Inferring Pedestrians' Emotional States through Physiological Responses to Measure Subjective Walkability Indices

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Abstract

Walkability is an indicator of how much pedestrians are willing to walk and how well a walking environment is created. As walking can promote pedestrians' mental and physical health, there has been increasing focus on improving walkability in different ways. Thus, plenty of research has been undertaken to measure walkability. When measuring walkability, there are many objective and subjective variables. Subjective variables include a feeling of safety, pleasure, or comfort, which can significantly affect perceived walkability. However, these subjective factors are difficult to measure by making the walkability index more reliant on objective and physical factors. Because many subjective variables are associated with human emotional states, understanding pedestrians' emotional states provides an opportunity to measure the subjective walkability variables more quantitatively. Pedestrians' emotions can be examined through surveys, but there are social and economic difficulties involved when conducting surveys. Recently, an increasing number of studies have employed physiological data to measure pedestrians' stress responses when navigating unpleasant environmental barriers on their walking paths. However, studies investigating the emotional states of pedestrians in the walking environment, including assessing their positive emotions felt, such as pleasure, have rarely been conducted. Using wearable devices, this study examined the various emotional states of pedestrians affected by the walking environment. Specifically, this study aimed to demonstrate the feasibility of monitoring biometric data, such as electrodermal activity (EDA) and heart rate variability (HRV), using wearable devices as an indicator of pedestrians' emotional states—both pleasant-unpleasant and aroused-relaxed states. To this end, various walking environments with different characteristics were set up to collect and analyze the pedestrians' biometric data. Subsequently, the subjects wearing the wearable devices were allowed to walk on the experimental paths as usual. After the experiment, the valence (i.e., pleasant or unpleasant) and arousal (i.e., activated or relaxed) scale of the pedestrians was identified through a bipolar dimension survey. The survey results were compared with many potentially relevant EDA and HRV signal features. The research results revealed the potential for physiological responses to indicate the pedestrians' emotional states, but further investigation is warranted. The research results were expected to provide a method to measure the subjective factors of walkability by measuring emotions and monitoring pedestrians' positive or negative feelings when walking to improve the walking environment. However, due to the lack of samples and other internal and

external factors influencing emotions (which need to be studied further), it cannot be comprehensively concluded that the pedestrians' emotional states were affected by the walking environment.