Chapter 4
Real-Time Brain Mapping Using Wireless Technology for the Future

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ABSTRACT

As it is known that different brain regions have specific functions, and before performing any surgery on the brain, including surgery for the treatment of epilepsy, the surgeon seeks to understand the functions of the areas affected by the seizures or of the lesion. The attempt to specify in as much detail as possible the location of function in the human brain is called brain mapping. In this paper the authors produced real time brain mapping from digitized EEG data recordings. And the authors developed this software to obtain continuous movie map and spectral slide. Nowadays, monitoring various signals from human body is an active area of research and development. Increasingly, monitoring devices are becoming wireless to allow patient mobility. For this aim the authors made it possible to be wireless.

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INTRODUCTION

The recording and use of electroencephalograms (EEG) to visualize "what the brain is doing" has been practiced since 1928 when Hans Berger first attached two electrodes to a scalp surface and recorded the first EEG on a cathode ray tube. The evolution of EEG technology has since improved substantially; including multi-channel recording, but the basic use of the EEG systems remains the same to record changes in potential between various locations on the scalp surface (Tyagi et al., 2020).

It is very well known that different brain regions perform specific functions. And also before performing any surgery on the brain, including surgery for the treatment of epilepsy, the surgeon seeks to understand the functions of the areas affected by the seizures or of the lesion. All of the surgical planning is done to preserve important functions such as speech, comprehension, sight, movement, or sensation, and to lessen the risk of loss of function from the surgery (Goyal et al., 2020).

While recognizing the vital role EEG plays in clinical diagnoses, it must be emphasized that the output of multipage row waveforms is rather difficult to interpret, especially for someone without long experience in EEG. The task of identifying the function of different regions of the brain is called brain mapping. The first aim of this project is to generate a brain map from digitized EEG recordings and the development of its software to obtain continuous movie map (animation movie) and slides. Which help the physicians to seek the area more carefully and compare the slides to find out what is the exact function of the human brain? The second aim of our work is making it real time. So that it is more possible to study how electrical activity evolves and changes overtime in a manner that is clear to even the casual observer. And our last aim is preparing a system for wireless electrical brain mapping (Madhav and Tyagi, 2022).

The greatest advantage of this wireless system is practically unlimited movement of the patients. The users can carry such EEG devices not only in their house, but also while working or sleeping. Also, the computer system allows the selection of the number of the electrodes, the interpolation method, the display mode, and also the number of spectral slides and the exact interval of EEG (Mishra and Tyagi, 2022).

High resolution structural magnetic resonance imaging (MRI) and Diffusion Weighted Imaging (DWI) images provide an unprecedented view of the human brain in vivo. Structural MRI images show a detailed grayscale three-dimensional picture of tissue organization, containing tens of millions of voxels. DWI builds on this information by capturing the diffusion of water molecules in tissue. It samples the diffusion strength in multiple directions at each point in the brain to generate a profile diffusion. This information furnishes a macro scopic view of the brain's tissue, which restricts diffusion because of interactions with axons, cell membranes and vascular structures. In subjects, these images along with the genome sequence, cognitive tests, age, and sex comprise a detailed picture of the human condition for the study of disease, genetic effects, developmental changes, and aging (Nair et al., 2021).

Researchers have designed methods that capture and interpret medical images using tools from computer science, statistics, and mathematics. They used an array of techniques to register MRI images into the same space such as the discrete cosine transform with Leven berg- Marquardt optimization or a Eulerian velocity framework with a multi-grid method. Others have tackled brain segmentation with a trained Markov random field model, a machine learning feature based discriminative model combined with a generative model, and recently a geodesic curvature flow on the cortical surface using level sets. In DWI, scientists first captured the diffusion information using a tensor and then introduced the orientation distribution function (ODF), a parameterization rich with information designed for high angular resolution diffusion imaging (HARDI). The knowledge represented by these models was used by investi-

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