

Smarter Smartmirror

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Systems Engineering

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TOC

Building a smarter Smartmirror

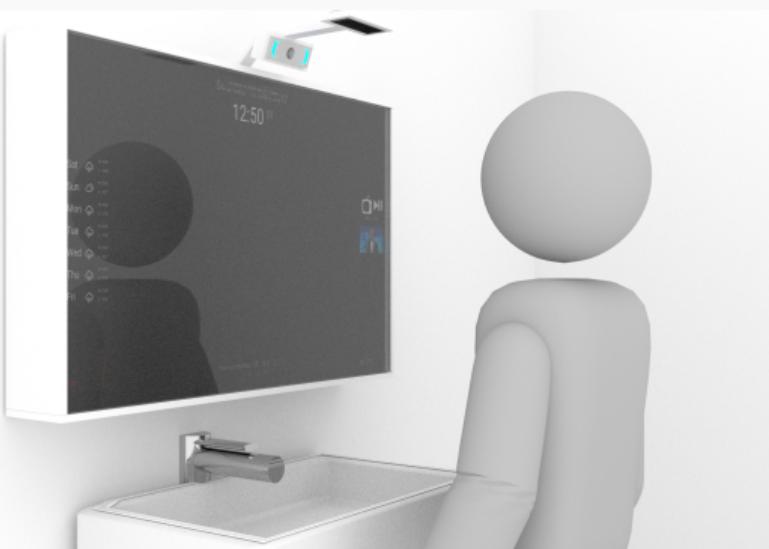
- ▶ **Smarter Smartmirror - Motivation**
- ▶ Requirements, mapping to hard- and software
- ▶ Implementation and choices
- ▶ Complete System
- ▶ Result and TODOs

Smarter Smartmirror

Motivation

Satisfy daily need of information in an unobtrusive way,
without holding a device or sacrificing time:

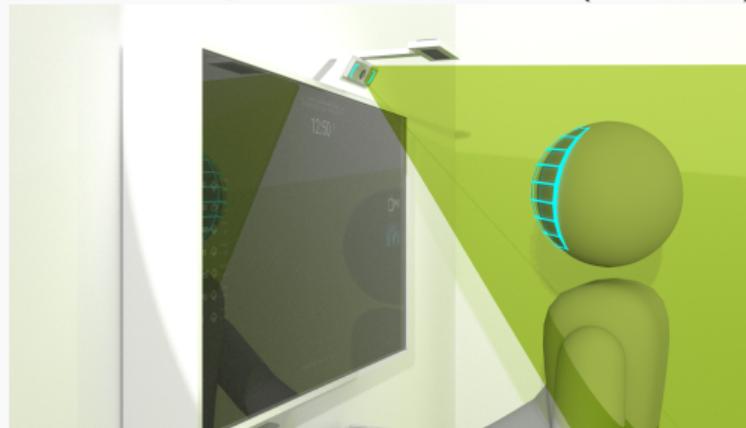
Extend the bathroom mirror to both mirror your face and display information!



While brushing teeth you
cannot do anything else
anyway..

UseCases

1. Show general information (time, weather)
2. Show user-specific information (calendar)



3. Start/stop video/music playback

TOC

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Requirements

General

- ▶ Mirror your face

Information needs

- ▶ Time
- ▶ Weather
- ▶ News
- ▶ Calendar
- ▶ Stock prices

Usability

- ▶ Easy control without touching the mirror
- ▶ Play video news (max. 5 minutes)
- ▶ Identify users to provide personalized information

Requirement mapping

Sources of required information

- ▶ Time - System time (works b/c of internet)
- ▶ Weather - Online service (JSON)
- ▶ News - Video (download using wget, script)
- ▶ Calendar - Google (JSON)
- ▶ Stock prices - Online service (JSON)

→ Display as website in a browser
in kiosk-mode

Fetching and displaying

- ▶ update each second
- ▶ simple markup to design display
- ▶ handle JSON data
- ▶ call system functions
- ▶ provide means of control

