When technology fails: a case study of a premature CS tool

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Tell me and I will forget.
Show me and I will remember.
Involve me and I will understand.
Ancient Chinese proverb

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## The Citizens' Observatories of Air

With the emergence of new low-cost sensor technologies, monitoring air pollution is in the hands of everyone. These novel sensor technologies open up the opportunity to monitor air quality at spatial resolutions not possible with traditional monitoring systems. Low-cost sensors are small, portable and easy to use. Citizens like you can now contribute to monitoring the environment. In the next years, low-cost sensors will transform the way we understand and interpret air pollution.

The CITI-SENSE Citizens' Observatories Central Web Portal is designed to enable citizens to access not only to real-time environmental information provided by a wealth of Sensor and sensor platforms (including portable sensors and static sensors, mobile apps and different types of air pollution perception surveys), but also to provide a forum for discussion, debate and sharing of your own personal observations. Your contributions are important and the Citizens' Observatories Toolbox (COT) is yours! Here you can find out what our COT can do for you and what you can do with our COT.

Find all the information you need in our COT on our Product brochure and Publications.

Be a **citizen** scientist

CITI-SENSE

Challenges exists beyond technical issues
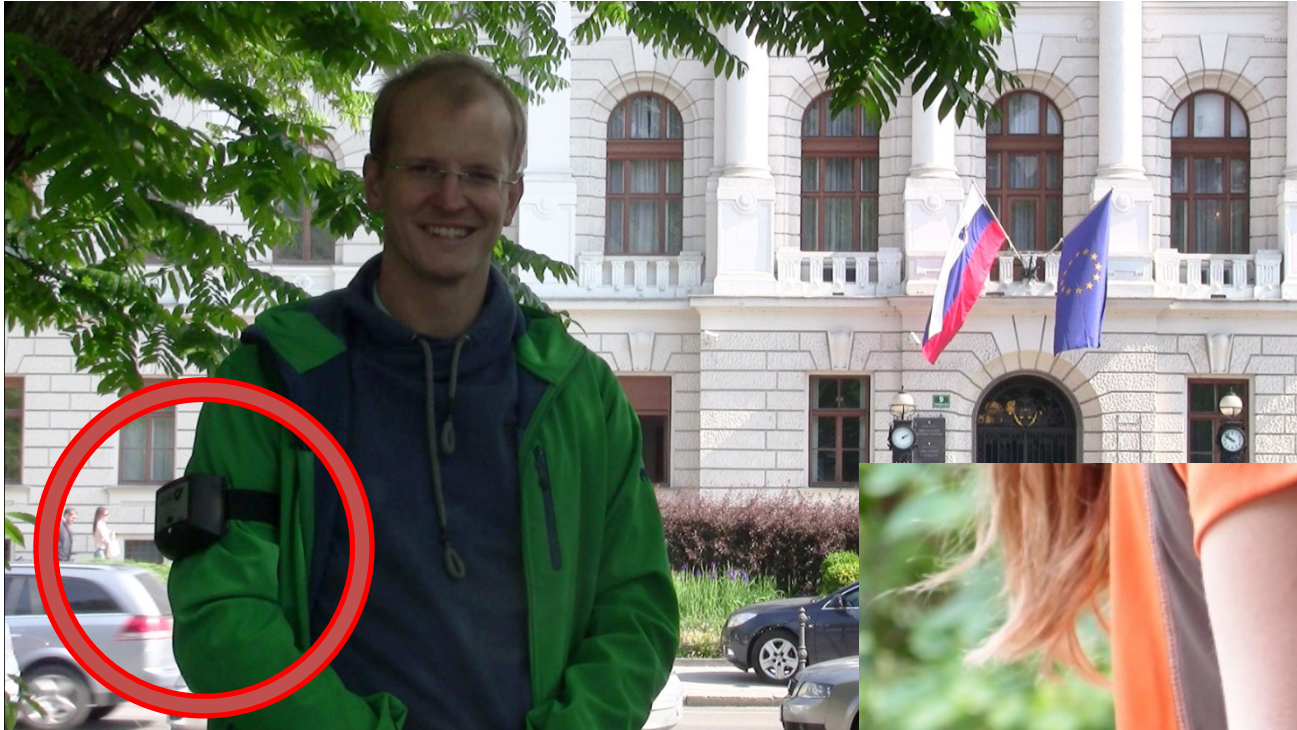
End-user validation

user experience (UX)

- 19 volunteers tested and evaluated a prototype

- Semi-structured focus groups and interviews

- Voice recordings were transcripted and translated

- Data analysis (content analysis)
  - The feedback was coded (R1 & R2)

What was tested and evaluated?

