

# **Theme : Sensor Technology**

## **Subject : Brain-reading for Mental Healthcare / User Interface by Brain Wave Information**

### **Introduction**

The goal of this research project is to explore promising application areas of BCI, in particular mental healthcare and user interaction for nondisabled users including brain sensing devices. We have seen the emergence of consumer level EEG devices and some innovative but still experimental sensors such as Ear-EEG and epidermal electronic sensor. Noninvasive and nonintrusive systems are still not a reality and much remains to be done. We expect that mental wellness applications in BCI are the next most promising area in terms of consumer device and we focus on the mental state monitoring, diagnosis of neurological disorders, cognitive enhancement in a noninvasive way and prevention of neurodegeneration.

As for the novel interaction, we believe that multimodal interaction which deals with brain activity can provide powerful, flexible, and natural interfaces. It would overcome the difficulties of interaction in wearable devices with small displays.

### **Scope**

Challenges that innovatively improve brain sensing device and investigate promising approaches in mental health care and user interaction application areas include:

- Exploring the feasibility of wearable brain sensing device in a user friendly, low-power, and compact type
- Investigating the potential diagnostic biomarkers of neurological and cognitive disorders from brain activities to manage mental and cognitive health in a noninvasive way (ADHD, depression, epilepsy, stroke, sleep disorder, etc.)
- Methods to boost mental performance or emotional wellbeing, and slow down cognitive decline
- Methods to improve the overall interaction performance using multimodal interaction by associating the user's intention inferred from brain activity with various other interfaces such as gesture and speech, etc.

### **Research questions**

We are interested in the following research questions. These questions are not exhaustive but different research questions are open to discuss with research partners.

- Is it plausible to detect brain waves other than scalp to reduce the intrusiveness of brain sensors?
- What would be the most promising brainwave sensing device type in a user friendly way?
- What kind of neurological or cognitive disorders can be detected using EEG?
- What is the most effective way to enhance the user's mental health and wellness other than just passive mental state monitoring?
- How does the BCI system fuse information from different input modalities?

### **Expected Deliverables**

The following is open to discussion:

- Prototype of EEG sensing device
- Algorithm for detection of neuropsychiatric disorder based on brain waves
- Demonstration and algorithm of multi-modal user interface using brain waves
- Detailed progress reports every 3 months summarizing accomplishments.
- Joint Patents (if agreed)