Sensor Discovery in Virtual Globes for Citizen Scientists

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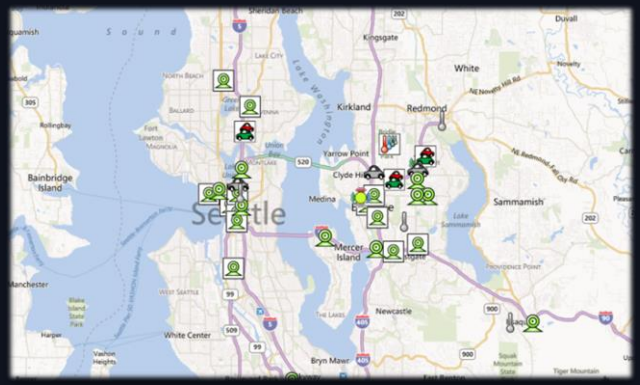
About me

- 2007 –2012: B.Sc. & M.Sc. Geoinformatics student, University of Münster
- Since 10/2012: Scientific assistant, Institute of Cartography and Geoinformation, ETH Zurich
  - Project “Atlas of Switzerland“

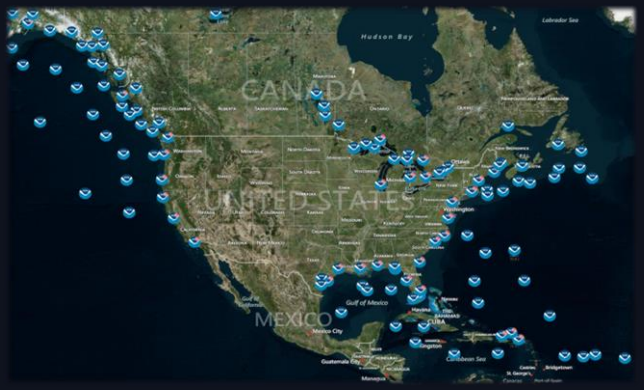
Sensor Discovery in Virtual Globes for Citizen Scientists

i. Motivation
ii. Methods
iii. Live Demo
iv. Implementation
v. Evaluation

Existing sensor portals



SensorMap



GeoCENS

SwissExperiment

Cosm (formaly pachube)

Mobile sensors

http://tinyurl.com/Sony-S-Photo

Smartphones

→ Ambient Temperature

→ Barometric Pressure

→ Humidity

→ Illuminance

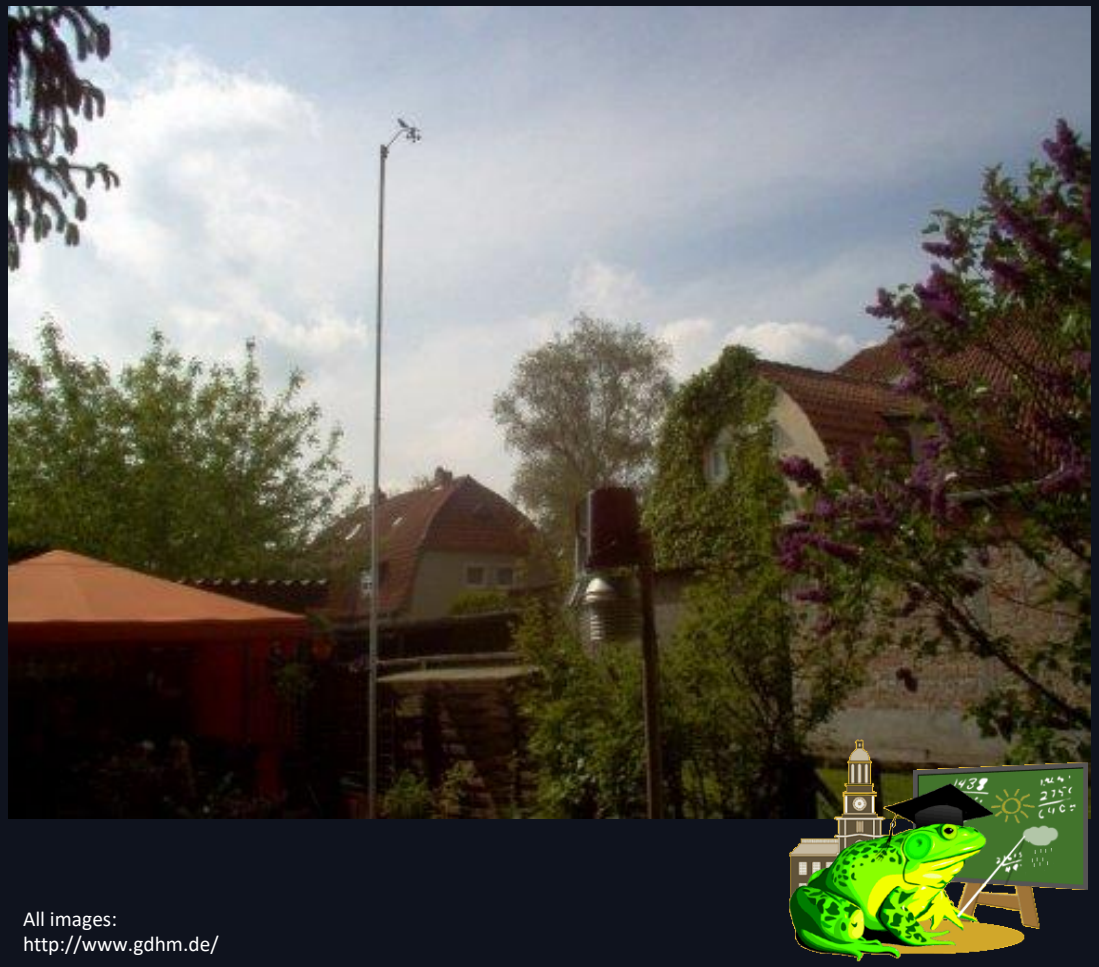
(Elen et al., 2012)

