SMIT STUDIES MEDIA INFORMATION TELECOMMUNICATION

hackAIR

COLLECTIVE AWARENESS FOR AIR QUALITY

A collective sensing approach for measuring air quality

Workshop: (Un)Plugging Data in Smart City-Regions

Urban Expertise for Citizen/Users Involvement

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Paulien Coppens, Carina Veeckman, Dr. Laurence Claeys

imec-SMIT, Vrije Universiteit Brussel

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688363

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CAPS project: hackAIR

Open technology platform for citizen observatories on air quality

DRAXIS ENVIRONMENTAL TECHNOLOGIES
NILU Norsk institutt for luftforskning Norwegian Institute for Air Research
CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS
BUND FRIENDS OF THE EARTH GERMANY
VUB VRIJE UNIVERSITEIT BRUSSEL
ONSUBJECT Momentum for Sustainability

HackAIR is a social innovation project

Social innovation:

*"New products, services or methods that tackle pressing and emerging **social issues** and, at the same time, **transform social interactions** promoting new collaboration and relationships"*

(Murray, Caulier-Grice and Mulgan, 2010)

Characteristics:

- Open knowledge sharing
- Multi-disciplinary
- Participation and empowerment of citizens
- Demand-led
- Tailored to local circumstances

(European Commission (2013): Guide to social innovation)

HackAIR is a CAPS project

- CAPS: Collective Awareness Platforms for Sustainability and Social Innovation
- EC initiative aimed at designing and piloting online platforms to create awareness on sustainability problems
- Support of environmentally aware, grassroots process to enable:
  - Knowlegde sharing
  - Active participation of European citizens
  - Changes in lifestyle, production and consumption

→ **User engagement + behavioral change**

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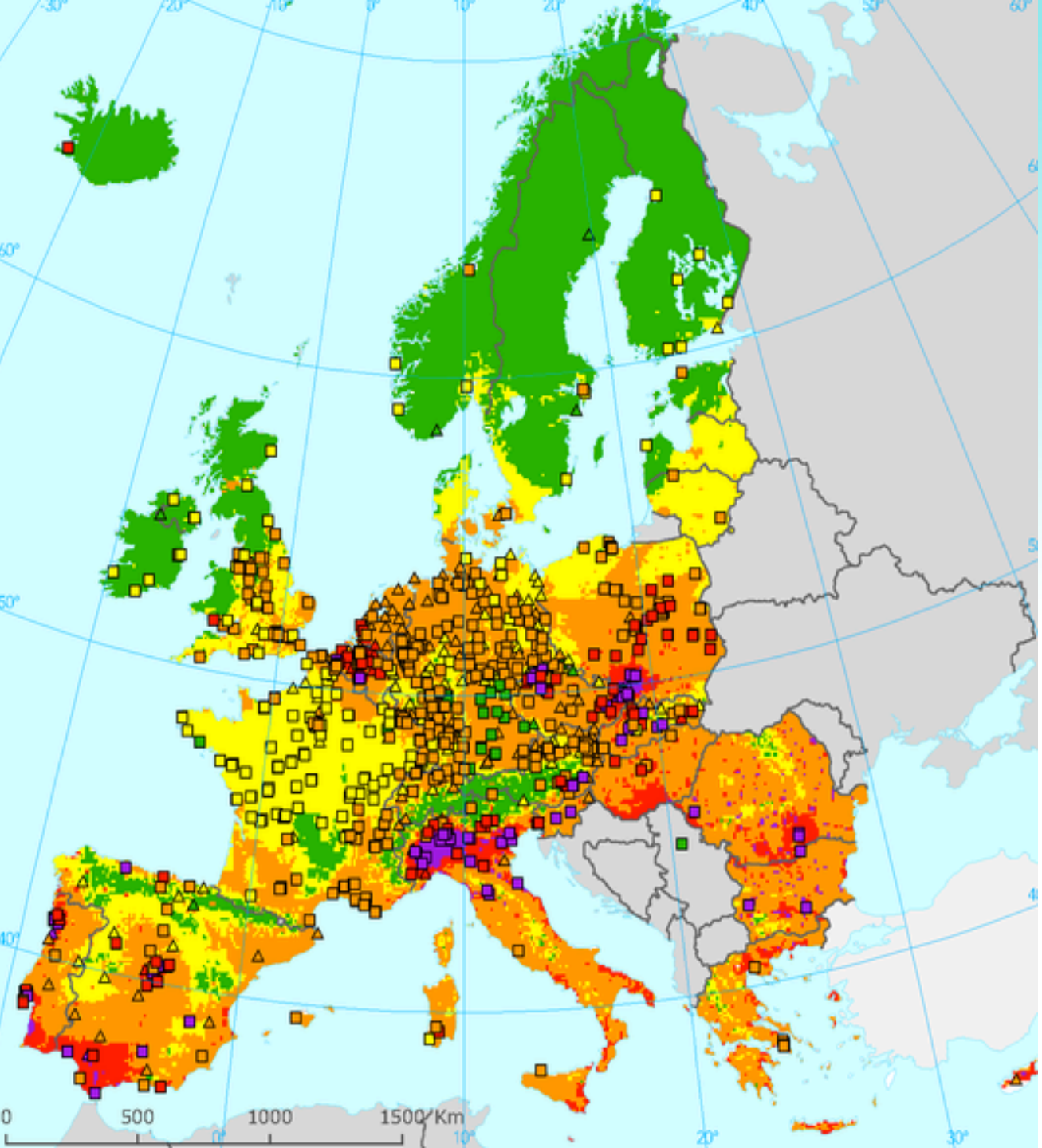
FOR AIR QUALITY

