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Amsterdam

Responsible Sensing Lab

Designing city sensing systems that empower people

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PROGRAM TONIGHT

- Overview of the Responsible Sensing Lab
- Project 1: Privacy preserving crowdedness sensor
- Project 2: ShutterUp!

THE CHALLENGE

Can we have a responsible digital city as balance between the two?

SMART SYSTEMS THAT BRING THE CITY

MORE SAFETY
MORE EFFICIENCY

TENSION

SMART SYSTEMS THAT RESPECT CITY VALUES

AUTONOMY
TRANSPARENCY
HUMAN CONTROL
PRIVACY

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THE SCOPE

How do we make the digital city responsible?

Legal & Regulatory

Formulating new laws to prevent undesired outcomes

Auditing systems

Methodically checking whether systems do what we expect them to do

Procurement

Specifying desired outcomes in buying digital solutions

Insourcing

Enhancing public control over digital systems by doing it oneself

Design

Redesigning sensing systems to prevent value conflicts

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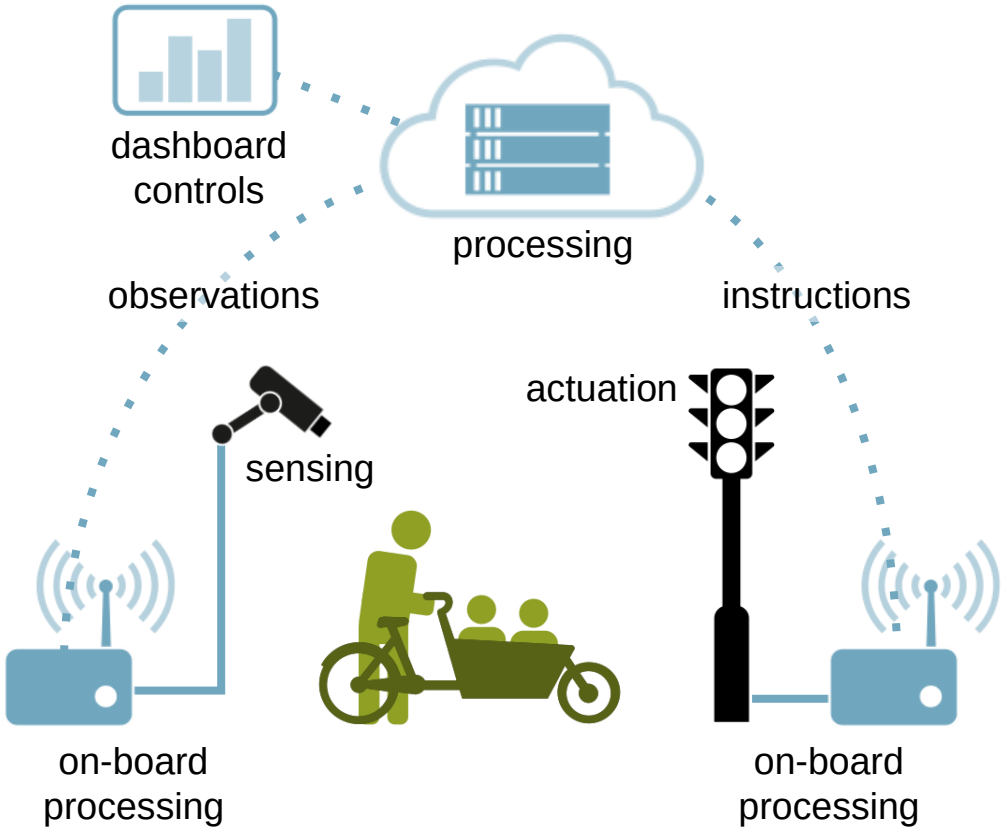
HOW CAN WE DESIGN RESPONSIBLE SENSING SYSTEMS



- Which type of sensor technology?
- Which local and cloud intelligence?

- What does it look like?
- Where is it placed?
- What does it explain about itself?

- How can you interact with it?
- How can you know you can trust it?
- How can you contest it?

