International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 12, Issue 7 (July 2016), PP.43-46

Issues and Challenges in Designing the wireless Architecture for Cochlear Devices

Ramesh .K[1], Santosh Pawar[2]
[1]*Department of Computer Science, Karnataka State Women's University, Vijayapur, Karnataka, India.*
[2]*Department of Computer Science, Karnataka State Women's University, Vijayapur, Karnataka, India.*

Abstract:- The latest cochlear Implant Naida CI Q70 with advanced wireless feature has got its speech processor and transmitter in the form of reliable wire communication architecture. This architecture creates problem for deaf in terms of maintenance and cost for its complex structure. The External components such as Transmitter, Sound processor and its internal components and microphones are apart in structure both internally and externally. The communication among the external devices requires a physical wire, and this structure has many disadvantages one is it needs a lot of care to maintain and on any small damage requires huge money needs to be spent on new head piece. Secondly its rare and unique structure creates a lot of nuisance with multiple enquiries from the people leading to the frustration while answering many people. Hence the innovative idea is to Design a wireless architecture to make the Transmitter and Sound Processor (external devices worn on head and year, for kids clipped on body inner wear) communicate wirelessly.During while there are a lot of issues and challenges are going to be encountered. This paper list outs all such issues and challenges and we also address their solution in future.

Key words:- Cochlear Implant, Head piece,SNR,

I. INTRODUCTION

In recent years there is a significant increase in the demand for the electronic implantable medical devices . it is quite challenging job to design a reliable wireless architecture for Cochlear implantable devices. In wireless communication communicating devices need to be small and their bandwidth is limited , key challenges are data rate enhancement, minimizing cost,minimizing power consumtion and noise reduction through SNR.Several factors influence the choice of a digital modulation scheme. A desirable modulation scheme provides low bit error rates at low received signal to noise ratios, performs well in multipath and fading conditions, occupies a minimum of bandwidth, and is easy and cost-effective to implement. The performance of a modulation scheme is often measured in terms of its power efficiency and bandwidth efficiency. Power efficiency describes the ability of a modulation technique to preserve the fidelity of the digital message at low power levels. In a digital communication system, in order to increase noise immunity, it is necessary to increase the signal power. Bandwidth efficiency describes the ability of a modulation scheme to accommodate data within a limited bandwidth. to increase the SNR, when the characteristics of the noise are known and are different from the signals, it is possible to filter it or to process the signal. efficient noise reduction in complex listening scenarios remains a challenging task, partly due to the limited number of microphones that can be integrated on such devices.

Cochlear Implant[2][3] system consists of a microphone,processor,headpiece,cable and implant. Sounds in the environment are captured through the microphone located on processor.The processor then coverts this sound information in to a distinctive digital code that is transmitted to implant by the head piece. The headpiece is held in place over the implant by a magnet that attracts to the implant magnet. Implant converts the digital code into electrical signals that are delivered to human auditory (hearing) nerve. Auditory nerve then carries this information to the brain, where it is interpreted as sound.

Cochlear implants can help the people who are suffering from the following:

- have moderate to profound hearing loss in both ears
- have profound hearing loss in one ear with normal hearing in the other ear
- receive little or no benefit from hearing aids
- score 65% or less on sentence recognition tests done by hearing professional in the ear to be implanted

Many people have cochlear implants in both ears (bilateral). Listening with two ears can improve your ability to identify the direction of sound and separate the sounds you want to hear from those you don't.

II. PRESENT ARCHITECTURE

The present structure[3][4] is shown in (fig 1).This structure has got microphone,processor,headpiece,cable and implant. Sounds in the environment are captured through the microphone located on processor.The processor then coverts this sound information in to a distinctive digital code that is transmitted to implant by the head piece. The headpiece is held in place over the implant by a magnet that attracts to the implant magnet. Implant converts the digital code into electrical signals that are delivered to human auditory (hearing) nerve. Auditory nerve then carries this information to the brain, where it is interpreted as sound.

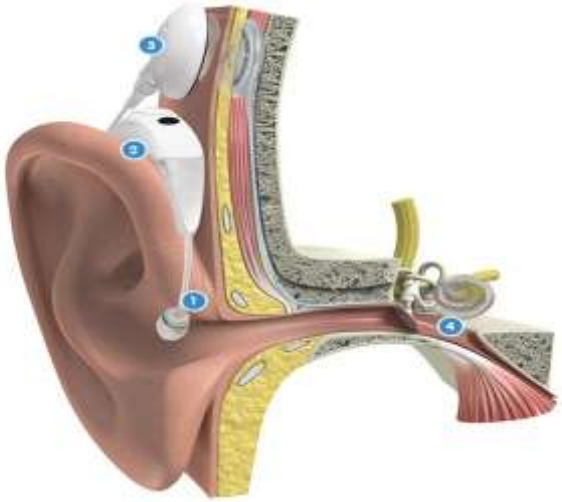

Fig:1-Present Cochlear device

The working of Cochlear Implant

1. First, the cochlear implant system captures the sound around you, with one or more microphones. AB has microphones placed in the front and back of the processor and in the headpiece.Unique AB microphone technology allows you to use ear buds, headphones and telephones like everyone else, to hear in water, and to hear better in noise.