Requirement mapping

Usability

- ▶ Control without touching
- ▶ Identify users
- ▶ Play videos

- LeapMotion controller
- Speech recognition
- Facedetection → Camera
- HTML 5 (mp4-video)
- Sound output → Speakers

Consequential requirements:
LeapMotion → Powerful computer
Speech recog → Microphone

TOC

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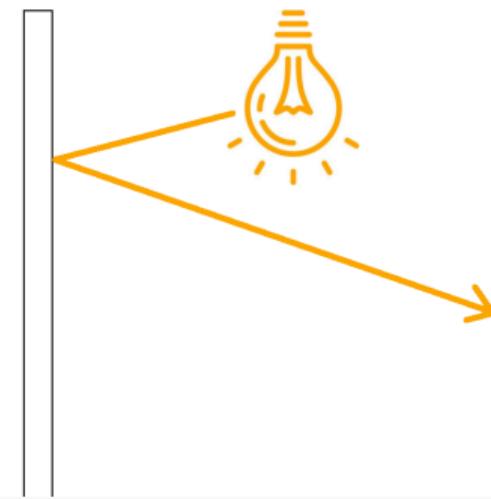
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Mirror

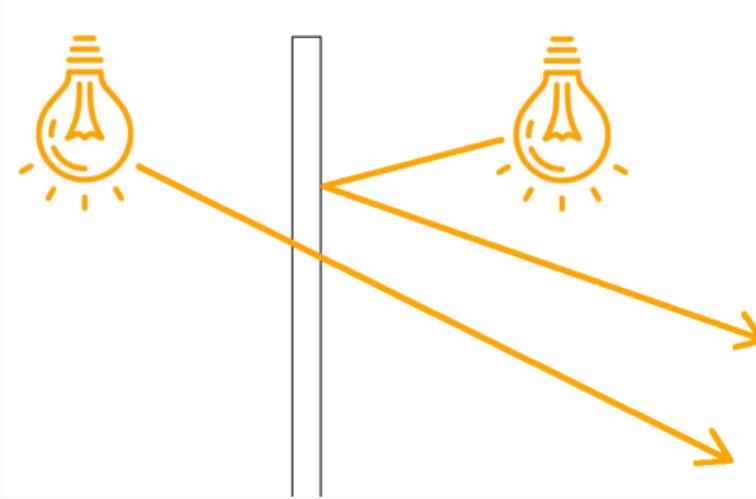
How to display information and still be a mirror?

Two-way mirrors allow light from the backside to pass through:

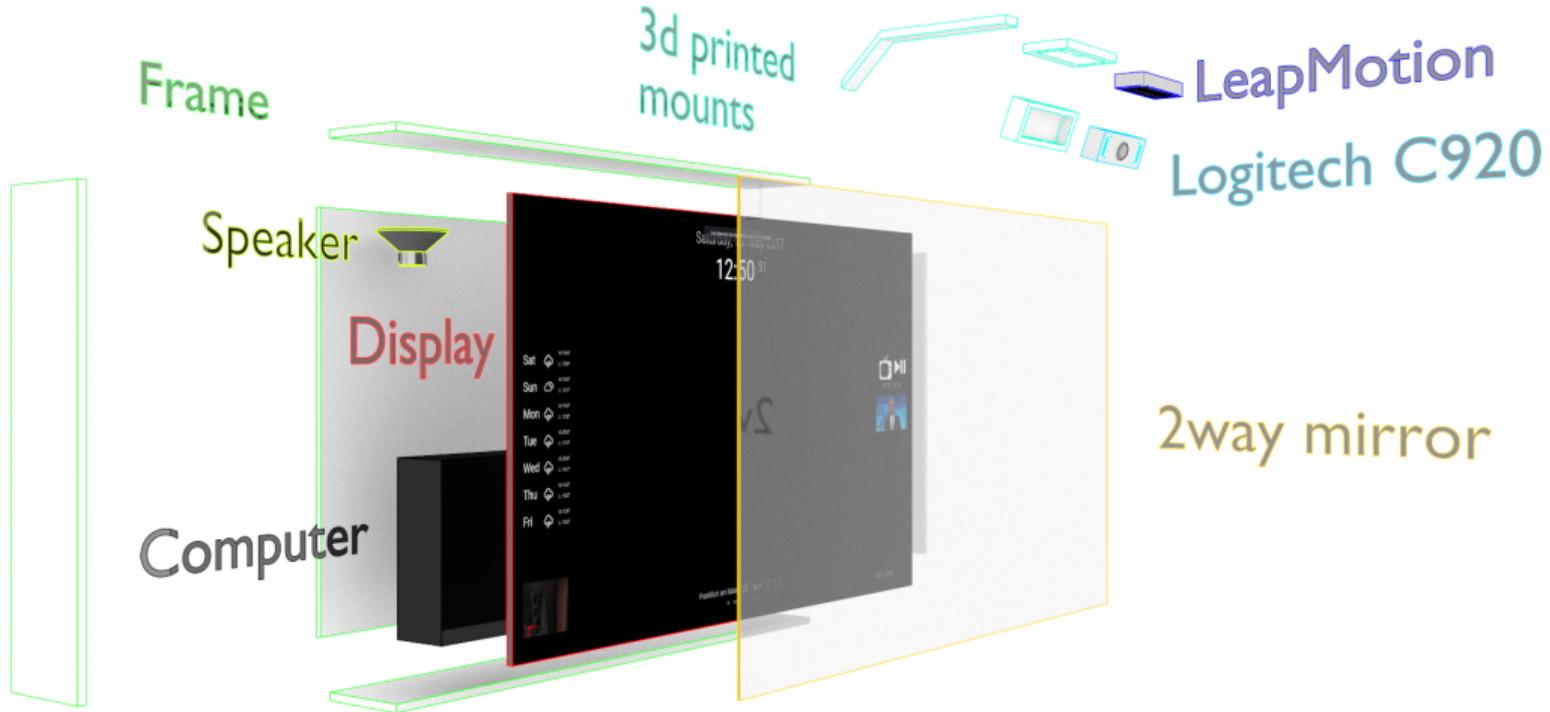
Regular mirror



Two-way mirror

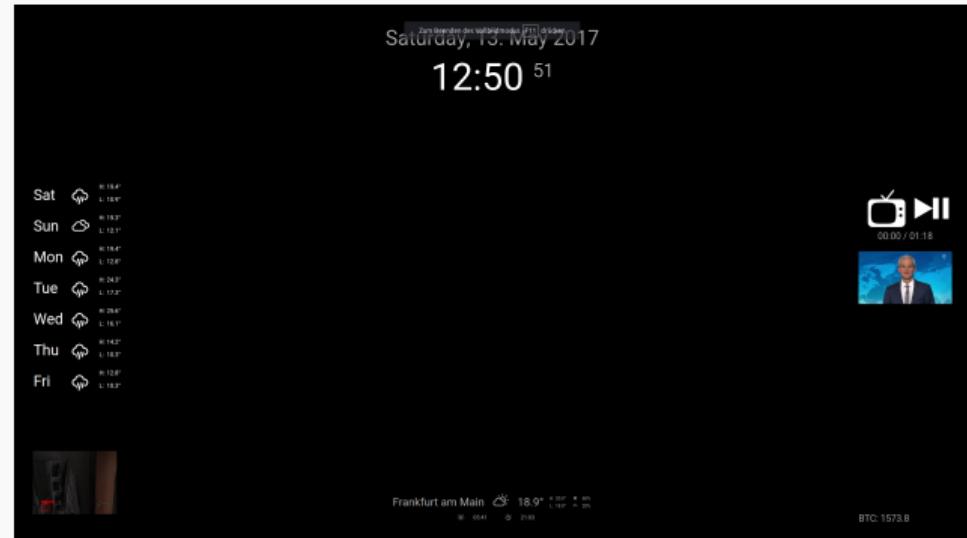


Requirement-mapping: Hardware



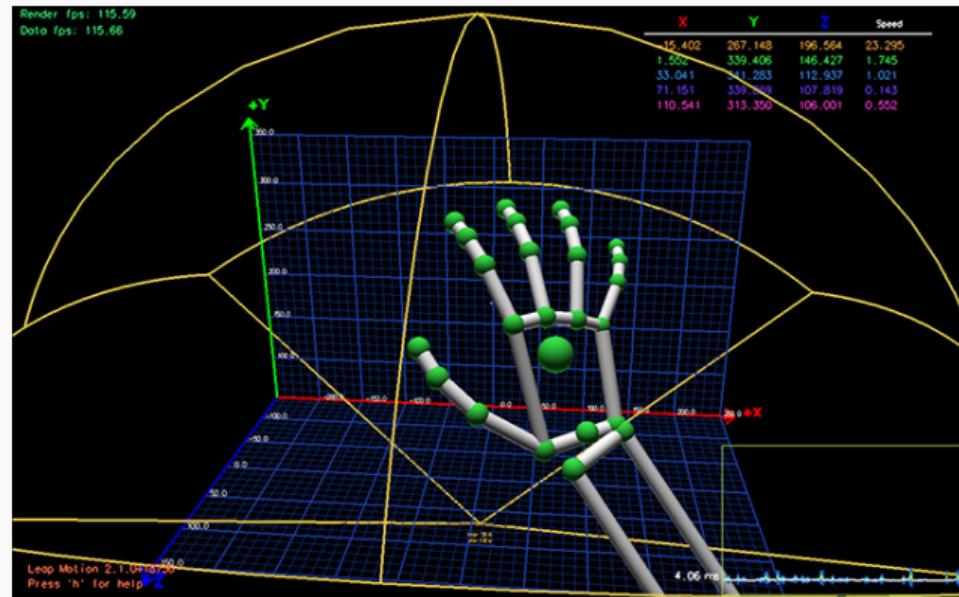
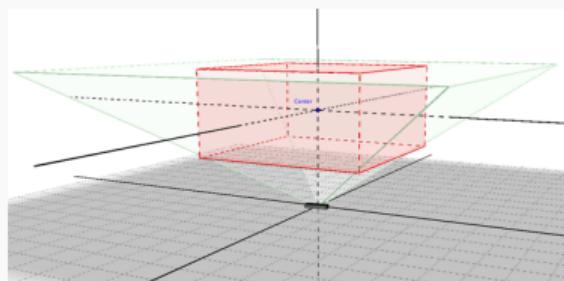
Software - GUI

- ▶ HTML 5 website
- ▶ Browser in kiosk mode
- ▶ javascript modules
- ▶ control: keypresses



Software - Control

- ▶ Leap motion SDK ¹
(python)
- ▶ detect gestures
- ▶ map to keypresses
(xdotool)