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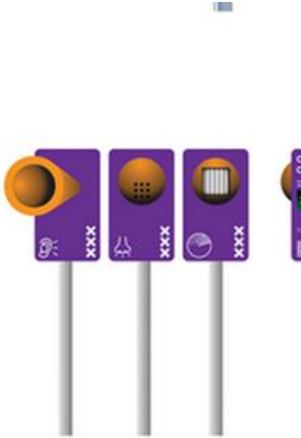
SOME PROJECTS

Transparent Charging Station

Human scan car

ShutterUp

Millimeter wave



User experience of being sensed

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mmWave Sensor for crowd sensing

5 November 2020

INITIAL USE CASES

AMSTERDAM PLAN

Corona Crowd Sensing by means of CCTV

ROTTERDAM PLAN

Playground Occupancy Sensing

PROJECT GOALS

Millimeter Wave Sensor Device

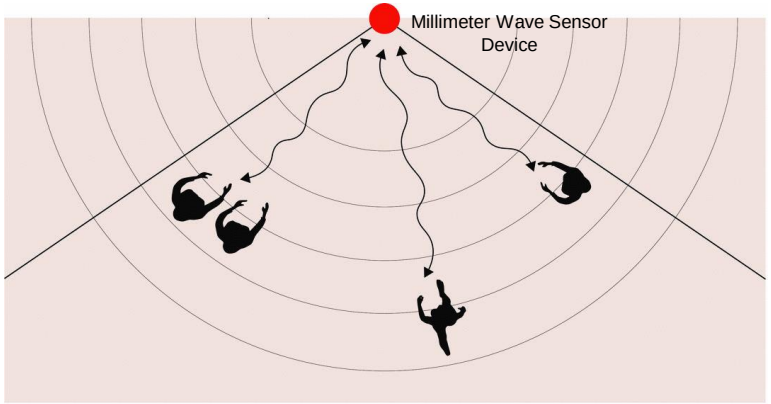
- Develop a sensor that does collect crowdedness info, but does not practically and legally collect personal information

- Develop a ‘user interaction’ for citizens being sensed

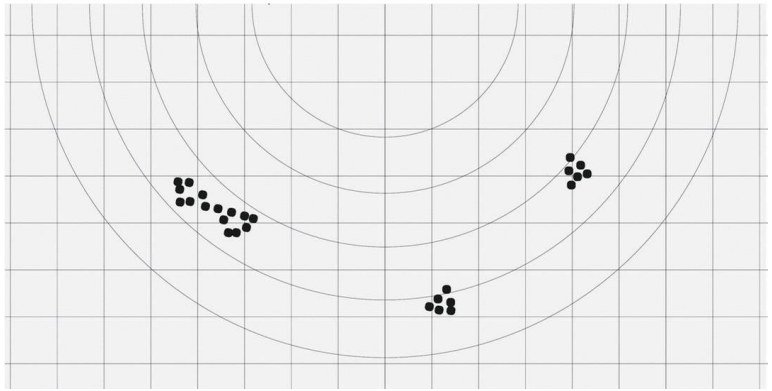
Involved parties: Amsterdam, AMS Institute, Marine Terrain, TU Delft, Rotterdam

CONCEPTUAL EXPLANATION

- The sensor works like a radar
- Low- resolution
- We are using hardware that can not be repurposed to collect personal data.



People Moving in Public Space



Dot based mapping by sensor

TECH STACK CHOSEN FOR PRIVACY

Stack level	Choice	Privacy protection effect
Algorithm	long_range_people_det_68xx_demo.bin	Set low sampling rate Only uploading ‘number of people’ to server
Hardware	Texas Instruments IWR6846ISK	Fixed ‘step size’ Fixed number of antennas
Sensing technology	Millimeter wave frequency	Max resolution (0,5cm)

PROTOTYPE DEVELOPMENT

- A prototype of the Sensor was developed by Beep Beep based on code developed by Bernard (TUD Master Student)
- It is an off the shelf development board by Texas Instruments assembly housed in a weatherproof box with a raspberry pi computer unit.

