Data recording infrastructure of obsessive hand washing

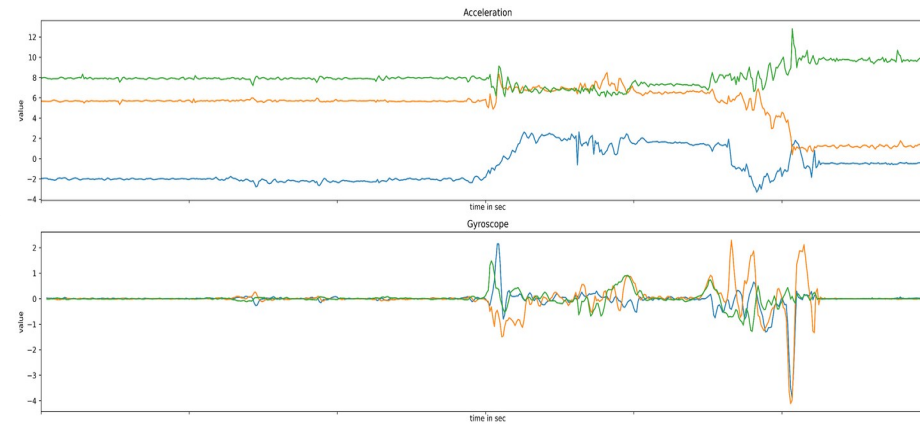Alexander Henkel

17.06.2021

Motivation

- Obsessive hand washing can be harmful to the skin

- Need a way to detect this process

- Use sensors of a smart watch

- Could use Machine Learning to determine hand washing
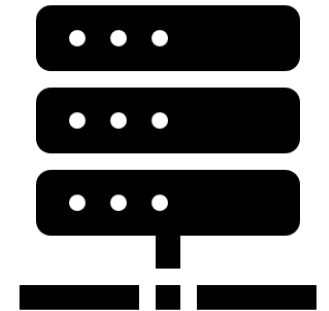
- Needs lots of data for training

Project idea

- Use a Smart watch to record and deliver data
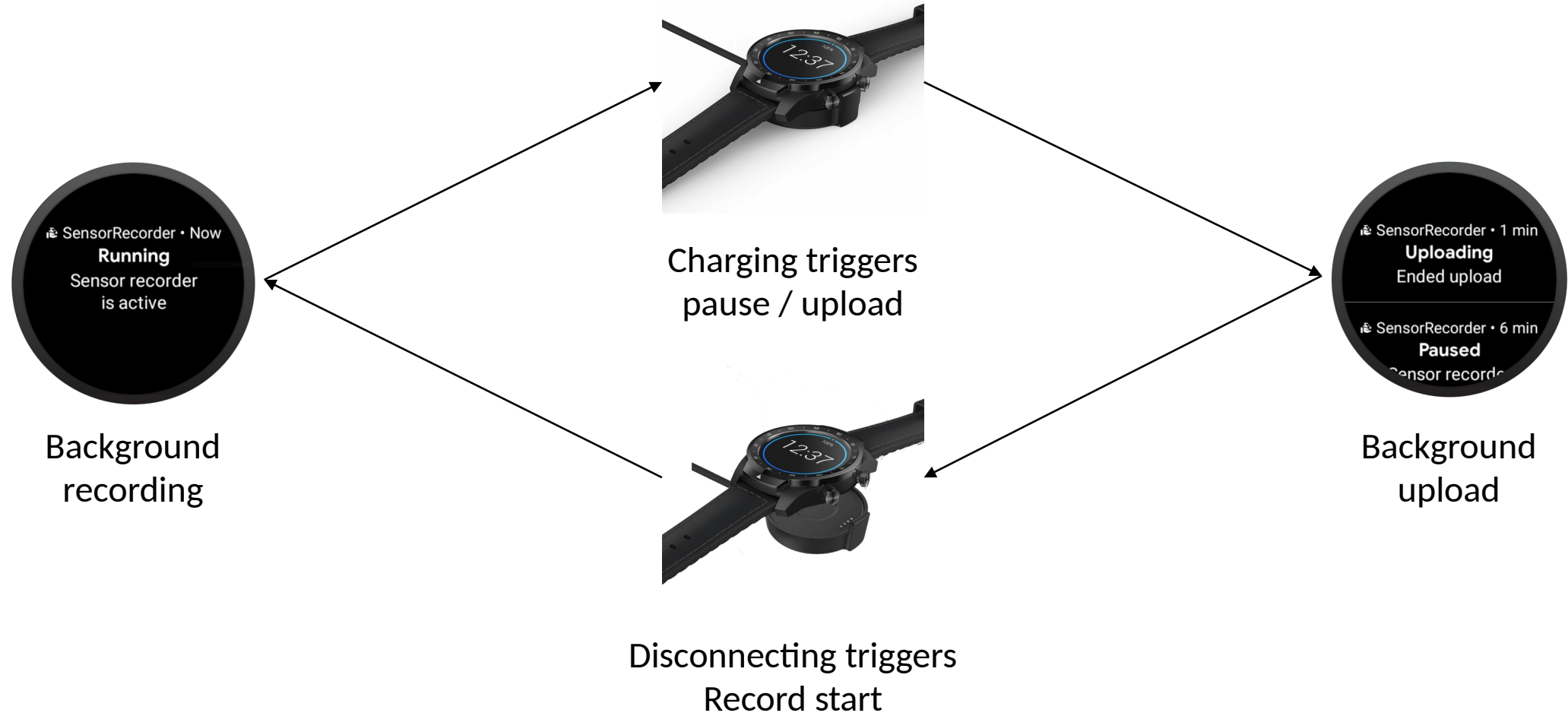- Do this on a daily base without much interaction

