Hearing-Impaired Communicator

[1]Ms.J.Sindhukavi, [2]Ms.R.Hehma Gayatri, [3]Ms.C.Janani

[1,2,3]Assistant Professor, Department of ECE

[1,2,3]Sri Manakula Vinayagar Engineering College
[1]sindhukavime23@gmail.com, [2]hehmagayatri@smvec.ac.in,
[3]c.jananichandru@gmail.com

Abstract

Worldwide communication has played a major part in human life. Still the "Hearing Impaired" people are unable to communicate through mobile. The proposed model has the technical concept to overcome the deafness in an altered way. All the inventories up-to-date, performs in a low grade level and it converts only speech to text, but "Hearing Impaired Communicator" can create a high impact in the hearing-impaired person's life. For conductive type of hearing loss people, it helps to hear the voice using vibrator via Bluetooth. For sensorineural and mixed type of hearing loss people, it helps to see the text output in LCD via dspic controller. This improves the life quality of the Hearing Impaired person in the mobile communication.

Keywords – Conductive Hearing loss, Sensorineural and Mixed Hearing Loss, dsPIC Controller

1. Introduction

Communication is the important aspect of life. Numerous communication that rely on a wireless signal to send data rather using physical medium. Hearing Impairment refers to the lack of ability to hear the normal speech. The proposed model produces two outputs. The voice output is for conductive type of deafness and the text output is for the people who have sensorineural and mixed type of deafness. This system can be implemented in real time to express the basic needs of hearing impaired.

2. Literature Survey

E. Saranya, B. Baron Sam and R. Sethuraman [2] proposed a novel approach for helping bidirectional correspondence between individuals of ordinary hearing is introduced. While the present hearing thwarted assistive contraptions, for instance, versatile hearing assistance and cochlear additions are defenceless in uproar conditions or post-surgery response.

The proposed thought is a discretionary approach wherein talked trade is expert by methods for utilizing a powerful discourse acknowledgement procedure which thinks about of boisterous ecological elements with no connection into human body. Proposed frame work is a versatile gadget with an acoustic bar previous for directional commotion diminishment and fit for performing discourse to content interpretation work, which grasps a catch phrase spotting system.

Shivakumar K M, Varsha V Jain and Krishna Priya P [3] proposed speech to text conversion comprises of small, medium and large vocabulary conversions. Such system process or accepts the voice which then gets converted to their respective text. This paper gives a comparative analysis of the technologies used in small, medium, and large vocabulary Speech Recognition System. The comparative study determines the benefits and liabilities of all the approaches so far. The experiment shows the role of language model in improving the accuracy of speech to text conversion system. This proposed system experimented the speech data with noisy sentences and incomplete words. The result shows a prominent result for randomly chosen sentences compared to sequential set of sentences.

Tao Liu, Wengang Zhou, and Houqiang Li [6] proposed a model that translates Sign Language (SL) into speech or text, so as to facilitate the communication between hearing-impaired people and the normal people. The proposed system uses Long Short-Term memory (LSTM) which can model the contextual information of temporal sequence well, end-to-end method for SLR based on LSTM. This system takes the moving trajectories of 4 skeleton joints as inputs without any prior knowledge and is free of explicit feature design. To evaluate this proposed model, a large isolated Chinese sign language vocabulary was built with Kinect 2.0.

Prof. Prashant G. Ahire, Kshitija B. Tilekar, Tejaswini A. Jawake, Pramod B. Warale [7] proposed a system that mainly consists of two modules, first module is drawing out Indian Sign Language(ISL) gestures from real-time video and mapping it with human-understandable speech. Accordingly, second module will take natural language as input and map it with equivalent Indian Sign Language animated gestures. Processing from video to speech will include frame formation from videos, finding region of interest (ROI) and mapping of images with language knowledge base using Correlational based approach then relevant audio generation using Google Text-to-Speech (TTS).

