234 Measuring the effect of dynamic lighting on pedestrian speed by means of overhead Kinect™ sensors and continuous pedestrian tracking algorithms

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Abstract:

For centuries the main aim of public lighting has been to support human functioning at night by providing visibility and a general sense of safety. However, current developments in solid state lighting (e.g., LEDs), lighting controls (e.g., wireless communication protocols) and related developments in smart city technologies (e.g., data-driven city management) provide an impulse to think about novel, and hitherto largely unexplored lighting-based services that include, amongst others, the application of dynamic lighting for crowd management during large events (den Ouden et al., 2014). Although research has been conducted on the efficacy of using dynamic lighting during emergency evacuation (e.g., Jin & Yamada, 1994; Ronchi et al., 2016), there is no research to date that has tested the efficacy of using lighting for crowd management in non-emergency situations, for example by 'nudging' crowds to adjust their direction and walking speed. In the present study we explore how different dynamic lighting patterns affect pedestrian flow—in particular walking speed—using an array of Microsoft Kinect™ sensors and state-of-the-art continuous pedestrian tracking algorithms developed in house (e.g., Corbetta, et al., 2016).

The experiment was conducted during the Glow festival in Eindhoven, the Netherlands from November 12 to 19, 2016. Being a large scale event, Glow is a representative occasion for conducting a naturalistic study on the use of dynamic lighting for crowd management in a city. The location of the experiment was the living light lab Markthal of the Intelligent Lighting Institute (ILI); a 75 by 62.5 meters roofed space equipped with various LED light sources and an array of three by four Kinect™ sensors. An approximately 12 meter wide path was demarcated by means of rope barriers, and an approximate 245,000 people passed underneath the sensor array during the experiment, as based on preliminary real-time analysis. Ten different dynamic lighting patterns and one static (i.e., non-dynamic) and more or less homogenous control pattern were displayed on an array of 24 by 20 ceiling-mounted LED modules and an additional 36 LED lamps directed towards the ceiling. Dynamic patterns consisted of a light wave which moved in one of four directions at different speeds: along with the crowd (at 0.5, 1.0, 3.0, 12.5, or 25 m/s), in the opposite direction of crowd (at 1.0, 12.5, or 25 m/s), or perpendicular to the crowd from either the left or the right (both at 12.5 m/s). All light patterns were displayed multiple times, each time for 8 minutes, in a randomized order for a total duration of 39 hours.

In our presentation we will present and discuss the preliminary results of the experiment. In addition, we discuss the potential of sensor technology and related data analysis algorithms for research in environmental psychology.

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