Project result (Watch)

Charging triggers
pause / upload

Background
recording

Disconnecting triggers
Record start

Background
upload

Project result (Server)

Project result (Server)

Recording: f77754aa-ba58-4f1c-b6be-714a546467f7

Description

Sample record 2

New description

Meta Info

tf_model:	model_27_05_21___10_59_31.tflite	Show all
app_version:	1.5	Show all
version_code:	8	Show all
build_board:	skipjack	Show all
build_device:	skipjack	Show all
build_sdk:	28	Show all
android_id:	4c0917b3b73170d6	Show all

Data

Data plot   Download data set   Clean plot data

Generate numpy data

Files 33.04 MB

battery_11_2021-06-14T22530000_4c0917b3b73170d6.csv   Delete

evaluation_11_2021-06-14T22530000_4c0917b3b73170d6.csv   Delete

README.md   Delete

android_sensor_gyroscope_11_2021-06-14T22530000_4c0917b3b73170d6.zip   Delete

metaInfo_11_2021-06-14T22530000_4c0917b3b73170d6.json   Delete

hand_wash_time_stamps_11_2021-06-14T22530000_4c0917b3b73170d6.csv   Delete

prediction_11_2021-06-14T22530000_4c0917b3b73170d6.csv   Delete

.f77754aa-ba58-4f1c-b6be-714a546467f7.zip   Delete
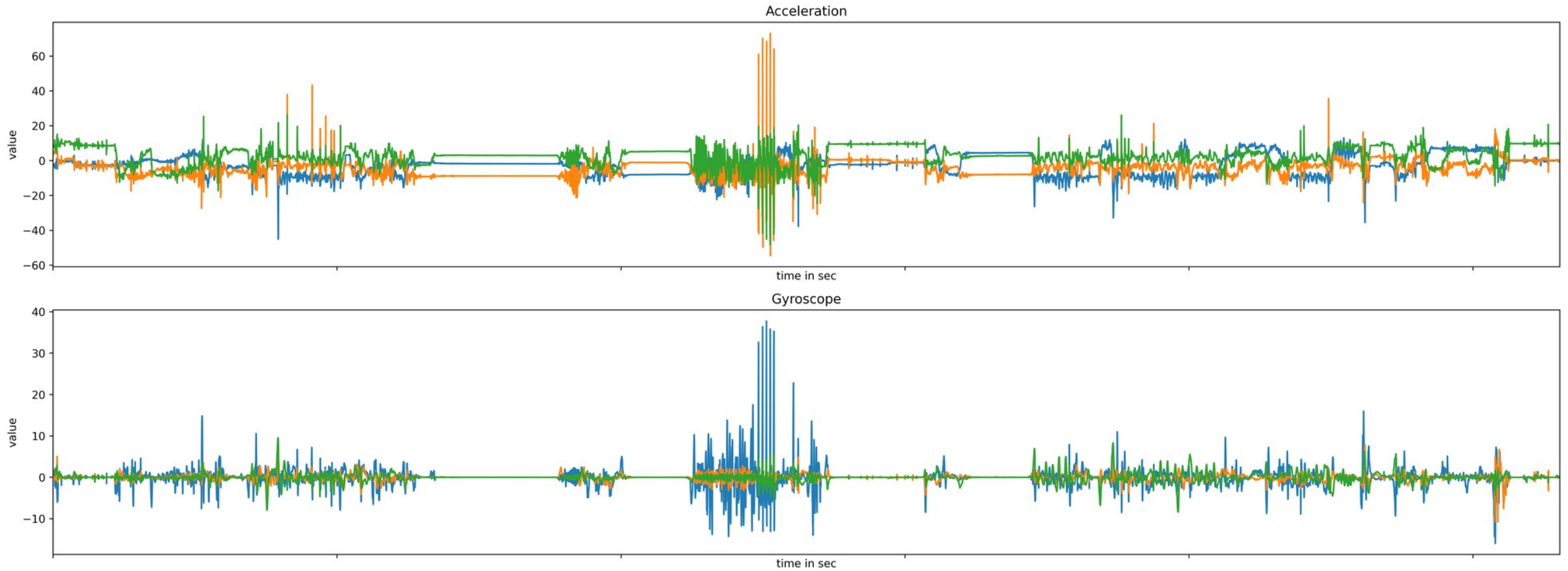
android_sensor_accelerometer_11_2021-06-14T22530000_4c0917b3b73170d6.zip   Delete