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CURRENT RUN

Testing results:

Fairly accurate, needs work on casing and weather condition

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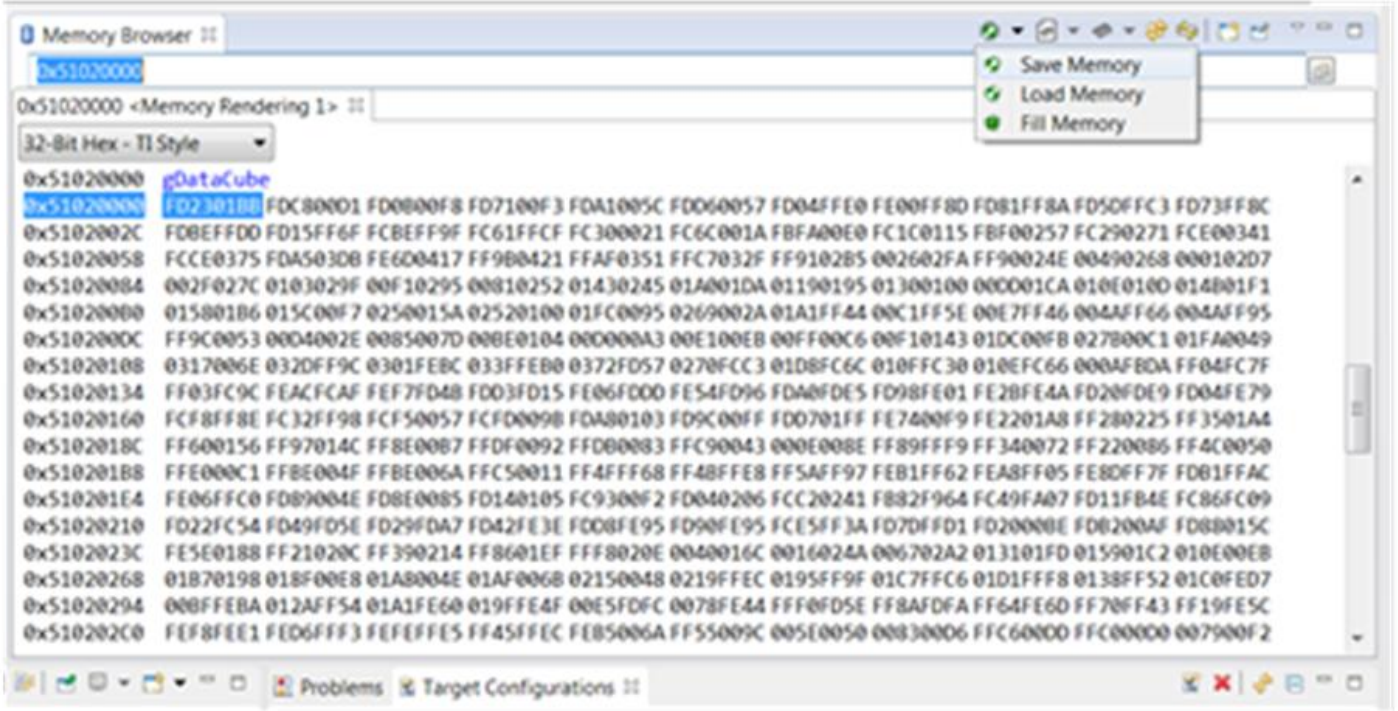
RAW DATA



