



DEVELOPMENT OF A SIGNALLING CIRCUITRY FOR COCHLEAR IMPLANTS

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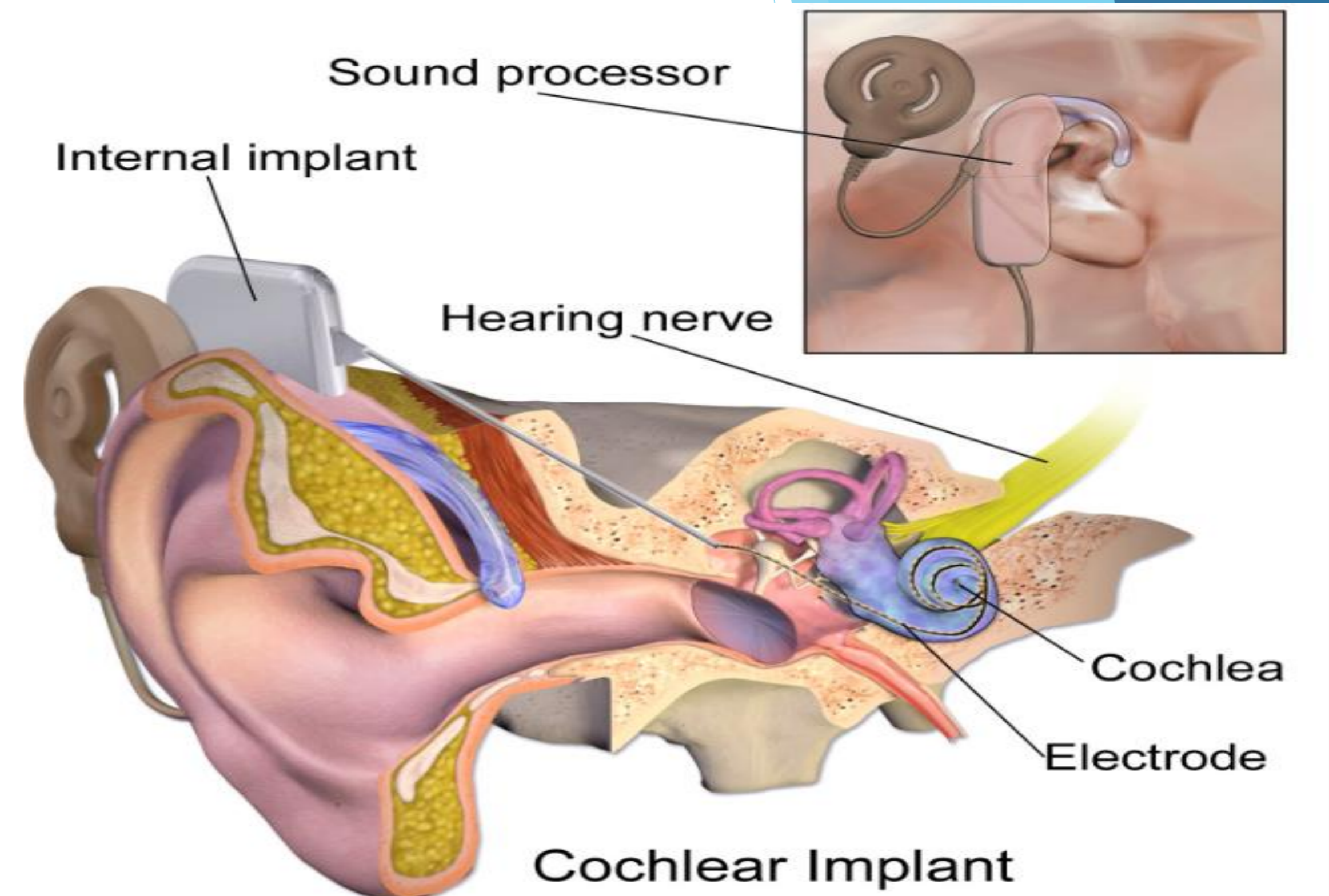