Su Myat Mon, Hla Myo Tun [8] proposed that the speech is an easiest way to communicate with each other. Speech processing is widely used in many applications like security devices, household appliances, cellular phones, ATM machines and computers. The human computer interface has been developed to communicate or interact conveniently for one who is suffering from some kind of disabilities. Speech-to-Text Conversion systems have a lot of benefits for the deaf or dumb people and find their applications in our daily lives. In the same way, the aim of the system is to convert the input speech signals into the text output for the deaf or dumb students in the educational fields.

And, Hidden Markov Model (HMM) method is applied to train and test the audio files to get the recognized spoken word. The speech database is created by using MATLAB.Then, the original speech signals are preprocessed and these speech samples are extracted to the feature vectors which are used as the observation sequences of the Hidden Markov Model (HMM) recognizer. The feature vectors are analyzed in the HMM depending on the number of states.

Ben Shirley, James Thomas, Paul Roche [10] proposed that the spread of Voice over Internet Protocol (VoIP) services, equipment and clients is transforming telephony worldwide.

In addition to providing inexpensive or even free, international telephone calls there is potentially additional benefit in using computer networks to facilitate telephony. Currently hearing impaired and deaf users are excluded from these VoIP services; unless the message is in text form to begin with the hearing impaired user cannot access these services effectively. The VoIPText project, funded by Ofcom, looked at the feasibility of utilizing "speech to text" software in order to generate text from natural speech over VoIP and so improve accessibility. The project has assessed the accuracy of current state of the art Automatic Speech Recognition (ASR) software to assess if it achieves a reasonable level of performance. Assessments of software developed during the project were carried out in peoples' homes over eight weeks and the trials indicated some issues associated with the implementation but showed real potential for ASR in telecommunications for deaf people.

3. Existing Model

Speech is an easiest way to communicate with each other. Speech processing is widely used in many applications like security devices, household appliances, cellular phones, ATM machines and computers. The human computer interface has been developed to communicate or interact conveniently for one who is suffering from some kind of disabilities. Human interact with each other in several ways such as facial expression, eye contact, gesture, mainly speech. The speech is primary mode of communication among human being and also the most natural and efficient form of exchanging information among human in speech.

Speech-to-text conversion (STT) system is widely used in many application areas. In the educational field, STT or speech recognition system is the most effective on deaf or dumb students. The recognition of speech is one the most challenges in speech processing. Speech Recognition can be defined as the process of converting speech signal to a sequence of words by means of Algorithm implemented as a computer program.

Basically, speech to text conversion (STT) system is distinguished into two types, such as speaker dependent and speaker independent systems. The paper presents the speaker dependent speech recognition system. Speech recognition is very complex when processing on randomly varying analogue signal such as speech signals. Thus, in speech recognition system, feature extraction is the main part of the system.

In recent researches, many feature extraction techniques are commonly used such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Independent Component Analysis (ICA), Linear Predictive Coding (LPC), Cepstral Analysis and Mel-Frequency Cepstral (MFCCs), Kernel based feature extraction approach, Wavelet Transform and spectral subtraction, Mel Frequency Cepstral Coefficients (MFCC) method is used.Speech-to-Text Conversion (STT) systems have a lot of benefits for the deaf or dumb people and find their applications in our daily lives.

In the same way, the aim of the system is to convert the input speech signals into the text output for the deaf or dumbstudents in theeducational fields. The paper presents an approach to extract features by using Mel Frequency Cepstral Coefficient from the speech signals of isolated spoken words.

The speech database is created by using MATLAB. Then, the original speech signals are pre-processed and these speech samples are extracted to the feature vectors which are used as the observation sequences of the Hidden Markov Model (HMM) recognizer. The feature vectors are analyzed in the HMM depending on the number of states.

It is based on the characteristics of the human ear's hearing, which uses a nonlinear frequency unit to simulate the human auditory system. Mel frequency scale is widely used to extract features of the speech. Mel-Frequency Cepstral features provide the rate of recognition to be efficient for speech recognition as well as emotion recognition system through speech.