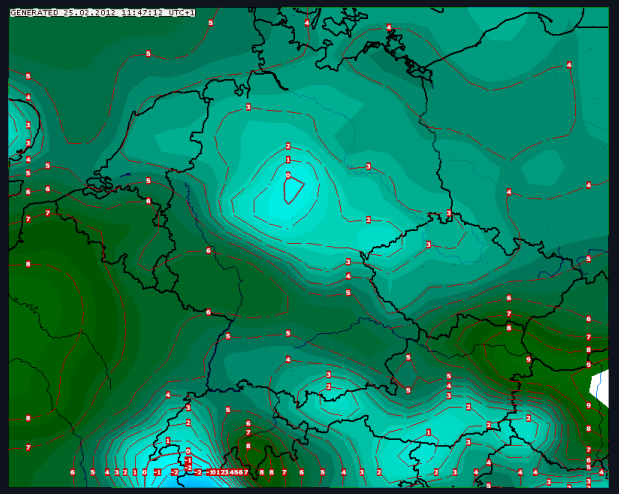
AeroFlex bike

http://www.tundria.com/trams/CHE/Photos/Zurich-Tram2000.jpg

OpenSense project

Citizen scientists





All images:
http://www.gdhm.de/

Overall aim

Build a sensor portal for citizen scientists supporting them in finding sensors of other providers to validate and eventually calibrate their own sensors

stationary
+ mobile

Virtual Globe

"A multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data."

(Al Gore, 1998)

