

Smarter Smartmirror

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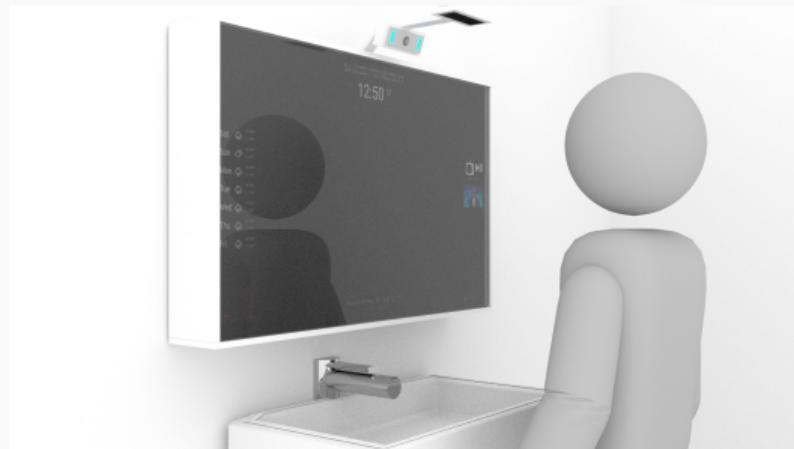
Systems Engineering

May 20, 2017

Building a smarter Smartmirror

- ▶ Smarter Smartmirror
- ▶ Requirements
- ▶ Hardware
- ▶ Software

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 the teeth you cannot do anything else anyway!

Requirements

General

- ▶ Mirror your face

Information needs

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

Usability

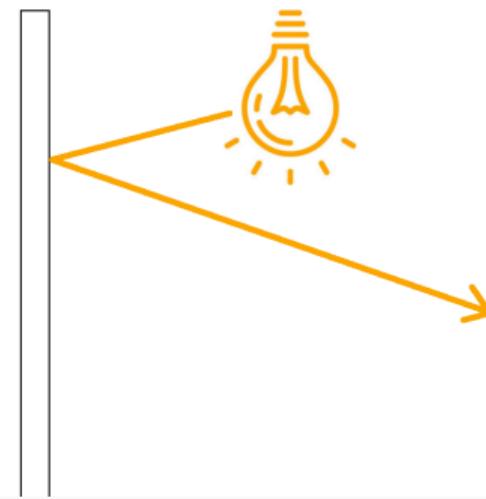
- ▶ Easy control without touching the mirror
- ▶ Play video news (max. 5 minutes)
- ▶ Identify users to provide personalized information

Mirror

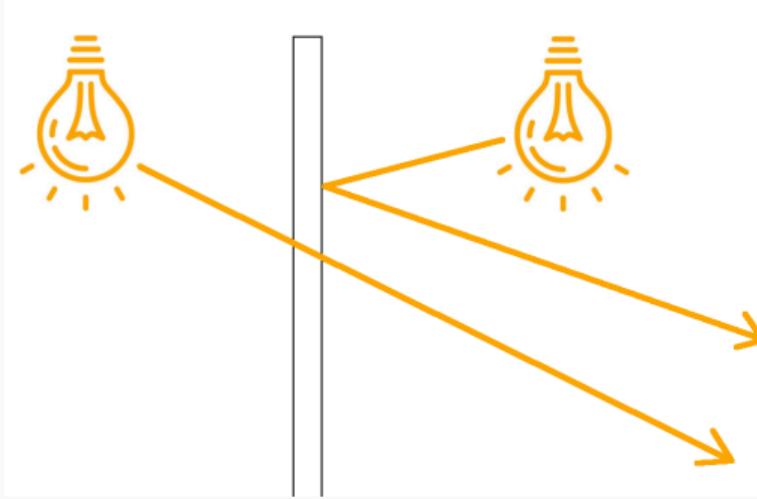
How to display information and still be a mirror?