2. When the sound is captured, it is processed. AB sound processors use the industry's most advanced technology to make hearing easier and include the only sound processing strategy in the industry recognized by the FDA to improve speech understanding in noise.

3. The processed sound is transmitted through the headpiece to the implant. AB's implant family features the most advanced sound processing circuitry in the world, with programming flexibility that provides nearly unlimited ways to deliver sound.

4. The sound is sent through an electrode directly to your hearing nerve. Every AB electrode delivers focused stimulation through current steering technology – available only from AB – for hearing that more closely resembles normal hearing.

III. ORIGIN OF THE PROBLEM

As I am aware of the structure of this Cochlear Implant where two external devices (Transmitter and Sound Processor)communicating through a wire and this structure has many disadvantages one is it needs a lot of care to maintain and on any small damage requires huge money needs to be spent on new head piece. Secondly its rare and unique structure creates a lot of nuisance with multiple enquiries from the people leading to the frustration while answering many people.

The External components such as Transmitter, Sound processor and its internal components and microphones are apart in structure both internally and externally. The communication among the external devices requires a physical wire, and this structure has many disadvantages one is it needs a lot of care to maintain and on any small damage requires huge money needs to be spent on new head piece. Secondly its rare and unique structure creates a lot of nuisance with multiple enquiries from the people leading to the frustration while answering many people.

Some of the disadvantages are as follows:

1) Exsting cochlear device is having wired connection between sound processor and transmitter.

2) Because of this wire patient can't perform his day today activities properly due to abstacles of wire.

3) When patients are implanted this device there is headpiece which is mounted on head looks odd,and patients feels uncomfertable in society.
4) Cost is more for existing cochlear device.

IV. PROPOSED SYSTEM

Hence to address the above problem the innovative idea is floated to design a wireless architecture[1] to make the Transmitter and Sound Processor (external devices worn on head and year, for kids clipped on body inner wear) communicate wirelessly. During while I found the number problems such as Reliability and the Quality of the communication where the factors such as SNR, Radio frequency allocation, and the proper structure of the wireless network. In this paper I have tried resolve and proposed the concepts to address the issues related to the wireless techniques for cochlear devices for some extent.
The objectives of idea is:

- To design wireless software architecture for cochlear device which helps thosands of deaf people.
- To increase the quality of signal by increasing SNR ratio.

4.1 Design issues and challenges

While achieving the above objectives there are various number of issues are encountered they are following

1. Designing reliable wireless architecture :

- ***Scalable and flexible architecture*** :In the wireless network the number of wireless nodes deployed may be order of hundred, thousands or millions so that we can easily extend the network size. The communication protocols must be designed in such a manner that deploying many nodes in the network does not affect clustering and routing. In other words, the network must preserve its stability. Introducing more nodes into the network means that additional communication messages will be exchanged, so that these nodes are integrated into the existing network.
- ***Error-prone wireless:*** *medium*-Since wireless networks can be deployed in different situations, the requirements of each different application may vary significantly. We should consider that the wireless medium can be greatly affected by noisy environments. An attacker interferes knowingly and causes enough noise to affect the communication.
- ***Fault tolerance and adaptability***- Fault tolerance means to maintain wireless network functionalities without any interruption due to failure of sensor node because in sensor network every node have limited power of energy so the failure of single node doesn't effect the overall task of the sensor network. Adaptable protocols can establish new links in case of node failure or link congestion. Network can able to adapt by changing its connectivity in case of any fault. In that case, well- efficient routing algorithm is applied to change the overall configuration of network.

2. Allocation of proper Radio frequencies: For any of the wireless network[9] significant choice as to which spectrum band to used for the designed wireless network. The choice must make a huge impact on the distance, robustness, and speed out of a network without wires.hence a proper bandwidth allocation method must be adopted.

3. Improving SNR: there is need to improve the signal to noise ratio (SNR) wireless network. [8]To best explain what that is, imagine your cable signal as a full swimming pool. All your channels and paths are floating on the surface, sailing along. Harmful things that can cause noise are eating holes in the bottom of the pool, therefore lowering the water level. The lower the water, the more hazardous your sailing is. Your boats start to hit rocks and come back to shore damaged.Hence an appropriate method is required to adopt to improve the SNR.

4. Selection of Input Dynamic Range (IDR): is the range of the softest to loudest sounds that are detected by a sound processor. The wider the range, the more sounds you hear. AB's AutoSound™ technology captures and delivers the widest range of sound of any cochlear implant system. With this wide range, you hear closest to the way normal-hearing people do, from a whisper to a shout.

