High Transfer Rate Brain-Computer Interface

Thomas Cavaliere
ELE 482 Biomedical Engineering Seminar III
Biomedical Engineering, University of Rhode Island
Kingston RI 02881
May 7th 2003

A brain-computer interface (BCI) is a communication channel connecting the brain to a computer. A BCI does not depend on the brain's normal output pathways of peripheral nerves and muscles. Two requirements are met for a communication channel between the brain and computer: 1) features that are useful to distinguish several kinds of brain state; 2) methods for the detection and classification of such features implemented in real time.

Current techniques of monitoring brain activity include EEG, magneto encephalography, MRI, and position emission tomography. EEG is the optimal choice for BCI implementation. The others are more difficult to setup and are expensive.

Visual Evoked Potentials (VEPs) reflect the electrophysiological mechanisms of visual information in the brain. The signals are always in response to changes in the stimulus. A static stimulus in the visual field does not appear to effect any significant alterations in EEG activity. The signals evoked by changes in the visual input have been shown to reflect certain properties of the stimulus.

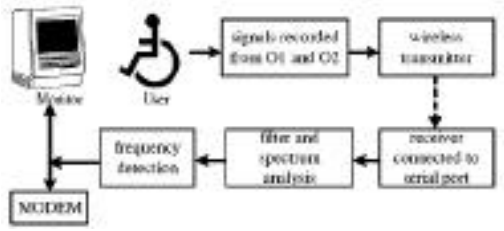

Figure 1

Fig. 1 shows the block diagram of the BCI system. The system allowed users to input a phone number simply by gazing at the button (see fig. 2). A beep was sent out from the loudspeaker of the computer after each selection, and the result was displayed on the monitor.

If the selection was wrong, users could delete it by gazing at the BACKSPACE button. The computer was connected to the telephone network through a modem. When ENTER was selected, the input number would be sent out.

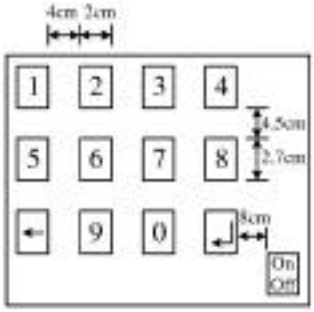

Figure 2

Two-channel EEG signals were recorded from O1 and O2. The electronic circuits provided amplification, A/D conversion, and signal transmission. A receiver connected to the serial port provided input data to the computer.

In the first experiment, eight of the thirteen subjects succeeded in ringing the mobile phone, the others failed. No false positives occurred for any subjects. In the second experiment, the average transfer rate over all subjects was 27.15 bits/min. The results could be classified into three grades:

Good: 6 subjects could input the phone number without errors. Their mean transfer rate was 48.93 bits/min
Moderate: Two subjects finished the phone number input successfully, but made some mistakes. Their transfer rates were 24.87 bits/min and 19.22 bits/min.
Bad: The rest were unacceptable. They could not input the phone number correctly; some subjects could not start or stop the stimuli. Their mean transfer rate was 3.05 bits/min