential growth in technological era, blind people face many problems when it comes to accessing the digital data. In this project, a real-time integrated solution of hardware and software is developed to help the visually impaired people all across the globe to support the communication and interaction of such individuals, thus fostering their independence. The fundamentals of the proposed system are based on Braille which is the system of embossed writing invented by Louis Braille that gradually came to be accepted throughout the world as the fundamental form of written communication for blind individuals in which reading is done character by character. This concept is evaluated for the blind voluntaries with ample amount of hands-on experience and knowledge about Braille. The successful implementation of real-time two- way translation between English and Braille, and communication of the wearable device with a mobile phone opens up new opportunities of information exchange which were hitherto un-available to blind individuals, such as remote communication, as well as parallel one-to many broadcast. The glove also makes communicating with laypersons without knowledge of Braille possible, without the need for trained interpreters.

LIST OF FIGURES

LIST OF TABLES

Chapter-1

INTRODUCTION

1.1 HISTORY OF BRAILLE

Braille is a system of raised dots that can be read with the fingers by people who are blind or who have low vision. Braille is not a language. Rather, it is a code by which many languages—such as English, Spanish, Arabic, Chinese, and dozens of others—may be written and read. Braille is used by thousands of people all over the world in their native languages, and provides a means of literacy for all. The basis of the Braille system is known as a braille cell (Fig 1.1). The cell is comprised of six dots numbered in a specific order. Each cell represents a letter, numeral or punctuation mark. Some frequently used words and letter combinations also have their own single cell patterns. It was based on a tactile military code developed by Charles Barbier known as night writing or sonography.

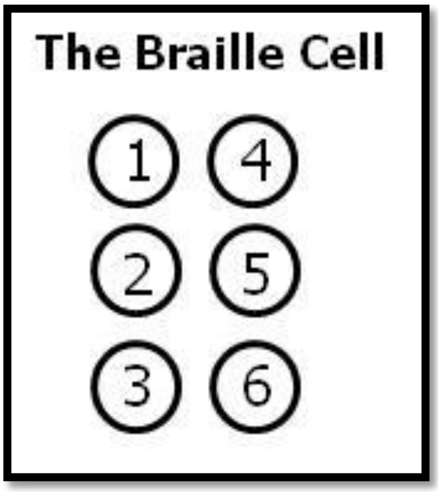

Fig: 1.1: Representation of a Braille cell

Since its development in France by Louis Braille in the latter part of the nineteenth century, braille has become not only an effective means of communication, but also an essential avenue for achieving and enhancing literacy for people who are blind or have significant vision loss.

Braille is also produced by a machine known as a braillewriter. Unlike a typewriter which has more than fifty keys, the braillewriter has only six keys, a space bar, a line spacer, and a backspace. The six main keys are numbered to correspond with the six dots of a braille cell. Because most braille symbols contain more than a single dot, combinations of the braillewriter keys can be pushed at the same time.

Technological developments in the computer industry have provided additional avenues of literacy for Braille users. Software programs and portable electronic Braille devices allow users to save and edit their writing, have it displayed back to them either verbally or tactually, and produce a hard copy via a desktop computer-driven Braille embosser. Because the use of computers is so common in school, children learn how to spell words out letter for letter so they can spell and write using a keyboard.

Braille, combined with technology, can open up the world for the less fortunate ones. Modern technology has made many useful tools for people who read and write braille. There are some devices that produce books in braille and others that let people read information on computers and from the Internet. Some devices are simple and inexpensive and others are very complicated. The devices below are used by many people who read braille to complete their schoolwork, take care of personal business, and do their jobs at work.

1. **Electronic braille notetakers** are portable devices with braille keyboards that braille readers can use to enter information. The text stored in these devices can be read with a built-in braille display or the device can read aloud with a synthesized voice.

2. The **Perkins braillewriter** works a little bit like a typewriter. It has six keys—one for each dot in a braille cell—a space bar, a backspace key, a carriage return, and a line feed key. The braillewriter uses heavyweight paper (just like the braille printer) but it doesn't need any electricity to work

3. **Electronic braille display** is a device that has a row of special "soft" cells made of plastic or metal pins. The pins are controlled by a computer and move up or down to display, in braille, the characters that appear on the computer screen.

4. **Screen Braille Communicator:** This is a small, portable device that enables them to communicate with sighted people. The device has a QWERTY keyboard with an LCD display on one side, and an eight-cell braille display on the other side. The sighted person types short text on the QWERTY keyboard. The deaf-blind person reads the printed text by placing his or her fingers on the braille display. He or she then uses the braille display to type back text. The sighted person can read the text on the LCD display.

The important point to take note is that all of these devices are meant for reading and writing i.e. face-to-face communication without any involvement of long distance communication. The above mentioned devices are conventional. Braille Hand glove is one such device which can help the blind to send and receive messages via cell phone. It is an effective two way communication device and the basic technology used is a microcontroller. A blind person will be able to send and receive a text message to/from any of the contacts in his SIM card with the help of this glove.

1.2 MOTIVATION

We are living in the era of Digital Revolution, which is making dramatic changes to our lives every day. Leveraging these technologies can provide the blind and visually impaired affordable, unlimited access to the digital world, yet participating in the Digital Age begins with literacy. Digital audio apps are useful, but listening is not literacy. Everyone, blind or sighted, must be able to read and write. Even as technology has become the primary means of communication, braille remains relevant. Those who learn braille and develop fluency with technology have a significant advantage, but it must be affordable to truly level the playing field. There are 39 million visually impaired people in the world and they are challenged in their daily lives by living in a sighted world. They also have an equal right to education and knowledge. But their ability to learn new stuff is drastically compromised. They have to rely on conventional methods of obtaining information. As a result, they are unable to access the information hub i.e. the internet. Emails, text messages, internet blogs, e-books etc. have become an integral part of our life and the visually impaired unfortunately are deprived of such facilities. To obtain information necessary to carry out normal day-to-day activities, this low cost real-time communication braille hand glove is one device which can immensely benefit the visually impaired people, who work in the computer environment. This concept will go a long way in helping them learn on an equal footing with their sighted counterparts.

The quality of interaction between blind people and the social environment can be tremendously improved with a combination of human efforts and technology. The challenges faced by the visually impaired population have been brought to light when Braille was developed. Since then, all over the world, this system has been adopted as a primary means of reading and communicating with the blind people. They are at a very high risk of being socially excluded as a result of poor access to information. In recent years, several attempts have been made in improving the communication methods for visually impaired people.

One of the most challenging tasks for the visually disabled is recognizing the characters because they are of complex shapes and very small in size as compared to the physical obstacles. In recent years, several attempts have been made which involve tactile sensation such as the print on palm method, manual alphabets, finger Braille, and several other electronic devices. But these methods had certain disadvantages such as lack of compatibility to computer environment, lack of privacy etc. In some cases, due to prolonged use, a person with diabetes loses sensitivity in fingertips. Also, Braille is now being targeted because of following limitations

- Computer Braille related software and hardware equipments are less in use
- Most of the Braille equipments are mechanical
- There have hardly been any devices for educational purpose and routine communication.

So, this project is a step towards improving the quality of life for the blind people. Reducing their dependency on their friends and family by developing such self help devices will help them to live a better life.

1.3 OBJECTIVES

The most important challenge for parents, caregivers, and teachers is to communicate meaningfully with the child who is blind. Continual good communication will help foster his or her healthy development. Communication involves much more than mere language. In today's technologically advanced world, where people communicate through social networking and present ideas on a global scale, an individual has become more resourceful. This is the point where visually impaired people can feel a certain let down, especially in case of distant communication. When it comes to using basic features of a phone like text messages, emails etc, and the blind people have a tendency to become socially excluded. Hence in our project, we have focused on technology-based solutions to blind communications which are specifically designed to facilitate distant communication: their costs, potential benefits, and detriments.

The project is divided into two basic modules:

Objective 1: BRAILLE GLOVE AS A RECEIVER
Objective 2: BRAILLE GLOVE AS A TRANSMITTER

1.4 BACKGROUND AND LITERATURE REVIEW

The visually impaired reader moves his fingers over the paper, detecting the points standing out in relief, and associates a combination of points with a letter. The blind are capable of reading 150 words per minute (300 to 1,000 words per minute for sighted person).The threshold of sensitivity of the skin corresponds exactly to the dimensions of a Braille character. The sensitivity of an organ is defined by the sensitivity threshold to a mechanical stimulation (entry of a point to a depth of 6 μm) and the spatial discrimination threshold (separation measured with dividers). Lowest thresholds occur at the tip of the tongue and on the fingertips (1-3 mm). The fingers have a very high density of touch receptors, which has led to an over-representation of the fingers in the somato-sensory cortex. The threshold of sensitivity of the skin corresponds exactly to the dimensions of a Braille character. The detection of Braille characters depends entirely on Merkel cells and Meissner corpuscles. Merkel cells, which are stimulated by angles, points and curves, provide the spatial characteristics of the Braille symbols, while Meissner corpuscles supply the temporal information. Because of the discrimination threshold, a Braille character is 4 mm x 6 mm, thus an A4 Braille page (21 X 29.7) only contains 27 lines of 30 Braille characters. A Braille book thus occupies 3 to 6 times more volume than the same document in normal script. Hence many reading devices for the blind were developed.

In 2007, Finger Braille Recognition System became the basis for many of the research papers that were published. It involved use of the first finger, the middle finger and the ring finger of both the hands to represent the six dots of the Braille cell. A sender dots Braille code on the fingers of a receiver like whether he/she does the type of the Braille typewriter. Then the receiver recognizes the Braille code. Blind people who are skilled in finger Braille can catch up with speech conversation and express various emotions. Because there are small non-disabled people who are skilled in finger Braille, deafblind people communicate only with interpreters. For instance, a finger Braille teaching system and a teaching interface which taught clauses explicitly, was developed. The teaching system recognized non-disabled people's speech and converted to Braille code. By parsing the Braille code, the teaching system retrieved clause information and segmented the Braille code into clauses. Then the dot pattern of the Braille code was displayed. By observing the dot pattern, non-disabled people dotted Finger Braille to blind people. An evaluation experiment between a blind person who was skilled in Finger Braille and two nondisabled people who were non-skilled in Finger Braille was carried out. The results showed that the fundamental functions (speech recognition, conversion to Braille code and clause segmentation) were practicable; the nondisabled senders could dot finger Braille accurately and communicate with the blind receiver directly. Therefore it was considered that the teaching system was effective. This was published in 2007 International Conference on Mechatronics and Automation.