http://worldwind.arc.nasa.gov/graphics/screenshots/00.jpg

Sensor representations

Eye altitude ~ Level of abstraction

Symbolic representation

Iconic representation

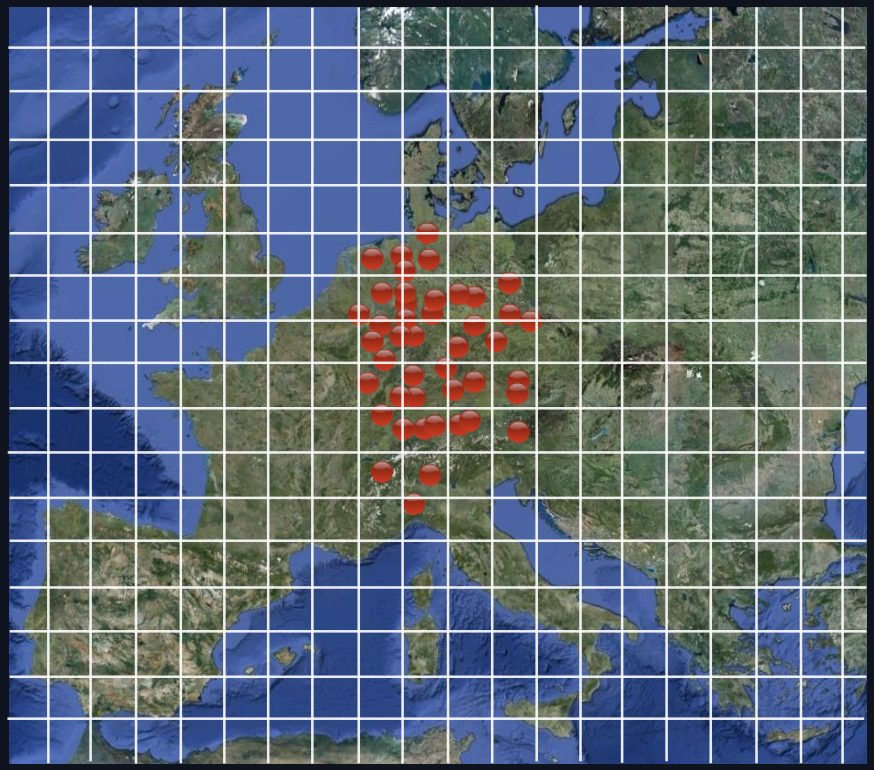
Indexed representation

Generalization

Eye altitude: 7250km

Eye altitude: 250km

Generalization



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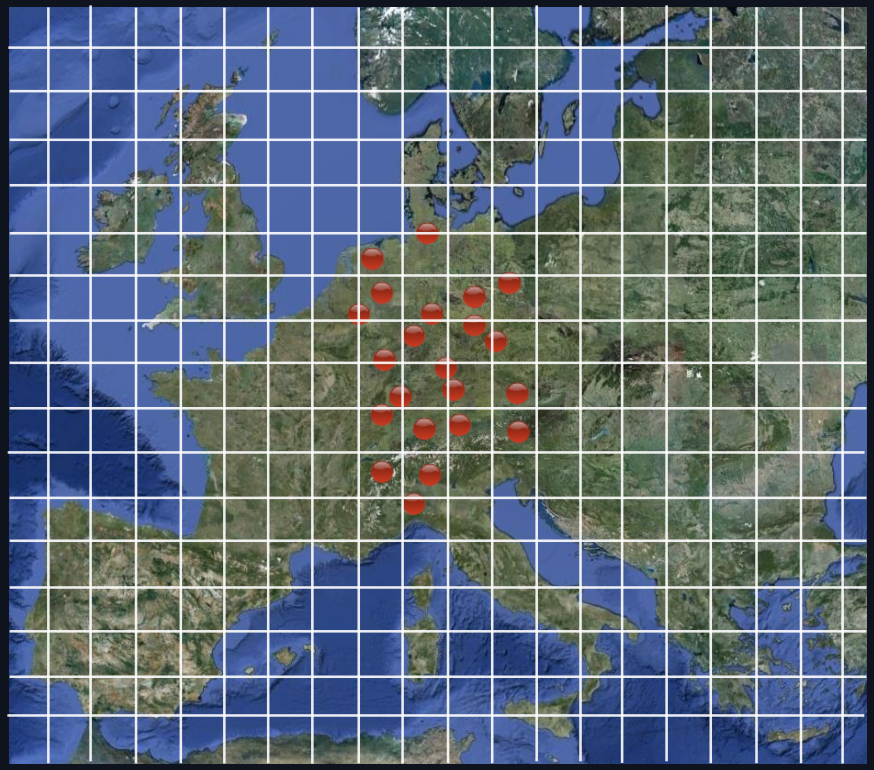
Generalization