bluetoothBeacons_11_2021-06-14T22530000_4c0917b3b73170d6.csv   Delete

Project result (Server)

Project result (Server)
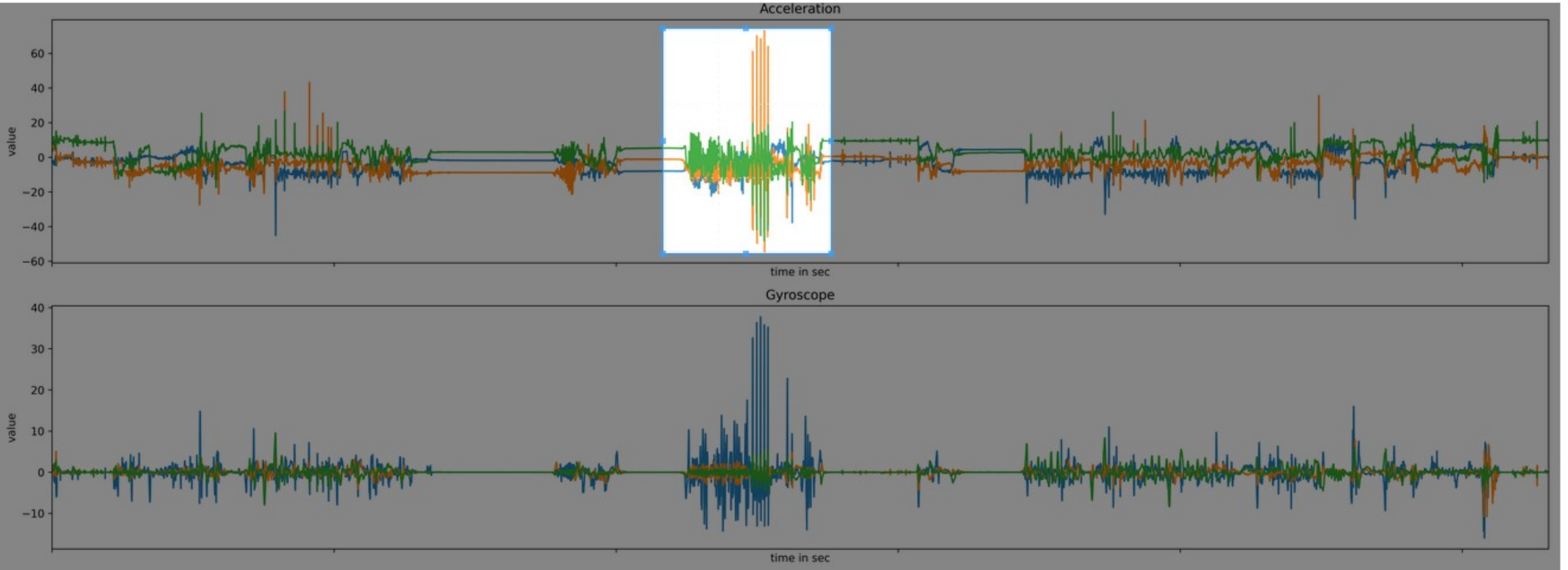
Project result (Server)
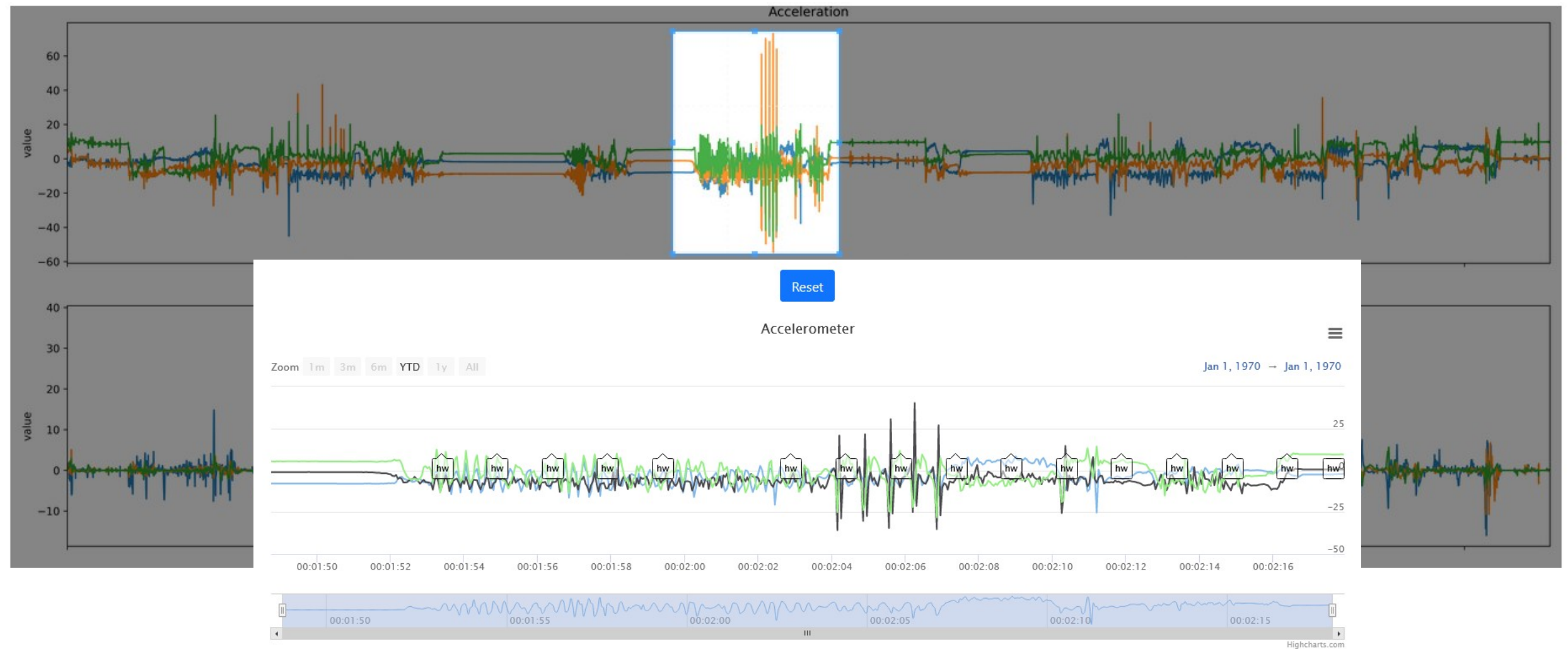
Additional Features