"Despite continuous improvements in recent decades, air pollution is still affecting the general health of Europeans, reducing their quality of life and life expectancy."

Hans Bruyninckx, Executive Director European Environment Agency, EEA

Photo: Lundrim Aliu / World Bank



We need better information

- **Fill gaps** in areas where distances between sites may be large;
- **Improve access to data** across many sources
- Provide **up to date** air quality information

Selected PM_{10} values, 2004 (from EEA 2015)

hackAIR objectives

Improve air quality **information**

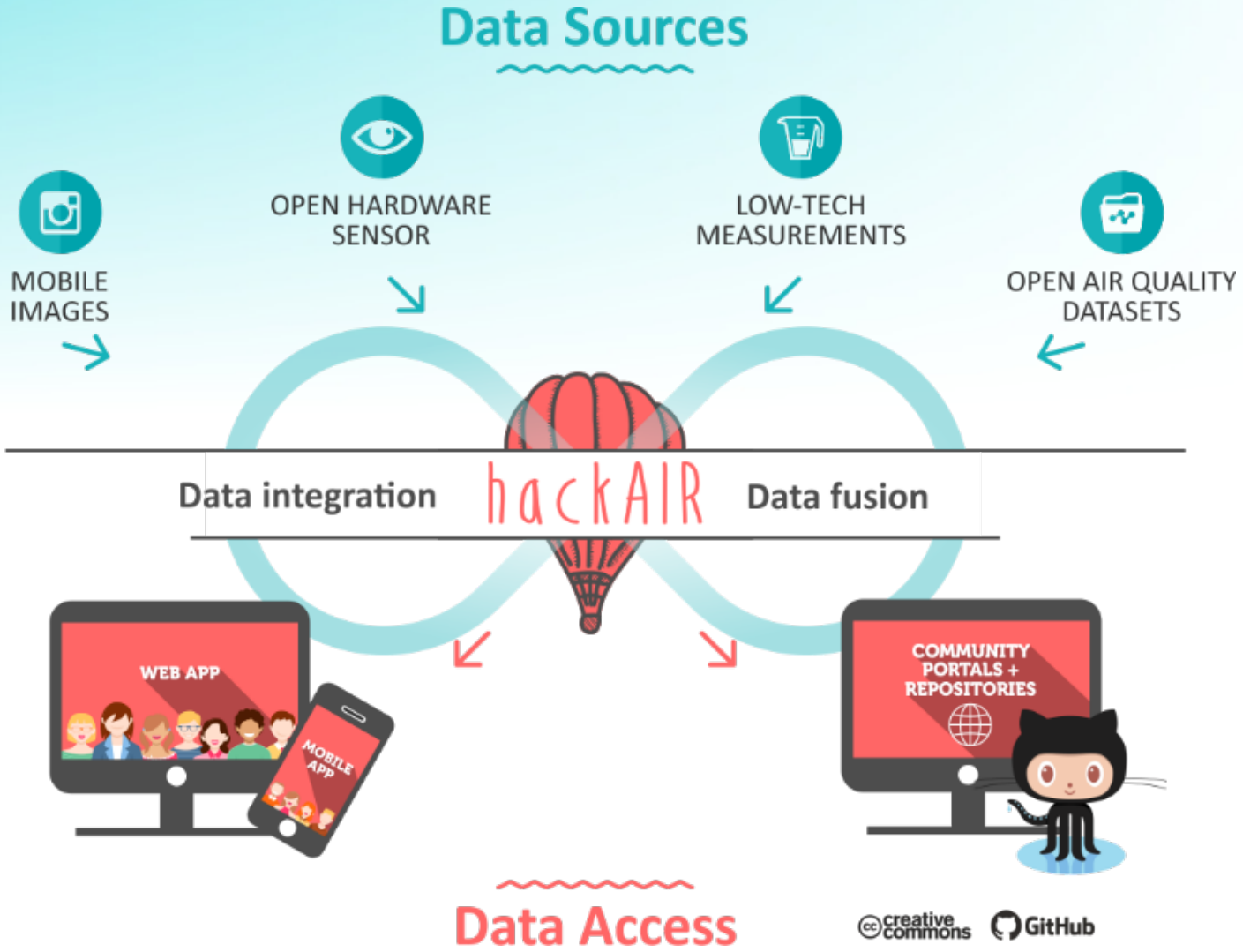
Contribute towards individual and collective **awareness** about air quality