Radar Cube Data Sample

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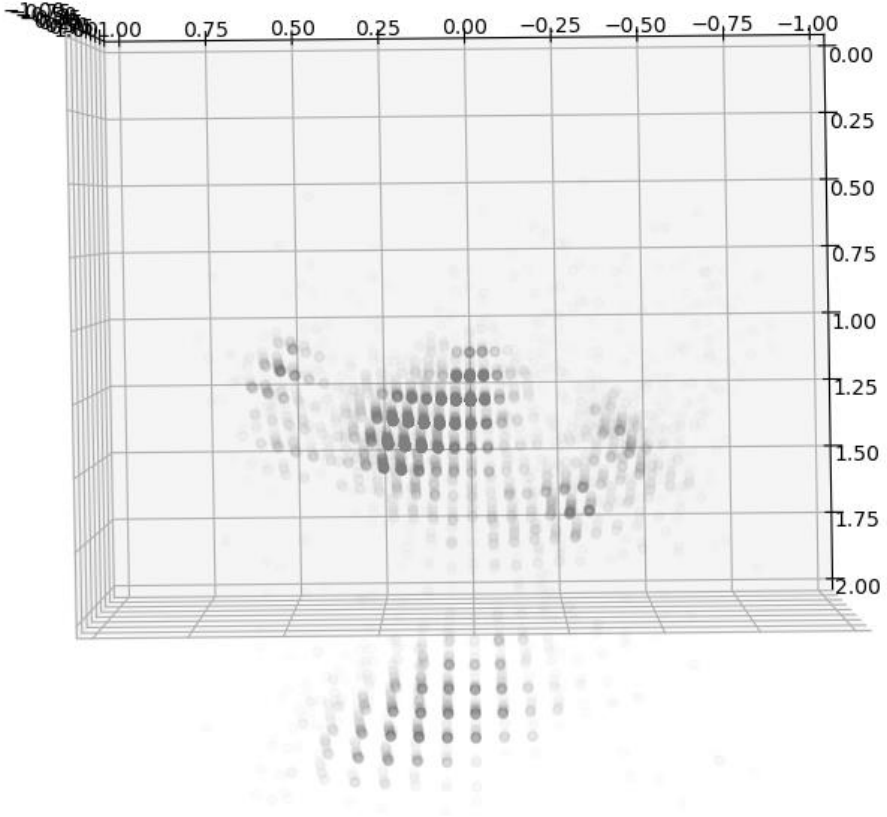
PROCESSED DATA

Point Cloud Data Sample

CURRENT PROCESS EXPLANATION

Sensor output

- Is point cloud information.
- Sampling rate can be limited, but if set too low tracking will be hard and it will be more difficult to properly count clusters/people.
- Theoretic maximum resolution is limited in practice by hardware. Range/distance accuracy is 4-8 cm (depending on configuration) and angular resolution is discreet (steps of 120°/ 64), around 2°
- Along with filtering out non moving objects, clutter is removed



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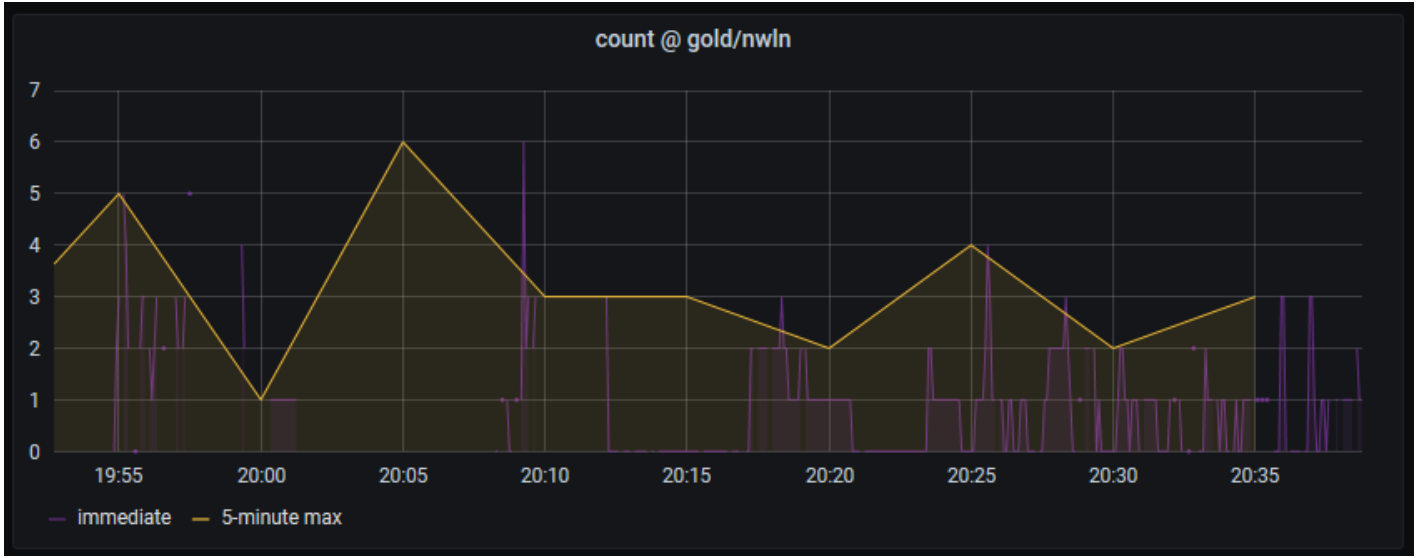
OUTPUT ON DASHBOARD