Moreover, Vector Quantization (VQ), Artificial Neural Network (ANN), Hidden Markov Model (HMM), Dynamic Time Warping (DTW) and various techniques are used by the researchers in recognition. Among them, HMM recognizer is currently dominant in many applications. Nowadays, STT system is fluently used in many control systems, mobile phones, computers and so forth. Therefore, speech recognition system is more and more popular and useful in our daily lives. In the system, MFCC and HMM are implemented by MATLAB.

The flowchart of speech to text conversion is illustrated in Figure1. To convert input speech to text output, the four main steps are developed by using MATLAB. These steps are speech database, pre-processing, feature extraction and recognition. Firstly, five audio files are recorded with the help of computer. Each audio file contains ten different pronunciation audio files. So, there are total of fifty audio files are recorded in speech database. The speech signals at low frequencies have more energy than at high frequencies.

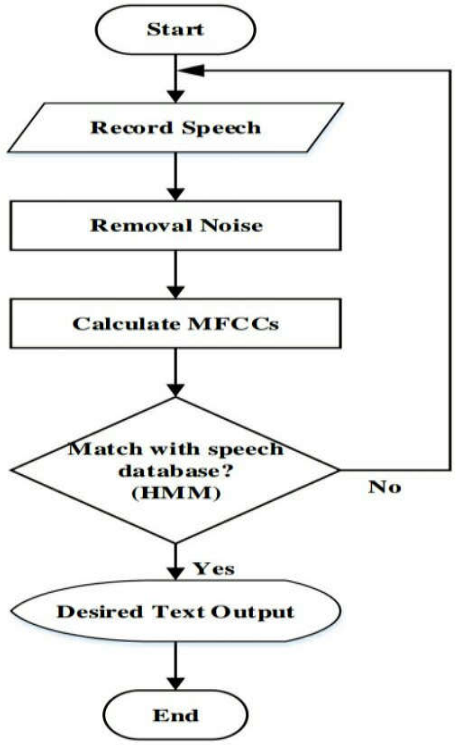


Figure 1: Flowchart of speech to text conversion

Therefore, the energies of signal are necessary to be boost at high frequencies. According to the saturation of environment, the unwanted noise may affect the recognition rate worse. This problem can be overcome by end point detection method.

After pre-processing stage is finished, the speech samples are extracted to features or coefficients by the use of Mel Frequency Cepstral Coefficient (MFCC). Finally, these MFCC coefficients are used as the input of Hidden Markov Model (HMM) recognizer to classify the desired spoken word. The desired text output can be generated by HMM method even if the test audio file is included in the existing speech. database adjacent elements.

3.1 Disadvantages

- Misdetection of word boundaries for the words with weak fricative, plosive and nasal sounds
- It requires long compression time
- If the number of states is too large, there are no enough observations per state to train the model. So, this may degrade the performance of the system
- More expensive
- Maintenance on your hearing aids from time to time. This may include removing any built up ear wax from the casing
- Hearing aids cannot magically restore a person’s ability to hear, rather they aid you in hearing better only for partially hearing impaired person

4. Proposed Model

To solve the problems of deafness, one way communication was proposed, later it was developed into two way communication (wired) and now the proposed model is a different approach with wireless technology that consists of Bluetooth receiver, DC motor, mono amplifier, microphone, mobile, battery, phone connector, adapter, headphone, dsPIC microcontroller, LCD. This device helps the hearing impaired peoples to communicate with others through mobile.

5. Implementation of Proposed Model

The proposed system is a user dependent system which employs the user to feel the vibration and to read the text via mobile. The vibrator converts an electrical signal into mechanical movement which results in a vibration. Text is produced by the dsPIC microcontroller via Bluetooth. The dsPIC is scripted in embedded for speech recognition with predefined set of voltages for respective words. The output from the dsPIC is displayed in LCD and mobile.

