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**Professor Heung-No Lee's research team developed a combined monitoring system of brain waves and brain hemodynamics that can be easily worn anywhere to observe long-term brain activity**

- GIST (President Seung Hyeon Moon) – Professor Lee Heung-No Lee of the School of Electrical Engineering and Computer Science has developed a comprehensive brain wave electroencephalogram (EEG) and functional near-infrared spectroscopy (fNIRS) system that can easily be worn anywhere and monitor brain activity in real time for a long period of time.
- Brain Imaging Technique for observing the phenomenon that occurs in the human brain includes electroencephalogram (EEG) for measuring the electrical signals of brain waves, functional magnetic resonance imaging (fMRI) and functional near-infrared spectroscopy (fNIRS), which can detect brain activation by differences in oxygen concentration of the blood flow in the brain, and magnetoencephalography (MEG), which can measure the micro-magnetic field generated in neuronal cells.
  - However, these techniques have been used for limited purposes, such as for research and treatment of brain diseases in laboratories

or hospitals, because the complex measuring devices are expensive. In addition, there is a limit to understanding the brain functions because one technique can only observe fragmentary information among the complicated mechanisms that occur simultaneously in biological systems.

- Professor Heung-No Lee's research team succeeded in miniaturizing the system as a small portable device, allowing simultaneous monitoring of brain waves and complex functional spectroscopy of the brain regardless of the environment.
- To simultaneously acquire relatively noisy functional NIR spectroscopy due to the switching of fine EEG and near infrared rays sources, which are about 100,000 times smaller than the size of a handheld device, a low-noise insulation design technique and a 24-bit delta-sigma type integrated analog-to-digital converter with a 16-bit serial comparator was used. This was designed to acquire brain hemodynamic signals 5 times per second based on EEG signals obtained 250 times per second for simultaneous acquisition of error for two signals.
  - The existing wet electrode that requires liquid conductive gel to be applied to the scalp for brainwave acquisition was replaced with a dry electrode, and the equipment was designed in the form of a hat that can be easily worn on the head enabling quick use. In addition, the researchers maximized the utilization of the system by transmitting EEG signals through Bluetooth communication to various IT devices, such as computers and mobile phones.
- This device can acquire two kinds of brain signals simultaneously in real time even in a non-laboratory situations. It can be used for real-time monitoring of brain diseases, such as epilepsy and dementia, It is expected to be widely used in the field of brain-computer interface technology.

- Professor Heung-No Lee said, "In this study, by measuring both types of brain signals at the same time, it was possible to maximize the amount of information for brain activity monitoring and to conduct a detailed analysis of how people think and make decisions in the real world when not in the laboratory."
  
- This research, led by Professor Heung-No Lee (correspondent author) of the School of Electrical Engineering and Computer Science and Seungchan Lee (first author), was supported by Korea Research Foundation and was recently published in *IEEE Transactions on Biomedical Engineering*, which is a well-known biomedical engineering journal (IF 4.28, top 11% in JCR rank, and 3rd place in Google Scholar Biomedical Technology).

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