Another research paper was published in 2010. Rather than incorporating sensors on both the hands, the paper focused on just a single hand glove with sensors and motors to allow easy face to face communication. The glove was connected to an LCD display via microcontroller which displayed text in English converted from Braille. This paper was published in International Journal of Advanced Computer Science and Applications in 2010. Thereafter, many prototypes have been developed for the blind using single hand Finger Braille concept. The major obstacle is the cost. All the products so far are advanced in their design and architecture but the cost per unit runs very high to be afforded by a layman.

This project focuses on developing a low cost prototype incorporating single hand Finger Braille for long distance communication. It combines technology of text messaging with hand gestures. Modifications can be made to use the same concept to further implement wireless applications and to interface hand gestures with emails, voice calls and other features of a smart phone. With rapid technological advancement, such real time communication applications will find a huge market. Such products will also be useful for education of blind people.

1.5 SCOPE

The high cost of technology has led to a general acceptance of the idea that one line of braille on a braille display device is okay. A multi-line display, however, would be more useful. But in recent years, the combination of Braille and technology has attracted attention of a lot of scientists and entrepreneurs. In the near future, advanced products prototypes have come which aim to make tactile sensing easier for the blind. The aim now is to reduce the cost. Piezoelectricity is popular as a technology for refreshable braille because it’s fast. Any new display technology needs to meet this bar.

After all the development that is going on in field of tactile sensing, the key idea boils down to five main parameters that have to be worked upon in future. They are as follows:

- **Cost:** The further designs have to be cost efficient to make the product widespread and accessible to all.
- **Size:** This is the biggest issue in designing a realizable product. Haptic QWERTY keyboards are emerging, but these are fifty times larger than a braille dot. Braille dots are very small, so it needs to be scaled down, but it’s too big a

leap right now. The smallest tactile switches and keys are five times the size of the braille dot. Tiny mechanisms are expensive.

- **Power consumption and portability:** The successful technology needs to be low-power, portable, and cool and can't include a heavy battery or require a main outlet.
- **Reading speed:** Piezo can react very quickly. Maximizing speed requires power, higher temperatures, and increased noise. All are too sensitive to noise, especially when it comes to reading in a group.
- **Reliability:** Piezo requires a lot of care and maintenance but can provide millions of cycles when kept in good condition. Most other technologies cannot meet that bar.

Chapter 2

PROPOSED ARCHITECTURE

In this project, we designed a Braille Hand Glove which will serve as an effective communication method to send and receive text messages to/from a visible person. This real-time, easy-to-use tool tends to create new and stimulating conditions for the blind people. The proposed method is divided into two modules:

Module A is designed for receiving or reading the text using the six vibration motors. Module B is designed for writing text messages to the person at the receiving end accomplished by slot sensors. The two modules are detailed in the following section:

2.1 RECEIVING MODULE

For the glove to function as a receiver, each of the fingers of the glove as well as the palm, is fixed with a small sized coin vibration motors. The location of the motors is indicated in the diagram below. (Fig: 2.1) These motors will receive the input from the microcontroller. Only those motors will vibrate simultaneously which will correspond to the black dots of the particular letter. And this will be possible with the help of a conversion code that will convert the English text message to Braille.

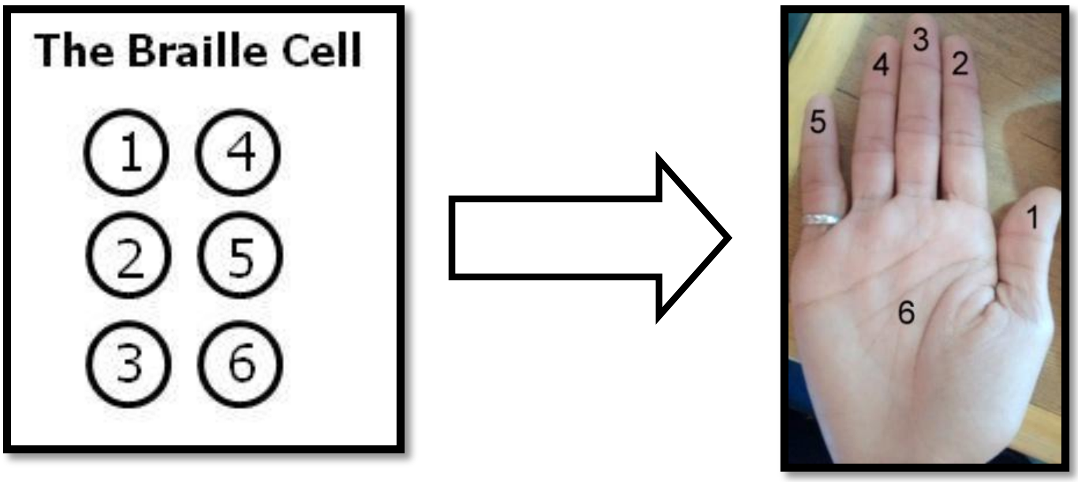

Fig 2.1: Mapping of Braille script on the hand to place the motors

The block diagram shown in figure 2.2 is that of the receiving module. The main components of the receiving module:

1. Six vibration motors
2. Microcontroller i.e., ARDUINO UNO
3. Connecting wires
4. GSM shield
5. SIM CARD

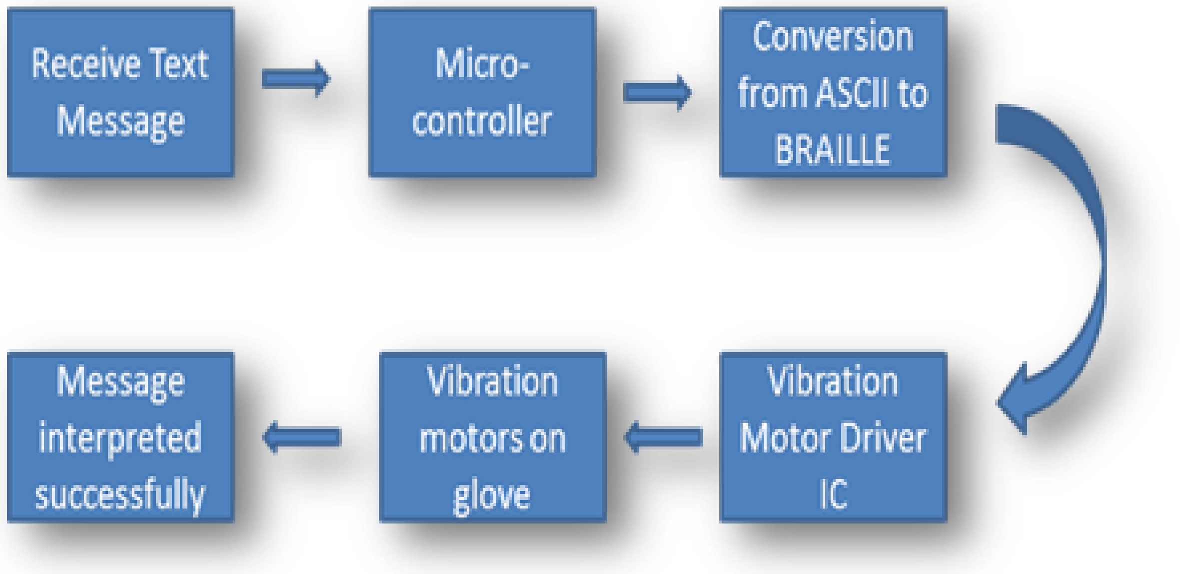

Fig 2.2: Block Diagram of Receiving Module

As seen in the block diagram, a text message is received from the person at the other end using a GSM shield. This message received through the GSM shield acts as an input to the microcontroller. The message after being received is to be processed to make it comprehensive to the receiver. The ASCII values of the text message are extracted and the English letters are converted to corresponding binary code using the look up table as shown in Fig 2.3. In the look up table, each alphabet is mapped to its unique binary equivalent and the final binary output is obtained on the output pins of the microcontroller. The binary output from the microcontroller provides sufficient voltage supply for the vibration motors which are fitted on the ventral side of the glove.

The conversion algorithm as written down in the code using Arduino IDE is used to vibrate the six vibration motors that are fitted on the ventral side of the hand glove. These vibration motors vibrate in accordance to the binary code which is a formulated from the alphabets in Braille language. As a result, the blind people can easily decipher the message received due to their proficiency in Braille.

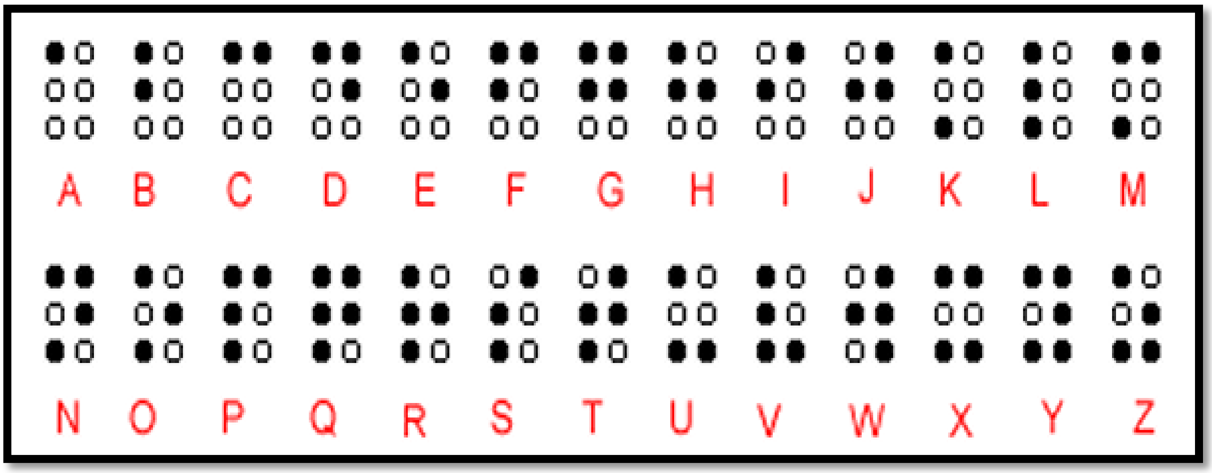

Fig 2.3: Lookup table used in Conversion Algorithm

The step-wise-step working of the receiving module is given below:

2.1.1 RECEIVE TEXT MESSAGE

When the microcontroller based systems are connected with the GSM network, it enables the user to control the system by sending or receiving messages. The advantage of using a GSM communication with a system or device is that the user can control the system wirelessly no matter how far it is kept compared to any other wireless communication, provided that both the user and the device should be in a cellular coverage area.