- Hand washing detection
- Marking of hand washing time stamps
- Evaluation
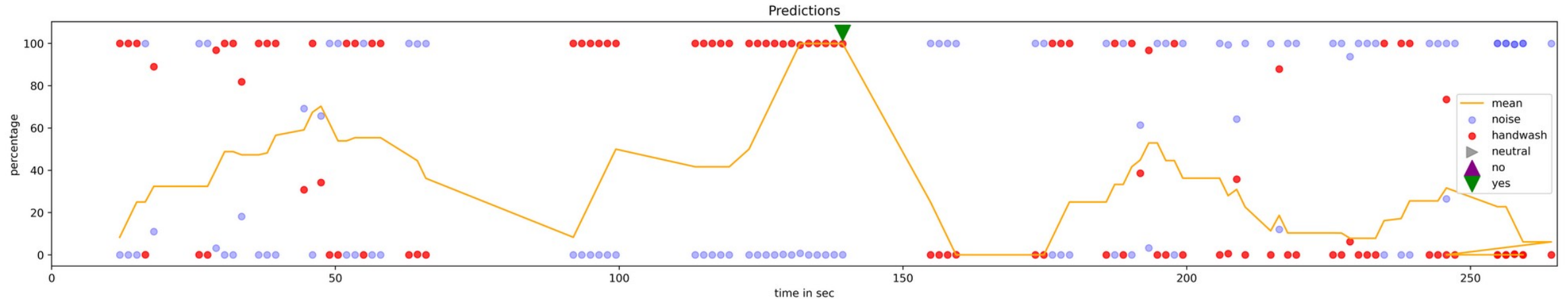
Overview
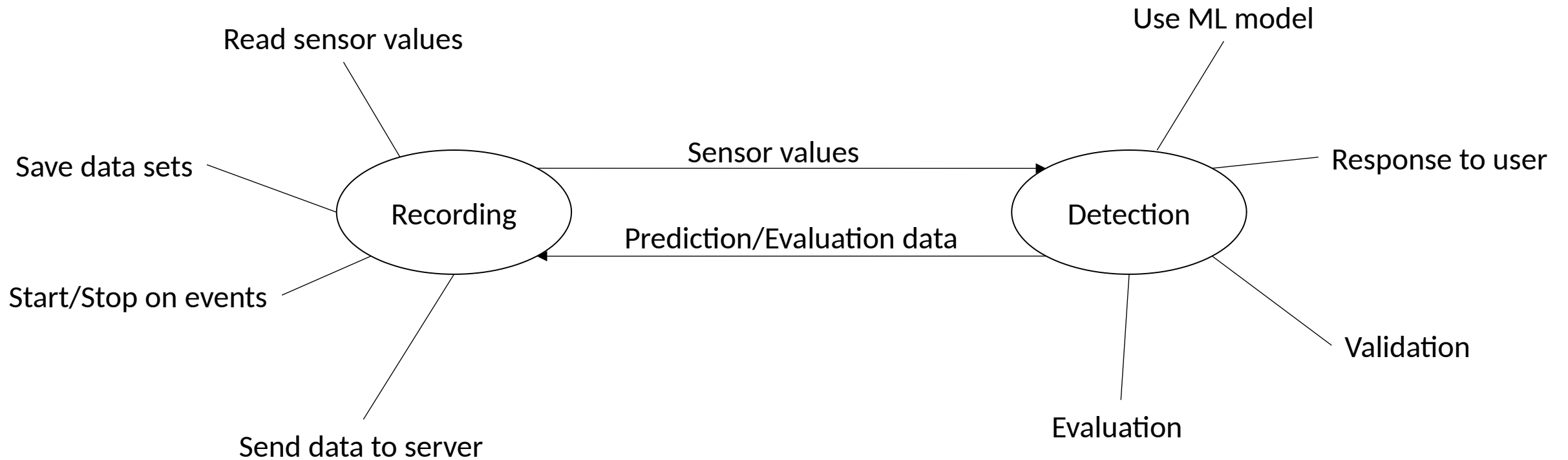
Recording

- Background process

- Continuously recording over long time period
    - Prevent Standby -> Wakelock
    - Prevent application termination by system -> Foreground service
    - Minimize Battery usage -> Sensor batching

- Store data

- Distinguish data between different sessions

Recording Lifecycle

On Boot/ App start → **Launch background service** — *Start recording* → **set wakelock & foregroud notification register listeners to sensors** ← *Start recording* — **Paused**

set wakelock & foregroud notification register listeners to sensors → **listen to sensor events**