Encouraging changes in **behaviour** towards a cleaner air

hackAIR in a nutshell

Its uniqueness:

- Openness
- Real-time air quality information
- Pictures as a measuring tool
- Easy to use hardware solutions
- Personalized recommendations



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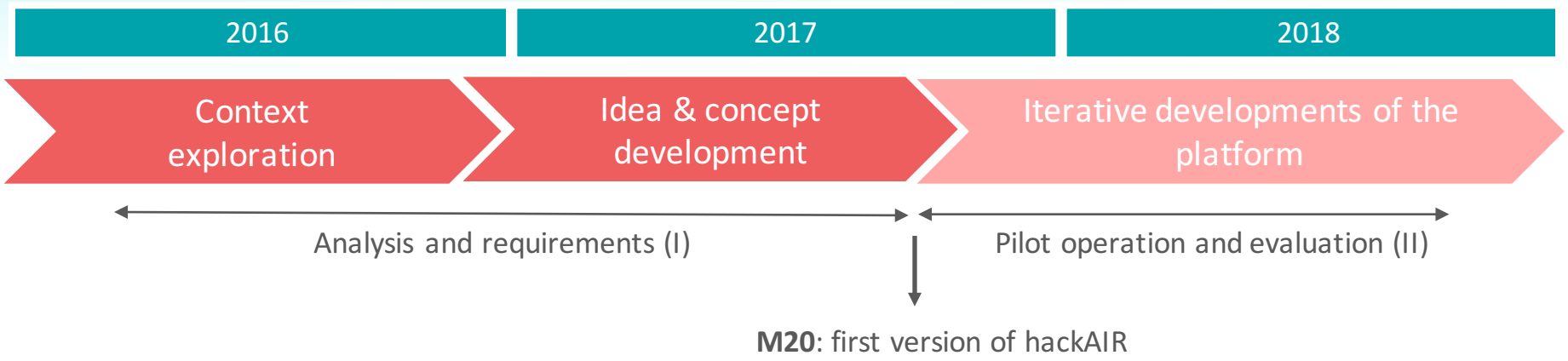
User involvement in hackAIR

- Involvement of users during the **co-creation** of the platform
- Involvement of users during the **use** of the platform: user contributions of air quality measurements

Co-creation of the hackAIR platform

The hackAIR platform = result of **co-creation** process between users and all stakeholders



Co-creation of the hackAIR platform (I)

Analysis and requirements

- Goal: In-depth insights into user requirements
- Method:
  - Co-creation workshops (2 phases)
  - Creative techniques to explore:
    - Current experiences and motivations for using air quality platforms
    - Expectations for hackAIR
    - Validation of functionalities hackAIR

Co-creation of the hackAIR platform (I)

Some findings:

- High need for **more fine-grained air quality data**

  How is the air quality in my neighbourhood? And in my street?