Engineering Accreditation Commission

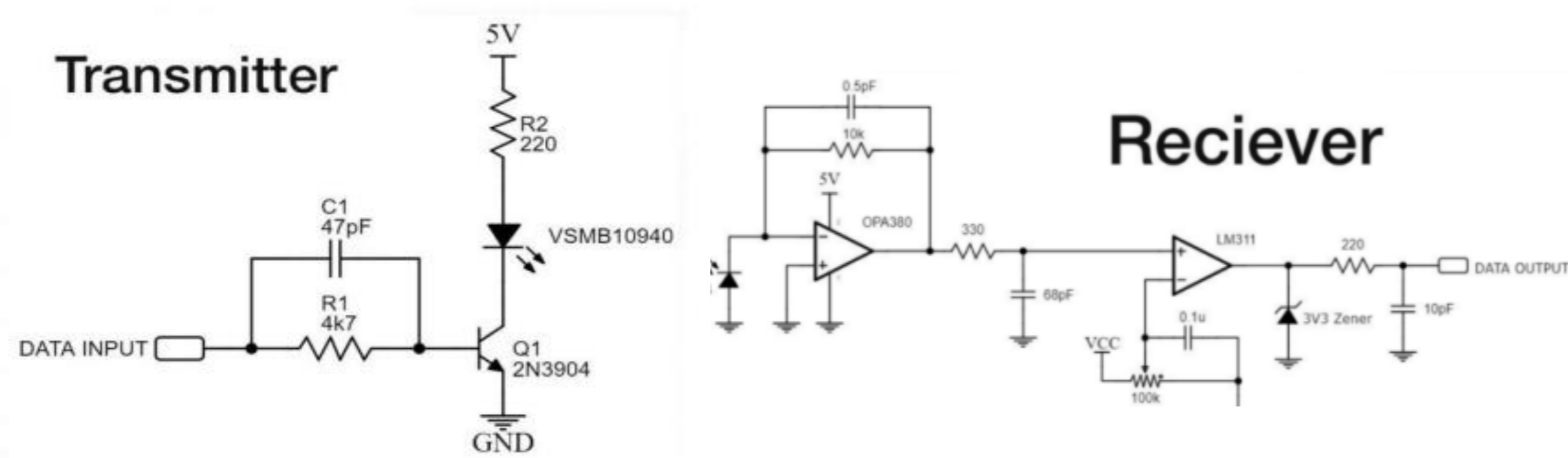


INTRODUCTION

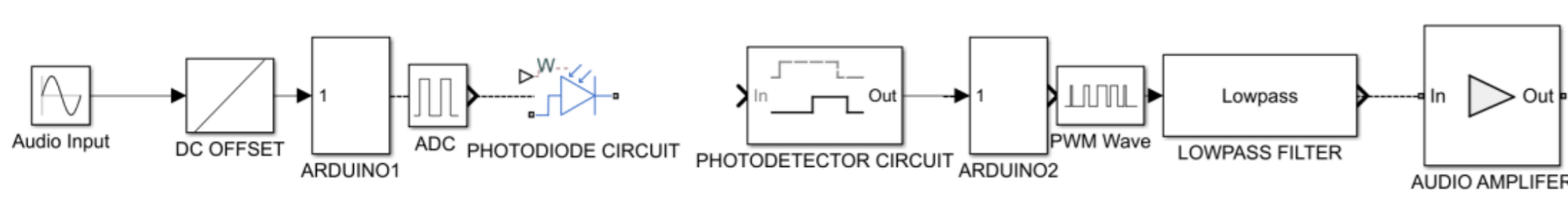
Cochlear implants are attractive solutions for hearing impaired persons to enable them to hear again. Basically, a cochlear implant translates acoustics signals at the outer world to electrical signals which stimulate the nerves of the cochlea in the ear. Hence, a typical cochlear implant is composed of two disconnected blocks: the outer and inner circuits. Our aim is to provide communication between 2 independent circuits (inner and outer circuits). It is our aim is improving the signaling along with this communication.



