Smart Medical Assistance using Soft Computing

[1]Hima Bindu Katikala*, [2a]Kommuri Manoj Kumar, [2b]Loshalika Reddy Malapati, [2c]Venkata Greeshmanth Bodduluri, [3] Gopal Krishna, [4] G. Ramesh, , [5] Namita Kaur, [6] L. Raghu kumar

[1]Assistant Professor, Department of Biomedical Engineering, Vignan's Foundation for Science Technology and Research, India-522213

[2a,b,c]UG Student, Department of Biomedical Engineering , Vignan's Foundation for Science Technology and Research, India-522213

3Uttaranchal University Uttarakhand, India-248007

4 Department of Computer Science and Engineering, GRIET, Bachupally, Hyderabad,Telangana,ramesh680@gmail.com

5 Lovely Professional University, Phagwara Punjab, 144001, India

6 KG Reddy College of Engineering & Technology,lrgupta528@gmail.com

[1*]katikala.himabindu@gmail.com, [2a]manojkumarkommuri2001@gmail.com, [2b]loshalikamalapati@gmail.com, [2c]greeshmanthchowdary16@gmail.com

Abstract

In recent years, in consumer electronics, the Health care system is the most important one to evaluate humans' diverse pathological activities. Collaborating with the biomedical field, electronics can find remedial designs for an artificial implant that functionalizes as a human organ to deal with different prostheses, therapy dialysis, etc., conditions and analyze the neural system responses. Using the advanced technological approach, the desired sub-blocks are to be designed to improve the Implant's performance, especially in cost & market-production. This paper briefly explains the Bionic hearing-aid Implant recognized as a Cochlear implant and its architecture in.

Keywords: Cochlear Implant (CI), Fin Field Effect Transistor (FINFET), Electrode Array, Back Telemetry.

I. Introduction

Many wireless medical implants [1] are specifically used for prostheses, diagnosis, and function to mimic regular body parts. In the field of Pharmacy, designing of these implants requires miniaturization of technology & also component scaling. In general, implants are contrived from the skin, bone, tissues &materials-metal/plastic/ceramic, insertion of nanometer scaled(nm) Implant, and generation of ionic potential stimulus from injected electrode array inside the human body through these kinds of Implant is a challenging task. The best HYPACUSIS treatment implant is COCHLEAR IMPLANT (CI) [2] helps to impetus the auditory nerve directly by stimulating the hair cells of the EAR. However, VLSI advanced technologies like CNTFET*, FINFET, and* TFET make the scaling of channel width rather than CMOS, leading to certain parametric variations *(*Power, Delay & Area) accordingly. Designing implants by incorporating the mentioned technologies may enhance productivity & performance. This paper deals exploitation of COCHLEAR implant circuit designing in advanced VLSI technologies. Moore's law [3] states *a doubling of* transistor count on *an* integrated chip by scaling the technology, as in Fig.1. Researchers ' progressive efforts from past decades originated a nanometer (*nm*) technology transistor known as FINFET, shortening the cons of CMOS technology. With the FINFET [4] narrow channel dual gate structure of Fig.2. The leakage current is lessened & deepens carrier mobility: without increasing doping concentration & requires low operating voltage (~0.4v), condense power dissipation.