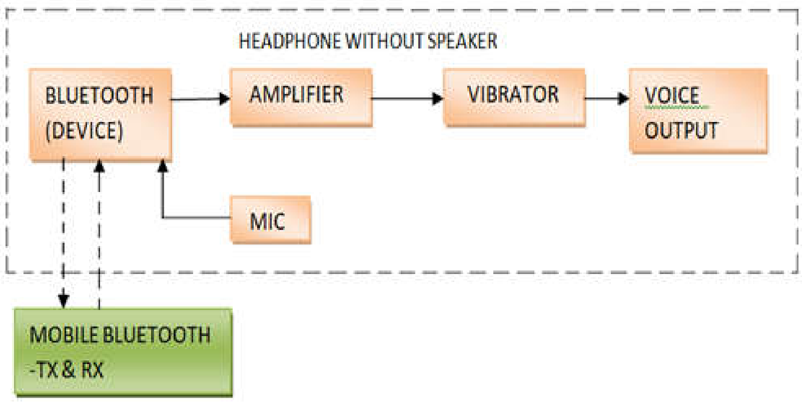


Figure 2: Block Diagram for Voice Output [Conduction Hearing Loss]

Conductive hearing loss occurs when there is a problem in conducting sound waves anywhere along the route through the outer ear, tympanic membrane (eardrum), or middle ear (ossicles). This type of hearing loss may occur in conjunction with sensorineural hearing loss (mixed hearing loss) or alone.

The conductive hearing loss people can feel only the vibration, so the call settings in the mobile phone should be in vibrated mode. The Bluetooth in phone settings and Bluetooth receiver in the headphone are paired.

After pairing, if the phone gets a call, it reaches the Bluetooth receiver and it is passed to the mono amplifier. The work of mono amplifier is that it can transmit only a single audio signal and it is used to deliver power to a vibrator. A mono amplifier is stable up to 2 ohms.

The work of vibrator is to convert the delivered power into movement i.e vibration. The vibration can be felt by biting the tip of vibrator. These vibrations passes through the mandibular bone and then reaches the ear ossicles via temporal bone and finally reaches the Cochlea of the ear as shown in figure 4.2. So, the voice can be clearly heard by the deaf people. Then the deaf people can reply with the help of microphone which is fixed in the headphone. High volume can damage the auditory nerve, so volume reducer is fixed in this device. Also, the volume in the mobile phone can be reduced.

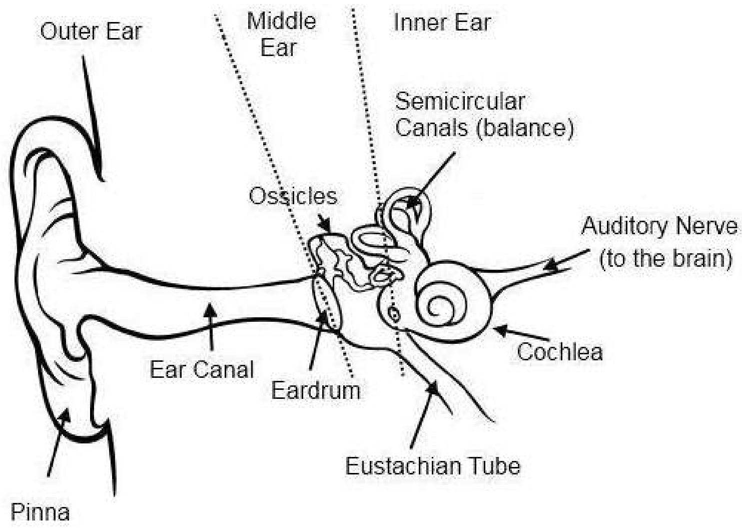


Figure 3: Ear Diagram

The text output model is for Sensorineural and Mixed type of Hearing Loss People. The deaf people who suffer from sensorineural and mixed type of hearing loss can only view the text and they could not able to feel the vibration.

