Evaluation report

Sniffer bike
City of Zwolle

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Short description

The main objective of this pilot is to collect data on air quality on and along bicycle routes in Zwolle. The city decided to distribute a certain amount of sensors among Zwolle inhabitants. The sensors have to be placed on the bicycles and they collect environmental data when the inhabitant is cycling. All collected data together gives insights in more and less clean cycle routes in the city. The objective at the start was to inform citizens afterwards about more and less clean cycle routes and to adapt cycling policy to the result, e.g. by giving more attention to management and maintenance of this route or by removing motorized vehicles from certain roads or during certain hours of the day.

Type of ITS

Sensors collecting air quality data

The responsible company offering the sensor and the supporting service is WeCity. The average price for ten Sniffer bikes is approximately €2500 for delivery and installation and approximately €1500 for back-office support and data collection.

Timeline

In December 2019 ten inhabitants of Zwolle started to cycle with a sensor on their bike, this as a small pilot study. They collected air quality data during several months. In a second phase, the city of Zwolle wanted to upscale the pilot, however due to COVID 19 and shortage of materials to build the sensors the larger roll-out took place on 7 September 2022. On that day over 140 cyclists started using the sensor. The intention is to scale-up to 250 Sniffer bikes. In Spring 2022, the first ten users of the Sniffer bike were presented a survey with some questions concerning their motivations to participate and their cycling behaviour. Since the large roll-out of the 250 sensors came too late for the evaluation within the BITS project, this was not taken into account anymore.

Hypothesis

Due to a promotion of the cleanest cycle routes in Zwolle, as a result of a large-scale air quality data collection using sensors on bicycles, cyclists will be motivated to use the clean cycle routes more often.

Data sources

- o Data on air quality and cycling behaviour collected by the sensors
- o Survey data collected among the first users of the sensors
- o Report of a meeting with the project manager about the evaluation of the pilot

Analysis

Report of the pilot

Starting in December 2019, ten inhabitants of Zwolle tagged a sensor on their bike, which collected air quality measures while cycling. The sensor measures the following indicators: particulate matter (in diverse parameters: PM10, PM2.5 and PM1.0), temperature, air humidity, air pressure, GPS location and time. Every 10 seconds this information is collected and users can follow the air quality while cycling due to the informing light on the sensor (see picture). The users also had the possibility to login on an online platform and view their collected data afterwards.


After a first pilot study with only ten cyclists, the intention was to roll-out this project on a wider scale. About 250 sensors would be distributed among inhabitants of Zwolle and these people would collect a lot of data while cycling in and around Zwolle. However, due to several problems (amongst others COVID-19, lack of materials, delay among the project managers of the city), the sensors weren't distributed in 2020 or 2021, as was planned, but were only distributed in September 2022. Unfortunately, due to time reasons, it was not possible to wait with the evaluation of the implementation until the results of the large-scale distribution were available. Therefore it was decided to prepare a survey for the first ten users of the Sniffer bike in 2019 and 2020 to ask their feedback and experiences with the sensor. In Spring 2022 six out of the ten first users replied to our request and completed the survey.

Before discussing the results of the survey with the experiences of the users, we provide some information on their cycled trips and the collected data. The graph below shows the total amount of measures made every week between December 2019 and October 2020. Note that these numbers are very high (between 1.000 and 10.000 each week) since a measurement is made every 10 seconds the bicycle is moving, although only a maximum of 10 cyclists are driving with a sensor in this period.
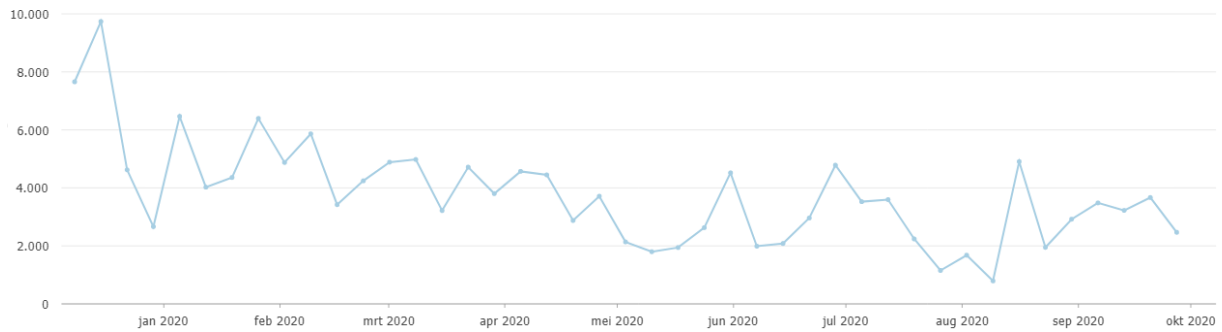

