The aim of this work is to explore parts of the human auditory pathway that are involved in encoding of acoustic stimuli to the neural activity in cochlear nerve. This knowledge is exploited in cochlear implant design. Cochlear implant bypasses the middle ear, and substitutes the inner ear by converting the mechanical energy (sound) to electric stimuli that evoke the sequence of impulses (action potentials) in cochlear nerve. Cochlear implants are used to partially restore hearing for patients with hearing loss caused by the damage of the inner ear. Today, we do not know exactly how the sound is encoded in cochlear nerve neural activity. However, there are methods used to stimulate the cochlear nerve, which are used in cochlear implants. Another aim of this work is to explore sound encoding methods used in present cochlear implants, and implementation of cochlear implant software simulation that uses one of these coding strategies. Simulation is implemented in Matlab environment that supports digital signal processing, which is the fundamental part of the cochlear implant. The result of this work is application that can encode and decode sound, configure and adjust cochlear implant parameters, and visualize basic acoustic parameters of the input and output sound. Results of the simulation for different parameter settings can be easily compared, which is very helpful feature of the application.