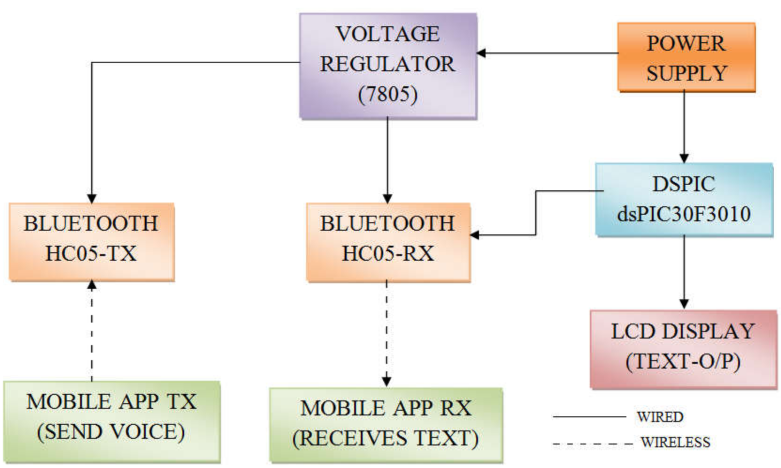


Figure 4: Block Diagram for Text Output [Sensorineural and Mixed Hearing Loss]

Sensorineural hearing loss (SNHL) is a type of hearing loss, or deafness, in which the root cause lies in the inner ear or sensory organ (cochlea and associated structures) or the vestibulocochlear nerve (cranial nerve VIII) or neural part. SNHL accounts for about 90% of hearing loss reported. SNHL is generally permanent and can be mild, moderate, severe, profound, or total. Various other descriptors can be used depending on the shape of the audiogram, such as high frequency, low frequency, U-shaped, notched, peaked, or flat. Sometimes a conductive hearing loss occurs in combination with a sensorineural hearing loss (SNHL) then it is called a mixed hearing loss.

When the power supply is on, mobile app transmitter in mobile phone is paired with the Bluetooth HC05 transmitter which is used for transmission purpose. Mobile app receiver in mobile phone is paired with Bluetooth HC05 receiver which is used for reception purpose.

When normal person makes a call, it will reach the dsPIC via Bluetooth HC05 (transmitter) through the mobile app transmitter. Here the speech signal is converted to text by using dsPIC.

The mobile phone sends the voice in digital (1's and 0's), it will be compared with the dsPIC library functions which are embedded in dsPIC. If the compared binary digits (32 bits) are same, then the text will be displayed as output in the LCD as well as in the deaf people mobile.

6. Result and Analysis

6.1 Voice Output

The stepwise procedure for voice output is as follows

The Bluetooth in the phone setting and Bluetooth device in the headphone are paired is shown in figure 5

