Centre for Analysis, Scientific Computing and Applications
Intelligent Lighting Institute

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3D-depth sensors driving intelligent illumination

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Beyond visual field

Ensuring a smart built environment that interacts with pedestrians for enhanced serviceability is a top technological priority. Among many factors, illumination is a paramount element of the user experience, and crowd-light interaction has garnered significant interests from the research community.

To guarantee proper proactive illumination, a real-time assessment of pedestrians' locations is essential. Depth fields from overhead 3D-depth sensors (cf. Figure 1) enable reliable evaluation of the instantaneous crowd state. The three dimensional information they enclose simplifies automatic analyses of the crowd motion, such as accurate background subtraction and pedestrian identification [1].

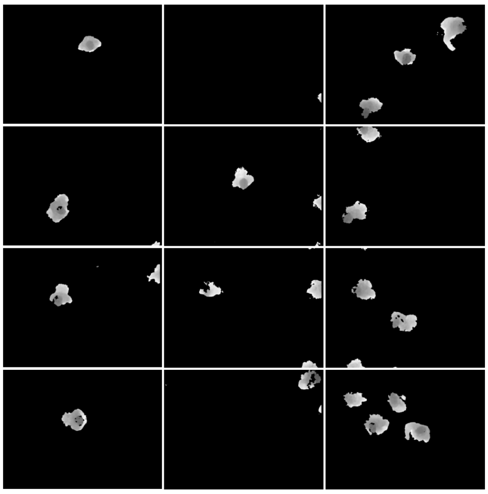

Figure 1: Depth fields captured by the Kinect sensors grid at "De Markthal", TU/e. Depth fields are an alternative visual feed than usual color images, in which each point is associated to the distance with the camera plane.

3D-depth controlled Intelligent lights: a proof of concept

In the Living Lab research infrastructure at "De Markthal", TU/e, a state of the art illumination system has been established to study the crowd-light interaction. We integrated 12 Microsoft Kinect 3D-depth sensors in the system to provide accurate pedestrian detection. This enables quantitative analyses of the human response to light as well as interactive light control. We arranged the sensors in a 3x4 grid configuration (cf. Figure 2) to cover a surface of *ca.* 150 m^2.

As a proof of concept of the coupling between Kinect sensors and lights, we implemented an automatic projection of the instantaneous pedestrian density fields via a heatmap (cf. Figure 3).

Technological and fundamental research will be carried out using the infrastructure to explore the practicability of crowd management through illumination and advance the development of non-intrusive crowd guidance.

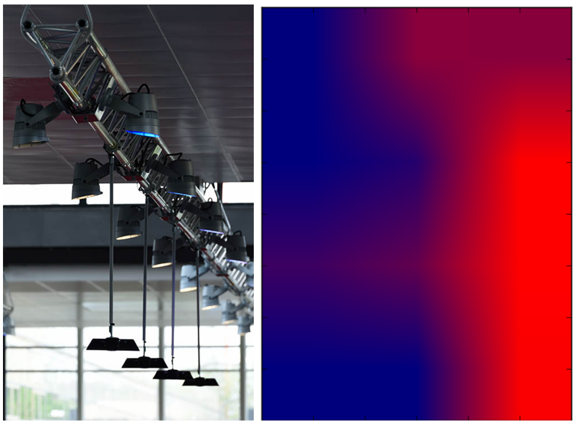

Figure 2: (left) A column of four Kinect sensors in "De Markthal". (right) Pedestrian density heatmap evaluated from the non-void pixel count. This evaluation yields the light pattern in Figure 3.

Figure 3: The pedestrian density heatmap is estimated and projected in real-time.

References

[1] A. Corbetta, L. Bruno, A. Muntean, F. Toschi (2014). High statistics measurements of pedestrian dynamics. *Transportation Research Procedia* 2, 96–104.

We thank Philip Ross for his support in the establishment of the infrastructure.