The mobile phones have built-in GSM modules which can be used by the processor inside the phone to make a call, send or receive message or even connect with the GPRS network. When it comes to a microcontroller based system a separate GSM module is used rather than using a cell phone as such. There are GSM modules available which can do serial communication with microcontroller based systems. The communication is done by sending or receiving AT commands with the GSM module.

Any AVR microcontroller based board which follows the standard Arduino schematic and is flashed with the Arduino bootloader is called an Arduino board. The Arduino is referred to as an open source hardware and the Arduino IDE is also an open source and anybody can contribute their libraries to the Arduino. All arduino boards are compatible with the Arduino IDE which can be used to program the Arduino boards. Using this programming technique, code is written down in order to receive a text message.

2.1.2 MICROCONTROLLER

The microcontroller used in our project is Arduino UNO. The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

The technical specifications are given below:

Table 2.1: Technical Specifications of Arduino UNO

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V

Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

(a) Programming

The Uno can be programmed with the Arduino Software (IDE). Select "Arduino/Genuino Uno" from the Tools > Board menu (according to the microcontroller on your board). The ATmega328 on the Uno comes preprogrammed with a bootloader that allows one to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

(b) Power

The Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.
The power pins are as follows:

- **Vin**: The input voltage to the Uno board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- **3.3V**: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**: Ground pins.
- **IOREF**: This pin on the Uno board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

(c) Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

(d) Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts.

Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

There are a couple of other pins on the board:

- AREF: Reference voltage for the analog inputs. Used with analogReference().
- Reset: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

(e) Communication

The Uno has a number of facilities for communicating with a computer, another Uno board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

2.1.3 CONVERSION FROM ASCII TO BRAILLE

The Hardware algorithm used in the hand glove is based on the retrieval value of English letter as ASCII value from the user typed in the software tool. The ASCII value is applied to 26 procedures and it activates the corresponding vibration motors as follows.

Read the input values one by one and convert it into the corresponding ASCII value up to the NULL value. Converted ASCII value is applied to 26 alphabets as per the following conditions: If the Input value is between "a" to "z" (ASCII Value 97 to 122) then the corresponding ASCII procedure number is activated and vibrates the motors on the glove.

Twenty six ASCII procedure numbers are linked with six digit binary numbers in an array. The presence of 1‟s in a six digit binary value is nothing but rising position of the Braille symbol. So the presence of 1‟s in a six digit binary value activates the corresponding vibration motors in the hand glove. The ASCII value from 97 to 122 is lower case letter "a" to "z".

These procedure numbers are linked with six digit binary number and ASCII value which are tabulated as follows:

Table 2.2: ASCII –Procedure Number for Lowercase Alphabets

PROCEDURE NUMBER	INPUT CHARACTER	ASCII VALUE	BINARY BRAILLE REPRESENTATION					
			D5	**D4**	**D3**	**D2**	**D1**	**D0**
1	a	97	0	0	0	0	0	1
2	b	98	0	0	0	0	1	1
3	c	99	0	0	1	0	0	1
4	d	100	0	0	1	0	1	1
5	e	101	0	1	0	0	0	1
6	f	102	0	0	1	0	1	1
7	g	103	0	1	1	0	1	1
8	h	104	0	1	0	0	1	1
9	i	105	0	0	1	0	1	0
10	j	106	0	1	1	0	1	0
11	k	107	0	0	0	1	0	1
12	l	108	0	0	0	1	1	1
13	m	109	0	0	1	1	0	1
14	n	110	0	1	1	1	0	1
15	o	111	0	1	0	1	0	1
16	p	112	0	0	1	1	1	1
17	q	113	0	1	1	1	1	1
18	r	114	0	1	0	1	1	1
19	s	115	0	0	1	1	1	0
20	t	116	0	1	1	1	1	0
21	u	117	1	0	0	1	0	1
22	v	118	1	0	0	1	1	1
23	w	119	1	1	1	0	1	0
24	x	120	1	0	1	1	0	1
25	y	121	1	1	1	1	0	1
26	z	122	1	1	0	1	0	1

2.1.4 VIBRATION MOTORS ON GLOVE

The main component in the Braille glove is a vibration motor. There are two types of motors. i.e. coin (or flat) and cylinder (or bar). Cylinder type motors are simple brush motors with a traditional axial design. The centric movement of the weight attached to the rotor provides vibration during operation. But coin type of vibrator motors are best fit in the tip of the finger positions inside the Braille glove. So Braille glove is constructed with coin type motor. In Coin type motor the amount of vibration is directly proportional to the voltage applied to the motor. Coin motors are manufactured in high volumes and are fairly inexpensive. An electrical current applied to the coil in the direction of the arrow generates upward force on the left side of the coil and downward force on the right side, causing the coil to revolve clockwise.

The vibration motors that are to be mounted on each of the five fingers of the hand glove as well as the palm are similar to the motors used in pagers or cell phones that are easy to mount and have adhesive backing. These motors are ERM (Eccentric Rotating Mass) motors, i.e. a DC motor with an offset (non-symmetric) mass attached to the shaft. As the ERM rotates, the centripetal force of the offset mass is asymmetric, resulting in a net centrifugal force that causes displacement of the motor. With a high number of revolutions per minute, the motor is constantly being displaced and moved by these asymmetric forces and the repeated displacement is perceived as a vibration. The revolutions can be controlled with the voltage supply.

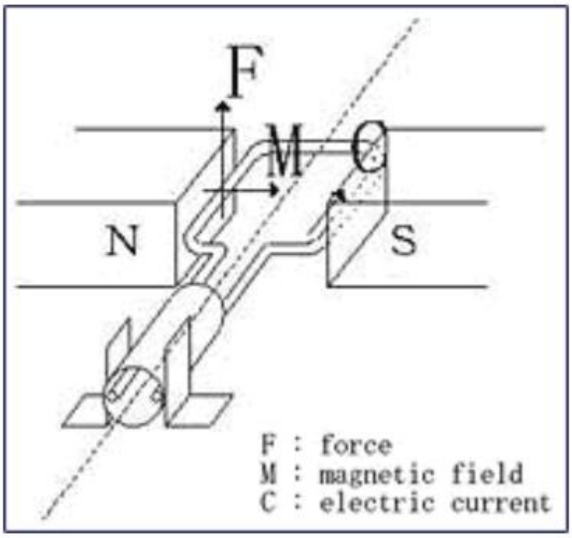

Fig 2.4: Working Principle of Vibration Motor

2.1.4.1 PRINCIPLE OF VIBRATION:

In Vibration motor, Counter weight is fitted in the end of the motor body shaft. When the shaft turns, the imbalance in the counter weight causes the coin type motor to vibrate. The various types of coin type vibration motors are listed below in the table 4.2. The 4CR R3.0*L3.5x150 type vibrator motor is used in Braille hand glove. It is fixed on the top tip of each finger in right hand and center of the palm. The principle design of the Braille hand glove is based on the six dots of the Braille cell. Similarly Braille glove contains six vibration motors which is equivalent to six dots of the Braille cell.

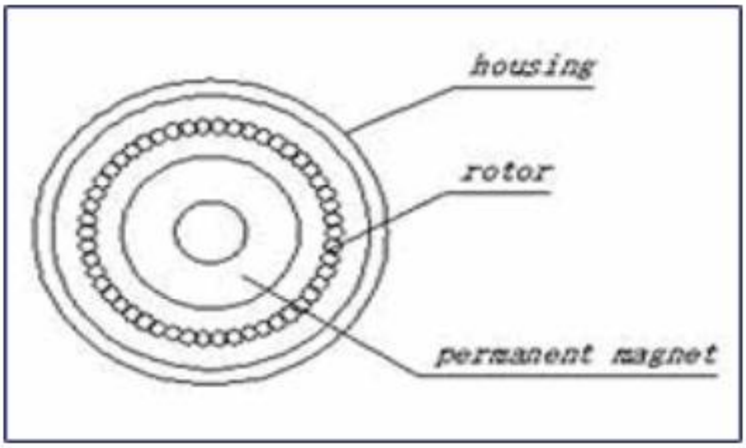

Fig 2.5: Cross Section of Coreless Motor

These motors are fixed on the five fingers and centre palm (Motor in Thumb finger is assigned to Braille value 1, Motor in Fore finger is assigned to Braille value 2, Motor in Centre finger is assigned to Braille value 3, Motor in Ring finger is assigned to Braille value 4, Motor in Little finger is assigned to Braille value 5 and Motor in centre palm is assigned to Braille value 6)

Table 2.3: Various Vibration Motor Speeds

Counter	Weight	Speed[rpm]
4CH	R2.5*L3.5*180	9500
4CH	R3.0*L3.5*150	9500
4CR	R2.5*L3.5*180	9500
4CR	R3.0*L3.5*150	7400
4.4CH	R2.5*L3.5*180	8500
4.4CH	R3.0*L3.5*150	9000

2.1.5 MESSAGE INTERPRETED SUCCESSFULLY

Once the vibration motors vibrate according to the message, it can be interpreted by the blind person easily because of their prior hands-on experience with Braille. Give below is an example of a simple text message being received using the Braille glove:

For instance, the person at the transmitting end sends a text message “HELLO” to the visually impaired person. So, through the proposed methodology, the combination of the vibration motors corresponding to the alphabets H, E, L, L, O are activated one after the other at a delay of 250 ms. For successful interpretation of H, vibration motors 1,2 and 5 are activated while vibration motors 3, 4 and 6 are deactivated. In the similar manner, remaining alphabets E, L, L, O are interpreted.