The graph below shows the approximate total cycled distance each week of these (maximum ten) cyclists. It is important to note here that this is an estimation, since measurements made by the sensor were not always exact and since GPS signals sometimes made small errors. Moreover, not all ten cyclists used their sensor until October 2020. However, this graph gives an indication of the total cycled distance by this group of cyclists.
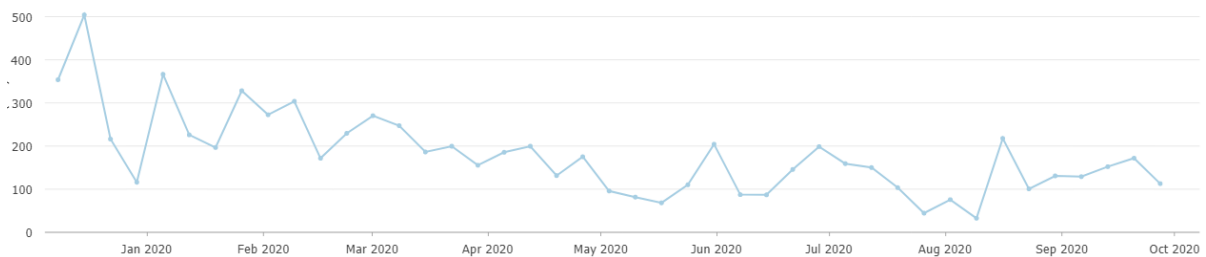
On the map below it is shown where the cyclists made their trips with the sensors and thus where air quality data was collected. The map gives an overview of all trips between 4 December 2019 and 3 October 2020. The designated zone is the city of Zwolle and you can see on the map that users mostly cycled in certain neighbourhoods of the city. The blue colours indicate the lowest density, going over red to yellow with the most measurements in that area.

Lowest density

Highest density
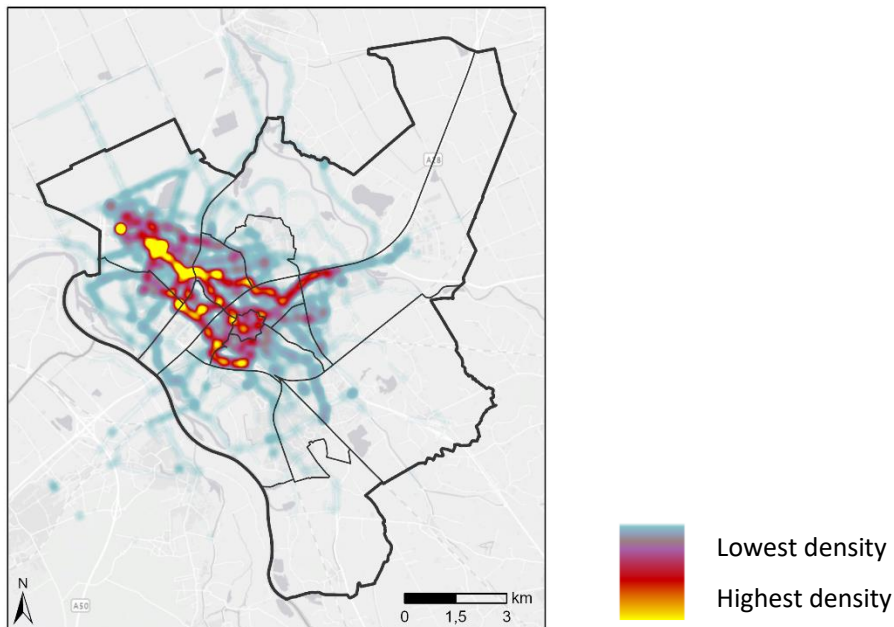
The following heath map is an example of all particulate matter measurements (PM2.5) in December 2019 (24 and 25/12/2019).

