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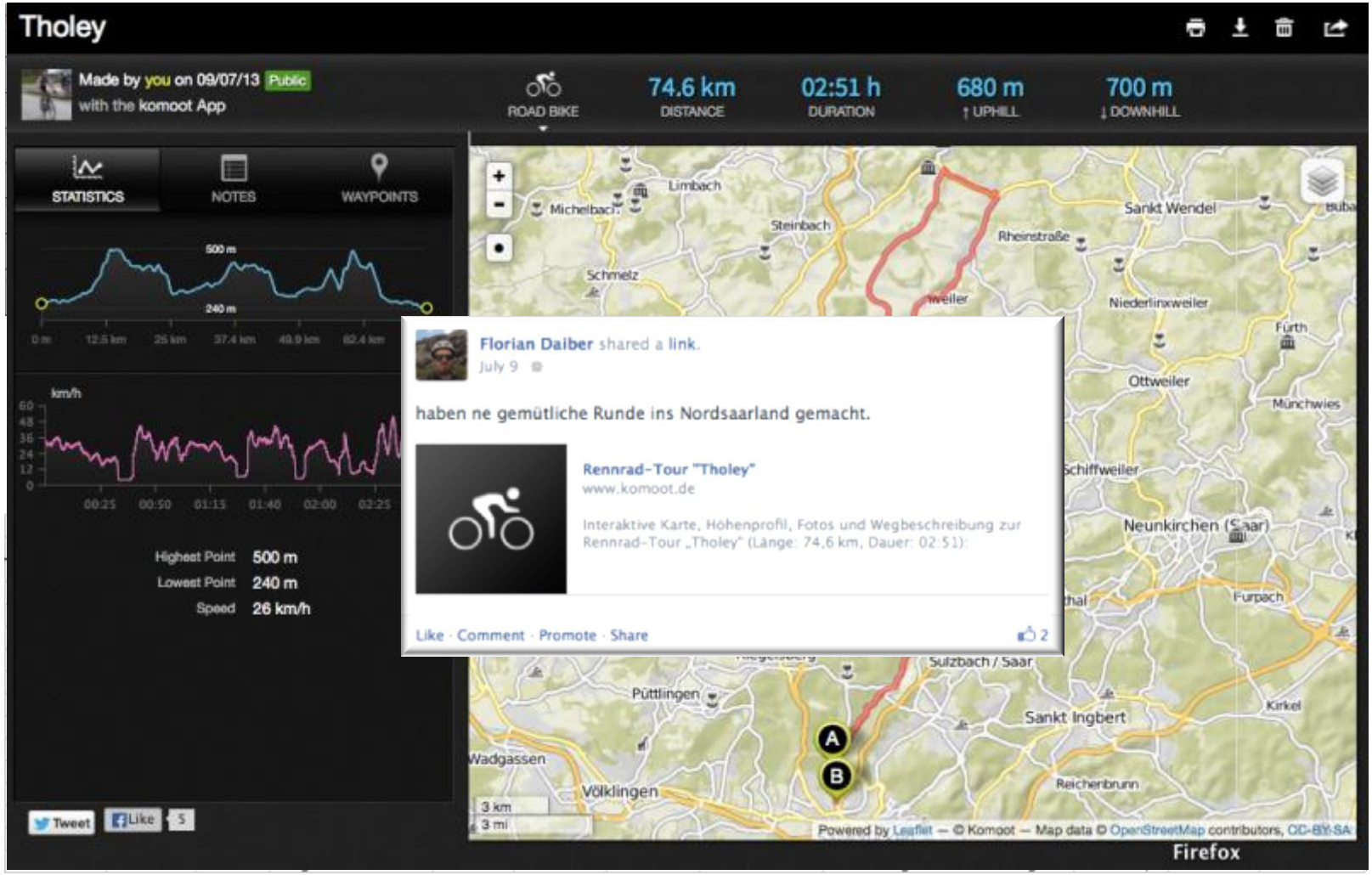
SIGGRAPH ASIA 2013

