The Use of Electroencephalography Signals to Recognize the Unspoken Speech

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Introduction

I wish to investigate the technique of electroencephalography (EEG) that has provided new methods of communication along with its well-known clinical applications (Porbadnigk et al., 2009). EEG has the potential to be applied in recognizing unspoken speech, which facilitates the lives of individuals by providing natural means to carry out communications, involving the machines (Wester, 2006). The automatic speech recognition provides specific solutions to carry out human-machine communication. People who have speech problems usually face certain difficulties in communication as speech recognition computing power was a problem previously in order to perform speech recognition in real time (Wester, 2006).

Over the last decade or so, the research on the use of EEG in speech and language production has increased substantially, (e.g., Ganushchak, Christoffels, & Schiller, 2011; Indefrey, 2011; Munding, Dubarry, & Alario, 2015; Stolze, 2016). Majority of the brain-oriented machines have mainly focused on the patients suffering from total paralysis or any degenerative disorder like amyotrophic lateral sclerosis (ALS). The method used in the majority of the studies is picture naming tasks and they examined the event-related potentials ERPs aligned on picture onset (e.g., Blackford, Holcomb, Grainger, & Kuperberg, 2012; Dell-Acqua et al., 2010; Llorens, Trebuchon, Riès, Liegeois-Chavel, & Alario, 2014; Strijkers, Costa, & Thierry, 2010). There are issues with this method which have been identified and discussed by Fargier et al., 2017.

Related Work

An active strand of research has resulted in the evolution of EEG-based brain computer interfaces. The brain computer interfaces are associated with the Berlin Brain Computer

Interface and Thought Translation Device (Blankertz et al., 2006). The brain computer interfaces are responsible for translating the intentions and thoughts of disabled individuals. The use of these interfaces need explicit manipulation of the brain's activity to control signals (Nijholt et al., 2008). Another study clearly stated that invasive approaches have been undertaken due to limitations in the bandwidth of EEG processing (Baranauskas, 2014). A study conducted by Wester (2006) implemented a system that was able to recognize unspoken speech through EEG signals. However, these signals were only recognized at a high recognition rate. Another study conducted by Salama et al. (2014) investigated EEG signals to recognize unspoken speech through the recognition of two words: “Yes” and “No”. Unlike the previous studies, this study used a single electrode device that was easy to set up and much suitable for the disabled individuals (Salama et al., 2014).

Proposed Study

A unique and comprehensive data set will be collected for testing the machine’s ability to classify EEG signals. The subjects will be asked to imagine any specific word while wearing an EEG headset to capture the produced EEG signals in the subjects’ brain. The data will be processed for minimising the effects of noise or any irrelevant signal activity. With this data, we will look for any patterns in the EEG signals for the same word. If patterns were found, then this could be a step forward in using EEG for speech production.

Another aspect we could investigate in this study, the influence of word order in EEG signals. The variation of word order across the sessions could be recorded per subject and then

the EEG signals compared for any significant patterns that might be beneficial for identifying any methods/ideas for EEG unspoken speech recognition and production.

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