Qualitative data analysis: Coding R1

- mixed coding methods for evaluation

  Saldaña (2009)

  - Descriptive
  - Magnitude
  - in vivo
  - Recommend

- All entries were numbered

Example:

[6] App: - "freezing constantly"

[10] REC: App: "phone app needs to be much more stable and reliable"

Results: structured feedback

1. User experience

2. Feedback on the device and its functionalities

3. Volunteers recommendations and possibilities

User experience

- Positive about the general idea, motivations

- Not user-friendly, inconvenient

- Data loss -> disappointment

- Not ready for the public

ID12: *"It crashes already at the settings. When they released a new update after a few days I got excited that perhaps it would work, but it didn't."*

ID1: *"If it only took few seconds to fix the problem it would be fine. It took a minimum of five minutes, which in itself is already too much. And it usually freezes right when you don't have the time. E.g. when you already have dressed your kids in the winter clothes and are ready to go to the car."*

Feedback on the app

- Freezes, crashes..

- Force stop, reinstall

- Data loss, ID

- Too many steps to set up (over 20p user manual)

- battery
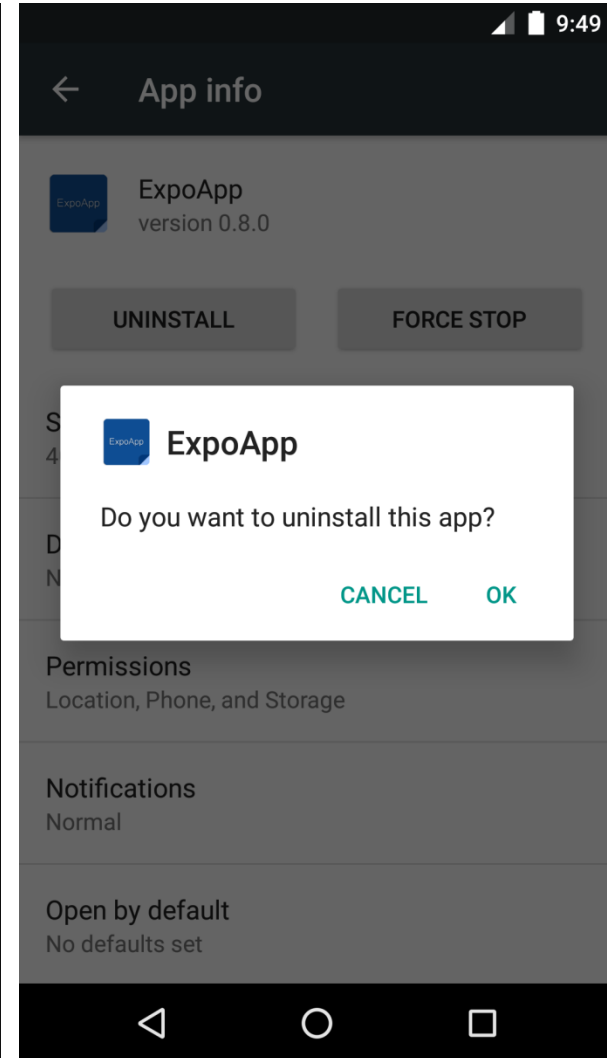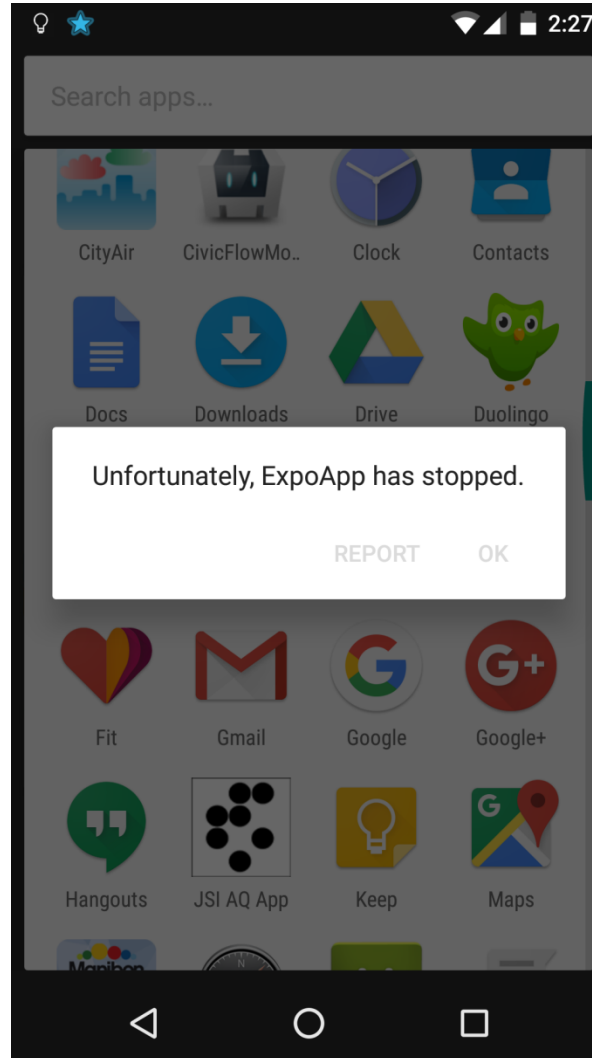
Imagine a situation