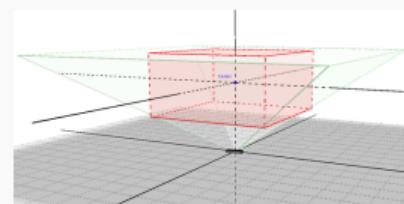


¹<https://developer.leapmotion.com/>

Software - Control

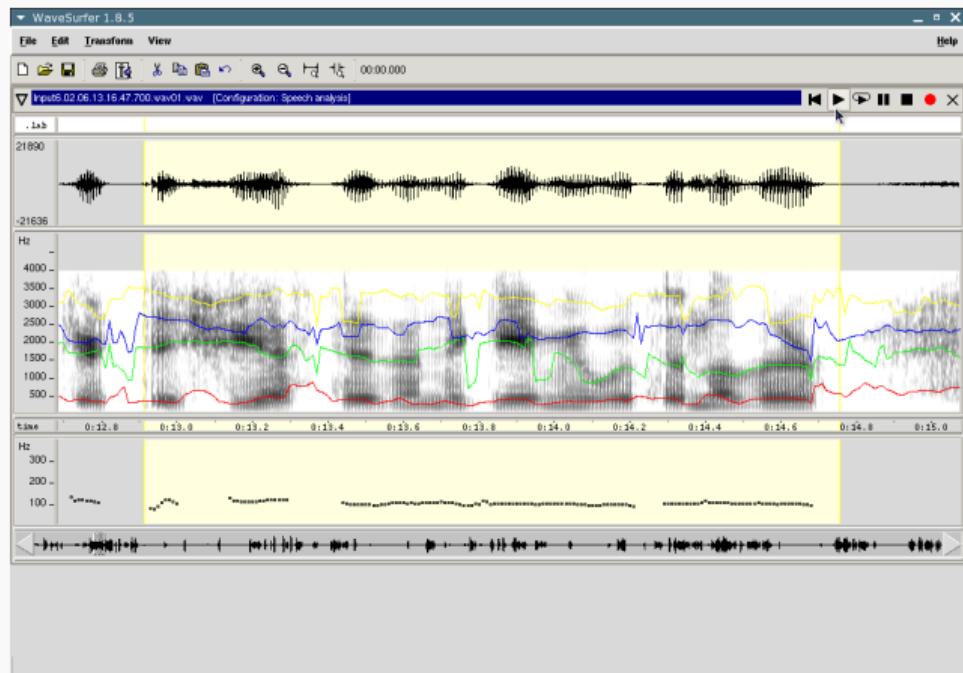
Leap motion - specifics

- ▶ Gesture recognition not reliable:
Resort to *coarse* gestures - whole hand movement,
This results in a limited set of possible commands



Software - Control

- ▶ Voice recognition
- ▶ CMU pocketsphinx²
(python)
- ▶ map to keypresses
(xdotool)

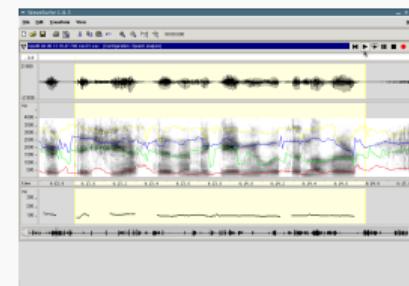


²<https://github.com/cmusphinx/pocketsphinx-python>

Software - Control

Voice recognition specifics

- ▶ Voice recognition has a lot of false detections out of the box:
Build a knowledgebase from a custom phrase-dictionary,
this improves accuracy a lot!
- ▶ Fails if video or music play
- ▶ Addition of new commands requires recompilation of
knowledgebase



Software - Identify users

Extrinsic and intrinsic parameters of camera, as well as the layout of the room dictate the possible distance of the user to the sensor, and therefore the possible scalings.



Software - Identify users - Flowgraph

Constrained scaling: Pre-trained Haar-Cascade face-detector

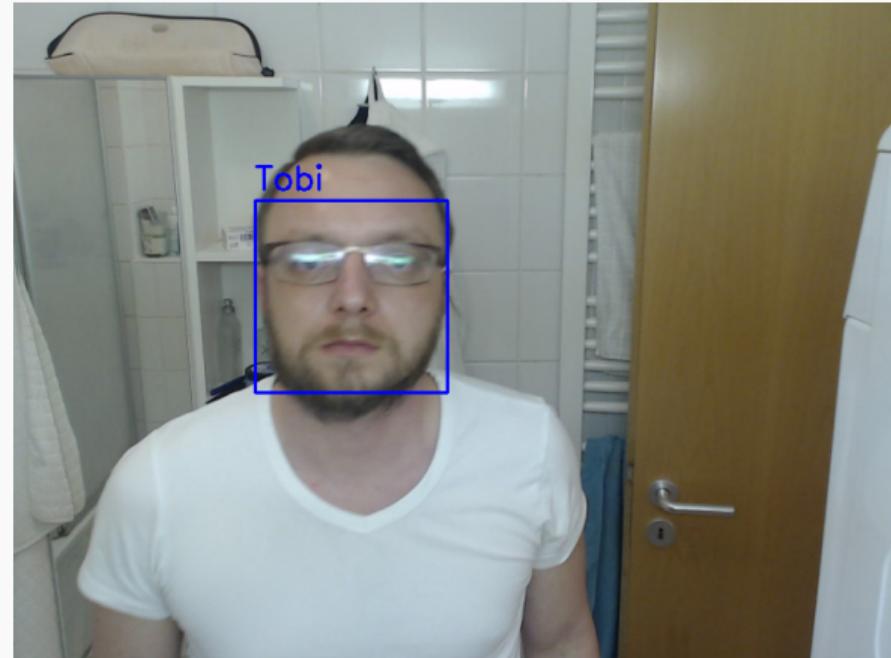


Software - Identify users

Training efforts

- ▶ Detect & save face patches
- ▶ First few hundred images:
manual classification
afterwards semi-automatic
(only correct errors)
- ▶ Train & evaluate 3-layer CNN