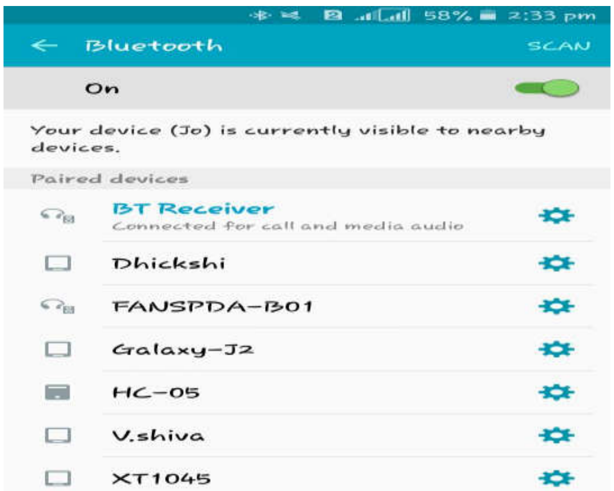


Figure 5: Pairing of Bluetooth device and Bluetooth in Mobile

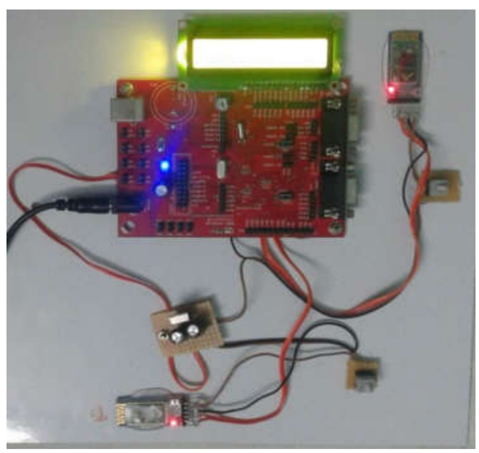
Thus after pairing, the voice signal from the mobile is converted into DC signal which is amplified and then the amplified signal is passed to the vibrator where the vibrations are produced.

Figure 6: Model for Voice Output

6.2 Text Output

The bluetooth in transmitter (normal person) mobile is paired with the Bluetooth device (HC05) which is used for transmission purpose. The bluetooth in receiver (deaf person) mobile is paired with the Bluetooth device (HC05) which is used for reception purpose.

The status of the mobile app in transmitter's phone should be in opened has shown in figure 7(a)



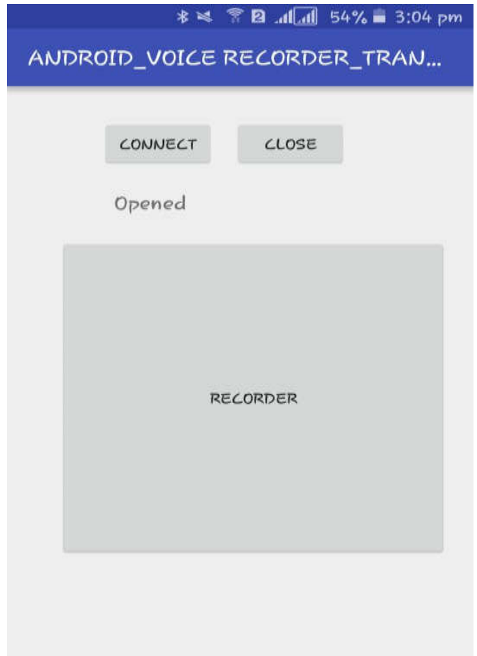
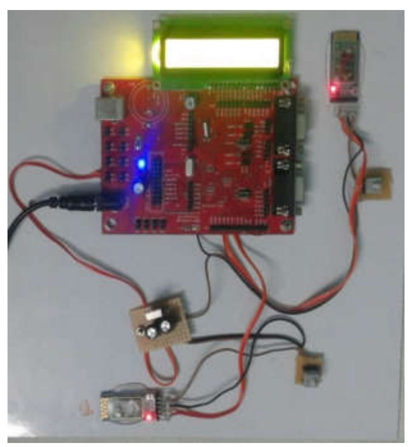


Figure 7(a): Status of Transmitter (Normal Person) Mobile

The status of the mobile app in receiver's phone should be in opened has shown in figure 7(b)



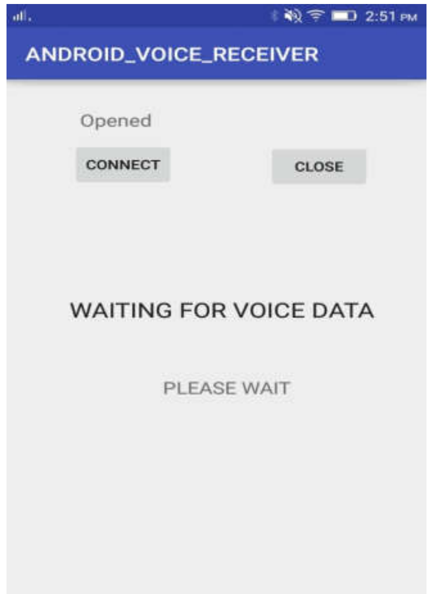


Figure 7(b): Status of Receiver (Deaf Person) Mobile App

If a normal person(transmitter) makes a call, then the normal person's voice is converted into text and it is shown in the LCD display as well as receiver's (deaf people) mobile phone is shown in figure 8(a) and 8(b).