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

Regular mirror



Two-way mirror



Requirement mapping

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

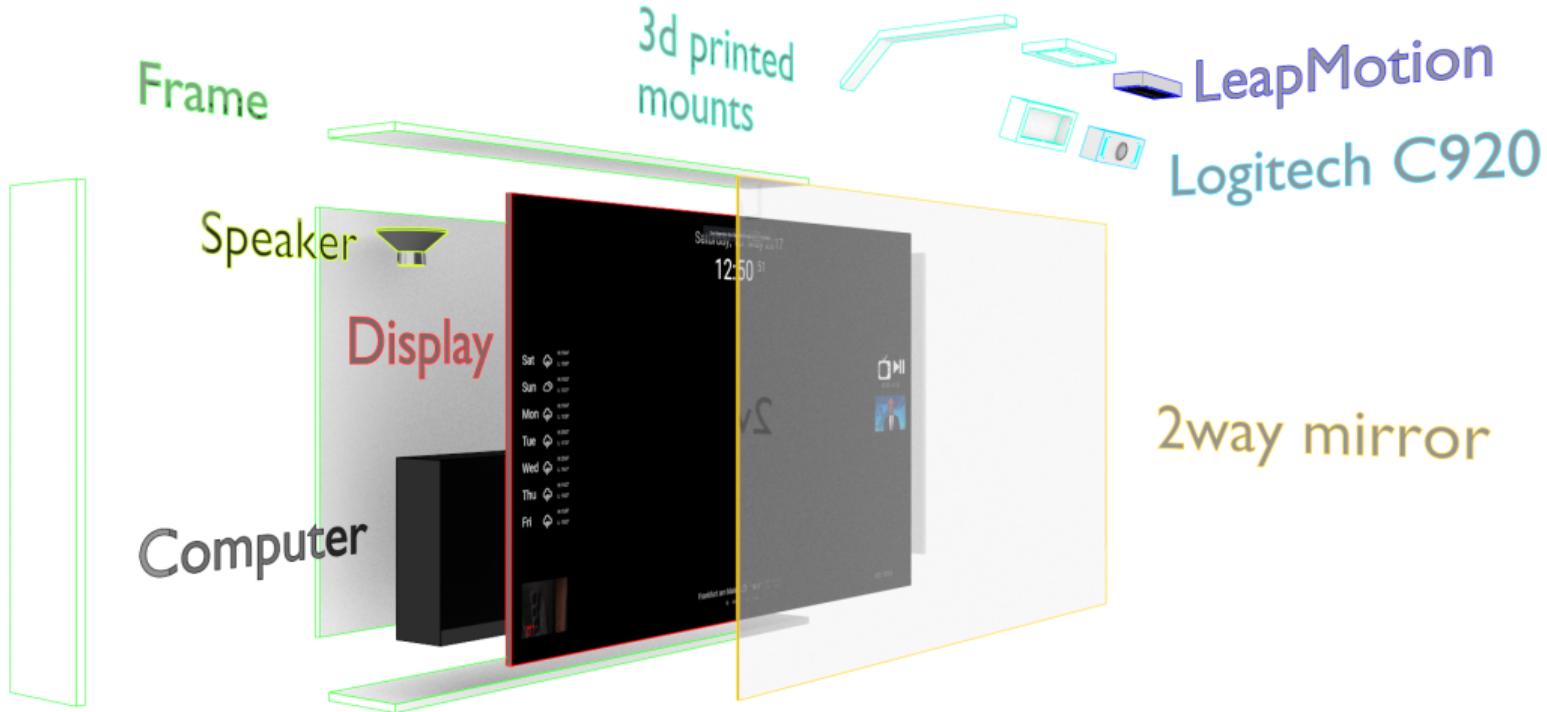
Requirement mapping

Usability

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

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

Requirement-mapping: Hardware



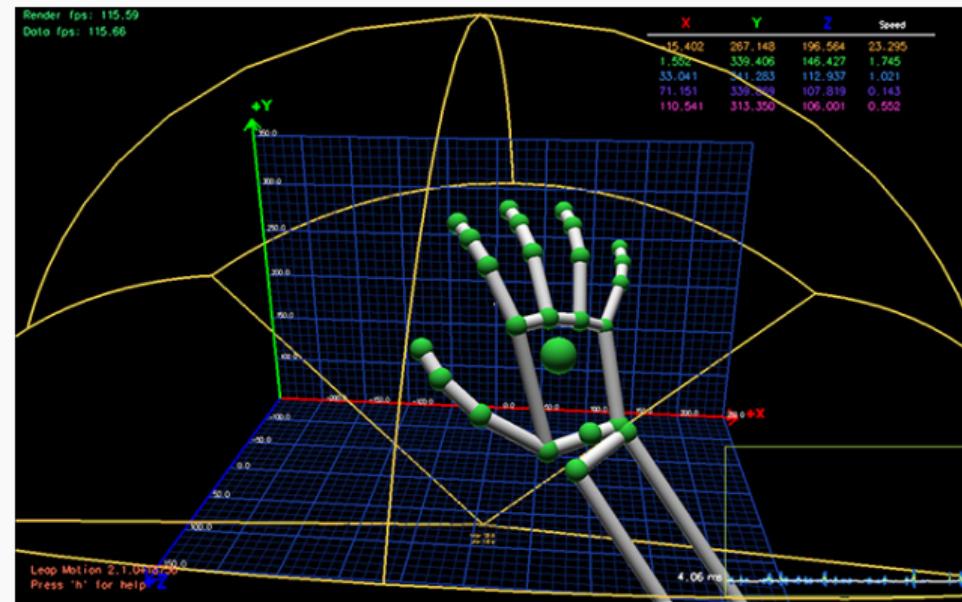
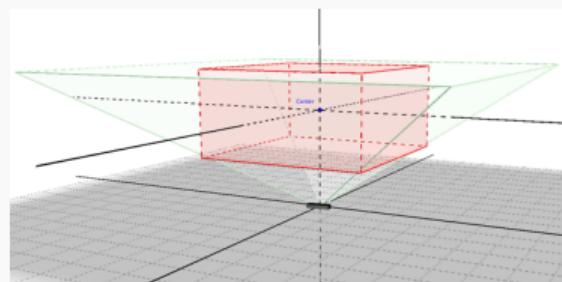
Software - GUI