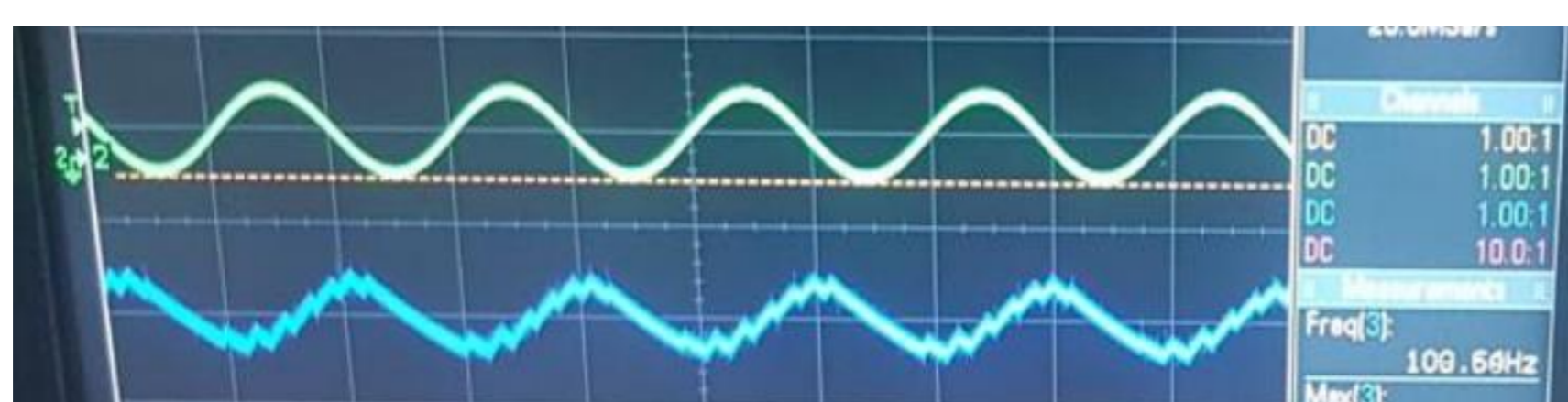
METHODOLOGY



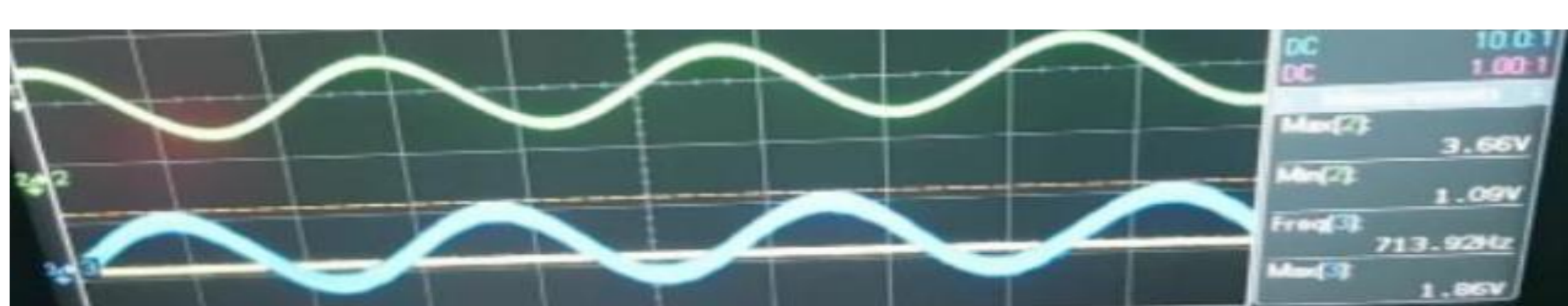
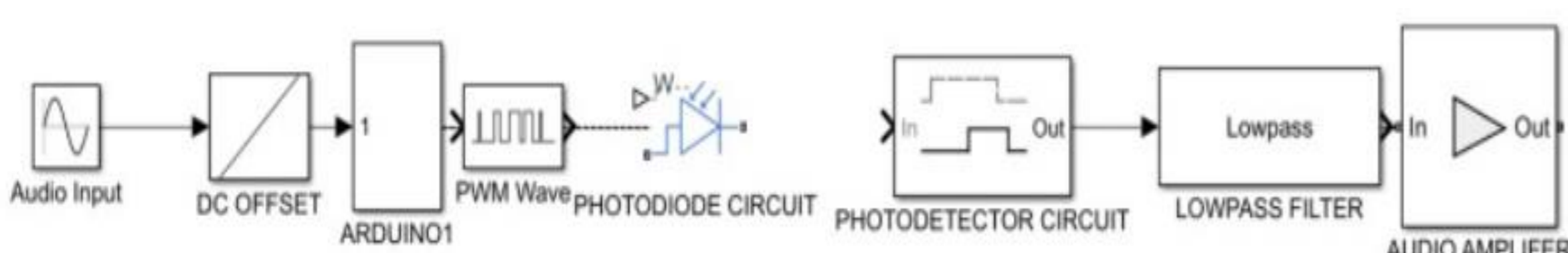
Our solution has 2 different methods. The first solution is as you can see in the block diagram below, first we pass the analog signal we receive through the DC offset and make it readable by the Arduino. Then we convert the analog to digital using serial communication on the Arduino and transmit it to the photodiode in digital form. Then we convert the analog to digital using serial communication on the Arduino and transmit it to the photodiode in digital form. The photo diode flashes and transmits data to the detector.



Finally, the other Arduino converts the serial data bundle to PWM. We pass the converted signal through a lowpass filter and through an audio amplifier. Then we get final result shown in below;



Second solution is so similar to previous one. The main difference of this one is we do not use ADC DAC applications. This time, we give PWM output directly from the 1st Arduino and send it to the photodiode.