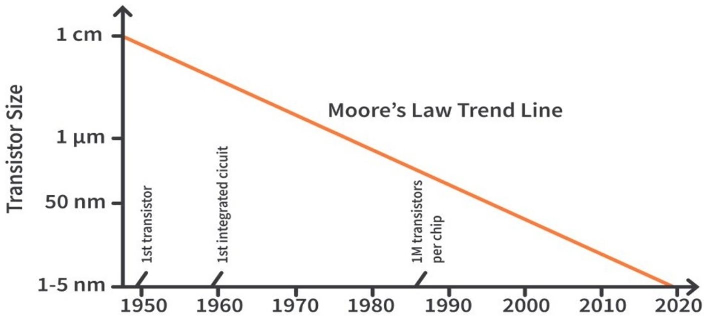

Fig.1. Transistor scaling technology

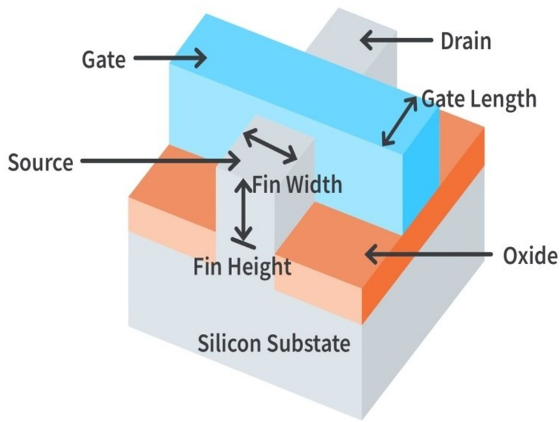

Fig.2. FINFET Planar Structure.

In evidence of WHO's recent proclamation [5], 488 million people complain of hearing disabilities for >40dB echo auditory signals & which may extend to >900 million by 2025 via environmental conditions, noise pollution, etc. Settling to the above strategy, research inventors proposed certain medication facilities like artificial implantation (CI) from the early 1800 to date by accommodating electrodes for designing purposes. CI uses 22 active platinum electrodes providing 11 channels as an array, with a length of 17mm, each electrode isolation of <0.1mm & facilitates the biphasic electric stimulus to the auditory nerve[6]and spiral ganglion nerve in Fig.3.

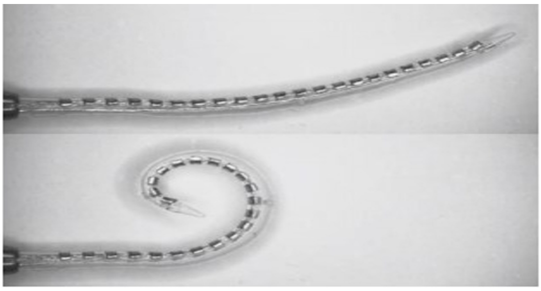

Fig.3 CI Platinum Electrode Array

Conventional CI contains internal parts: electrode array, transmitter & receiver /Stimulator (9.5 gm) enclosed with external parts: microphone and speech processor. A highly designed CI requires 5-6 hours of surgery to stabilize hearing sense & place of Implant inside the ear. Fig.4 describes the signal processing of CI from internal to external parts perfectly. As table.1 discusses the contribution of inventors, especially for auditory neuro-stimulus and their functionalities [7].

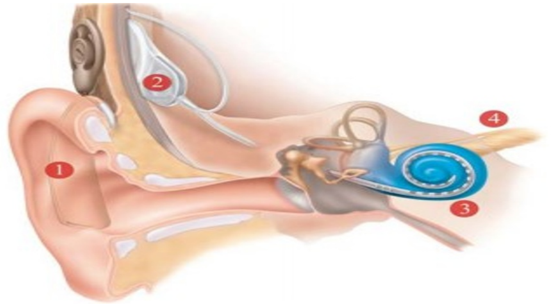

Fig.4.CI Signal Processing

1. Speech Processor-receives acoustic signals via a microphone
2. Transmitter-transmits the encoded audio signals to the internal receiver
3. Electrode array receives transmitted impulses.
4. Auditory nerve-The Electrode array electrically stimulates the auditory nerve.

Table.1. Invention Route-map of CI.