Eye altitude: 7250km

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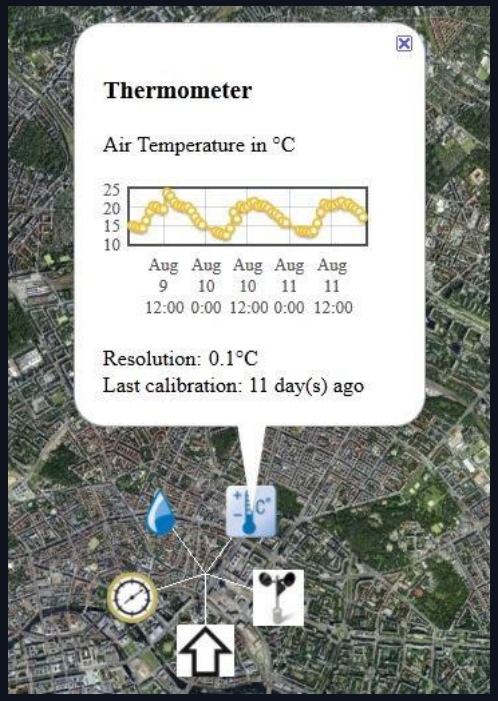
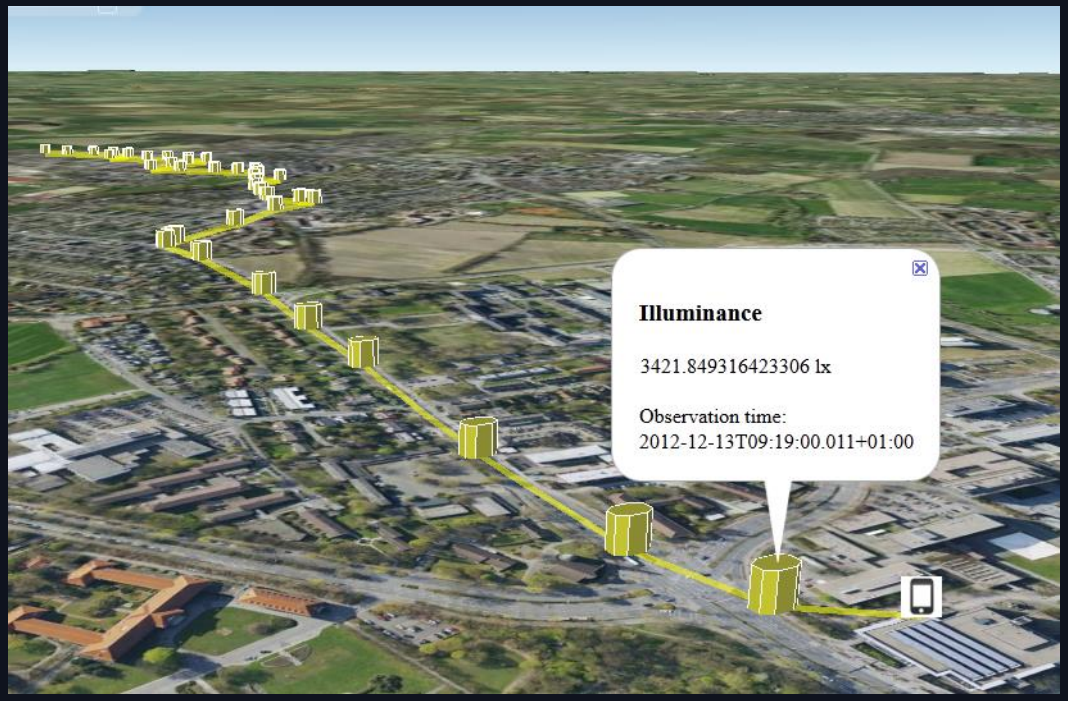
Generalization

