CrowdScan

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CROWD•SCAN

THE FUTURE OF CROWD ANALYTICS

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CrowdScan

CrowdScan was created as a spin-off by IMEC and the University of Antwerp (UA) in 2020. Its founding team consists of four members, each completing each other in terms of technological knowledge and (corporate) experience.

The patented and innovative technology developed by CrowdScan applies a passive human mass meter which makes use of an RF-based wireless network of sensors. These sensors send – in a coordinated way – signals to one another that are then processed through a gateway. After all, it's the signals' enfeeblement due to the presence of people compared to the empty space that enables us to make the association with the number of people present. We therefore don't need to use any smartphones or cameras.

CrowdScan is "the new kid in town" since it is a recently started company with a unique and innovative technology. Thanks to its unparalleled characteristics (non-privacy sensitive, real time, accurate in all circumstances such as e.g., rain) the applications of CrowdScan can be either complemented with third-party systems or on its own. That choice naturally depends mostly on the needs of clients but creates an enormous potential market.

Three of the four founders (Ben Bellekens, Stijn Denis, Maarten Weyn) together bring an immense technological knowledge to the table through their academic specialisation in the domain. Fourth founder Anton Dierickx built up a vast experience in crowd management and the operational needs of emergency services and safety professionals through his role within the Antwerp Police Department.

CEO
Technology & Operations
Sales & Finance

Dr. Ing. Ben Bellekens

Research & Innovation

Dr. Ing. Stijn Denis

Business Developer & Sales
Crowd Safety Expert

Anton Dierickx
Commissioner Local Police department

Technology

Prof. Dr. Maarten Weyn
Professor UAntwerpen / imec
Serial entrepreneur

After its first succesful round of investment with Qbic funds and Cronos, CrowdScan is rolling out several commercial projects which soon will be launched internationally.

In addition, CrowdScan has drawn prof. Dr. Keith Still as an independent member of the board. Dr. Still is the leading authority globally when it comes to crowd management and crowd science.

Legal information

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Pitchbook

- https://pitchbook.com/profiles/company/469765-18#overview

Offer

General Principle

The operation of the technology can be explained by drawing an imaginary zone in which the amount of people will be tracked. This zone could be any area, whether it's either indoors or outdoors. Around this zone the battery powered nodes are mounted at a height of approx. 5 ft. The exact number of nodes needed is defined in a preliminary analysis.

Each sensor will form part of a wireless network of sensors that will be configured with the help of a gateway at this location. The function of the gateway is to, on the one hand, synchronize the wireless network and, on the other hand, to send the collected results to the CrowdScan servers. These servers are in control of real-time processing, analysis and storing of the data. Then, the results can be presented to the end user in a dashboard.

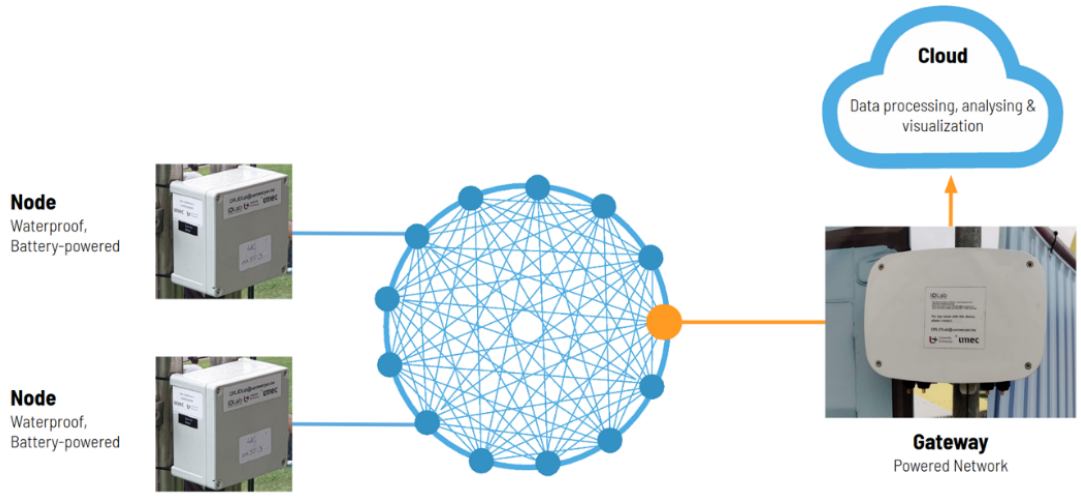


Figure 1: Summary of CrowdScan's hardware devices

The goal, hence, is to equip every critical location with a temporary or permanent installation. In this, the number of locations is unlimited. Software will process all locations in real-time and visualize all the data in one or multiple, accessible dashboards.

As only the zone in between sensors is measured, the technology permits very specific counting without any ambiguity on the received data. By numbering the sensors, a surveyed zone can be divided into sub-sections. This allows for separate measurements & visualizations.