- ▶ approx. 10k images/class



Software - Identify users



Figure: Example trainingset Tobi

Figure: Example trainingset Mariam

Software - Identify users

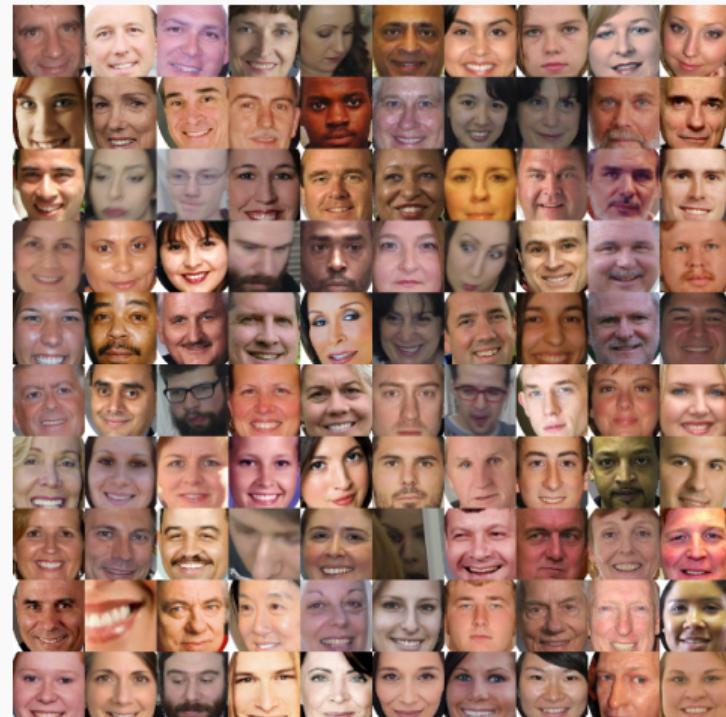


Figure: Example trainingset Other

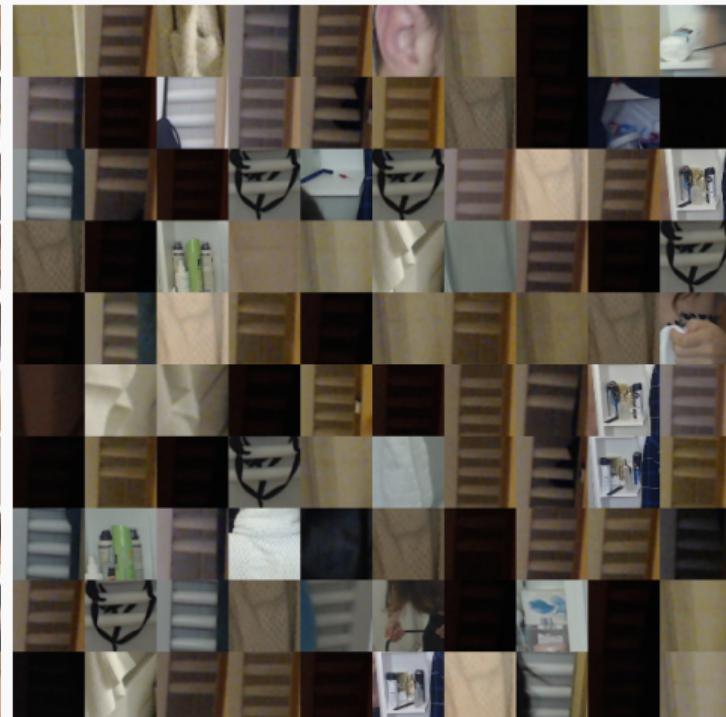


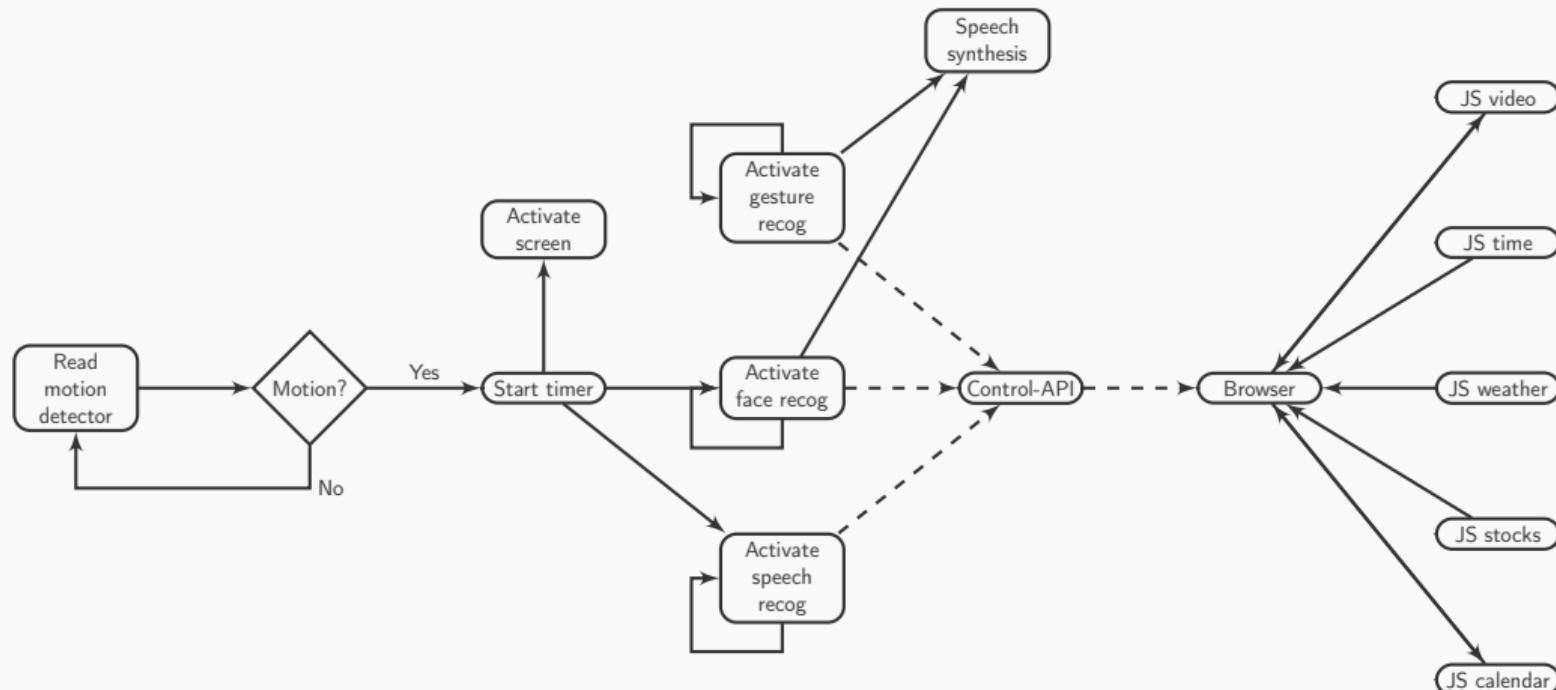
Figure: Example trainingset Negative

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System - Flowgraph



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Result



Science fiction

- ▶ Cluster unknown faces and automatically retrain (e.g. recurring guests/friends)
- ▶ Non-invasive health diagnosis
- ▶ Selection of *good* pictures to create a timelapse
- ▶ Personal metrics: create a journal of wakeup-times
- ▶ Personal assistant: voice-interaction (set reminders, detach early email, etc.)
- ▶ Interface with smart home: automatically start the coffee-brewer on wake-up

End

Some funny extensions

- ▶ Bloody Mary Protocol (Video)