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



Software - Control

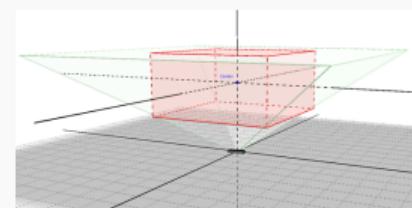
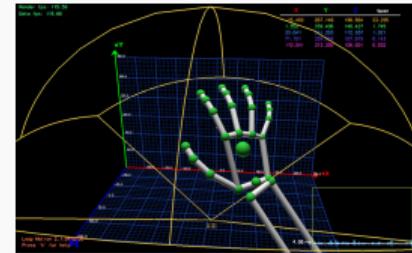
- ▶ Leap motion SDK (python)
- ▶ detect gestures
- ▶ map to keypresses (xdotool)



Software - Control

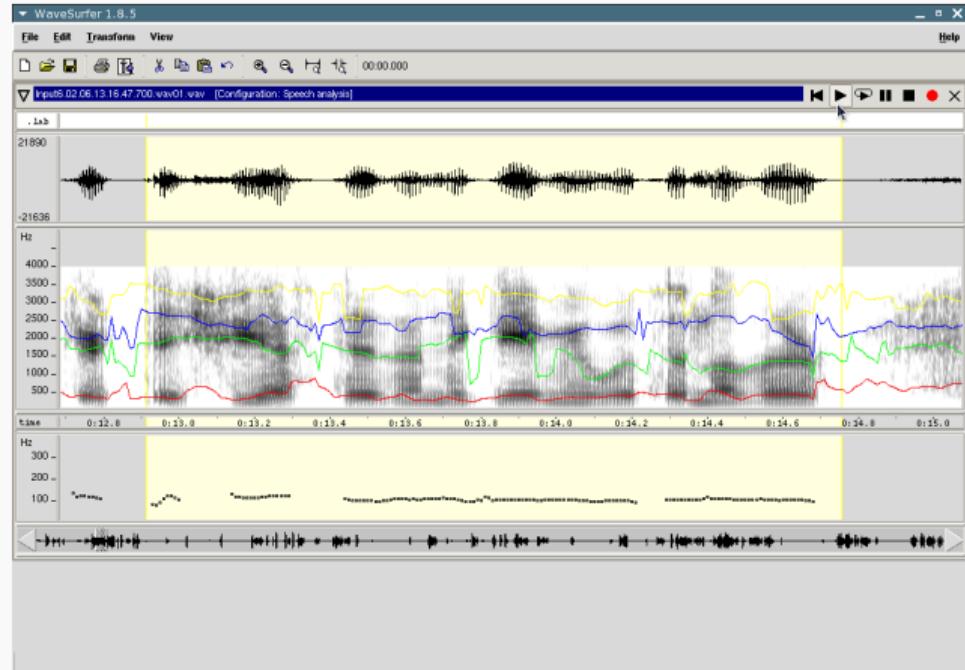
Leap motion - specifics

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



Software - Control

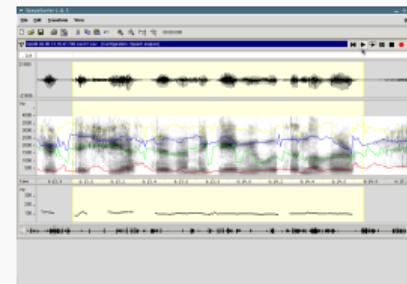
- ▶ Voice recognition
- ▶ CMU pocketsphinx
(python)
- ▶ map to keypresses
(xdotool)