This technology is situated in the microscopic domain (so long as sub-sections were defined) while still allowing to count large numbers of people in these zones. There is, however, no limit as to the number of sensors that can be joined in a network. The arrangement and building of the optimal network happens in consultation with the end user.

How the Monitoring Happens

Every sensor sends out an electromagnetic signal at a frequency of 868 MHz, which is captured by all other sensor in a weakened form. The frequency at which these sensors were synchronized is 50 milliseconds. The enfeeblement of the signal strength is caused by several different factors; the largest impact is that of distance between sensors, weather, people, and physical objects (cars, trees, …)

Figure 2: Visualization of the enfeeblement of a wireless signal due to people. The more people stand between the devices, the weaker the signal.

It is this specific enfeeblement by the people present that is translated by the technology into a head count. Research has shown that this weakening of the signal is linear to the number of people present. That means that if many people are in attendance in the area between sensors, a high enfeeblement will be detected compared to a reference measuring (meaning when the area was empty). This linear connection will then be calculated by means of a mathematical model, after which the enfeeblement will be automatically linked to a number of persons. The mathematical model behind will thus be dependent on location, size of the people mass as well as the manual counts that will need to happen once.

Gathered Data

It is of great importance to understand well what the technology exactly measures. After all, no single individuals are counted, but a weakening of the radio signal by the people present. The technology represents the number of people, in the specific zone, at a defined moment in time. Hence, one knows that X number of people at point in time Y. That does not give any information on the number of people that have passed over a period of time without additional assumptions like the length of that time frame. By means of extrapolation an estimate can be made in a post-analysis.

Passerby Volume – Actual Crowd– Crowdedness: These can be demonstrated both in real-time as well as in post-analysis. The correct mounting of sensors allows for counting in very specific zones/areas.

Passerby Profile: Unique intelligence cannot be identified with this technology, as there exists no direct connection between the signal strength that's picked up from the network of sensors and the degree of how much one single person weakens that signal. In addition, at no moment is any connection made with smartphones, making this technology completely privacy-friendly. This technology use the typical Internet-of-Things frequency of 868 MHz because of its large range.

Movement Directions: This is under development by CrowdScan and soon available. Presently, by comparing crowds between subsections, this can be mapped in a post-analysis.

Sensor Measurements

While every 50 milliseconds a measuring takes place, the data will be aggregated in block of 10 seconds, 1 minute or 15 minutes – depending on the specific application. When in true crowd management, we make use of an interval of 10 seconds, enabling us to quickly observe changes in masses.

For individual trends and changes in weather or time of year (e.g., sale periods, Christmas, …) intervals of 1 to 15 minutes are used.

Data Accuracy

With the help of several research projects at large events, such as Tomorrowland, Christmas markets, The Sound of Science, etc, CrowdScan has validated the technology compared to other methods of counting, i.e., manual counts and wristbands.

Since the system counts all persons that move between sensors, no extrapolations or corrections need happen on the generated data as is the case in WiFi-count methods or telecom data. As the same counting method is continuously used (historic) data of different zones or events can be applied to analyze trends and influences.

Literatuur:

- Denis, S., Bellekens, B., Kaya, A., Berkvens, R., & Weyn, M. (2020). Large-scale crowd analysis through the use of passive radio sensing networks. *Sensors*, *20*(9), 2624.
- Kaya, A., Denis, S., Bellekens, B., Weyn, M., & Berkvens, R. (2020). Large-scale dataset for radio frequency-based device-free crowd estimation. *Data*, *5*(2), 52.
- Denis, S., Bellekens, B., Weyn, M., & Berkvens, R. (2020). Sensing thousands of visitors using radio frequency. *IEEE Systems Journal*.
- Denis, S., Berkvens, R., Bellekens, B., & Weyn, M. (2018, September). Large scale crowd density estimation using a sub-GHz wireless sensor network. In *2018 IEEE 29th Annual International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)* (pp. 849-855). IEEE.