Feedback on hardware

- Bulky, not that portable

- Not displaying enough changes in AQ

- Battery runs out suddenly

- Does it work?

ID2: *"It would be good if one would know for sure if the device works or not. I know there are those indicating LED lights, but they do not always work the way they should. It leaves the user confused. There should be a clear indication if it works or not."*
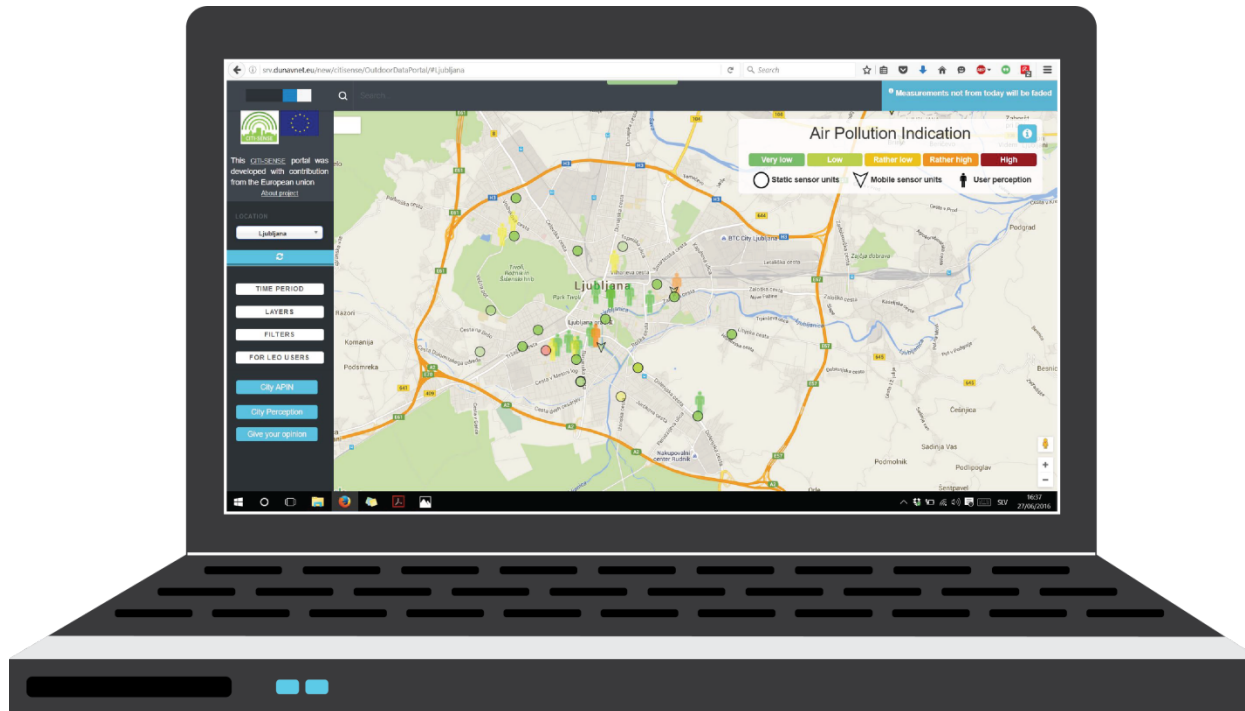
Air pollution concentration not shown