PM2.5 (µg/m³)
- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- > 40
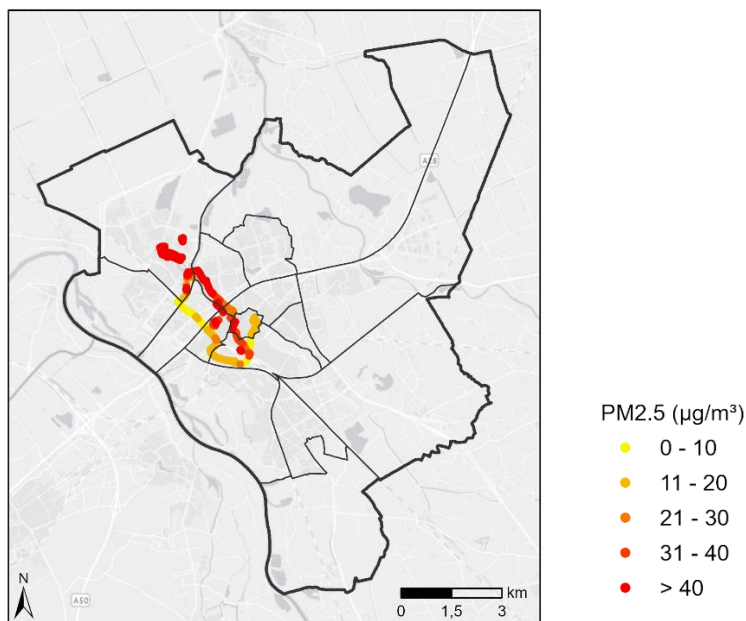
Six cyclists completed the user experience survey. They indicated that they cycled during several months to one year with the sensor. All of these cyclists mainly use the bicycle for commute, two of them also use it mainly for recreational purposes and two for daily activities. Four out of six cyclists use the bike daily; the other two cyclists use it several times a week. None of these cyclists indicated they cycled more with the sensor on their bicycle, compared to before.

For the users, positive aspects on the Sniffer bike are the collection of useful information, the possibility to see the own collected data and the efficient way the sensor worked. On the other hand, negative aspects for them were the lack of involvement of the city, the weakness of the battery and no possibility to see the status of the battery, the sensitive mount on the bike, the lack of ease of removing the sensor and the limited amount of collected data. For two cyclists their collected results had an impact on their cycling behaviour or frequency; i.e. one cyclist cycled longer and/or other routes to collect more data and one chose a cleaner route if possible. For the other four cyclists this had no impact on their cycling behaviour or frequency. Half of the users cycled a different route once they knew which route was cleaner than another; the other half did not do this. Finally, the users were asked what they would want to change to the Sniffer bike or the project. They wish for more involvement from the city, a better visualisation of the results and the maps, a better mount on the bicycle, a broader collection of data and taking care of an anti-theft sensor.

Although only six users completed the survey and the input is thus very limited, we can still draw some provisional conclusions from the responses. The collection of data was appreciated by the users and impacted to some extent their cycling behaviour. On the other hand, some issues could be solved in the larger roll-out of the sensors, amongst others the support from the city and the mounting of the sensors. The sensors and/or the results of the sensors partly impacted their cycling behaviour, but did not make them cycle more.

The city of Zwolle took the feedback into account and learned lessons from the pilot roll-out in December 2019. On the one hand, they made arrangements with the providing company who is responsible for what part of the implementation. It was decided that the provider will take care of the back-office as well, which is being available for responding questions and offering support for technical problems. On the other hand, they will also meet regularly with the provider and make communication giving an update to the users of the Sniffer bike. The objective is to motivate users with these updates and figures about their collected data.