Figure 8(a): Text output in LCD display

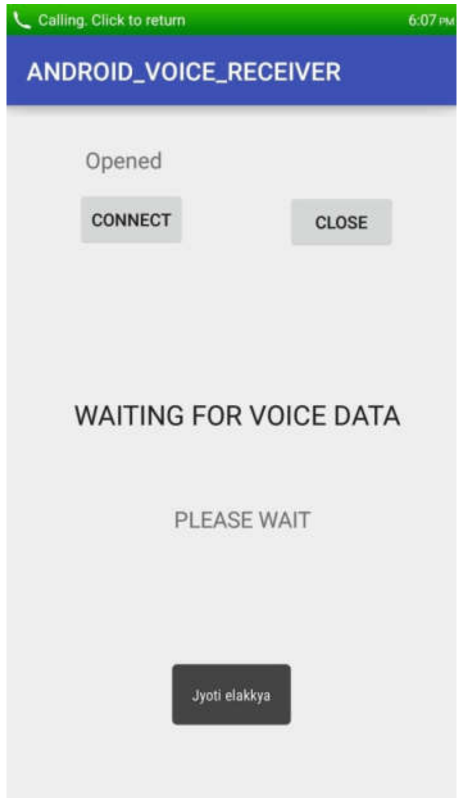


Figure 8(b): Text output in receiver's mobile phone

7. Conclusion

The inspiration behind this work came from the thought of helping to bridge the communication barrier issues faced by the hearing impaired communities. The system is being presented as a solution for the conversion of vibrations to voice and speech to text. The proposed model helps the hearing-impaired person, a regional voice output for conductive type of deafness and text output for sensorineural and mixed type of deafness for their needs. The development towards an efficient and practical application still needs to be finalized. As it is portable and requires low power consumption with swiftness communication having less weight, cost and gives patient liberty to carry it anywhere. However, there are several highlighted issues which limit the performance and usability of the device to communicate over shorter range. This confirms that further work is needed for longer distance communication. Overcoming these limitations will be the focus of the future research

References

[1] "Basic rate/enhanced data rate (br/edr)". Bluetooth.com. Retrieved 3 June 2016.
[2] "Bluetooth traveler". hoovers.com. Archived from the original on 11 January 2011. Retrieved 9 April 2010.
[3] Newton, Harold. (2007). Newton's telecom dictionary. New York: Flatiron Publishing
[4] "Bluetooth.org". Bluetooth.org. Retrieved 3 May 2011.
[5] Cowlishaw, M.F. (December 1974). "The Characteristics and Use of Lead-Acid Cap Lamps" (PDF). Trans. British Cave Research Association. 1 (4): 199–214.
[6] International Library of Technology: ... Principles of Telephony ... International Textbook Company, Scranton, PA. 1907.
[7] http://www.princeton.edu/~mae412/TEXT/NTRAK2002/292-302.pdf
[8] "Brushless DC motor cores for servomotors". Maxon Motor.