Software - Control

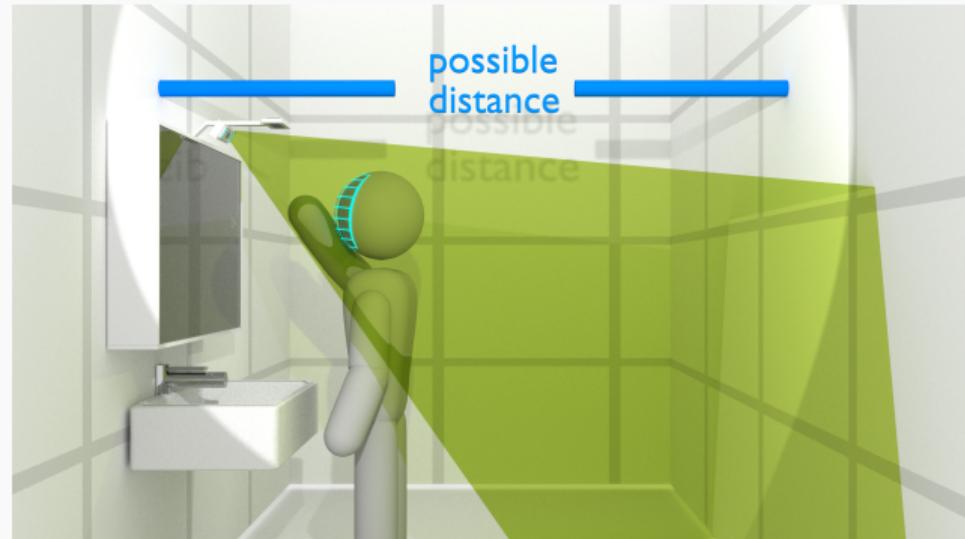
Voice recognition specifics

- ▶ 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

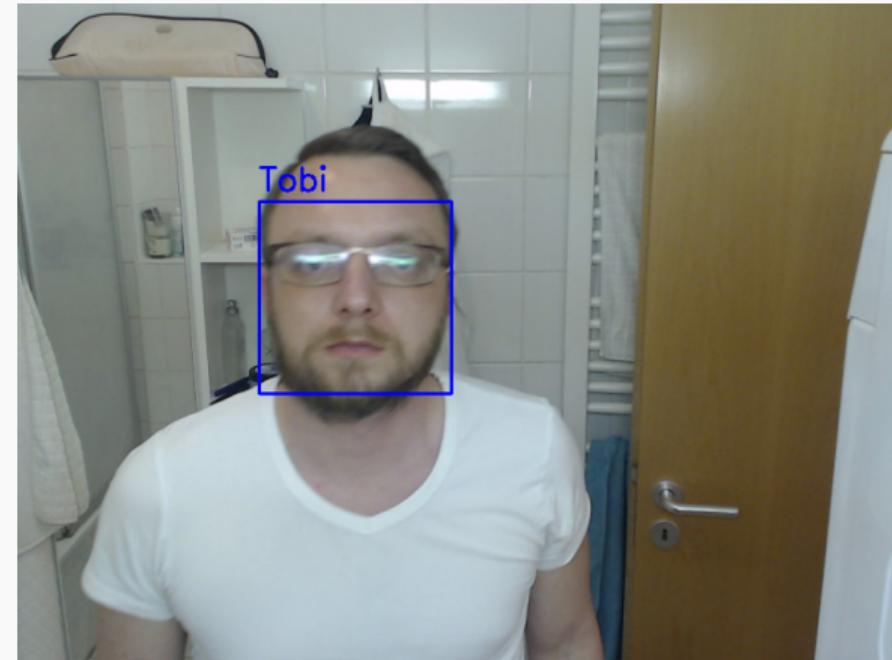


Software - Identify users