**write values into buffer (for energy optimization)** ← *New event* — **listen to sensor events** — *Stop recording* → **update foreground notification flush and close sensor services unregister listeners from sensors close file streams save all files in new directory release wakelock**

write values into buffer (for energy optimization) → **Buffer full**

Buffer full — *No* → listen to sensor events

Buffer full — *Yes* → **write buffer to disk**

write buffer to disk → listen to sensor events

Upload data to server

- Background process

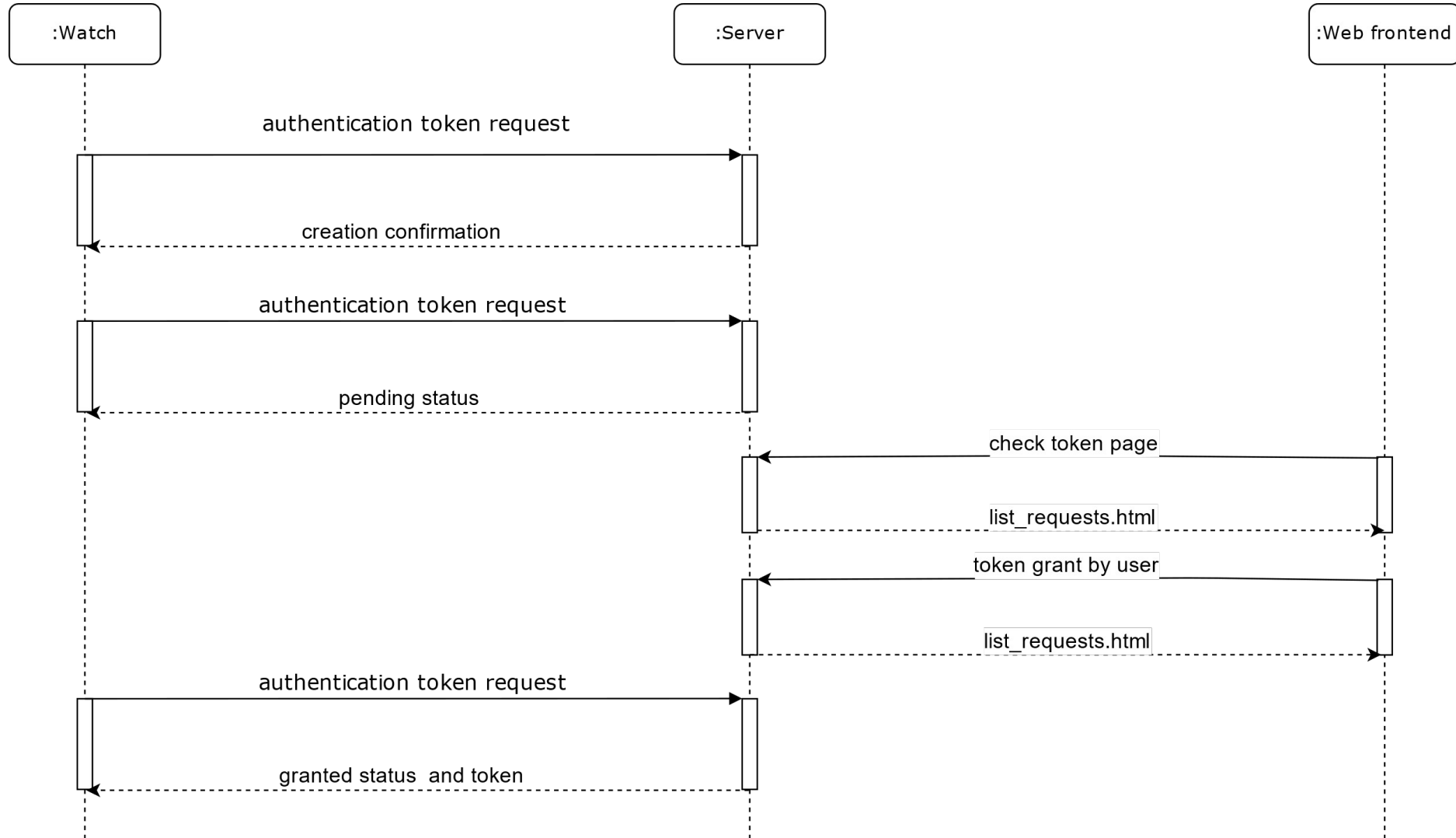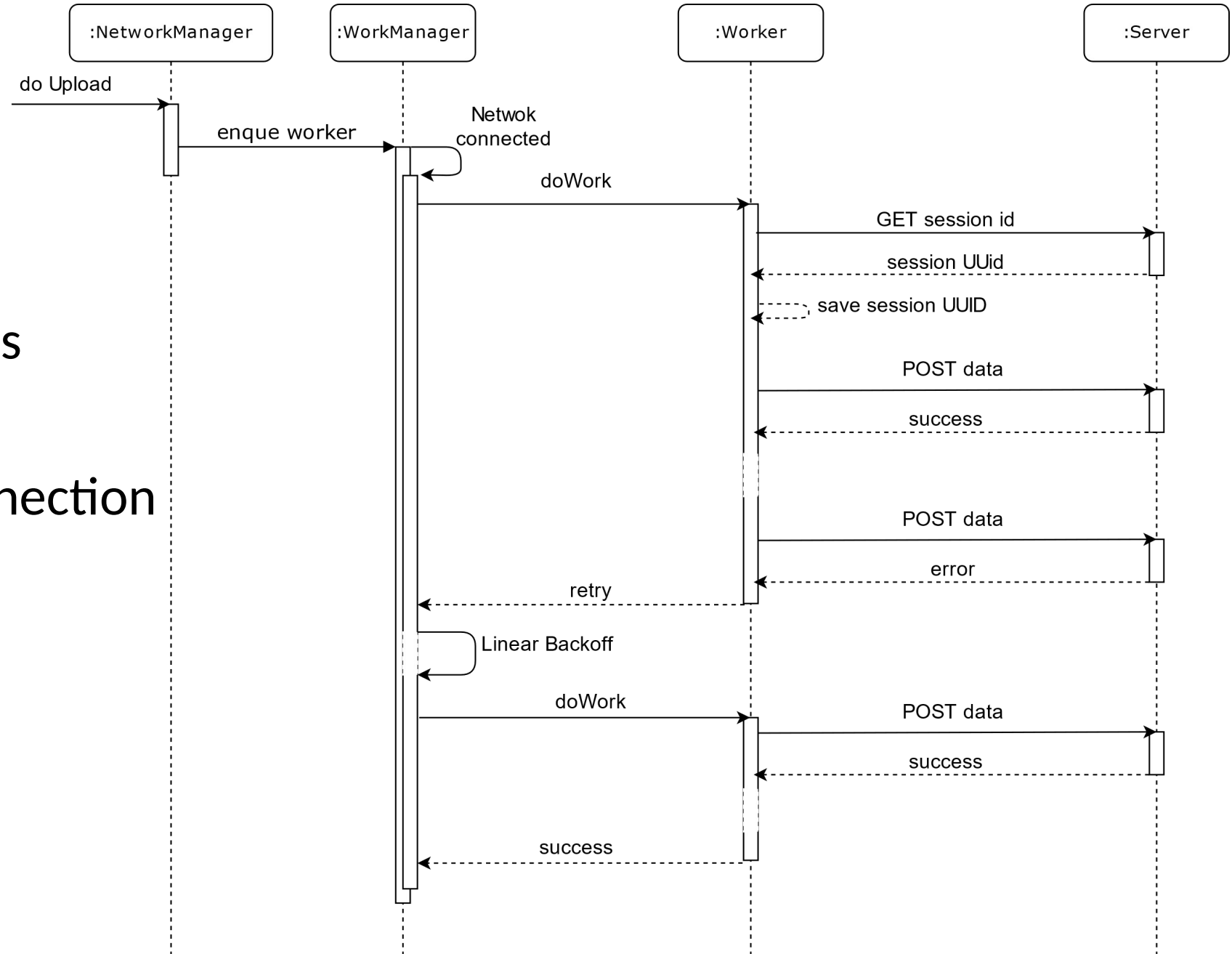- Data is anonymized