Impact

Since only six users completed the survey and only a very limited amount of data is available, no thorough conclusions concerning the BITS objectives can be made (i.e. increase in uptake of cycling and decrease of CO_2 emissions). No information is available on the potential impact on uptake of cycling or on decrease of CO_2. All responders indicate they did not cycle more due to the sensor on their bicycle or due to the information on the cleaner routes. Some cyclists used another route due to this information, but did not cycle more. Moreover, the original objective of the pilot, i.e. promoting clean cycles routes in the city and motivating citizens to cycle more, is not (yet) achieved since the larger roll-out of the sensors took only place in September 2022. Possibly, this pilot will have a positive impact on the amount of cyclists and CO_2

emissions on the longer term, but unfortunately we can currently not conclude that the Sniffer bike ITS technology has an impact.

Experiences project managers

In September 2022, close to the larger roll-out of the sensors, we had a meeting with the project manager from the city of Zwolle.

According to him, the Sniffer bike collects objective air quality data which has an added value on technical models often used to calculate air quality, since these are objective and actual statistics. Moreover, this pilot used citizen participation to collect its input. While they could behave as they would do anyway, i.e. cycling in the city, citizens were involved in the data collection which contributes to policy preparation and policy making. Also, the Sniffer bike stimulates cycling and stimulates the contribution to charity and a better living environment.

Some barriers were encountered during the ITS implementation. As the users mentioned in the survey as well, during the small roll-out in 2019-2020 no clear arrangements were made between the offering company and the city about responsibilities and point of contact. Due to other priorities, lack of arrangements and lack of designated coordinators, users didn't receive responses on their questions and problems, which frustrated them. This issue was solved when the larger roll-out started in September 2022. Another barrier according to the project manager was the topic of privacy. This is an issue which needs time and effort beforehand, since it cannot be ignored anymore in these times. A lot of personal data is collected and a good policy concerning how to deal with these data is needed. One of the actions here is that the sensor only starts collecting data 200m after starting the bicycle, so the exact starting location (which is often the home address of the users) isn't visible. Also, users needed to sign an agreement concerning the privacy rules. Thirdly, due to a lack of materials and administrative issues, the larger roll-out of the Sniffer bikes was delayed several times and took only place in September 2022.

For the project manager, the pilot only partly reached its goal. The ITS implementation collects useful data concerning air quality, which is certainly an added value and which learned the project managers and others in the city that the Sniffer bike can be used for obtaining insight in clean routes. On the other hand, the objective was to promote and invest in clean cycle routes in Zwolle. Since the roll-out of 250 sensors had such a huge delay, it was not possible to launch a promotional campaign within the scope of the BITS project. In this way, the implementation did not reach its goal.

The project manager also had two more recommendations for others. First, he advised to strive for enough coverage. If you aim for a full overview of the air quality of your city, you need sufficient data collected on a diverse set of roads. Therefore, you need sufficient cyclists, people cycling often and a lot and using a variety of roads. Secondly, involving policymakers can be an added value for two purposes: they can on the one hand be involved in a promotional campaign motivating other citizens. On the other hand, they can experience the impact of the sensor itself and take their experience (unconsciously) into account when developing future (cycle) policy.

Conclusions

The city of Zwolle rolled-out sensors to be added on bicycles to collect air quality data. Although the roll-out on a larger scale took place in September 2022, only the results of the pilot roll-out in December 2019 could be taken into account for evaluation within the scope of the BITS project. However, also from this small experiment several interesting lessons could be learned. Users appreciated the fact that they contributed to data collection on air quality on a larger scale. The lack of involvement from the city and several technical issues were barriers for them. No conclusions concerning the BITS objectives could be made due to a lack of data and the goal of the pilot (collecting data and promoting clean cycling routes) was only partly achieved. We can however conclude that an important added value of this ITS implementation is the citizen participation. Without much effort, citizens are involved in data collection which contributes to policy preparation and policy making. This implementation also learned it is important to consciously consider the aims of the data collection on beforehand. Data collection can be very useful, but it needs to have a purpose. However, the potential of this type of data collection in the future is very high, since the more data that is collected, the more valuable the collected data becomes.