- Need for information on how to **make sense of the data**

  What is good and what is bad air quality?

  Why is it useful to retrieve air quality data?

- High interest in **what can be done about air pollution**

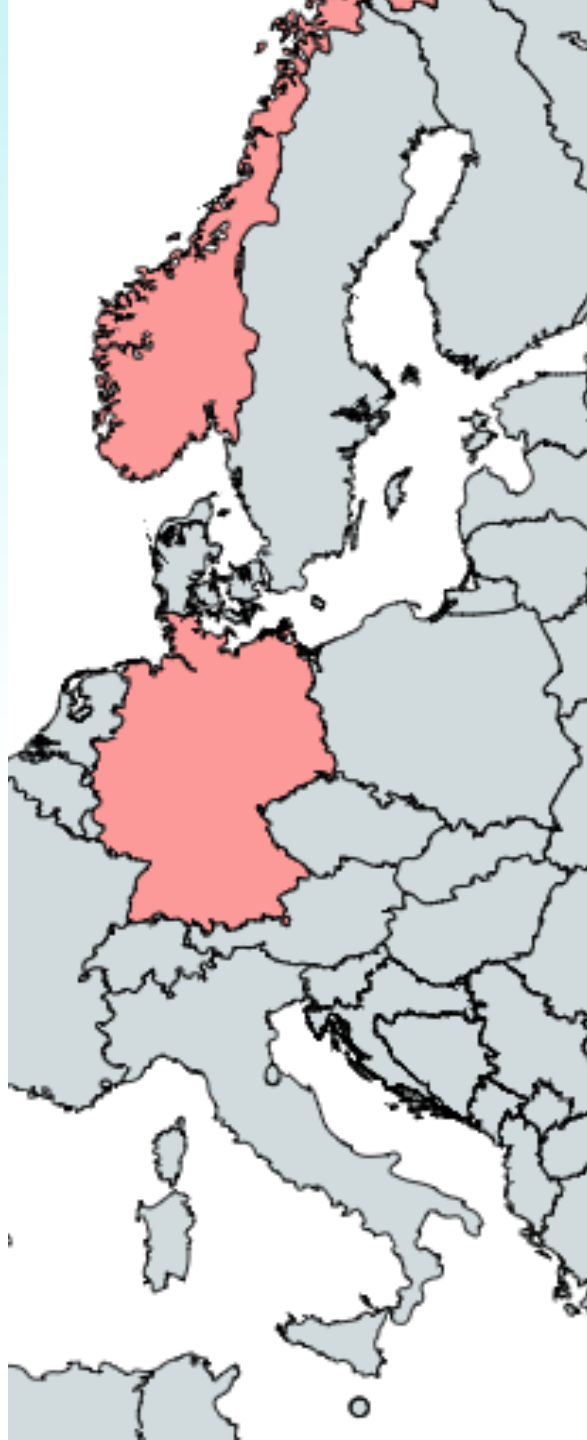
  How can I reduce air pollution myself?

  How has my contribution helped society?

Co-creation of the hackAIR platform (II)

Pilot study in 2 countries

Country	Germany	Norway
Goal	Testing and validation of hackAIR	
User groups	Focus on environmental activists	Focus on health interest groups
Target numbers	Citizens: 5000 Air activists academy visitors: 200	Citizens: 3000 Air activists academy visitors: 90
Timing	3 test periods: 1. Sept 2017 – Dec 2017 2. Jan 2018 – April 2018 3. May 2018- Aug 2018	