Simplification

Preview of sensor data



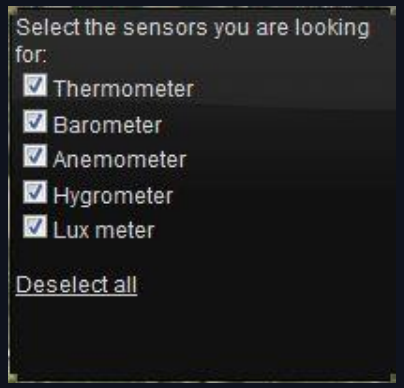
Stationary sensor platform



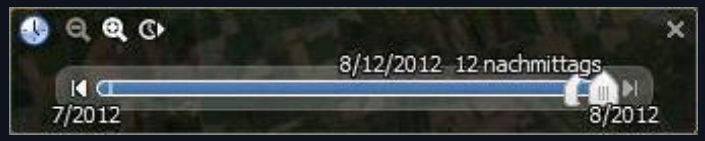
Mobile sensor platform

Search controls

Spatial search



Thematic filter

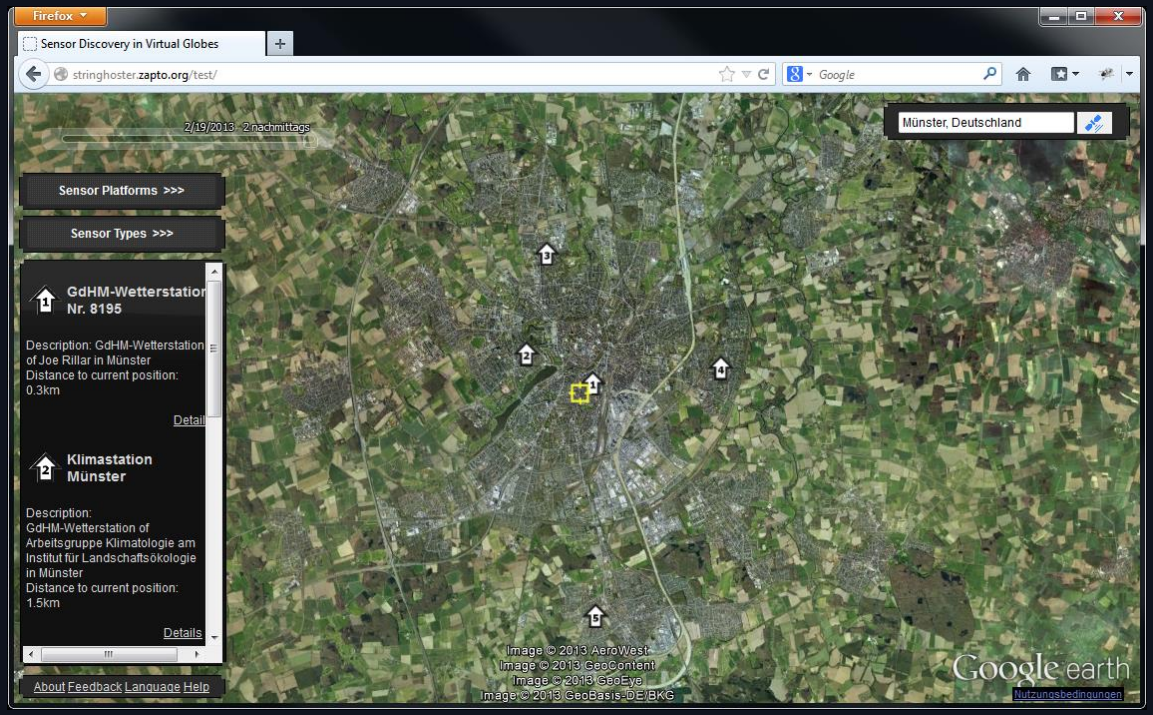


Temporal filter

Live Demo

http://stringhoster.zapto.org/test/

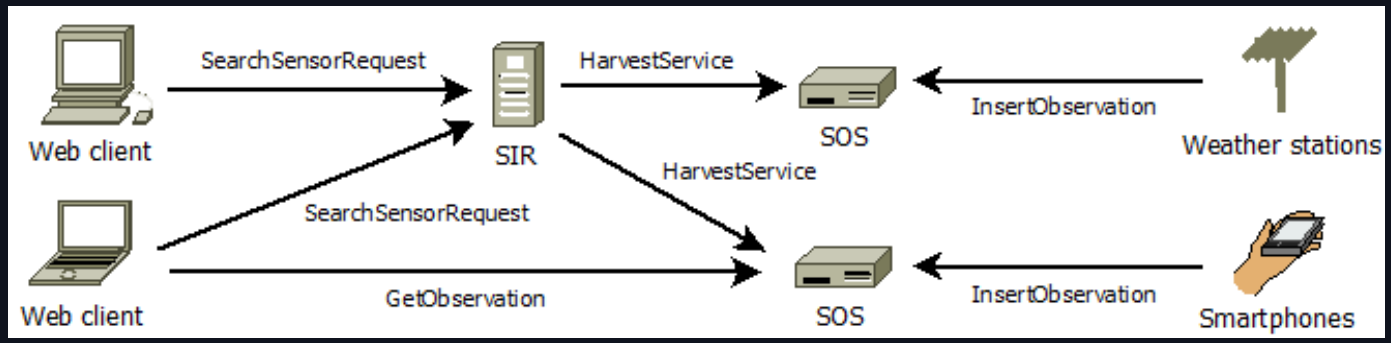
Web client



Software:

- Google Earth API
- jQuery (UI)

Architecture



Software:

- 52°North Sensor Instance Registry (SIR)
- 52°North Sensor Observation Service (SOS)
- metaf2xml
- Android SDK

