EEG-based Brain Computer Interface System of Smart Devices for the Motor-impaired

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MOBILE technology continues to enhance our daily lives. While the majority of people benefit from these technical advances, the disabled who have limited means to hear, see, and move are excluded to enjoy mobile technologies not providing sufficient accessibility. Neuro-scientific research has been studied for decades to explain the brain mechanisms by which the brain senses and reacts to novelty [1]. Brain activity can be observed by detecting changes in the electric fields which can be collected from the scalp of the brain [2]. This electric potential, called electroencephalography (EEG), provides a distinctive way to investigate functional information of the brain activities [3]. EEG is often used to provide interfaces to control machines or computers, attributed to the recent developments in inexpensive, easy-to-wear, and low power EEG acquisition systems [4]. EEG-based brain computer interface (BCI) introduces promising direct communication pathway between the brain and external devices, especially for the motor-impaired because it does not require any muscle activity. We developed an EEG-based BCI system (Figure 1) for the motor-impaired to use smart devices utilizing Steady State Visually Evoked Potential (SSVEP). We demonstrated four major paradigms to control smart devices: waking-up, application selection (called Launcher in the Android operating system), music player, and Augmentative and Alternative Communication (AAC) using our BCI system. Most research on BCI focused on personal computers without consideration of special circumstances raised on mobile devices such as limited processing power, RAM space, wireless connectivity, and mobile display. We overcome these predicaments by fundamentally understanding the platform architecture of mobile devices, timing synchronization in wireless EEG communication, and functional brain activity. The system comprises active dry EEG electrodes, wireless data acquisition system, and Samsung Galaxy Note 10.1 and shows 80~95% accuracy with 5 second per instruction.

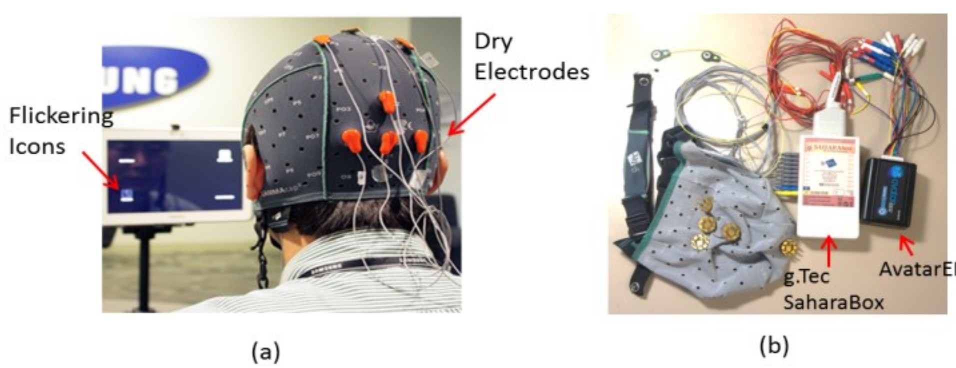

Figure 1. Proposed BCI system for mobile handsets. (a) the proposed EEG-based BCI system, (b) EEG acqusition system.

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