[9] Max A. Denket (2006). Frontiers in Robotics Research.Nova Publishers.pp. 44–.ISBN 978-1-60021-097-6.
[10] Jacek F. Gieras (22 January 2002). Permanent Magnet Motor Technology: Design and Applications, Second Edition,.CRC Press.pp. 283–.ISBN 978-0-8247-4394-9.
[11] Dreyfus, R.; Baudry, J.; Roper, M. L.; Fermigier, M.; Stone, H. A.; Bibette, J. (2005). "Microscopic artificial swimmers".Nature.437: 862–5. doi:10.1038/nature04090.
[12] Bamrungsap, S.; Phillips, J. A.; Xiong, X.; Kim, Y.; Wang, H.; Liu, H.; Hebard, A.; Tan, W. (2011). "Magnetically driven single DNA nanomotor".Small.**7** (5): 601–605. doi:10.1002/smll.201001559.
[13] T. E. Mallouk and A. Sen, "Powering nanorobots," Scientific American, May 2009, pp. 72-77.
[14] "Earphone". Retrieved 4 January 2014.
[15] Stanley R. Alten Audio Basics Cengage 2011 ISBN 0-495-91356-1 page 63
[16] "Headphones : The Ultimate buying guide - Hi-fidelity headphones". StereoCompare. Retrieved 2016-03-03
[17] https://www.fastcompany.com/3055208/its-true-apple-will-drop-the-headphone-jack-to-make-the-iphone-7-slimmer-and-simpler
[18] Lee, Richard M.L. "U.S. Patent 5245220". USPTO. Google Patents
[19] Standring, Susan; Borley, Neil R. (2008). "Overview of cranial nerves and cranial nerve nuclei". Gray's anatomy: the anatomical basis of clinical practice (40th ed.). [Edinburgh]: Churchill Livingstone/Elsevier. ISBN 978-0-443-06684-9.
[20] Su Myat Mon, HlaMyoTun, 'Speech-To-Text(STT) Conversion System using Hidden Markov Model(HMM)',International Journal of Scientific and Technology Research Volume 4, Issue 06, June 2015.
[21] E. Saranya , B. Baron Sam and R. Sethuraman, 'Speech to Text User Assistive Agent System for Impaired Person', IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), VeltechDr.RR& Dr.SR University, Chennai, T.N., India. 2 - 4 August 2017. pp.221-226.
[22] Shivakumar K M , Varsha V Jain and Krishna Priya P, 'A study on impact of Language Model in improving the accuracy of Speech to Text Conversion System', International Conference on Communication and Signal Processing, April 6-8, 2017, India.
[23] GopalKrushna Pal, Professor of Physiology, 'Comprehensive Textbook of Medical Physiology', first edition, 2017.
[24] Sunitha K. A, AnithaSaraswathi. P, Aarthi. M, Jayapriya. K, Lingam Sunny, 'Deaf Mute Communication Interpreter- A Review', International Journal of Applied Engineering Research ISSN 0973-4562, Volume 11, Number 1, 2016.
[25] Tao Liu, Wengang Zhou, and Houqiang Li, 'Sign language recognition with long short-term memory', IEEE International Conference on Image Processing (ICIP) 2016.
[26] Prof. Prashant ,G. AhireKshitija, B. Tilekar, Tejaswini, A. Jawake,Pramod, B. Warale, 'Two Way Communicator Between Deaf and Dumb People And Normal People', International Conference on Computing Communication Control and Automation, 2015.
[27] Arunodhayan. B, Prasanth. S, SadhamHussain ,Srivatsan. S, Sumathy. B, 'Automatic Generation of Speech for Mute and Hearing Impaired People', International Journal for Research in Applied Science and Engineering Technology, Volume 3, Issue IV, April 2015.
[28] BenShirley,JamesThomas,PaulRoche, 'VoIPText: Voice Chat for Deaf and Hard of Hearing People',IEEESecondInternational Journal onConsumer Electronics-Berlin (ICCE-Berlin), 2015.
[29] Akshay S. Utane, 'Emotion Recognition through Speech using Gaussian Mixture Model and Hidden Markov Model', International Journal of Advanced Research in Computer Science and Software engineering, volume 4, Issue 5, May 2013.
[30] Govindam. M, Madhan Kumar. M, 'Voice In Text Out And Text In Voice Out Communication Device For Deaf-Dump', International Journal of MC Square Scientific Research, Vol. 4, No. 1, Nov 2012.
[31] Ben Shirley, James Thomas, Paul Roche, 'VoIPText: Voice Chat for Deaf and Hard of Hearing People', IEEE Second International Conference on Consumer Electronics –Berlin, 2012.
[32] SantoshK.Gaikwad, 'A review on Speech Recognition Techniques', International Journal of Computer Applications, Volume 10, No.3, Nov 2010.
[33] http://www.explainthatstuff.com/hearingaids.html.