Usability study

- 33 participants
- Task: “Find a suitable sensor platform in or near the city of Münster, Germany, where you can validate whether the thermometer in your smartphone measures the right temperature.”
- Online questionnaire:
  - 19 semantic differential scale & 2 Likert scale questions
  - 2 free-text questions

Usability study

- Test data:
  - 70 real weather stations of citizen scientists across Germany
  - 5 fake weather stations and 3 fake smartphones in Münster
  - my smartphone
- Different characteristics of sensor platforms:
  - Sensor configuration
  - Accessibility
  - Date of last calibration
  - Date of deployment
  - Comments/rating
  - Smartphone trajectories

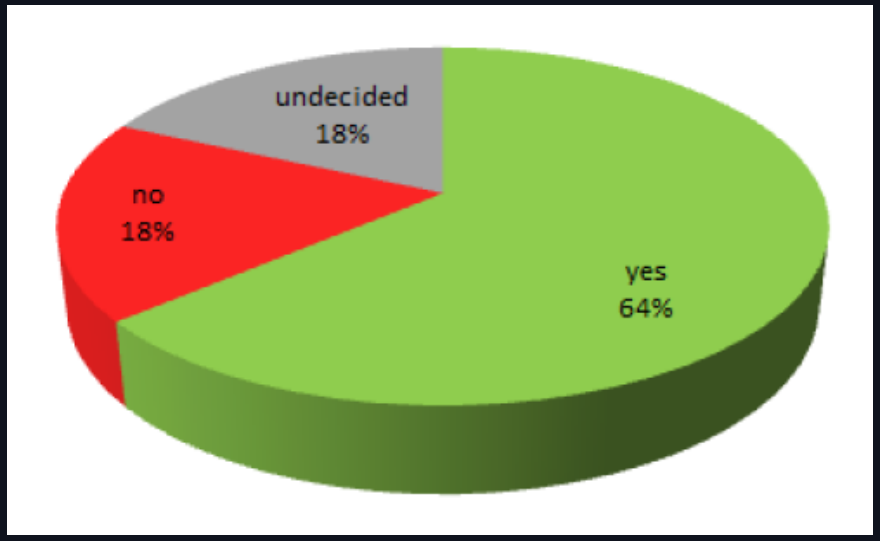
Results

Worked out
Generalization
Visualization of sensors and sensor data
Search controls
Interaction with the virtual globe

Needs improvement
Performance
Compatibility
Comparison of metadata
Graphical design

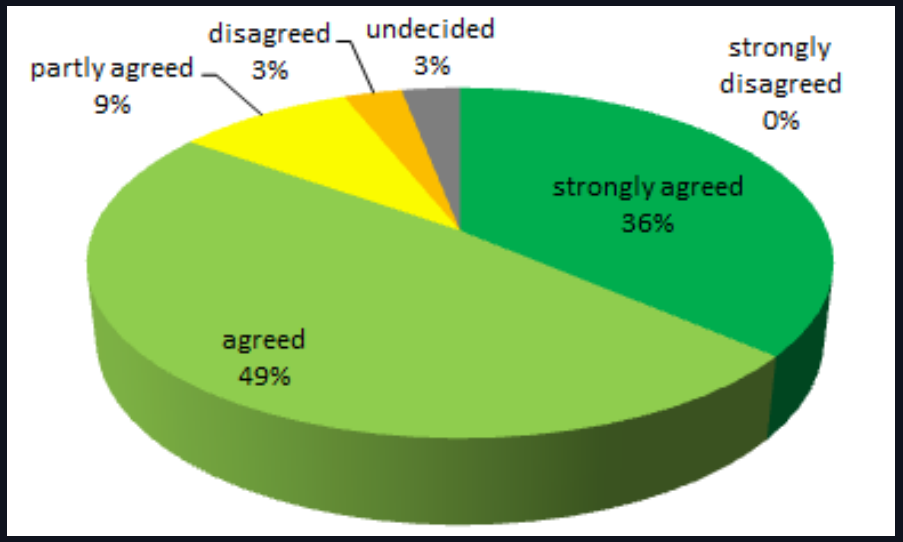
Results

“A virtual globe is the best user interface to accomplish the given task.“



Results

“All in all, the application facilitates the discovery of sensors.“



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Thank you for your attention!