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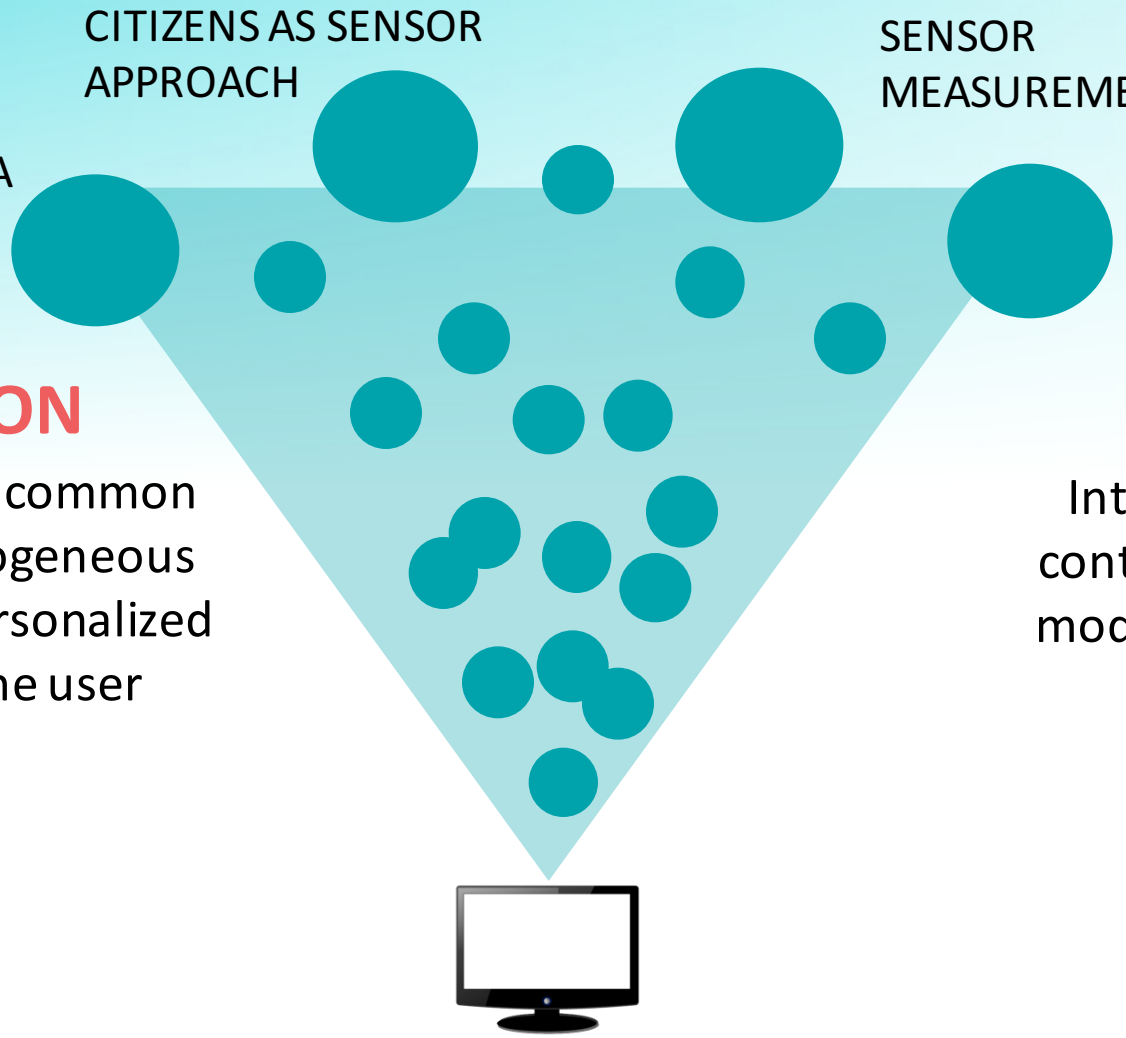
Air quality monitoring – Data collection approaches

Measurements from existing air quality stations	User-generated images of the sky	Sensors
• Governmental organizations or stand-alone initiatives • Current AQI values and predictions (PM2.5 and PM10) • Open data • E.g.: IRCEL-CELINE (BE), VMM (BE), AirNow (US, Canada), ..	• Images captured of the sky through **the hackAIR app** • Publicly available geo-tagged and time-stamped images on **social network sites** (e.g. Twitter or Flickr)	• **COTS sensors:** commercial off-the shelf based sensors • Low-cost dust sensors: **DIY** • hackAIR node: **air quality beacon** • **'Citizens as sensors approach':** subjective observations of the air quality

