Electroencephalogram-based evaluation of voice user interface for affective satisfaction

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SUMMATIVE STATEMENT: The present study evaluates the electroencephalogram(EEG) based user affective satisfaction for voice user interfaces (VUIs) and identifies users' preferred VUI elements based on brain signals which explain user affective satisfaction.

KEYWORDS: Electroencephalography (EEG), Emotion, Voice user interface (VUI), Affective satisfaction

PROBLEM STATEMENT: Research on human affective satisfaction recognition using EEG signals to auditory stimuli has become active as the use of VUI has become popular with the development of AI speaker and voice recognition technology. EEG has been employed as an appropriate measure for objectively evaluating user affective satisfaction. EEG-based emotion evaluation can increase the usability of a product by understanding the user preference and affective satisfaction.

OBJECTIVE/QUESTION: This study aims to evaluate EEG-based user affective satisfaction from voice user interface (VUI) and explore the signals of brain wave that explain the elements of user affective satisfaction.

METHODOLOGY: A total of 30 participants (15 females and 15males; age = 34.1 $\pm$ 10.6) without a history of mental illness participated in the EEG experiment with two product use contexts: product use without VUI warning and product use with VUI warning. The VUIs have nine conditions by combining three levels of speech rate (fast: 405 spm, moderate: 345 spm, slow: 285 spm) and three levels of pitch (high: 240 Hz, Moderate: 210 Hz, Low: 170 Hz). EEG signals were recorded while the participants listening the nine VUI conditions with different speech rates and pitches. The subjective evaluation consisting of five items (arousal, valence, clarity, friendliness, and over satisfaction) was evaluated after EEG signals were recorded. The EEG signal features were extracted by frequency after pre-processing process which include body artifact removal and filtering and features from the EEG signals were compared and analyzed with the subjective evaluation data.

RESULTS: The arousal was higher with increasing speech rate and pitch, while valence, clarity, and friendliness were highest in the condition of moderate speech rate and moderate pitch. The accuracy of information delivery was higher when the speech rate was higher in the product use context with warning, but the highest when the speech rate was moderate in the product use context without warning.

DISCUSSION & CONCLUSIONS: The present study evaluated the user affective satisfaction when listening to VUI based on EEG and identified the users' preferred speech rate and pitch. The findings of the study can be used to design products with VUI for increasing user usability and preference.