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Original Research Article

Design of Bionic Ear - Cochlear Implant and Artificial Hearing System; a Unique Project "Mobile Bio-Ear-Tronic System"

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Abstract
This article introduces the "Mobile Bio-Ear-Tronic System" which is an artificial hearing system for the hearing-impaired people. "Mobile Bio-Ear-Tronic System" is a completely original project and unique to the author of this article. [1-29]
According to the data of the World Health Organization (WHO), 466 million people live with hearing impairment worldwide. 34 million of these people are children under the age of 15. When the current project study carried out with the bionic ear is examined, the sound signals coming from the mobile phone are transferred to the microphone on the outer part of the bionic ear via wireless transmission, the transferred acoustic information is converted into electrical signals by the microphone-processor system and these signals are transferred to the auditory cortex of the brain through the processor, thus improving the life quality of hearing-impaired individuals. It is certainly possible to say that there is no other system in the literature that obtains hearing results using a mobile phone and software. The bionic ear system stated in this article will be a first in this respect. The cost of cochlear implant systems currently used in the world to a patient is extremely high. When these systems are imported to our country, the cost in question increases exponentially. The Bionic Ear that to be developed will be tested for the first time in terms of using the mobile phone infrastructure, high hearing quality will be achieved and the developed system will also be aimed to be economical. In addition, the Bionic Ear system to be developed within the scope this project is a local and national system development study. In this respect, it will also benefit our country economically. In summary, this project work is extremely important both in terms of human health, scientific and technical aspects, and the country's economy. In addition, it is of great importance for our university (Iğdır University, Turkey) to consider health, science and technology together and carry out such a project study. [1-29]

Keywords: Mobile Bio-Ear-Tronic System, Bionic Ear, Cochlear Implant, Cochlear Implantation Surgery, Ear Prosthesis, Sound Signal, Artificial Hearing, Speech, Electrode Bundles, Neural Engineering, Brain Stem Implant.

INTRODUCTION
This article introduces the "Mobile Bio-Ear-Tronic System" which is an artificial hearing system for the hearing-impaired people. "Mobile Bio-Ear-Tronic System" is a completely original project and unique to the author of this article. [1-29]

According to the data of the World Health Organization (WHO), 466 million people live with hearing impairment worldwide. 34 million of these people are children under the age of 15. In contrast, manufactured hearing

aids and bionic ears meet less than 10 percent of global need. This corresponds to less than 3 percent of the needs of hearing-impaired people in developing countries. South Asia, Asia Pacific and Sub-Saharan Africa stand out as the regions where most hearing-impaired people live. The most important problem of hearing-impaired individuals living in these regions is that their access to relevant health services is limited and bionic ear technology is not developed. It is estimated that 5 out of every thousand babies born have hearing problems. However, WHO points out that 60 percent of hearing loss cases, especially in children, are preventable with early diagnosis. The number of hearing-impaired people, who make up more than 5 percent of the world's population, will reach 630 million in 2030 and 900 million by 2050, if necessary, measures are not taken. This means that one in every 10 people will be hearing impaired in 2050 and that individuals with hearing impairments have lost or weakened their speaking skills. In Turkey, this number is approximately 3 million. WHO also states that untreated hearing loss costs $70 billion annually globally. Based on these statistics, the main aim of this article is to appeal to millions of people, to help them fully or partially fulfill their daily activities, to improve the quality of life of these hearing-impaired people and to restore their health. In addition, the scientific and technical studies to be carried out on this subject will contribute to the enrichment of the literature on the subject and will also be beneficial for scientific and technical progress. [1-29]

When the current project study carried out with the bionic ear is examined, the sound signals coming from the mobile phone are transferred to the microphone on the outer part of the bionic ear via wireless transmission, the transferred acoustic information is converted into electrical signals by the microphone-processor system and these signals are transferred to the auditory cortex of the brain through the processor, thus improving the life quality of hearing-impaired individuals. It is certainly possible to say that there is no other system in the literature that obtains hearing results using a mobile phone and software. The bionic ear system stated in this article will be a first in this respect. [1-29]

Supportive technologies that improve the user's quality of life are needed, especially by specially designed electrodes for different genetic inner ear problems, speech processors that can process sound in much more detail, and wirelessly connected to the mobile phone. Mobile phone technology has been developing over the years and is intertwined with other technological structures. People fulfill many of their needs via mobile phones. Wireless connection of mobile phone and cochlear implant, which is not available in the literature, will be discussed in this project study. Therefore, as a result of this connection, we ensure signal transmission between the mobile phone and the cochlear implant devices. In other words, a person using a cochlear implant can use a mobile phone comfortably. This improves the patient's quality of life. While the use of mobile phones is the first idea, it will significantly reduce the cost of bionic ears according to other existing studies. Thus, patients will be able to easily afford the bionic ear. As mentioned earlier, the bionic ear system stated in this article will be a first in this respect. The cost of cochlear implant systems currently used in the world to a patient is extremely high. When these systems are imported to our country, the cost in question increases exponentially. [1-29]