COMMUNITY INVOLVEMENT

Air quality monitoring – hackAIR concept



DATA INTEGRATION

Semantic interoperability: common presentation of the heterogeneous information, to provide personalized recommendations for the user

DATA FUSION

Integrating the various data sources containing air quality information with model-derived information (base map)
Algorithm-based approach

hackAIR WEB APP

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Citizens as sensors approach: ‘How do you feel the air today’

Air quality info

Estimating air quality through sky-depicting images – hackAIR mobile app

- Take a picture of the sky with the hackAIR mobile app
- The hackAIR mobile app estimates the particulate pollution through measured light intensities (aerosol depth) – specific algorithm
- Picture is uploaded to the hackAIR server
- Pictures need a good deal of sky + not too cloudy + geo-location stamp

Estimating air quality through COTS dust sensors

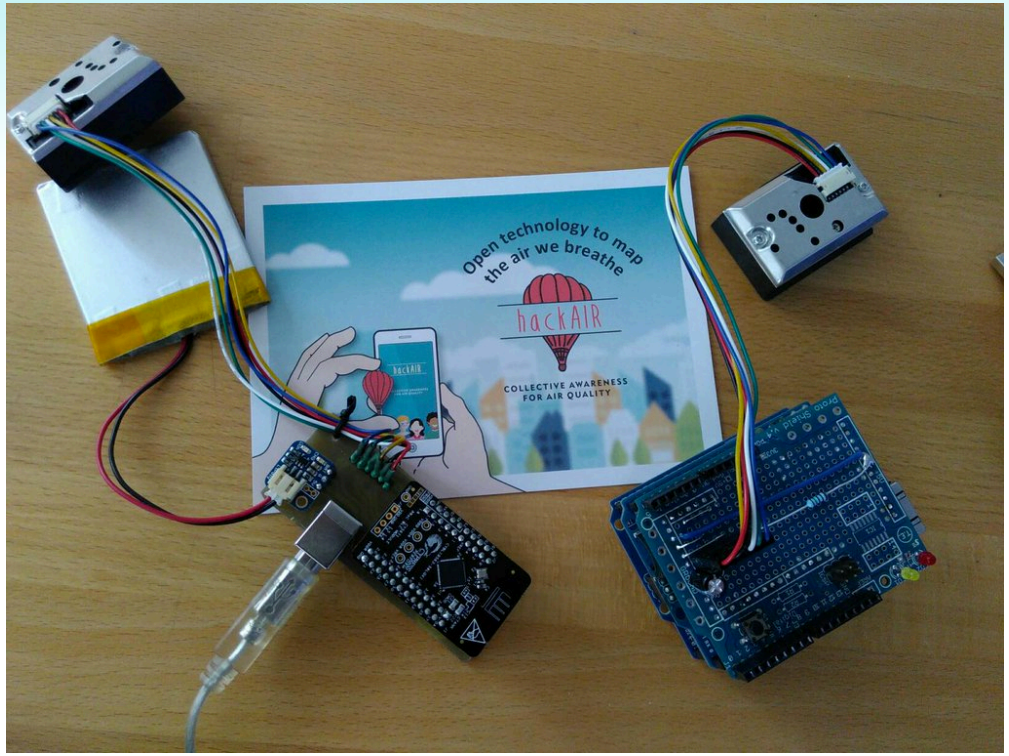
- Simple setup: Pump/vacuum cleaner + food container + paper filter
- Make a hole in the food container, place a paper filter in front of it, and turn on the pump/vacuum cleaner
- Air is pumped from the free environment and guided through the filter
- Measuring PM