5. Proper stimulation of Electrodes: The steering is the process of using multiple current sources to stimulate two electrodes at the same time so that recipients hear additional pitches compared to when either electrode is stimulated alone. a breakthrough in sound processing technology is required that uses current steering to increase the number of pitches heard.

6. Providing the confident communication to achieve Clear Voice : Clear Voice provides you with the unique opportunity to converse more effortlessly in noisy settings, understand your favorite song lyrics, enjoy the world around you, and hear your best at any moment and any place your day takes you.

7. latest design of electrodes : Developing a extensive and state-of-the-art manufacturing processes, to design a electrode[11][13] for optimal placement in the cochlea. This must Feature the latest soft surgery approaches, including round window insertion, to suit surgeon preferences and individual recipient needs.

The electrodes must be uniquely designed for easy control and placement and also exclusively provides the ability to reload the electrode.

8. **Providing best Wireless Solutions:** To Hear Better in Extreme Noise and Over Distance
a digital wireless standard must be developed that enables you to hear and understand more speech in extreme noise and over distance. A good directional microphone technology, that transmits crystal clear sound while reducing background noise.
9. **Bringing on the Effortless Communication, on the Phone:** To Chat with loved ones. Keeping in touch with business associates. Ordering takeout. Whenever you use the phone, you want the comfort and confidence that comes with hearing and understanding as clearly as possible. The technology must make talking on the phone easier and better than ever. Wireless streaming options mean that crystal clear audio is transmitted directly to your hearing devices. When you hold the phone to one ear, ear-to-ear technology streams the sound to both devices at the same time.Use a hands-free option or hold the phone directly to your ear like everyone else Hear calls in both ears clearly even in noisy placesVideo chat online with wireless streaming from your computer, tablet, or smartphone Use any Bluetooth-enabled mobile phone, anytime, anywhere.

V. CONCLUSIONS

This Technology will investigate a focused initiative on Technology interventions for the benefit of deaf persons(specifically children's)in the country and across the globe.This Proposal will sure come out with technological solutions and product with multidisciplinary approach to improve the quality of life of deaf persons (specifically children's) and in making them self sufficient .

REFERENCES

[1]. "Design & Implementation of Wireless system for Cochlear Devices" Ramesh K,De Gruyter Digital Library , July 09-10, 2016.

[2]. www.advancedbionics.com .

[3]. http://www.hearinghouse.co.nz/children-families/appropriate-amplification/

[4]. The History of Cochlear Implants – Comparing the Current Cochlear Implant Manufacturers byAshley Nicole Norkus Bloomsburg, Pennsylvania 27 June 2007.

[5]. Cochlear Implant Speech Processing for Severely-to-Profoundly Deaf People by Graeme M.Clark.

[6]. Configuration of FPGA for Computerized Speech/Sound Processing for Bio-Computing Systems by V Hanuman Kumar, SeethaRamaiah P,International Journal of Computer Science Issues (IJCSI), Vol.8, Issue 5, No 3, September 2011 ISSN (Online): 1694-0814 .

[7]. NIH Publication No. 11-4798 (2011-03-01). "Cochlear Implants". 'National Institute on Deafness and Other Communication Disorders' as of December 2010,

[8]. [Clark, 2006] Graeme M. Clark, "The multiple-channel cochlear implant: the interface between sound and the central nervous system for hearing, speech, and language in deaf people a personal perspective", Phil. Trans. R. Soc. B , 2006, Vol. 361,pp 791–810

[9]. [Greenwood, 1990] Greenwood, D. D. (1990). _A cochlear frequency position function for several species: 29 years later‖, Journal of the Acoustical Society of America, Vol. 87, 1990, pp 2592-2605.

[10]. The Parents' Guide to Cochlear Implants. Gallaudet University Press. 2002. p. 44. ISBN 1-56368-129-3.

[11]. Papsin, BC (2005 Jan). "Cochlear implantation in children with anomalous cochleovestibular anatomy.".The Laryngoscope 115 (1 Pt 2 Suppl 106): 1–26. doi:10.1097/00005537-200501001-00001.PMID 15626926.

[12]. Pakdaman, MN; Herrmann, BS, Curtin, HD, Van Beek-King, J, Lee, DJ (2011 Dec 1). "Cochlear Implantation in Children with Anomalous Cochleovestibular Anatomy: A Systematic Review.". Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery. doi:10.1177/0194599811429244. PMID 22140206.

[13]. Cochlear implant maker says hi-fi bionic ear will help the deaf hear music. News. com.au,December 18, 2008.

[14]. Auditory sensation to the deafenedperson using cochlear mplant system with computerized fpga speech/sound processing unit.V Hanuman Kumar1and P Seetharamaiah2 International Journal of Information Technology Convergence and Services (IJITCS) Vol.2, No.5, October 2012 DOI : 0.5121/ijitcs.2012.2503 19 1.