Table 2.4: Binary equivalent of the word "Hello"

ALPHABET	BINARY EQUIVALENT
H	110010
E	100010
L	111000
L	111000
O	101010

2.2 TRANSMITTING MODULE

For the glove to function as a transmitter, the dorsal side of the glove is fixed with slot sensors on each of the finger joint and the wrist. The numbering of the slot sensors will be same as that of the motors (as shown in fig 1.3). The blind person will move that particular fingers together which will correspond to black dots of a letter. The sensors will convert that movement to an electrical signal which will be sent as input to the microcontroller. The microcontroller will convert the Braille input to English with the help of conversion code. The microcontroller will also be connected to a GSM shield which will send the text message to the required contact.

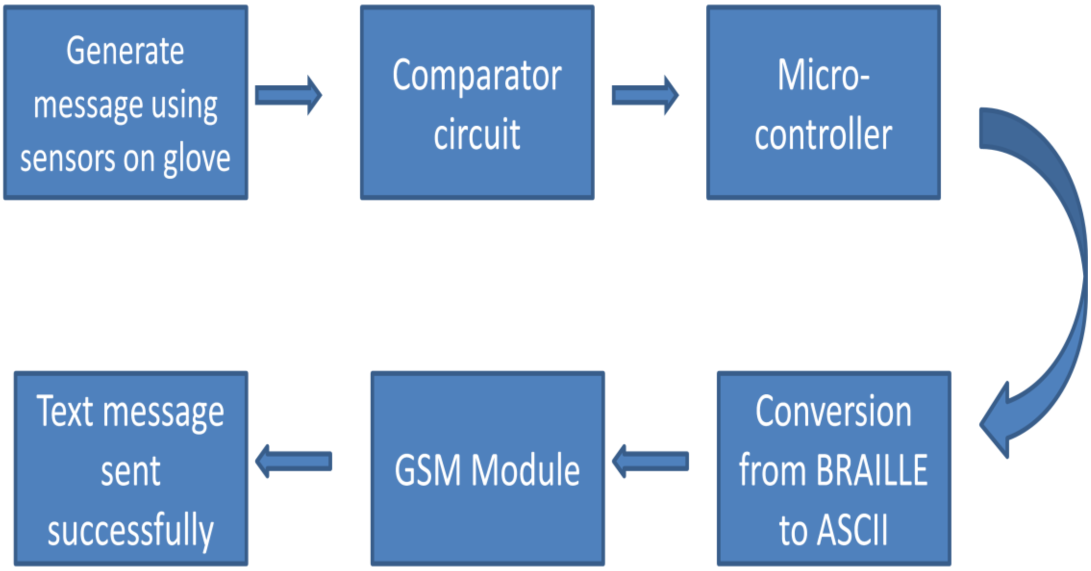

Fig 2.6: Block diagram of transmitting module

The block diagram shown in Fig 2.6 is that of the transmitting module which is discussed in detail in the coming section. The main components used in the transmitting module are as follows:

1. Six Slot sensors
2. Arduino Uno
3. GSM shield
4. Connecting wires
5. SIM card

To make our methodology viable for not only receiving the message but also for transmitting the message, a transmitting module is also developed. The block diagram of the transmitting module is represented in Fig 2.6. The slot sensors are fixed on the dorsal side of the fingers and the wrist of the glove. The message is generated by bending the fingers corresponding to the binary equivalent of the Braille code. This Braille value is further converted into English character value by using a conversion algorithm similar to the one used in Receiving module.

The slot sensors are mounted on each finger and the wrist which can sense the bends, which will eventually result in a change in the output voltage which can be sensed by the external comparator circuit. The message generated is sent to the person at the receiving end using a GSM Module already connected with the microcontroller. The person receives this message on his cell phone or tablet. Henceforth, message is transmitted successfully.

2.2.1 GENERATE MESSAGE USING SLOT SENSORS

The slot sensor used in our project is MOC7811. A slot sensor is an Opto-isolator module, with an Infrared (IR) transmitter & a photodiode mounted on it. It performs Non-Contact Object Sensing. This is normally used as a position sensor switch (limit switch) or as Position Encoder sensors used to find the position of the wheel. It consists of Infrared (IR) LED and Photodiode mounted facing each other, enclosed in plastic body as shown in Fig. 2.7 and Fig 2.8.

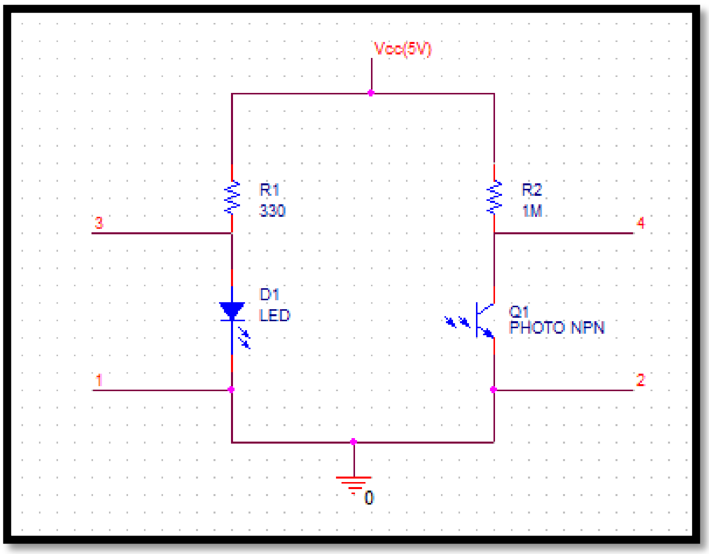

Fig 2.7: Circuit Diagram of slot sensor

When the light emitted by the Infrared (IR) LED is blocked by an obstacle logic level of the photo diode changes. This change in the logic level can be sensed by the microcontroller or by discrete hardware. The output voltage given by the slot sensor can be manipulated by changing the resistor values connected to it. One of the reasons for choosing these slot sensors was their low cost and simple design. A mechanism was developed for the slot sensors and mounted on each finger and the wrist. The bends of the fingers and the wrist can be sensed which would eventually result in a change in the output voltage. This change can be sensed by an external circuit.

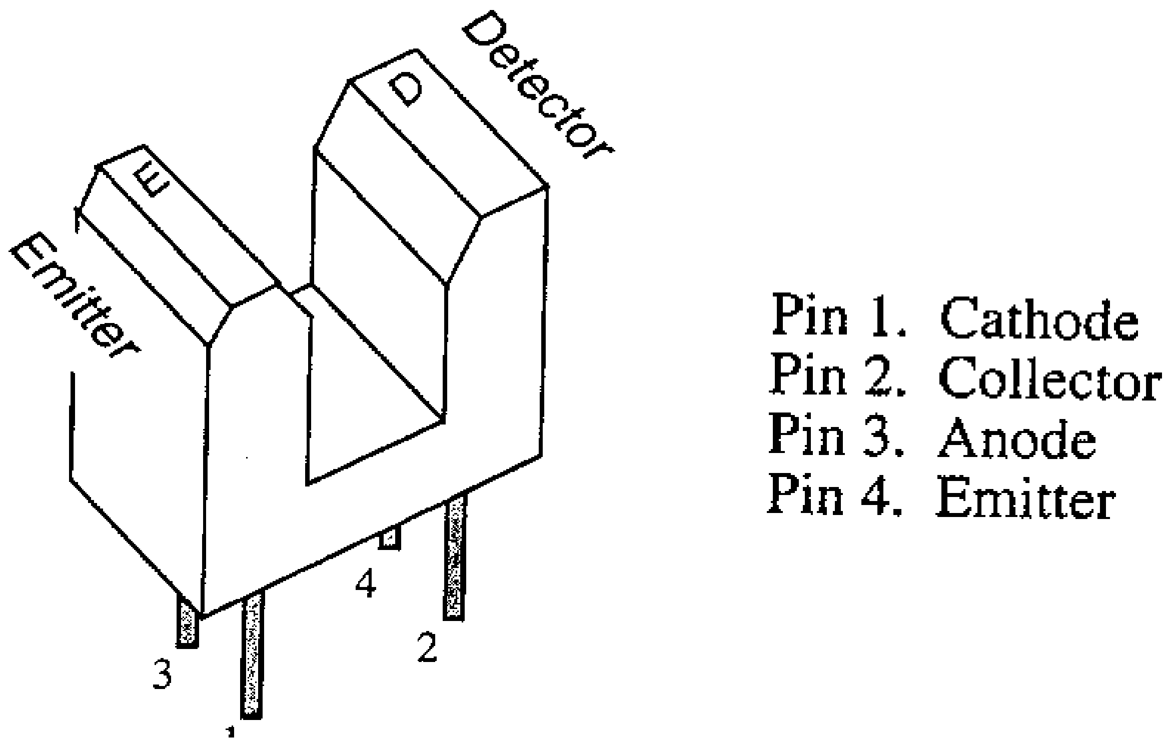

Fig 2.8: Pin Configuration of Slot sensor

2.2.2 MICROCONTROLLER

The working and the technical specifications of the microcontroller being used in the project are discussed in detail in Section 2.1.2.

2.2.3 CONVERSION FROM BRAILLE TO ASCII

As already mentioned, the technique of Reverse Engineering is being used in the project i.e., we already deviced an algorithm for conversion of ASCII to Braille in the receiving module, so a similar but reverse algorithm is designed for the conversion of Braille to ASCII in order to generate a message in English language that is easily understood by the person at the receiving end. Thus a blind person can communicate effectively with any visible/blind person across the globe.

2.2.4 GSM MODULE

In the receiving module, GSM shield was used to receive a text message from the person at the transmitting end, whereas in the transmitting module, GSM shield is used to send the text message generated using slot sensors to the person at the receiving end. Thus, GSM shield plays a potent role in successful sending and receiving of text messages. Mentioned below are some details on GSM shield.