The Bionic Ear that to be developed will be tested for the first time in terms of using the mobile phone infrastructure, high hearing quality will be achieved and the developed system will also be aimed to be economical. In addition, the Bionic Ear system to be developed within the scope this project is a local and national system development study. In this respect, it will also benefit our country economically. In summary, this project work is extremely important both in terms of human health, scientific and technical aspects, and the country's economy. In addition, it is of great importance for our university (Iğdır University, Turkey) to consider health, science and technology together and carry out such a project study. [1-29]

The Cochlear Implant electronic device to be designed will enable children and adults with bilateral severe or profound sensorineural hearing loss, who cannot benefit sufficiently or at all from hearing aids, to perceive sounds better and understand speech better.

The basic working principle of the Cochlear Implant to be designed by this project can be explained as follows; External parts receive acoustic signals, which is where the technical possibilities provided by the mobile phone can be used. It converts these signals into electrical signals so that they can be transferred to the receiver under the skin. Signals are sent to the electrode array by the receiver. These signals are transferred to the auditory nerve by the relevant electrodes. Signals reach the brain through the auditory nerve and are perceived as sound there. With the Cochlear Ear transplanted to the patient through surgical interventions, the person's sentence comprehension rate increases by 80%. Voices can be distinguished better in noisy environments. A person perceives the notes in the music he/she listens to in more detail. They feel safer in daily life. In addition, in this project, the bionic ear device will be compatible with the mobile phone. [1-29]

In other words, the sound signals coming to the mobile phone will be transferred to the microphone on the outer part of the bionic ear via wireless transmission. The transmitted acoustic information will be converted into electrical signals by the microphone-processor system. These signals will be transferred to the auditory cortex of the brain through

the processor. In this way, the life quality of hearing-impaired individuals will increase even more. While the use of mobile phones is the first idea, it will significantly reduce the cost of bionic ears according to other existing studies. Thus, patients will be able to easily and economically afford the bionic ear. As mentioned earlier, the cost of Cochlear Implant systems currently used in the world for a patient is extremely high. The bionic ear that to be developed will be tested for the first time in terms of using the mobile phone infrastructure, high hearing quality will be achieved and the developed system will also be aimed to be economical. [1-29]

Method, Findings and Discussion

A general view of a cochlear implant unit including all containing parts is shown in Figure 1. The "Mobile Bio-Ear-Tronic System" which is an artificial hearing system for the hearing-impaired people is shown by Figure 2. "Mobile Bio-Ear-Tronic System" is a completely original and unique project, it is designed and named by "Emin Taner ELMAS", the author of this article. In this project, the cochlear implant unit shown in Figure 1 will be compatible with "Mobile Bio-Ear-Tronic System" shown in Figure 2. [1-29]

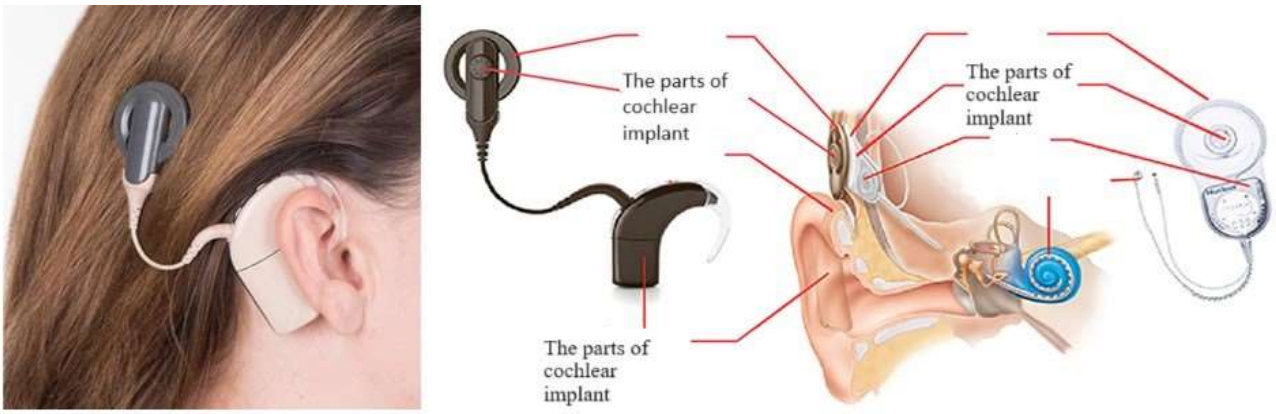

Figure_1: A general view of a cochlear implant unit including all containing parts.