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

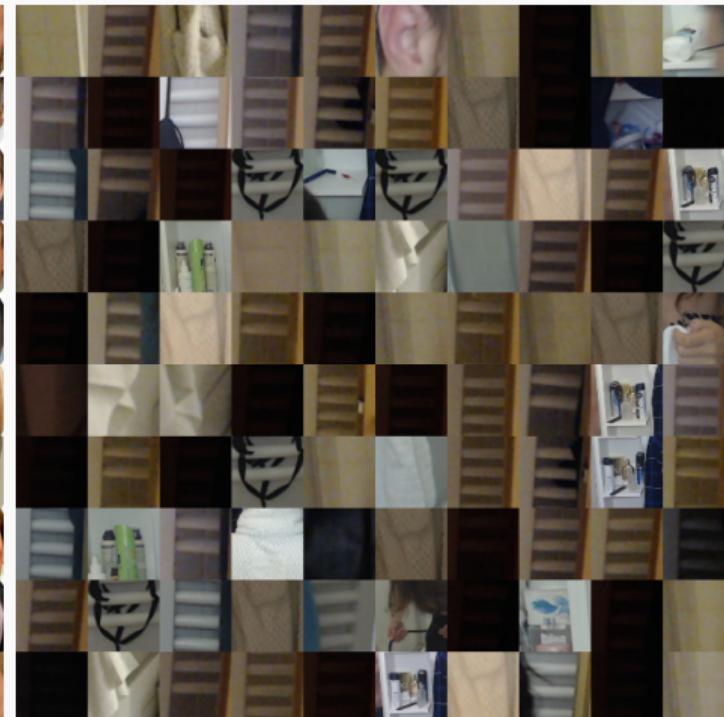
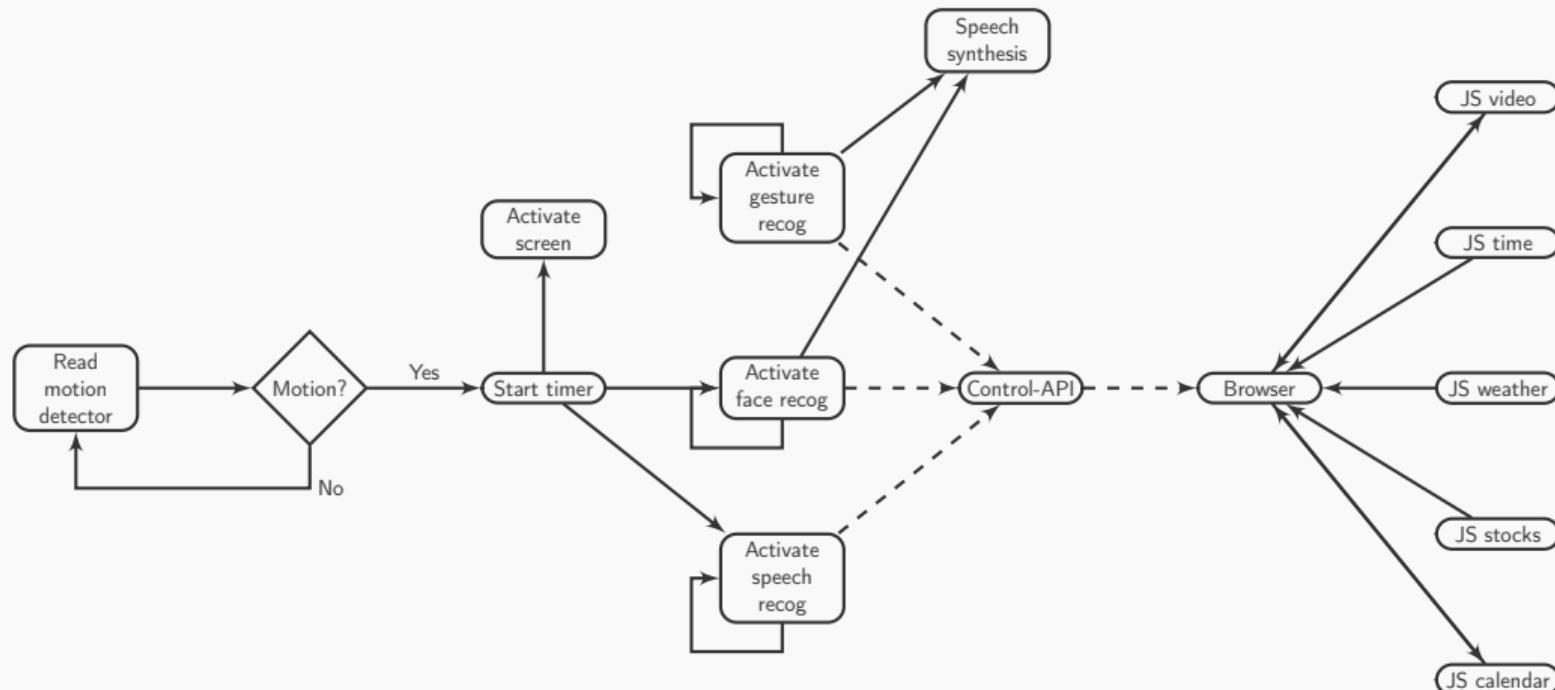


Figure: Example trainingset Negative

System - Flowgraph



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)