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The least crowded path: where to start?

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Abstract:

By 2050 68% of the world's population will live in urban areas, but while our cities become more crowded, they also become smarter (Celes et al., 2019). This means that we will be able to use smart technologies to tackle the challenges of urbanization. One example of these smart technologies are crowd tracking sensors, such as cameras, cell phone traffic monitoring, GPS, WiFi, Bluetooth and radio frequency signals. More and more cities invest in these sensors to monitor pedestrian flows for economic purposes (e.g., the VLOED project in the cities of Ghent and Bruges, Belgium[1]), but also for safety during events (e.g., during the tour of Flanders[2]). This last one in particular is very important as overcrowding can lead to hazardous situations, the recent tragedy during the Halloween festivities in Seoul reminded us of that[3]. Imagine that the people in Seoul had accurate information on the crowdedness that night, that their route planner would take this into account and would have guided them along the least crowded route, could the crowd crush have been avoided this way? These are the fundamental questions that this research project would like to address in the upcoming years.

Research has shown that the willingness to pay for the least crowded route is often as high as for the fastest route (Li and Hensher, 2011). However, route planners today almost always guide pedestrians along the fastest route (Vanhaeren et al., 2020). This is because there is not many data available on pedestrian crowding (Haghani and Sarvi, 2018). This might be resolved in the smart cities of the future by using crowd tracking sensors, but even if we know how crowded it is, we still don't know when it is too crowded or not crowded enough. In other words: for which levels of crowdedness will pedestrians deviate from their original path? The answer to this question highly depends on the context, e.g., a tourist might be willing to take a busy route if it takes him along the scenic spots in town, but a commuter might not feel the same when he is late for work. Furthermore, the relation between crowdedness and emotional response is not linear, e.g., a subway packed with people is not very pleasant, but this might be the same for an empty park late at night. Pedestrians take into account all environmental variables when they have to choose between different route options. The utility theory aims to quantify this process by assigning a value of utility to each route alternative. While the first component of this utility value is determined by the weight of each attribute, the second component represents the uncertainty caused by a lack of data or knowledge about the decision making process (Tong and Bode, 2022). This research would like to fill this gap by collecting crowdedness data and analysing the decision making process of pedestrians regarding this parameter. To this end a first study has been conducted in July 2022 during the Ghent festivities, a ten day festival in the city centre of Ghent (Belgium). During these ten days crowd counts were collected by the wireless Communications Group of Université libre de Bruxelles with WiFi sensors along the main street (Belfortstraat) and on two event squares (Emile Braunplein and Vlasmarkt). From July 20th 7 am until July 22nd 7am an additional survey was conducted by the geography group of Ghent university in which visitors were asked how crowded they found it at that time and place and how agreeable they found that on a 5-point Likert scale. The moving averages of the two ratings and the sensor counts during those 48 hours for one of the event squares (Vlasmarkt) can be found in Figure 1.

[1] https://stad.gent/nl/over-gent-stadsbestuur/stadsbestuur/wat-doet-het-bestuur/gent-internationaal/samen-internationaal-werken/europese-subsidies-en-projecten/kunnen-we-drukte-de-stad-voorspellen

[2] https://showcases.cumul.io/cases/case-study-telecom-operator-proximus

[3] https://www.bbc.com/news/world-63448040

https://doi.org/10.5194/ica-abs-6-47-2023

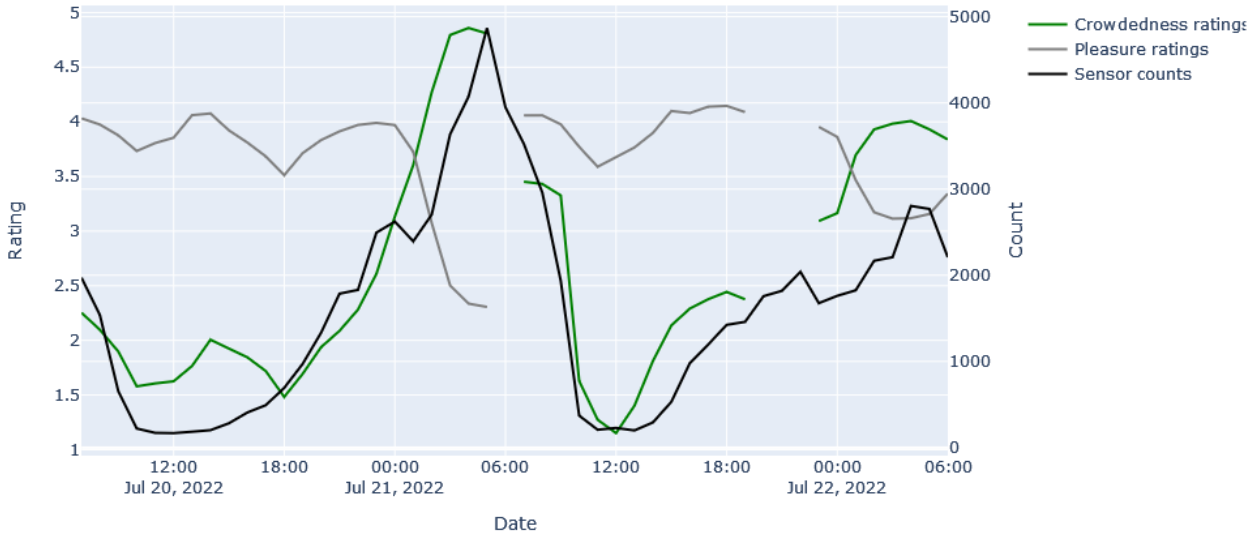

Figure 1. Moving average of crowdedness and pleasure ratings and hourly sensor counts on the Vlasmarkt event square during the Ghent festivities.

First of all, we can see from the sensor counts that the first night was very crowded with 4869 visitors during the peak at 5 am, at that time there were about 4.5 visitors per square meter on Vlasmarkt. The second night was less crowded with 2804 visitors or 2.5 visitors per quare meter. Second, the crowdedness ratings of the visitors seem to match the sensor counts quite well, except for the second day when they estimated the crowdedness too high during the peak hours. Third, the pleasure ratings seem to have an almost linear relationship with the crowdedness ratings (more crowded means more pleasure) until one point, at midnight on both days, where this relationship is reversed and there is a steep drop in pleasure while the crowdedness increases. On the first day, this drop happens when there are 2622 visitors and on the second when there are 1761 visitors. While the sensor counts are different at those timestamps, the crowdedness ratings are almost equal, i.e., 3.13 on the first day and 3.16 on the second. We can conclude from these preliminary results that the emotional response to crowdedness can best be predicted by the crowdedness perception of visitors. In the case of this event this means that a rise in crowdedness perception caused a rise in pleasure until this perception exceeded the third point on a 5-point Likert scale. At that point, it was too crowded. Therefore, visitors could have benefited from a crowd-aware route planner that would have advised them not to enter this event square after midnight. It will be future work to link the emotional response to the willingness to pay of visitors. In other words, how far are they willing to deviate from their route to avoid or seek a crowd?

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