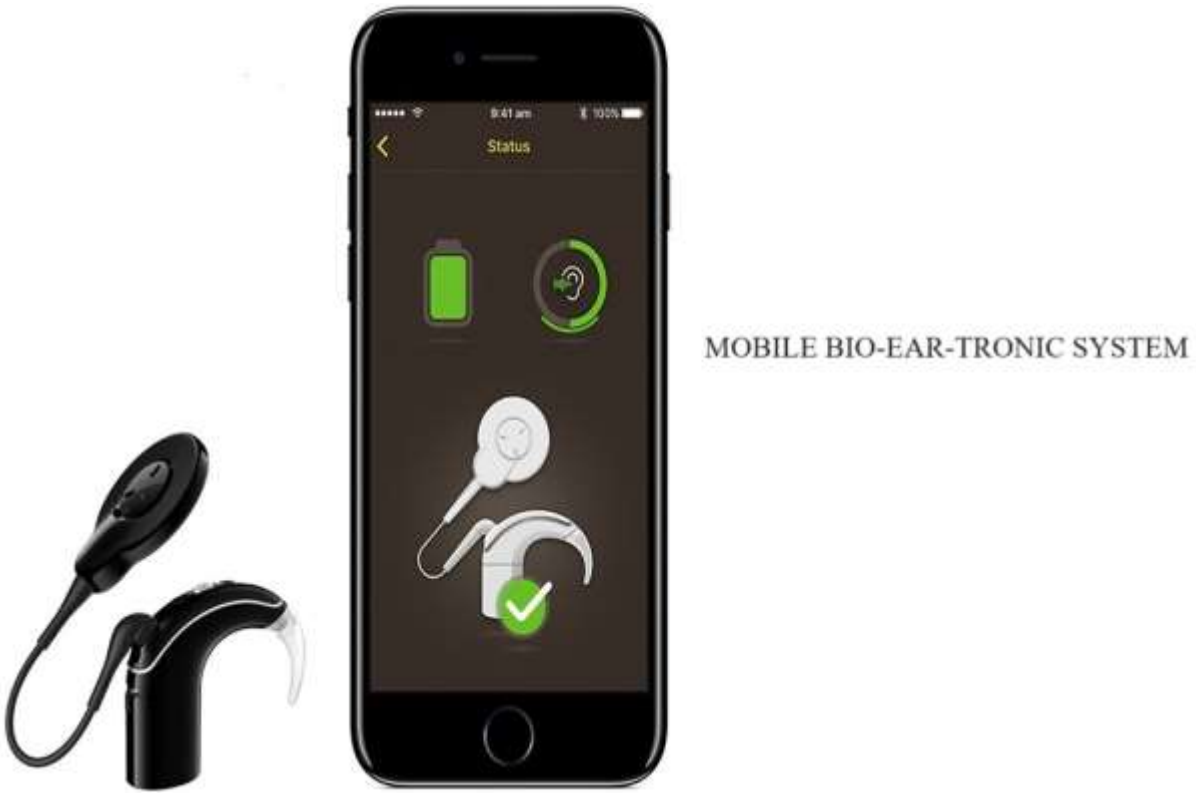

Figure_2: Mobile Bio-Ear-Tronic System" is a completely original and unique project, it is designed and named by "Emin Taner ELMAS", the author of this article.

The material and method for "Mobile Bio-Ear-Tronic System" project will be as follows, as itemized: [1-29]

- Sound is detected through the microphone.
- Acoustic information is received by the microphone and converted into electrical signals by the processor, and these signals are transferred to the processor.
- The speech processor encodes and amplifies the signal, making it suitable for inner ear stimulation.
- The electrical impulse is then transmitted to the external antenna.
- The external antenna transfers the electrical impulse from the skin to the internal antenna.
- The internal antenna transmits the electric current to the receiver-stimulator.
- The Receiver-Stimulator ensures the stimulation of the relevant electrodes according to the incoming signal.
- The electrode bundle transfers the electrical stimulus to the inner ear and stimulates the relevant localization within the cochlea.
- Sound amount (sound density), electrode bundle, wavelength, frequency, signal transmission speed, voltage and current can be compared and these will be the main parameters.
- Mobile phone can be used, a Cochlear Implant system connected to the mobile phone via wireless connection can be made.
- Electronic circuits can be drawn by using a special software.
- Voltage and frequency measurements can be made with an oscilloscope
- Computer Modeling can be done.

CONCLUSION

The conclusion items for Mobile Bio-Ear-Tronic System" project can be stated as follows: [1-29]

- The amount of sound energy will be measured with a decibel meter and different wavelengths of sound, transmission speed of sound, frequency, electric current and voltage values will be obtained.
- These values will be given in tables and graphs.
- Corresponding to the amount of sound (sound density); by comparing the obtained frequency, wavelength, transmission speed, current and voltages with the literature, their compliance with the signal values required for hearing will be confirmed.
- General system configuration will be created. [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30]

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