Estimating air quality through COTS dust sensors

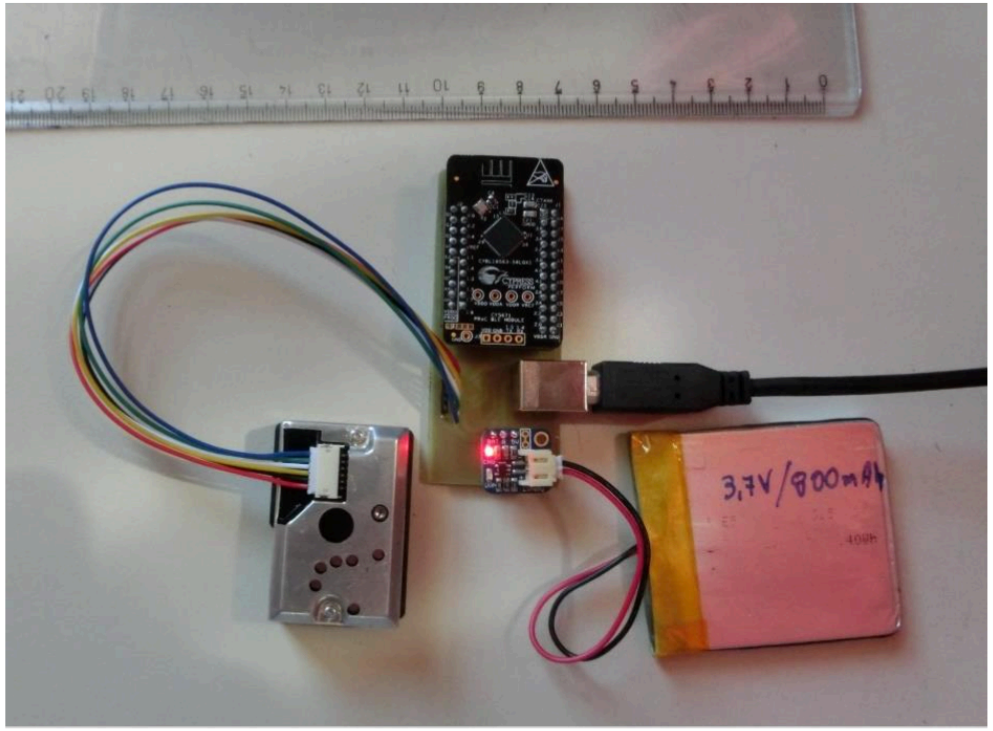
- Remove the paper filter, take a HQ image with a clip lens
- Upload smartphone photo of the resulting colorized paper and a reference filter through the hackAIR mobile app
- hackAIR estimates air pollution based on relative difference of filter colors

Estimating air quality through low-cost sensors (Arduino) and air quality beacons

First prototype of the low-cost sensor for makers and hackers (PM)



First prototype of air quality beacon to measure outdoor air quality (PM)



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Engagement strategies for air quality monitoring

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Engagement strategy in hackAIR

- **Engagement strategy** will be outlined for the pilot communities by summer next year
- Engagement strategy will focus on recruiting **new members** for the hackAIR community, **maintaining their interest** and **encouraging behaviour change (pro-environmental behaviour)**
- Engagement strategy should result in an increased **awareness, pro-environmental behaviour** at the individual level**,** increased **knowledge** about specific actions to protect oneself
- Specified for **target groups** (e.g. children, asthma patients, students, etc.) and the available **tools** (e.g. COTS sensors for children, mobile app for the general public, etc.)
- Engagement strategy will focus on different **tactics** both **online** and **offline** to engage citizen communities – and done in an iterative way to see what works (or did not work)

Engagement strategy in hackAIR

Four levels of citizen science engagement (Haklay, 2011):

- **Level 1 – Crowdsourcing**: Citizen as sensors
- **Level 2 – Distributed Intelligence**: Citizens as basic interpreters
- **Level 3 – Participatory Science**: Citizen participate in problem definition and data collection
- **Level 4 – Extreme Collaborative Science**: Citizens participate in problem definition, data collection and data analysis

Citizens can use the hackAIR tools to contribute with air quality measurements at different levels

- **Low level**: Submit air quality perceptions & take sky-depicting images
- **Middle level**: COTS sensors and the low-cost sensors (Arduino)
- **High level**: Air quality beacons

Engagement tactics in hackAIR – 7E-framework (Brambust, 2015)