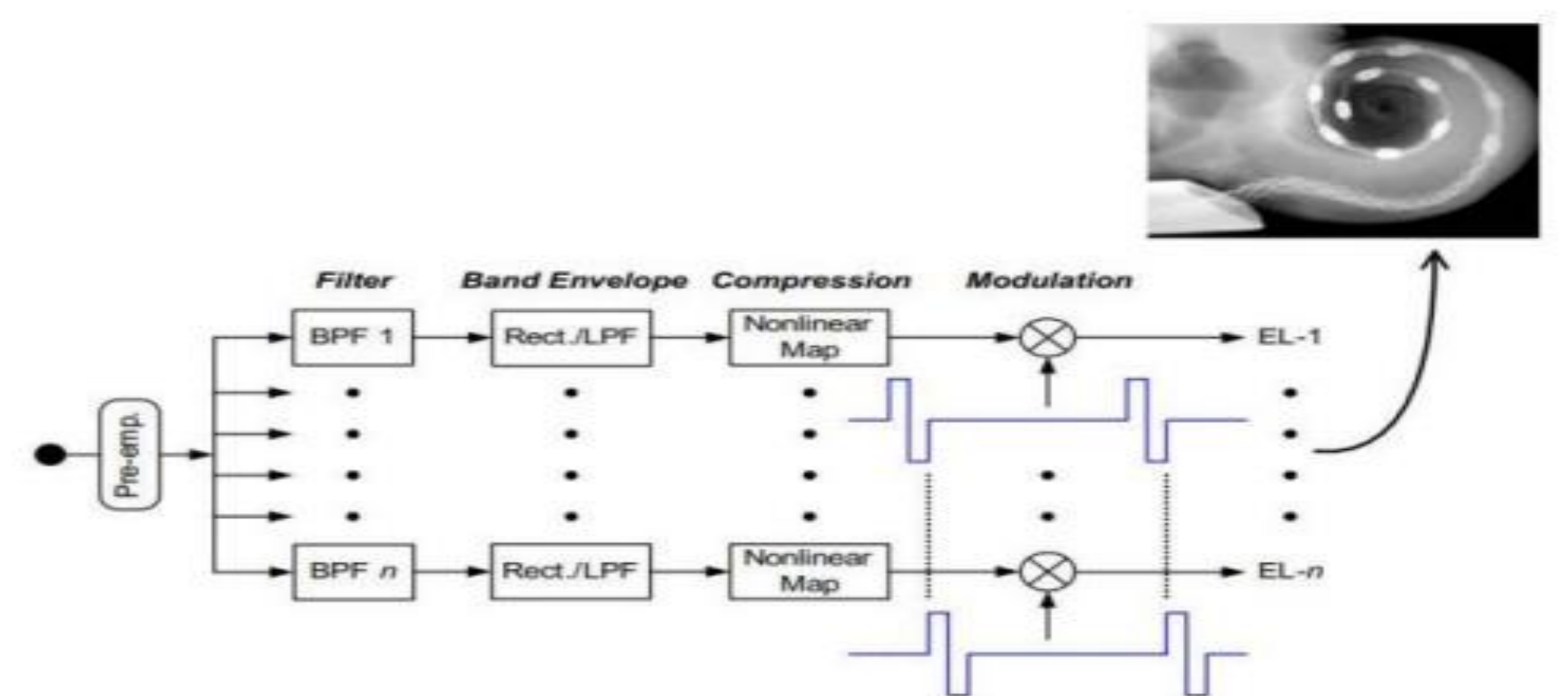


APPLICATION AREAS

Since the basis of the project is cochlear implants, we can consider clinical and medical fields as application areas. However, this project can be used for any Digital signal processing study, where the most basic of our work is the studies on improving signaling.

RESULTS AND DISCUSSION

Although we are satisfied with the result of our project, much more can be added to it in the future by spending more. In this project journey, we gained a lot of awareness on medical and embedded systems that we did not know. The idea of being a solution for millions of hearing-impaired people with 2 independent circuits is very nice. The most important thing that we think is missing in our project is that we provide single channel communication. Therefore, in the future, a structure with several channels and BPF add-on that comes with these channels can be made as seen in the figure below.



REFERENCES AND ACKNOWLEDGEMENTS

- This project was completed within the context of ELE401-402 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.
- Komal Arora, Cochlear Implant Stimulation Rates and Speech Perception By Komal Arora Published: November 28th 2012
- Nogueira, W., Litvak, L., Edler, B., Ostermann, J., & Büchner, A. (2009). Signal Processing Strategies for Cochlear Implants Using Current Steering Hindawi Publishing Corporation EURASIP Journal

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