System output

In the device the active clouds (people) are converted to clusters, which are then counted and sent to the database. So **no images (point clouds) are being stored!**



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THEORETICALLY AND PRACTICALLY PRIVACY PROOF IN AN URBAN CONTEXT

Machine learning and gait analysis

With current mmWave technology it is possible to distinguish people in a **tightly controlled setting, that does not resemble reality**.

Suppose the universe only consisted of 10 people. In this case a neural network can be trained (with a human annotator) on the mmWave sensor data to distinguish these individuals. Since the radar data holds position, size and speed this effectively comes down to **distinguishing based on size (height) and movement (gait).**

But if there are one or more additional persons introduced to this universe, the **success rate will drop fast and the sensor will lose its recognition capabilities**. The amount of variation in the detected features is not big enough to distinguish between large groups of people. (there are a lot of people who are 1,8m tall)

Could you recognize me in a city of 1 million people? No. Not enough variation.

LEGALLY:
DOES IT COLLECT PERSONAL DATA?

Interpretation 1

This device is 100% privacy proof

Device does not fall under GDPR

Interpretation 2

This device it 100% proof, except for:

- Contextual factors. Other data points might be used in combination to identify a person
- Recurring patterns (Somebody waking up at six o'clock every morning)

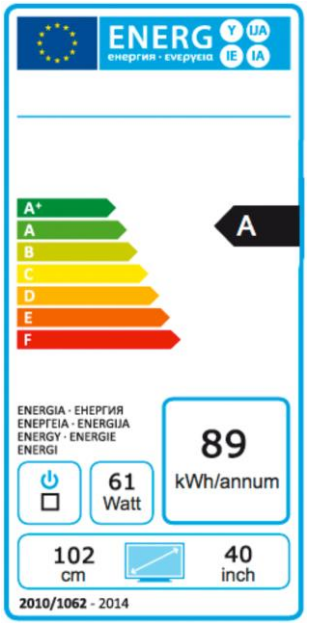
Device does fall under GDPR, but substantial merits in data-minimization and preventing function creep

Source: Meetings with Rotterdam, Amsterdam Privacy Officers / Functionaris Gegevensbescherming, Commissie Persoonsgegevens Amsterdam

NEXT STEPS

- Towards a privacy classification for crowd sensors

- Develop software and hardware into reliable open source system



SHUTTER CAMERAS

INCREASING USAGE OF CAMERAS IN THE CITY TO IMPROVE URBAN FUNCTIONS…..
GROWING THE SURVEILLENCE STATE?

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PROBLEM

Intentional or unintentional, things can go wrong with CCTV

Only a small group of experts oversees the system.

What if they miss things?

How can we involve a bigger group in oversight?

ASSESSABILITY

HYPOTHESIS :

SENSOR SYSTEMS SHOULD ALLOW YOU TO ASSESS THEIR AFFORDANCES WITHOUT HAVING TO RELY ON LABELS AND THIRD-PARTY GUARANTEES.