The GSM Shield connects the Arduino to the make/receive voice and send/receive SMS messages.As always with Arduino, every element of the platform – hardware, software and documentation – is freely available and open-source. This means we can learn exactly how it's made and use its design as the starting point for our own circuits..

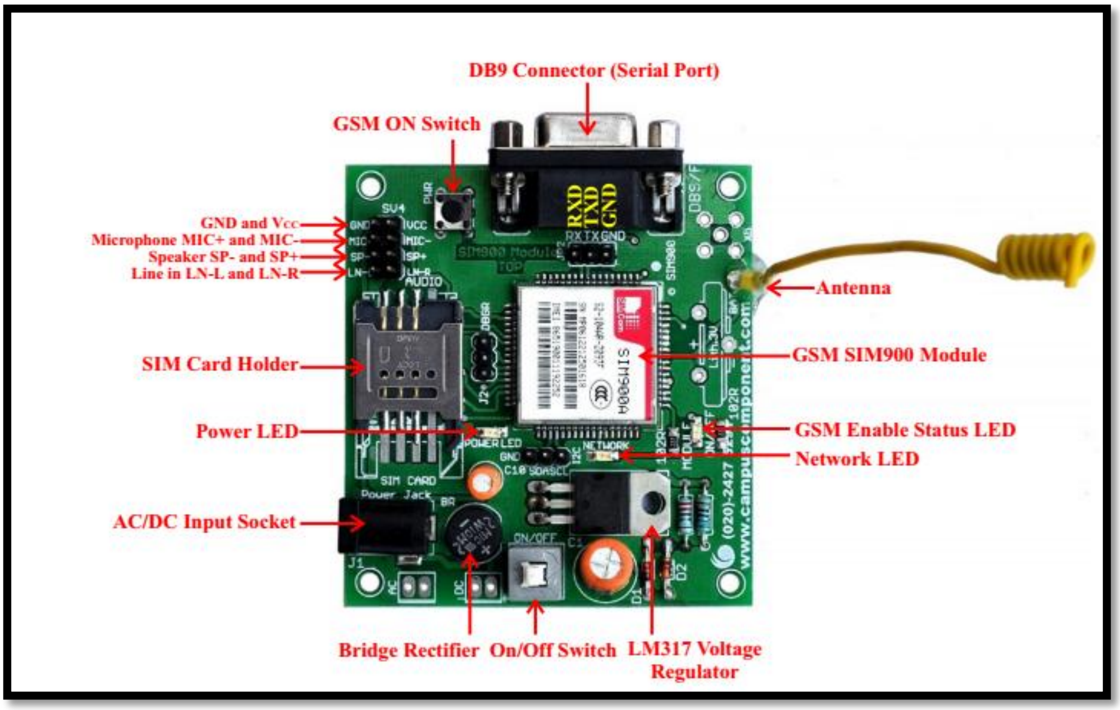

Fig 2.9: GSM Shield

The GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL-Modemis SIM900 Quad-band GSM / GPRS device, works on frequencies 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 5V DC TTL interfacing circuitry, which allows user to directly interface with 5V Microcontrollers (PIC, AVR, Arduino, 8051, etc.) The baud rate can be configurable from 9600-115200 bps through AT (Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable user to connect with internet through GPRS feature. It is suitable for SMS as well as data transfer application in mobile phone to mobile phone interface. The modem can be interfaced with a Microcontroller using USART (Universal Synchronous Asynchronous Receiver and Transmitter) feature (serial communication).

Key Features:

- Quad Band GSM/GPRS : 850 / 900 / 1800 / 1900 MHz
- Built in RS232 to TTL or vice versa Logic Converter (MAX232)
- Configurable Baud Rate
- Built in SIM (Subscriber Identity Module) Card holder
- Built in Network Status LED
- Inbuilt Powerful TCP / IP (Transfer Control Protocol / Internet Protocol) stack for internet data transfer through GPRS (General Packet Radio Service)
- Audio Interface Connectors (Audio in and Audio out)
- Normal Operation Temperature : -20 °C to +55 °C
- Input Voltage : 5V to 12V DC
- LDB9 connector (Serial Port) provided for easy interfacing

2.2.6 TEXT MESSAGE SENT SUCCESSFULLY

After the reverse algorithm code is burnt into the microcontroller and the given Braille characters are converted to the corresponding English alphabets, the message is now ready to be sent at the other end. In this way, the desired is message is sent successfully.

Chapter-3
RESULTS

3.1 SOFTWARE SIMULATION USING PROTEUS

The Fig 3.1 illustrates the software simulation of module A i.e. receiving the text message in English character value and converting it to the corresponding Braille value. For this simulation, the software used is Arduino IDE for the code and Proteus v1.0.7 for the circuit designing.

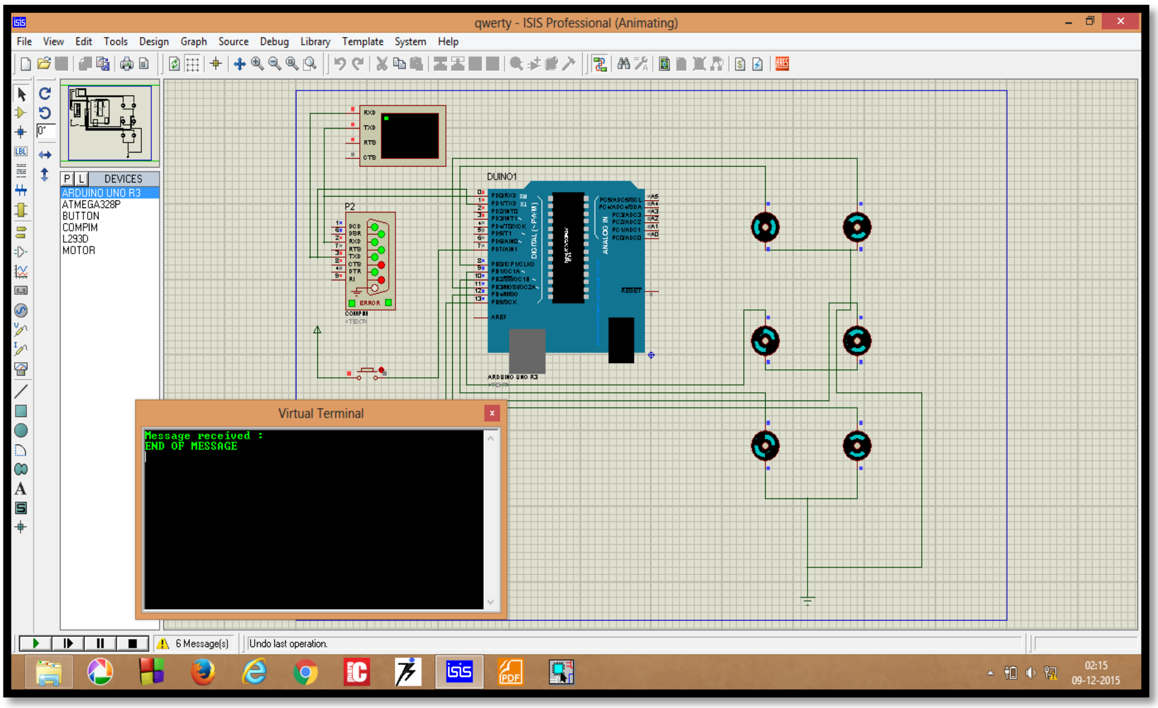

Fig 3.1: Software Simulation of Receiving Module on Proteus 1.0.7

The conversion code of the receiving module is interfaced with the circuit designed using a hex file. The message is generated in the code itself and when interfaced, the vibration motors corresponding to the English message get activated. In the given figure, the six motors have been connected to the pin numbers 8 to 13, which are operating at a voltage of 3.3V. The virtual terminal is connected to the Rx and Tx pin of the microcontroller and whenever a message is received, it shows a prompt window displaying “message received”. As the message gets converted, the motors rotate and when the process is complete, it displays “END OF MESSAGE”.

3.2 HARDWARE IMPLEMENTATION OF THE RECEIVING MODULE

As we have already discussed in the previous sections, the important components of the receiving module are vibration motors, Arduino Uno, connecting wires and GSM shield. Fig 3.2 illustrates the working model of the receiving module where vibration motors are connected to the output pins of arduino i.e., PIN 8 to Pin 13. The arduino is further connected to the laptop and the code written in ARDUINO IDE is burnt to the microcontroller, a snapshot of the same can be seen in Fig 3.3.

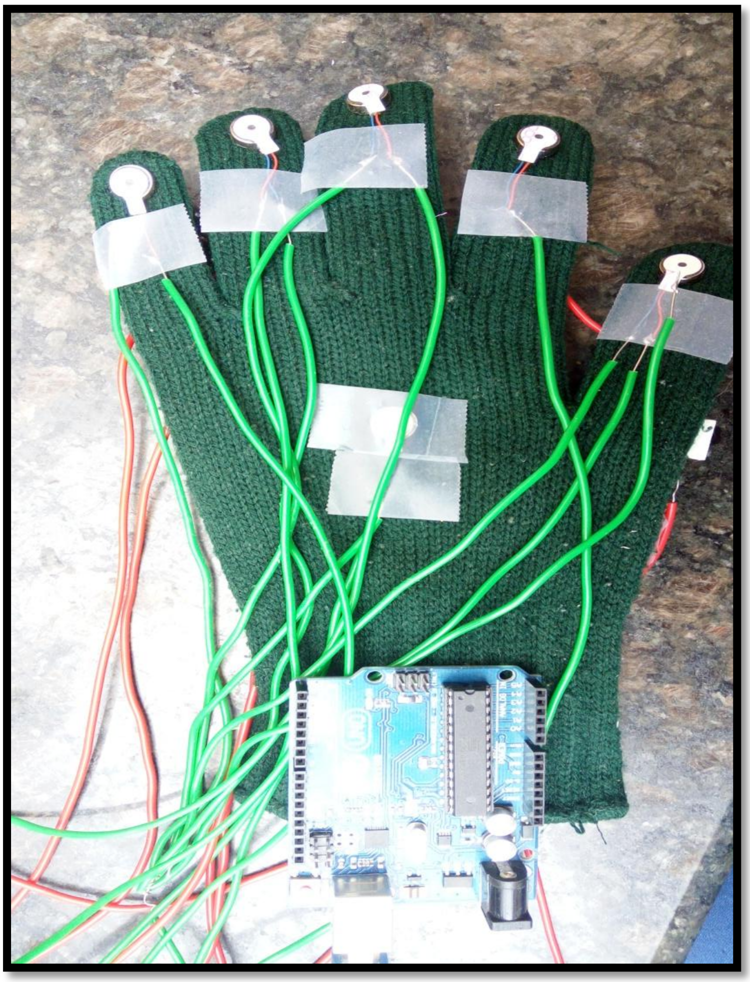

Fig 3.2: Dorsal side of the hand glove representing the receiving module

In Fig 3.3, we can see the serial monitor representing the message that is received using the GSM shield. Now this message will be stored be stored in an array and the motors will vibrate according to this message.