Relative and Aggregated values

Data portal

- "OK", "nice", "interesting"
- No improvements really needed
- For some, it was a non relevant component of the system

Volunteers recommendations

- self-explanatory device
- wearable (for real)
- detect and display differences in AQ
- longer batterylife

- Visualisation (tracks)
- Notes/tags
- Pop-ups
- iOS
- Max 200€

ID17: "I would like that there were as few steps as possible. That it would be automatically connected and sending the data. There needs to be as little such extra pressings of buttons like "OK", "Save", "confirm" etc. It would be good that once you press the stop button, you would get a notification that you had been measuring successfully. That you get a feeling everything went well."
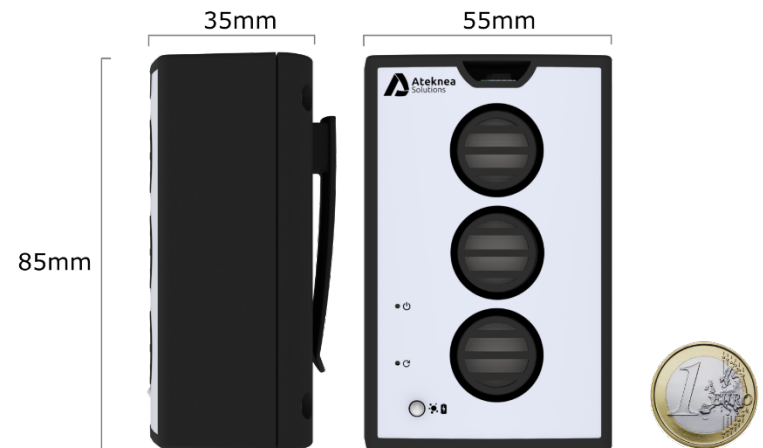
Possibilities

- Spatial distribution of AQ
  – Exposure studies
  – City bikes
- Indoor AQ
- Projects/experiments for schools, NGOs..
- Renting service
- City authorities seen as data hub services

Contributing to the redesign

- Feedback given to the developer
- New hardware was designed:
  - Better battery life
  - Low energy Bluetooth
  - Better electronics for noise reduction

Conclusions and recommendations

- Continues being a trend
- self-evaluation by project members not enough
- low maturity of the technology -> not ready for citizen science
- volunteers suggestions
- Include UX into the quality assurance process

These findings are summarized:

Open Access Article

End-User Feedback on a Low-Cost Portable Air Quality Sensor System—Are We There Yet?

by Johanna Amalia Robinson [1,2,*] ✉ iD , David Kocman [1], Milena Horvat [1,2] and Alena Bartonova [3] iD

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Abstract

Low-cost sensors are a current trend in citizen science projects that focus on air quality. Until now, devices incorporating such sensors have been tested primarily for their technical capabilities and limitations, whereas their usability and acceptability amongst the public rarely goes beyond proof of concept, leaving user experience (UX) unstudied. The authors argue that UX should be taken into account to make sure that products and services are fit for purpose. Nineteen volunteers tested and evaluated a prototype device and provided feedback through semi-structured interviews and during focus group sessions. Their UX was then coded using mixed coding methods regarding device functionality and recommendations for future product development. The results indicate that UX can identify potentially problematic design aspects while giving deeper insights into user needs. For example, UX recognized that one of the most important aspects of user involvement and motivation was successful data harvesting, which frequently failed. This study recommends that future developers of low-cost portable air quality sensor systems prioritize reliable data transmission to minimize data loss. This will ensure an efficient and positive UX that supports user engagement in citizen science based research where collecting sensor-based data is the primary objective.

Keywords: **low-cost portable sensor system**; **user experience**; **user needs**; **air quality**; **citizen science**

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Questions?

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