CCD Camera

ASSESSABILITY : SOLUTION

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TYPES OF CAMERAS IN THE CITY

Cameras that …

1)…should always be on

2)…should always appear to be on

3)…could be switched off, with some loss of relevant data

4) …could be switched off, without loss of relevant data

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EXAMPLE OF CATEGORY 4

CASE OF CAMERAS ON BRIDGES

The cameras at the bridges over the canals are installed to check if there are any people on the bridge when the bridge needs to open.

At other times, these cameras can be closed without loss of much significant data.

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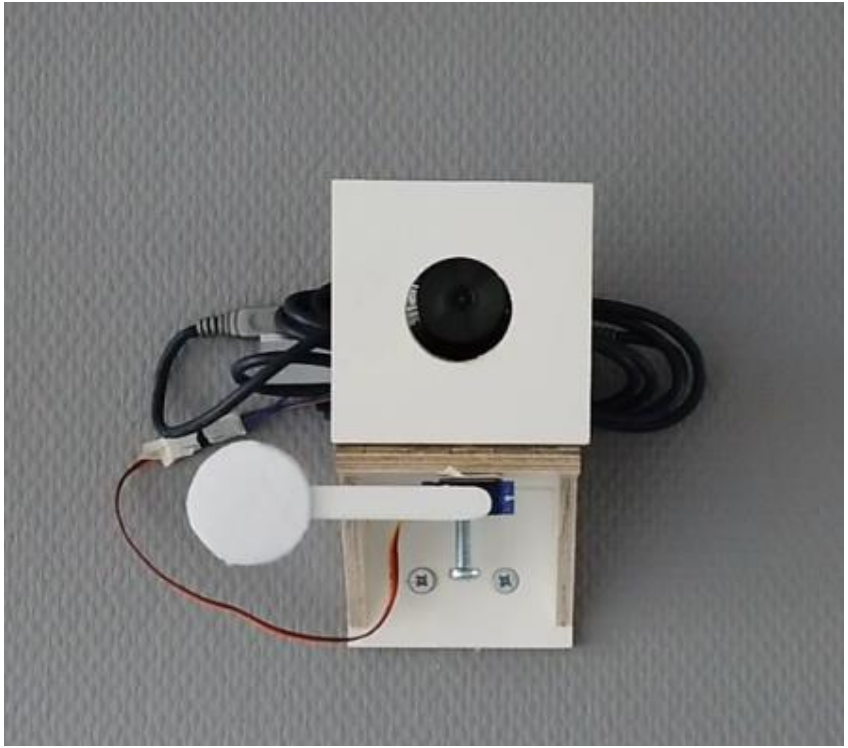
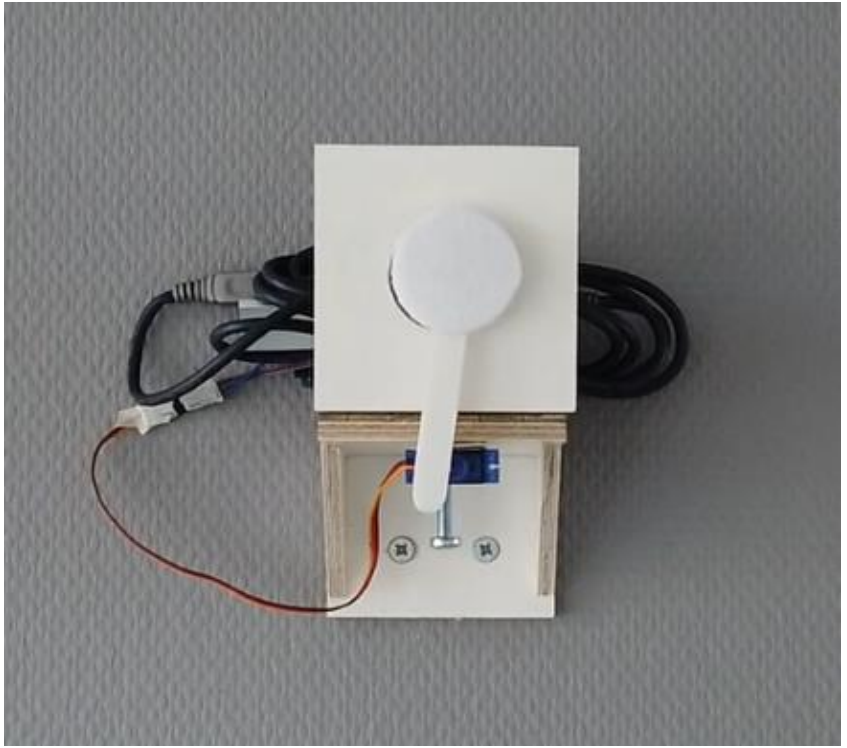
ITERATION 1