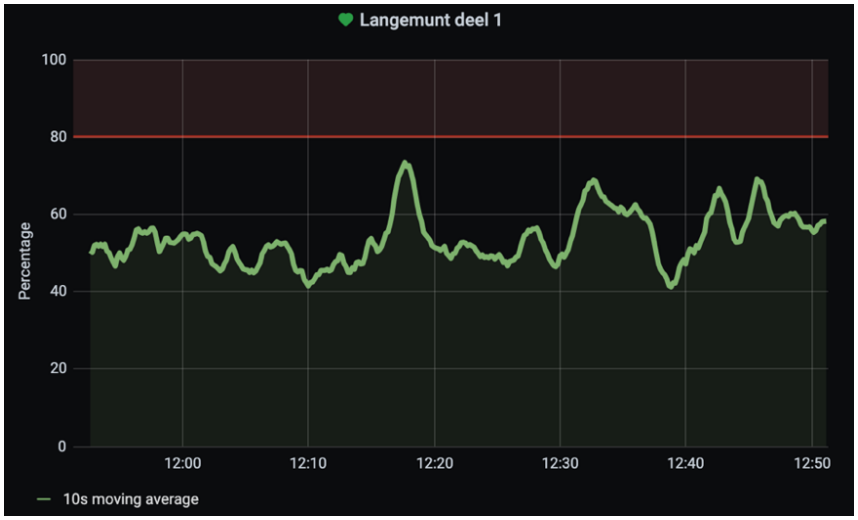
Impact

As illustrated, the algorithm operates with a calibration of the system, thus every measuring will be relative to the calibration in an empty environment. In one, single zone some changes can occur over time, such as weather changes or other variables. By executing daily (automated) re-calibrations these deviations are filtered out and will have minimal effect. Neutralizing such effects is of critical importance in order for the cumulating drift to be kept to a minimum. Furthermore, this counting method is not hindered by other communication technologies like 4G, Wi-Fi or others.

For CrowdScan it's a priority to meticulously follow up on the quality of the sensor network and always assure it in view of the synchronization of the number of received messages. When for some external reason the quality is reduced, the network can be adapted at distance.

Real-Time Visualization

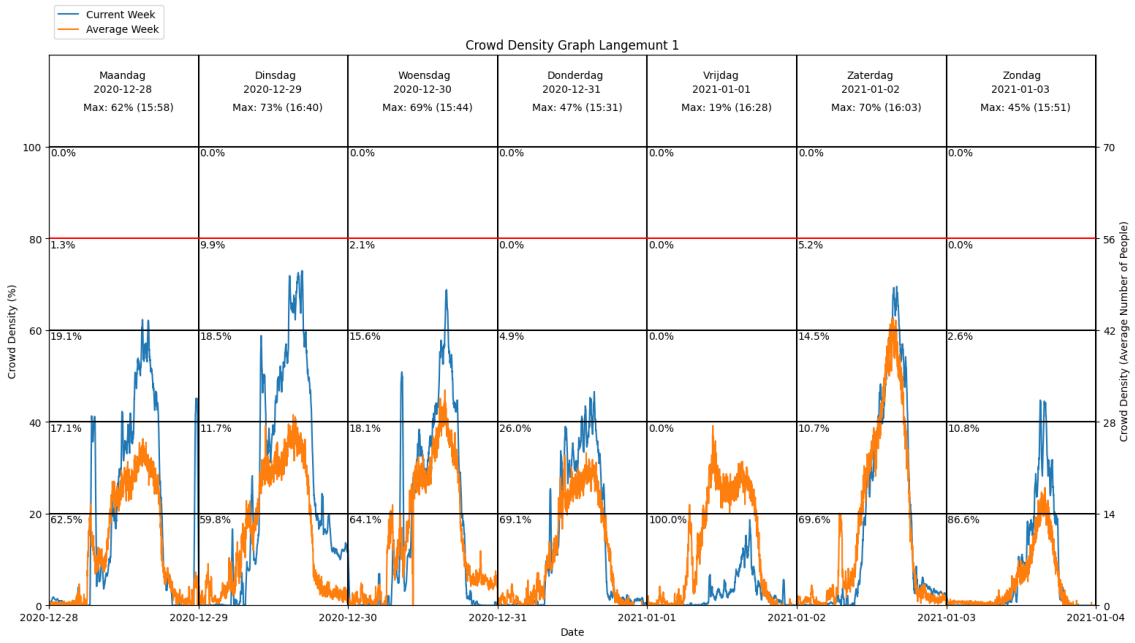
CrowdScan's data is presented in the open-source platform Grafana. This enables us to create distinct dashboards that can be viewed on any type of device. Each dashboard is always configured in function of its usage and end user. In the below visualization, an example is shown of the processed data in which we, proportionally, exhibit what the actual density is within a 10-second time frame, in function of an earlier defined alarm-level (80% density). A warning will be activated once the 80% is exceeded.



Visualizaiton in Post-Analysis

No technical limitations, to be discussed with the end user.

The below graph shows an overview of the average crowdedness of passerby in a Belgian shopping street. With this summary it's easy to find and investigate trends, together with additional meta data like e.g. weather info.



Legal Framework

As our application does not in any way gathers personally identifiable information, no GDPR-questions arise with regards to the usage, storage, and availability of the data.

Access

Access to the visualization platform is completely tailored to the needs of clients. Individual accounts with distinct access rights are available at a mere request.

Performance

- Reliability & Redundancy
  The network of sensors is calibrated daily and is operational 24/7. When the system due to technical reasons (like, e.g., power outage on the central gateway) cuts out, it will immediately start measuring once back online. There is no dependency on other technologies or calibrations that need to happen again. This attributes to the high accuracy and reliability of the system.
- Back-up systems
  To not lose any data, the following back-up systems have been set up:
  1. Databases that contain raw data are continuously being replicated to two, additional locations (set of replicas of three nodes with failover)
  2. A daily export of databases is created