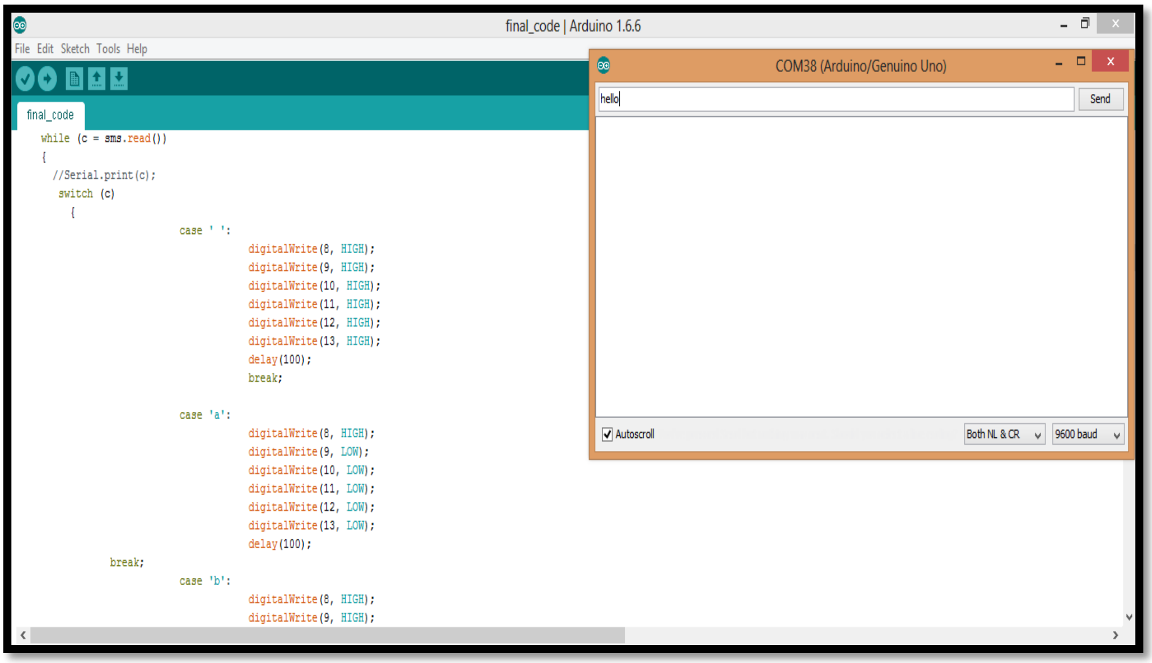

Fig 3.3: Serial Monitor depicting the received message

3.3 HARDWARE IMPLEMENTATION OF THE TRANSMITTING MODULE

In the transmitting module, we have used the slot sensors as the main component which easily helped us to generate raw data in form of 1's and 0's. This binary data is further converted into the English character value using the Braille look up table. In this way the message is generated and further sent to the person at the receiving end using the GSM shield.

Now as shown in the Fig 3.4, slot sensors are connected to the arduino using the red connecting wires and to detect the change in the signal of slot sensors, we have used ice cream sticks. These are easy to move and can fix on the glove without much effort. Two resistances of 330 ohm and 1 M-ohm are connected to the slot sensors. The 330 ohm resistance is connected to the anode pin of the photodiode and the 1M-ohm resistance is connected to the collector of the photo detector. The other two pins of the slor sensor i.e., the emitter of the photo detector and the cathode of the photo diode are connected to the GND pin of the arduino. All the resistances are connected together and also to the VCC pin of the arduino.

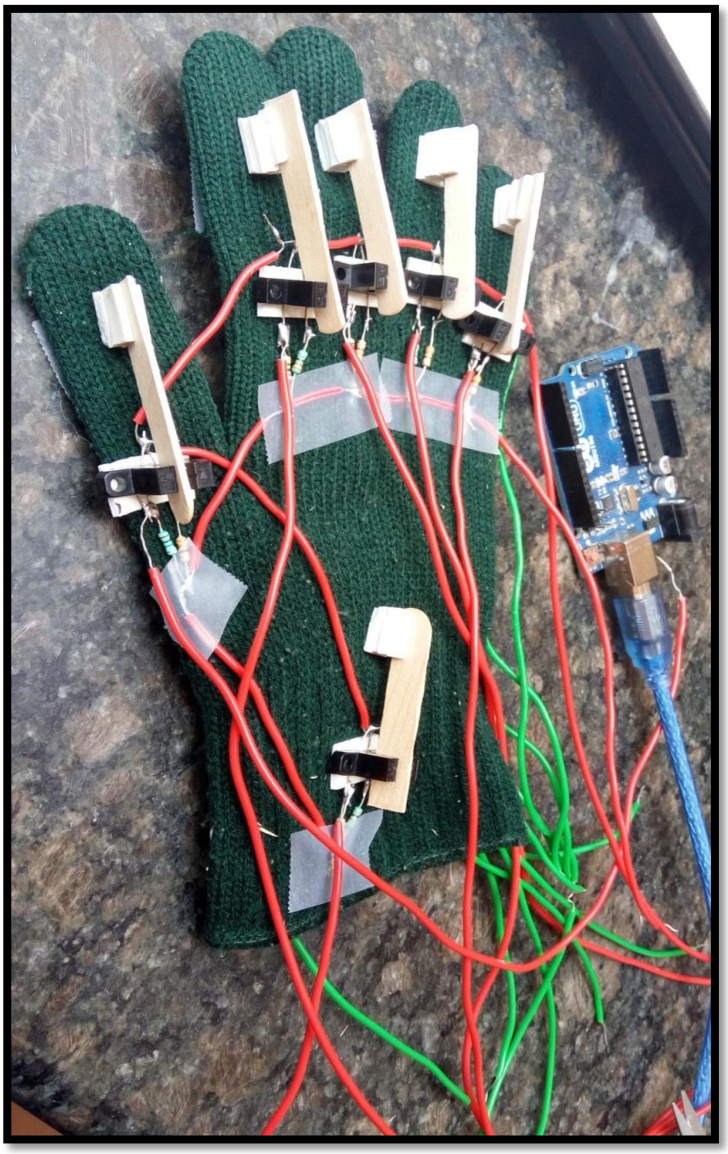

Fig 3.4: Ventral side of the Braille glove representing the transmitting module

In Fig 3.5, we can see the message that is transmitted using the slot sensors. The movement of the slot sensors generate the resulting message which can be seen on the serial port in the figure. This message is sent to using the GSM to the person at the other end.

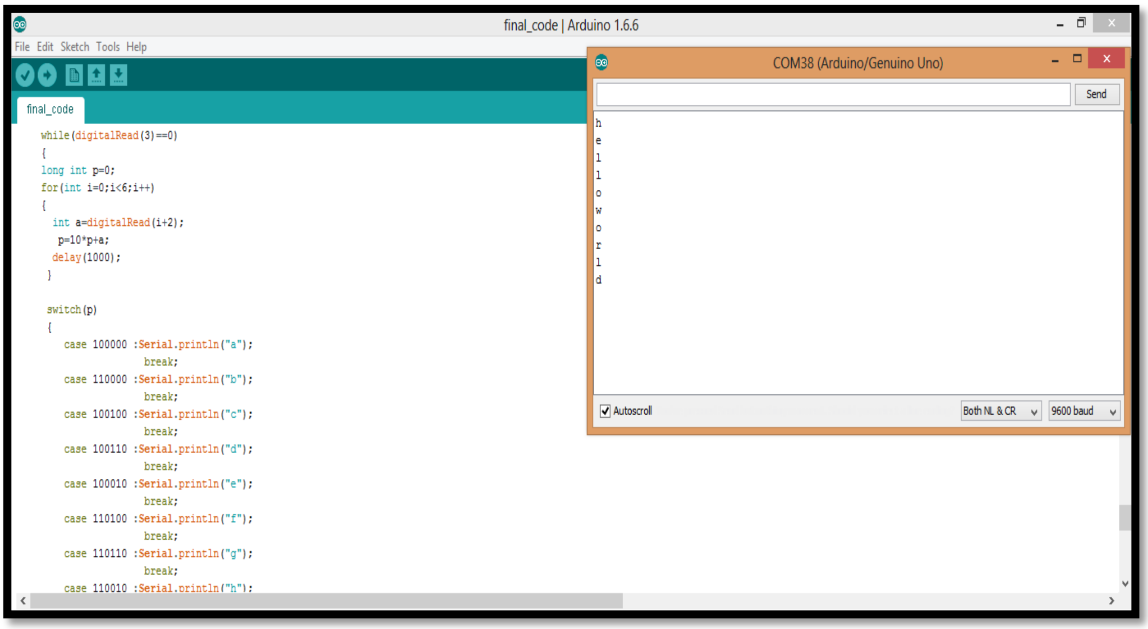

Fig 3.5: Serial Monitor depicting the message to be sent

Chapter 4

CONCLUSION AND APPLICATIONS

4.1 CONCLUSION

The main objective of this research work is to develop an easy-to-use hand glove for the blind people in order to enlighten their dark lives. With the designed Braille Hand Glove, we are able to provide an efficient method of communication to the visually impaired people. Through the proposed model, they are exposed to technology and have greater access to the digital media. The given design will also enable the blind people to stay in touch with the people at distant places through a SMS. So apart from the delay caused during the procedure, the given model is win win situation for the blind people when we talk about digital communication.