Year	**Inventor**	**Device**	**Application**
1800	Alexandra Volta	Metal rod insertion	Auditory Sensation
1930	Waver- Bray	Auditory nerve connected with an electrode	Sound Processing.
1950	Lundeberg	Stimulate Auditory nerve using electricity	Anticipate Processing
1957	Djourna and Eyeries	Stimulate Auditory with current	Perfect Auditory Purpose
1961	House- Doyle	Electrodes insertion for profoundly deaf adults	Clear Auditory Response
1972	Cochlear Corporation	1stsingle channel cochlear implant development	Stimulus functionality
1984	Cochlear Corporation FDA	Wearable Speech Processor "NUCLEUS"	Speech Coding Strategy
1989	Cochlear corporation	Mini Speech Processor (MSP)	The small size made it suitable for children
2006	Ronald	Advanced Electrolyte Stylet (AOS)	Multi-channel Speech Processor.

2. FINFET trends in COCHLEAR IMPLANT.

The electronics in CI's scope are designing functioning circuits like speech processors transmitter, etc. using VLSI technology. Signal processing from the external source to the ear's internal part is perfectly prototyped in Fig.5 [8].

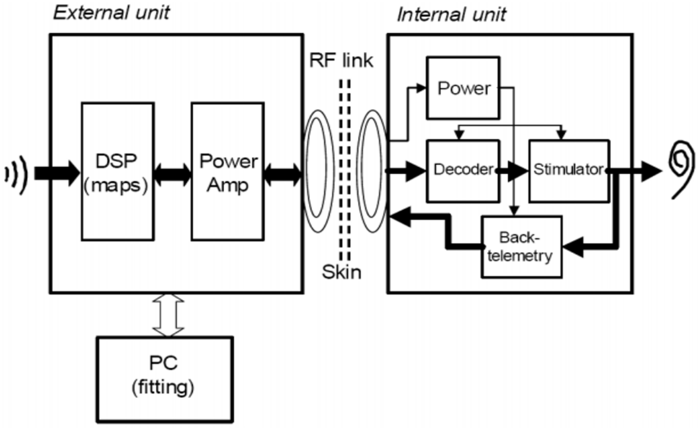

Fig.5. Modern CI Functional Block Diagram.

Modern CI can be successfully progressed by applying a properly synchronized clock implemented in FINFET topology [9] in Radio Frequency (RF) range. All the medical devices in terms of advanced security[14-16, 21, 22] are driven mostly in the RF range for ensuring safety interconnect between internal and external parts, to transmit both power and data. The major sub-block is back telemetry pretends to monitor the internal unit, electrode unit conditions & neural responses. An ASIC chip with a power amplifier [10], and an error-free decoder/demodulator [11, 20]. and Analog to Digital Converter (ADC) is integrated for internal feedback purposes. However, propagating the signal impulse in the mv range into the body is crucial.

3. Artificial Intelligence (AI) Based PC Unit in Cochlear Implant.

As shown in Fig.6 the advanced artificial intelligence (AI) technology is used in the biomedical cochlear implant assistive device to have the advanced computational process. The Personal Computer (PC) unit will assist the AI technology from the basic functionality of peripheral to controllers. With help of external controllers the acoustic energy is transmitted to the cochlear implant in serial systemic mechanism.

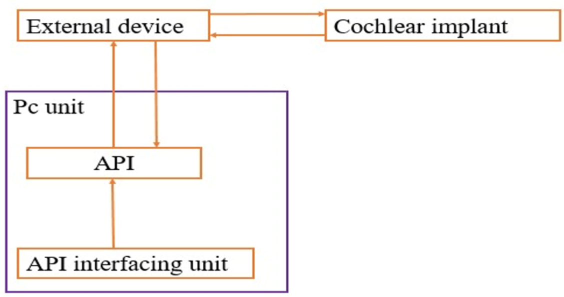

Fig.6. AI Based PC Unit.

Conclusion

Trends in advanced artificial intelligence technology in medical assistance may enhance the biomedical file especially auditory nerve system through cochlear implant functionalities, making sense of low-frequency sound by hearing-impaired individuals with the usage of soft computing methodologies. By incorporating appropriate safety measures, a perfect implant design can be developed.

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