Motivate = reinforce motivation towards picking-up the behaviour

- **Enthuse**: make people enthusiastic by making it personal to them and create expectations for the desired behaviour and its consequences
- **Encourage**: show the potential benefit and reward
- **Engage**: show the social support; show that a group of people is behind the endeavour and get people involved (if they can do it, I can do it too)

Support = provide opportunities for choosing and acting the desired behaviour

- **Enlighten**: provide information, clarification and knowledge on the issue/behaviour
- **Exemplify**: proof that you mean it by acting as an example and sharing responsibility
- **Enable**: lower the barriers by making the action possible in an easy, supportive, adaptable way

Experience: highlight the positive benefit of the desired behaviour

- **Experience**: let people experience the desired behaviour in a positive way and accentuate its purpose (wow, I want to experience this again)

Engagement tactics

- **Engagement campaigns:** Specific challenges in the form of campaigns to post pictures on different themes (e.g. photo contests) or to share data of specific taken actions (e.g. number of km biked instead of driving)

  ➔ **Enthuse, Experience**

- **Gamification/badges:** Gathering points, earning badges, leaderboards and a reputation system based on the user contributions

  ➔ **Encourage**

- **Workshop tours:** Workshops to explore the hackAIR tools through a hands-on approach (e.g. build your own COTS sensor)

  ➔ **Experience, enlighten**

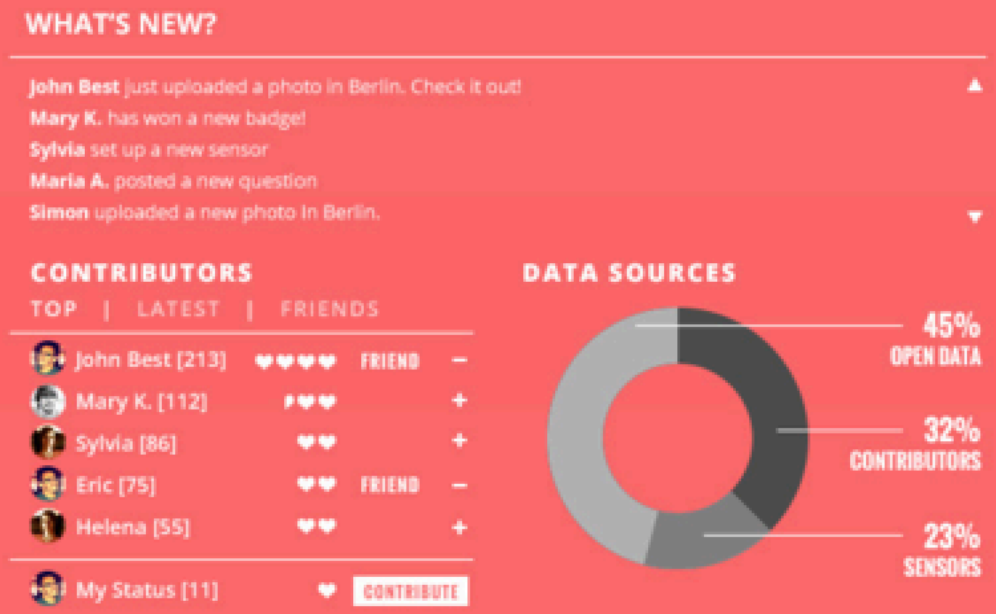
- **Community portal:** Customized web application linked to a specific organisation, or region

  ➔ **Exemplify, enlighten**

Gamification and community involvement

Community activity

Top contributors



Next steps..

- Exploring **motivations** and **barriers** for **long-term participation** in air quality monitoring (limited studies that have now full understanding)
- Defining the **roles** and **levels of user engagement** in hackAIR: starting with simple, clear tasks to more advanced data collection approaches – and processing?
  - From taking pictures of the sky, low-cost sensors and beacons
- **Empowerment**, **inclusion** and **participation**: which tools work the best for which target group?

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Thank you!

Paulien Coppens, paulien.coppens.ext@imec.be
Carina Veeckman, carina.veeckman@imec.be
Dr. Laurence Claeys, laurence.claeys@vub.ac.be

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