The Braille Hand Glove can be successfully used to receive as well as transmit text data from the PC to the glove and vice versa based on the different standard Braille combination. In this project we have used Grade 1 Braille conversion chart. The efficiency of the glove can further be improved by using the Grade 2 Braille conversion chart, in which we transmit and receive an entire word for a particular Braille pattern and hence increase the speed of receiving and transmitting text with very good efficiency. This Braille Hand glove can also be used by blind people for other applications like opening web pages and reading E-books independently with the help of Graphical User Interface (GUI) from MATLAB and other Integrated Development Environment (IDE) like Code Composer Studio.

4.2 AREAS OF APPLICATION

4.2.1 Send and receive text messages

Braille Glove is a special device designed to able the blind to communicate and have a fair chance at being as intelligent as people who are not blind. So this is basically the building block for all things to do with Braille. Using this glove, the blind person can send and receive text messages effectively.

4.2.2 Read e-books, blogs, e-newspapers

Today, where a normal human being has access to the abundant knowledge over internet and can explore anything and everything, a blind person is deprived of all these facilities. This device, if put into proper use can also be used to read e-books, blogs and e-newspapers, thus bringing the visually impaired people closer to technology and making their life more bright.

4.2.3 Distant communication

It is surprising to know that the deafblind person's life expectancy is, on average, about 35, simply because his brain does not develop. He does not get the information he needs and dies earlier. So this device will basically target to help them with necessary information whether, it is through talking to a person sitting at the other end of the globe or grasping the knowledge about events and activities taking place distantly.

4.3 ADVANTAGES

(a) The development of low cost Braille hand glove is necessary for the visually impaired community. It links them to computer oriented technology.

(b) It is a new teaching methodology which is quickly understood by blind people. Through vibration blind people can understand the six positions of Braille cell in a quick manner.

(c) The logic of both hardware and software algorithm is very simple and understandable.

(d) Braille code vibrations inside the Glove play a vital role in building new accurate sensing model for blind persons having a sensorial deficiency and also introduce a possible alternative way of communication.

(e) Various Display format of Braille software produces easy understanding for beginners of Visible Braille users.

(f) Vibration sensation in Braille Glove is a more accurate hardware device for communication amongst blind people due to less sensation in their finger tips.

(g) The wearable Braille Hand glove is flexible, easily fabricated and a low cost device.

(h) In designing the hand glove, efforts have been made to provide increased computer accessibility to the blind.

(i) It is a fast recognizing system when compared to traditional Braille touch reading method

4.4 FUTURE SCOPE

The design and implementation of an Arduino UNO microcontroller based, text-to-Braille translator has been presented in this project. In its current version, the system can be used in embedded and high-performance applications. However, there are several improvements which will be incorporated in future versions of the hardware translator. For example, the current system is a stand-alone component. Its structure has to be changed for every individual application.

For further future scope the texts are to be translated but the translated Braille English text to be stored in a PC as a file format so that it can be connected to Braille printer and the user can get the hard copy of it. Braille printers are easily available in market but with the high cost.

Also for further improvement, a multi-language-Braille translator will be considered. Look-up tables for different languages could be stored in flash memory so that when translation of text in a particular language is required, the microcontroller loads the corresponding look-up table. Thus, we hope that the future hi-tech improvement will enlighten their life.

4.5 CHALLENGES

Some of the challenges being faced while designing this project are as follows:

(a) **Cost effectiveness:** The devices already available for the blind people's communication practices are overestimated. So there was a strict need to design this device in a way that is easily affordable as well as maximally efficient.

(b) **Easy to handle:** The given design of Braille glove is simple to use and easy to comprehend. A blind person who has fair amount of knowledge regarding Braille along with enough practice can make the best use of this device. The circuitry is designed effortlessly without any cross-connections. In all, the device is very user-friendly.

(c) **Mobility:** In the present scenario, where all devices ranging from cell phones to restaurants are becoming mobile, here we are, with a design of the electronic glove for the blind which can be easily carried from one place to another and there are no location restrictions. We were able to achieve this feature using a power jack which provides the necessary voltage and power ratings for the device to work properly. This power jack is portable and can be displaced anywhere. Moreover once the battery discharges, it can be charged time and again, thus power efficiency and time management are being taken care of at the same time.

PUBLICATION

Braille hand glove - a Real time translation and communication device

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BRAILLE HAND GLOVE - A Real time translation and communication device

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Abstract— **Visually impaired people are those who have the inability to see to a degree that causes problems not fixable by usual means and the people with complete vision loss are termed to be blind. With the exponential growth in technological era, blind people face many problems when it comes to accessing the digital data. So in this paper, a real-time integrated solution of hardware and software is developed to help the visually impaired people all across the globe. The fundamentals of the proposed system are based on Braille which is the system of embossed writing invented by Louis Braille that gradually came to be accepted throughout the world as the fundamental form of written communication for blind individuals in which reading is done character by character. This concept is evaluated for the blind voluntaries with ample amount of hands-on experience and knowledge about Braille.**

Keywords—Braille, cell, visually impaired, vibration motor, slot sensor

I. INTRODUCTION

Globally 285 million people are visually impaired for whom acquiring the vital knowledge in life is extremely difficult. The world is moving towards digitalization whereas these people are totally deprived of the digital media. Moreover they are becoming more and more prone to social exclusion as a result of poor information access. So the need of the hour is generation of smart and efficient methods of communication for the visually impaired people. The quality of interaction between blind people and the social environment can be tremendously improved with a combination of human efforts and technology. The challenges faced by the visually impaired population was brought to light when Braille was developed. Since then, all over the world, this system has been adopted as a primary means of reading and communicating with the blind people.[1]

The people who are blind or who have a low vision follow a unique system for reading and writing. The system consisting of fixed patterns of raised dots is widely known as the Braille System. It is often mistaken for a new language, but actually it is just a code by which many other languages such as English, Spanish, French, Arabic- can be written and read. Thus, it provides a means of literacy for people all over the world. Braille consists of symbols formed within units of space known as Braille Cells. A single Braille cell consists of six dots arranged in two parallel rows having 3 dots each as shown in Fig 1[2]. The dot positions are identified by numbers one to six. A number, an alphabet or a letter can be replaced by single Braille cell. A correspondence of English alphabets to the Braille language is shown in Fig 2[3].

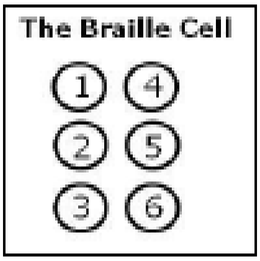

Fig. 1. The Braille Cell used to represent English alphabets

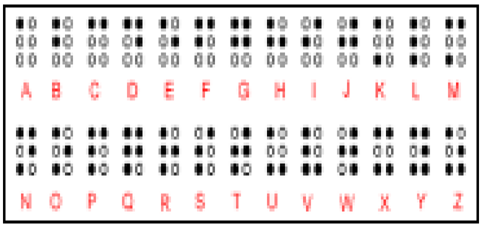

Fig. 2. Braille Script representation of English characters

One of the most challenging tasks for the visually disabled is recognizing the characters because they are of complex shapes and very small in size as compared to the physical obstacles. Several attempts such as the print on palm method, manual alphabets and finger Braille have been made which involve tactile sensation but all these methods failed due to certain disadvantages. These disadvantages are lack of compatibility to digital environment, lack of privacy, inefficiency etc. Manier times, due to prolonged use, a person with diabetes loses sensitivity in fingertips and is no longer able to sense braille. [4] Also, Braille is now being targeted because of the following reasons:

- Less use of computer Braille related software and hardware equipments.
- Most of the Braille equipments being used are mechanical and require a lot of effort.
- No device has been designed for educational purpose and routine communication of the blind.

The proposed system intends to revolutionize the method of communication for blind people by using the vibrating hand glove. A blind person will be able to send and receive a text message to/from any of the contacts in his SIM card with the help of this glove. The focus is on producing vibrations in six different positions in the right hand which matches the Braille code as shown in Fig 3.

This rest of the paper is organized as follows:

Section II deals with the Proposed Methodology, Section III deals with a description of the hardware components needed for hardware implementation and Section IV summarises the results followed by conclusion in section V and references in Section VI.

Fig. 3. Mapping of Braille Cell on the ventral side of palm

II. PROPOSED METHODOLGY

This paper describes a Braille Hand Glove which shall serve as an effective communication method to send and receive text messages to/from a visible person. This real-time, easy-to-use tool tends to create new and stimulating conditions for the blind people. The proposed method is divided into two modules:

Module A is designed for receiving or reading the text using the six vibration motors. Module B is designed for writing text messages to the person at the receiving end and accomplished by slot sensors. These signals signify different hand gestures corresponding to the Braille code of the particular character to be typed. The two modules are detailed in the following section:

A. RECEIVING MODULE

The receiving module is fitted on the dorsal side of the hand glove that is further connected to the microcontroller ATmega 328P. The message after being received is to be processed to make it comprehensive to the receiver. Fig 4 depicts the block diagram of various stages involved in the process of receiving.

The message received through the GSM Module acts as an input to the microcontroller. The ASCII values of the text message that is received are encoded to binary nmber system and converted to corresponding Braille code using the look up table. In the look up table, each alphabet is mapped to its unique binary equivalent as shown in Table 1.

TABLE I. BINARY EQUIVALENT OF ENGLISH ALPHABETS

ALPHABET	BINARY EQUIVALENT
H	110010
E	100010
L	111000
L	111000
O	101010

The binary equivalent of respective alphabets are directed to the pins of the microcontroller which is connected to the motor driver IC drv777 that provides sufficient voltage supply for the vibration motors which are fitted on the ventral side of the glove.

