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Inferring Pedestrian Level of Service for Pathways through Electrodermal Activity Monitoring

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Abstract

Due to rapid urbanization and population growth, it has become crucial to analyze the various volumes and characteristics of pedestrian pathways to understand the capacity and level of service (LOS) for pathways to promote a better walking environment. Different indicators have been developed to measure pedestrian volume. The pedestrian level of service (PLOS), tailored to analyze pedestrian pathways based on the concept of the LOS in transportation in the Highway Capacity Manual, has been widely used. PLOS is a measurement concept used to assess the quality of pedestrian facilities, from grade A (best condition) to grade F (worst condition), based on the flow rate, average speed, occupied space, and other parameters. Since the original PLOS approach has been criticized for producing idealistic results, several modified versions of PLOS have also been developed. One of these modified versions is perceived PLOS, which measures the LOS for pathways by considering pedestrians' awareness levels. However, this method relies on survey-based measurements, making it difficult to continuously deploy the technique to all the pathways. To measure PLOS more quantitatively and continuously, researchers have adopted computer vision technologies to automatically assess pedestrian flows and PLOS from CCTV videos. However, there are drawbacks even with this method because CCTVs cannot be installed everywhere, e.g., in alleyways. Recently, a technique to monitor bio-signals, such as electrodermal activity (EDA), through wearable sensors that can measure physiological responses to external stimuli (e.g., when another pedestrian passes), has gained popularity. It has the potential to continuously measure perceived PLOS. In their previous experiment, the authors of this study found that there were many significant EDA responses in crowded places when other pedestrians acting as external stimuli passed by. Therefore, we hypothesized that the EDA responses would be significantly higher in places where relatively more dynamic objects pass, i.e., in crowded areas with low PLOS levels (e.g., level F). To this end, the authors conducted an experiment to confirm the validity of EDA in inferring the perceived PLOS. The EDA of the subjects was measured and analyzed while watching both the real-world and virtually created videos with different pedestrian volumes in a laboratory environment. The results showed the possibility of inferring the amount of pedestrian volume on the pathways by measuring the physiological reactions of pedestrians. Through further validation, the research outcome is expected to be used for EDA-based continuous measurement of perceived PLOS at the alley level, which will facilitate modifying the existing walking environments, e.g., constructing pathways with appropriate effective width based on pedestrian volume. Future research will examine the validity of the integrated use of EDA and acceleration signals to increase

the accuracy of inferring the perceived PLOS by capturing both physiological and behavioral reactions when walking in a crowded area.

Keywords: Pedestrian level of service, electrodermal activity, wearable sensor