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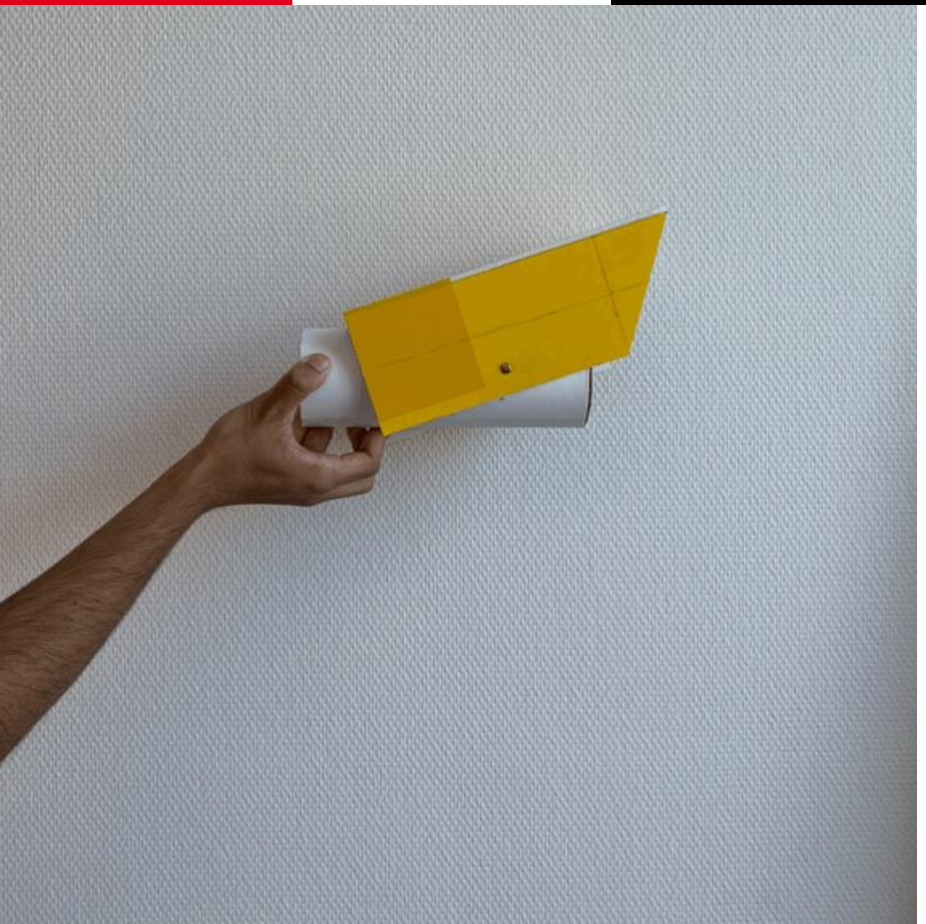
ITERATION 2



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NEXT STEPS

- Test on Marineterrain with functional prototype.
- Operator: how comfortable with loss of data
- Citizen / activist: can this be useful?

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QUESTIONS

- How can we design a sensor / camera so that we can improve oversight and trust