- All files are bundled in sessions

- Error handling for:
  - No network connection
  - Server not reachable
  - Error during upload

  -> Android Worker

Auth token request

Upload

- HTTP POST files
- Identify related files
- Background Task
- Needs netwok connection
- Error handling

:NetworkManager → **:WorkManager** → **:Worker** → **:Server**

do Upload

enque worker

Netwok connected

doWork

GET session id

session UUid

save session UUID

POST data

success

POST data

error

retry

Linear Backoff

doWork

POST data

success

success

Detection

- Simultaneously while recording

- Use pre learned model

- Available sensor can vary

- Reduced battery usage
    -> do not predict every window

Detection
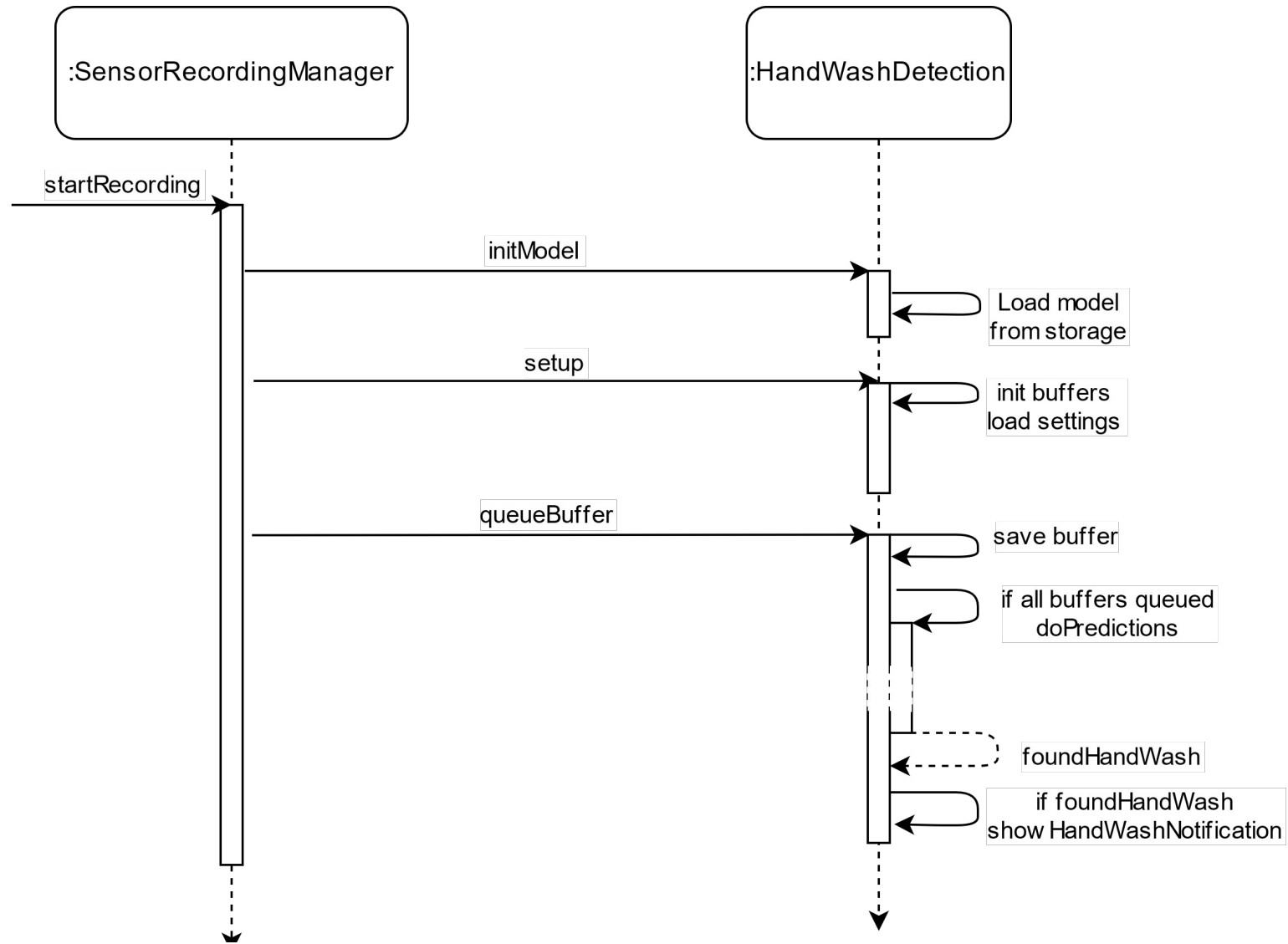
Conclusion

- User just needs a Wear OS smart watch

- Install the application and set it up in some easy steps

- Record hand washing on a daily basis without interaction

- Validate predictions by confirmation by the user

- Give evaluations for observing their condition

queueBuffer

save buffer

if all buffers queued
doPredictions

for each window

if possibleHandwash
doHandWashPrediction

build ByteBuffer

run model on Buffer

predictions

calc running mean

if running mean > meanThreshold
foundHandWash = true

foundHandWash

foundHandWash

if foundHandWash
show HandWashNotification