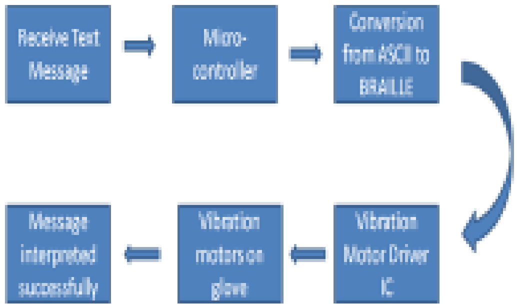

Fig. 4. Block Diagram of Receiving Module

Consider the person at the transmitting and sends a text message "HELLO" to the visually impaired person. So, through the proposed method, the combination of the vibration motors corresponding to the alphabets H, E, L, L, O are activated one after the other at a delay of 250 ms. For successful interpretation of H, vibration motors 1,2 and 5 are activated while vibration motors 3, 4 and 6 are deactivated. In the similar manner, remaining alphabets E, L, L, O are interpreted.

B. TRANSMITTING MODULE

To make our methodology viable, a module is developed not only for receiving a text message but also for transmitting the message termed as the transmitting module. The block diagram representing the various stages of the transmitting module is represented in figure 5. The transmission begins with generating a Braille message using the slot sensors that are fixed on the dorsal side of the fingers and the wrist of the glove. The slot sensors are mounted on each finger and the wrist which can sense the bends, which will eventually result in a change in the output voltage of the external comparator circuit. This comparator circuit converts the analog voltage levels to digital values which are converted into English character value by using a conversion algorithm similar to the one used in Receiving module.

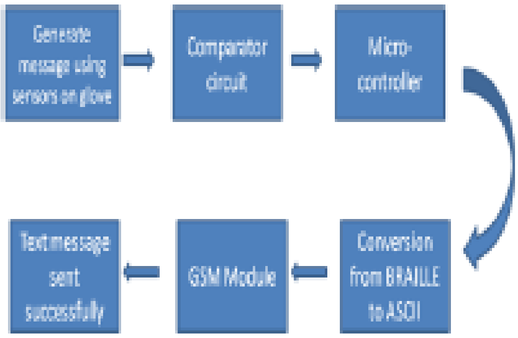

Fig. 5. Block Diagram of Transmitting Module

The message generated is sent to the person at the receiving end using a GSM Module already connected with the microcontroller. The person receives this message on his cell phone or tablet. Henceforth, message is transmitted successfully.

III. HARDWARE COMPONENTS

A brief description of the hardware components for the design is as follows:

A. ARDUINO UNO:

The microcontroller is the processing unit of the proposed design. All the conversion algorithms are to be stored in the memory of microcontroller. The Arduino UNO is a microcontroller board having ATmega328P. It consists of 14 digital input/output pins and 6 analog input pins to connect with the different peripheral devices, a 16 MHz crystal oscillator for the clock, a USB(mini) connection, a power jack, and a reset button.

B. COIN VIBRATION MOTORS

The vibration motors that are to be mounted on each of the five fingers of the hand glove as well as the palm are similar to the motors used in pagers or cell phones that are easy to mount and have adhesive backing. These motors are Eccentric Rotating Mass (ERM) motors, i.e. a DC motor in which a non-symmetric offset mass is attached to the shaft. As the ERM rotates, a net centrifugal force is created due to the asymmetric centripetal force that exists because of offset mass, this causes displacement of the motor. As the number of revolutions per minute is very high, the motor is constantly being displaced and moved by these asymmetric forces and the repeated displacement is perceived as a vibration. The revolutions can be controlled with the voltage supply.

C. SLOT SENSORS

A slot sensor consists of an Infrared (IR) transmitter & a photodiode which performs Object Sensing if the signal transmitted from the photoemitter to the photodiode is obstructed by an obstacle .The circuit diagram of slot sensor is shown in Fig 6. A slot sensor with a slot width of 2 mm has some characteristics like 12 bit resolution, a low response time of 20μs and a switching frequency of 25 kHz.

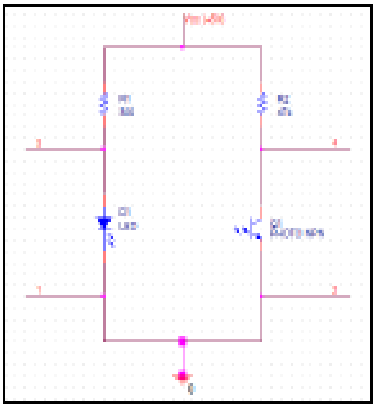

Fig. 6. Circuit Diagram of Slot sensor

There is a change in the logic level of the photo diode when the light emitted by any source is blocked by an obstacle and an analog output is generated which is digitalized with the help of a comparator circuit. The output of the comparator circuit is further connected to the pins of the microcontroller.

D. GSM MODULE

A Global System for Mobile communication supports outgoing and incoming voice calls, SMS or text messaging with the help of a GSM network. To send and receive text messages, a GSM Shield is connected to the microcontroller which has a modem

In future the given design can also be implemented for different languages like Hindi, Punjabi, Spanish, etc depending upon the region to which the blind person belongs to and work upon making the device more efficient by generating power using piezoelectric technology.

VI. REFERENCES

[1] Kenneth Ingham. 1998, "Braille, the language Its machine Translation and Display", IEEE Transactions and Man Machine systems.

[2] Al-Salman, El-Zaart, AL-Suhaibani, Al-Hokail, "An Efficient Braille Cells Recognition", Wireless Communications Networking and Mobile Computing,2010

[3] Manjeet Singh, Parteek Bhatia, "Automatic conversion of English and Hindi text to Braille Representation", International Journal of Computer Applications (0975 – 8887),Volume 4 – No.6, July 2010

[4] M.Rajasenathipathi, M.Arthanari and M.Sivakumar, "An Electronic Design Of A Low Cost Braille Handglove", International Journal of Advanced Computer Science and Applications, Vol. 1, No. 3, September 2010

[5] B. L. Shivakumar1 and M. Rajasenathipathi, " Braille Glove Vibration System For Diabetic Affected Disabled Persons", vol. 8, no. 8, august 2013.

[6] Mukul Bandodkar, Virat Chourasia, "Low Cost Real-Time Communication Braille Hand-Glove for Visually Impaired Using Slot Sensors and Vibration Motors".

[7] J. K. Dupress and D. M. B. Baumann, "Towards making Braille as accessible as print," Dept. ofMech. Engrg., Massachusetts Institute of Technology, Cambridge, Mass., Rept. DSR 70249-1, June 19, 1968.

[8] Deepak Kumar, Mohammed Abdul Qadeer, "Mobile Application and BClasses for Increasing the Availability of Information for Visually Impaired Persons," International Journal of Machine Learning and Computing, Vol. 1, No. 3, August 2011.

REFERENCES

[1] Kenneth Ingham. 1998, “Braille, the language Its machine Translation and Display”, IEEE Transactions and Man Machine systems.

[2] Al-Salman, El-Zaart, AL-Suhaibani, Al-Hokail, “An Efficient Braille Cells Recognition”, Wireless Communications Networking and Mobile Computing,2010

[3] Manjeet Singh, Parteek Bhatia, “Automatic conversion of English and Hindi text to Braille Representation”, International Journal of Computer Applications (0975 – 8887),Volume 4 – No.6, July 2010

[4] M.Rajasenathipathi, M.Arthanari and M.Sivakumar, “An Electronic Design Of A Low Cost Braille Handglove”, International Journal of Advanced Computer Science and Applications, Vol. 1, No. 3, September 2010

[5] B. L. Shivakumar1 and M. Rajasenathipathi, “Braille Glove Vibration System For Diabetic Affected Disabled Persons”, vol. 8, no. 8, august 2013.

[6] Mukul Bandodkar, Virat Chourasia, “Low Cost Real-Time Communication Braille Hand-Glove for Visually Impaired Using Slot Sensors and Vibration Motors”.

[7] J. K. Dupress and D. M. B. Baumann, "Towards making Braille as accessible as print," Dept. of Mech. Engg., Massachusetts Institute of Technology, Cambridge, Mass., Rept. DSR 70249-1, June 19, 1968.

[8] Franklin S. Cooper, Jane H. Gaitenby, Ignatius *G.* Mattingly, Noriko Umeda, “Reading Aids for the Blind: A Special Case of Machine-to-Man Communication,” *IEEE Transactions* ox audio and electro acoustics vol. au-17, no. 4 December 1969.

[9] Deepak Kumar, Mohammed Abdul Qadeer, “Mobile Application and EClasses for Increasing the Availability of Information for Visually Impaired Persons,” International Journal of Machine Learning and Computing, Vol. 1, No. 3, August 2011.

[10] Prasaanth.N, Parish Vyas, Rahul Tolani, Sandhya Pati, “Advanced aid for Visually Impaired for reading text online," International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-2, December 2012.

[11] Raj S. Mamarde, Rasika A. Lodhi, Rahul D. Bhor, “Communication system for Deaf blind people,” International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 2 Issue 4, April – 2013.

[12] D. Sreenivasan, Dr. S. Poonguzhali, "An Electronic Aid for Visually Impaired in Reading Printed Text," International Journal of Scientific & Engineering Research, Volume 4, Issue 5, May-2013.

[13] S.Jain1, S.Majumder, K.J.UKe, "An Experimental Driven Approach of Braille Embosser Print Head Design Using Analytical and Computational Techniques," Proceedings of the 1st International and 16th National Conference on Machines and Mechanisms (iNaCoMM2013), IIT Roorkee, India, Dec 18-20 2013.

[14] Ramiro Velázquez, Enrique Preza, Hermes Hernández, "Making eBooks Accessible to Blind Braille Readers," HAVE 2008 – IEEE International Workshop on Haptic Audio Visual Environments and their Applications Ottawa – Canada, 18-19 October 2008.

[15] Bindu Philip, R. D. Sudhaker Samuel, "Human Machine Interface – A Smart OCR for the Visually Challenged," International Journal of Recent Trends in Engineering, Vol 2, No. 3, November 2009.