

34. Wireless crowd monitoring in Arnhem

Monitoring the movements of crowds in cities can lead to improved city planning, more efficient traffic flows and safer crowd management. As camera surveillance might lead to privacy violations, we use wireless sensor networks to measure who is close to whom. In particular, we use ordinary smartphones as sensors. We make sure that the data of individuals are anonymized.

Our demo shows a website acting as a dashboard for live streams from downtown Arnhem, where tens of WiFi-hotspots are tracking smartphones as they move. The trajectories of pedestrians are mapped onto the actual city plan of the downtown area. We don't know who the pedestrians are, nor can we find out: all smartphone identification is irreversibly transformed into a single cryptographic number before it enters our tracking system. Given such a number, it is impossible to say to which smartphone it belongs, let alone that we can identify its owner.

In our demo we will also show screen recordings of trajectories during the World Living Statues Festival on 27 September 2014, which is expected to attract some three hundred thousand people to Arnhem.

ICT science question

How can we reliably detect mobile devices and realistically project their trajectories onto a city plan? One of the problems is that there are many false and missed detections, originating from very different sources. Identifying trajectories is difficult as there may be many alternatives paths between two subsequent detections of the same device at different locations.



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COMMIT/ project
EWIDS Very large wireless sensor networks for well-being

Application

Our main application is crowd monitoring in highly populated areas. Our partner Foundation Wireless Arnhem provides WiFi-hotspots for detection. Members of Arnhem City will use our application to obtain insight in crowd movements during the World Living Statues Festival. Our live streaming of hotspot-based crowd detections is unique. Urban sensing as such is not unique, but the way we support crowd management has not yet been reported.

Alternative Application

Our research can also be applied to identify different groups of people visiting a city, such as shoppers, tourists and commuters. It can provide much better insight in the long-term movements in a city, which can be used for city planning (traffic, parking spaces, bicycle trajectories). It can also be used to correlate shops and venues: e.g. if Alice goes to A, will she also visit B? Natural partners in our research are other cities, their shops and venue organizations. Monitoring crowds is applicable to many things and not limited to humans.

Nice to know

It is expected that in 2017 seventy percent of the world population will own a smartphone. Most of these will be WiFi-enabled.



We automatically measure the movement of crowds in urban spaces.



Our data will allow for the development of a to-do recommendation app.



With this system you will be able to optimize urban/pedestrian logistics.



We need new real-time and scalable mining techniques to deal with noisy data on proximity graphs.