CYCLO

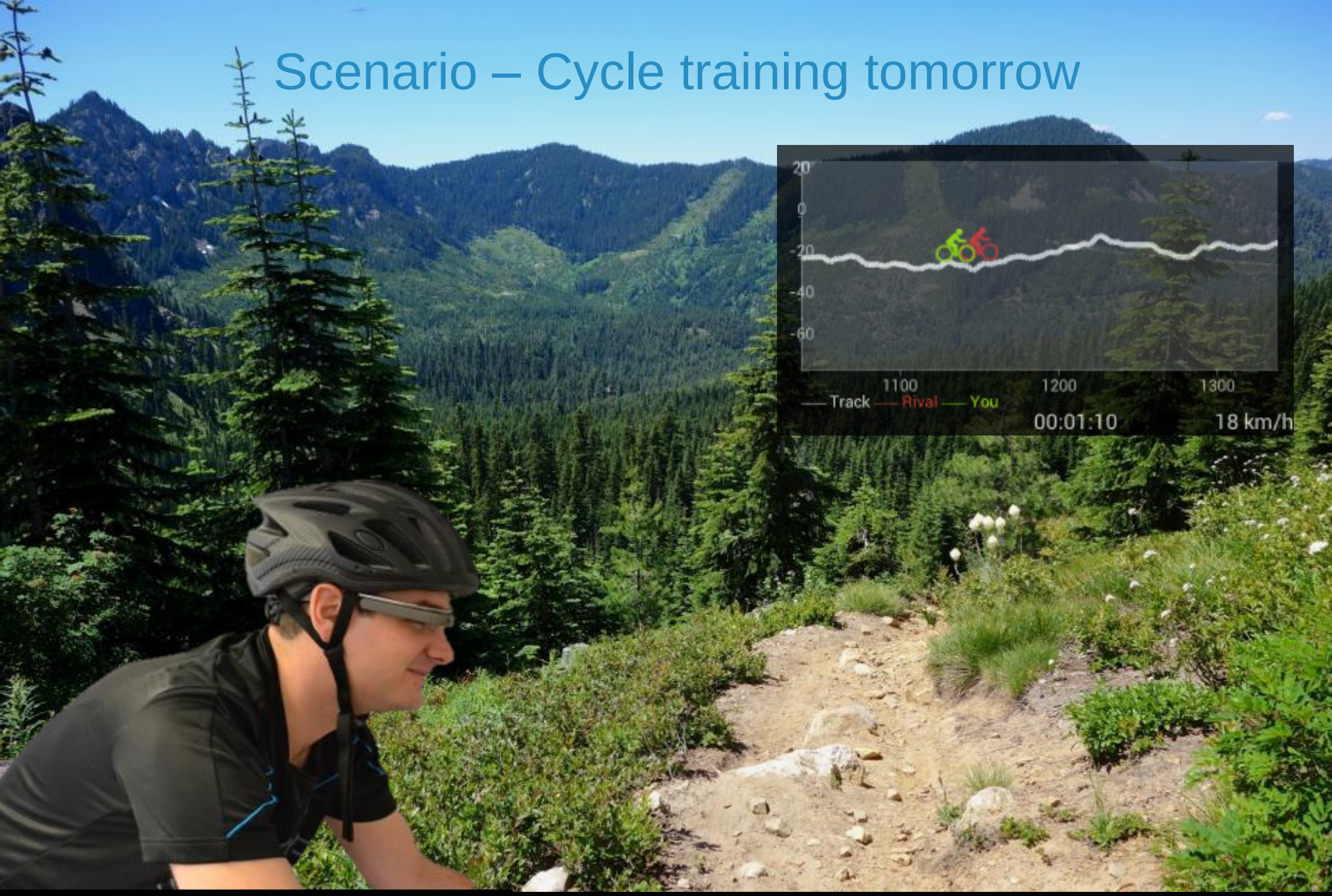
A Personal Bike Coach Through the Glass

Introduction & Motivation

Cycle training today



Scenario – Cycle training tomorrow



Sports Technologies

- Latest generation smart gadgets opened the way for computer support in everyday sports training:
  - Pedometer
  - Smartphones
  - Heart-rate monitors
  - GPS-enabled watches
  - Sophisticated cycling computers

  - Displays (e.g. cycling computers, watches, etc.)
  - Audio, e.g. warning sounds, speech (e.g. Runkeeper)

  - Limited input and output capabilities

Technology in Sports Training & Research

- Computers have a long tradition in sports
  - Numerical modeling, statistical analysis and simulation, measurement of biomechanical data and documentation [Baca 2006]
  - Computer-supported training [Wiemeyer 2006]
- Ubiquitous computing in sports technology
  - Computer supported collaborative sports [Wulf 2009]
  - Computer-augmented sports systems [Reilly 2009]
- Research directions
  - Wearable sensors to support fitness exercises
  - Heads-up displays (HUDs)

Recent wearable HUD technology

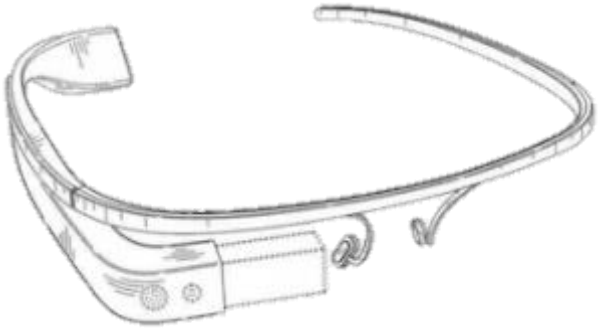
http://optinvent.com/

http://jet.reconinstruments.com/

http://www.glassup.net/

http://www.vuzix.com

http://tele-pathy.us



http://www.google.com/glass/start/

Contribution

- Cyclo prototype
  - Bike assistant application on a Glass device
  - HUD for personal and collaborative sports training
- Design approach & UI Design
  - Requirement survey with 35 participants
  - User interface design for Glass
- Implementation
  - First impressions about developing for the Glass platform

Requirement Survey

Requirement Survey

- **Performance measurements**
  current speed, average speed, distance, stopwatch, burnt calories
- **Performance comparison**
  race against self, race against others → virtual partner
- **Navigation**
  map, elevation profile
- **Assistance notifications**
  traffic, weather, stops
- **Video recording**
  scene recognition, night vision, post-race analysis

Requirement Survey

- **Display**
  for training and entertainment
- **Communication**
  with team and with coach
- **Interaction**
  few buttons or touch screen, or even hands-free
- **Form factor**
  weather-proof, dust-proof, light, easy to mount on bike

Almost all these features are available with a smartphone and a Glass!

Glass

Glass Hardware

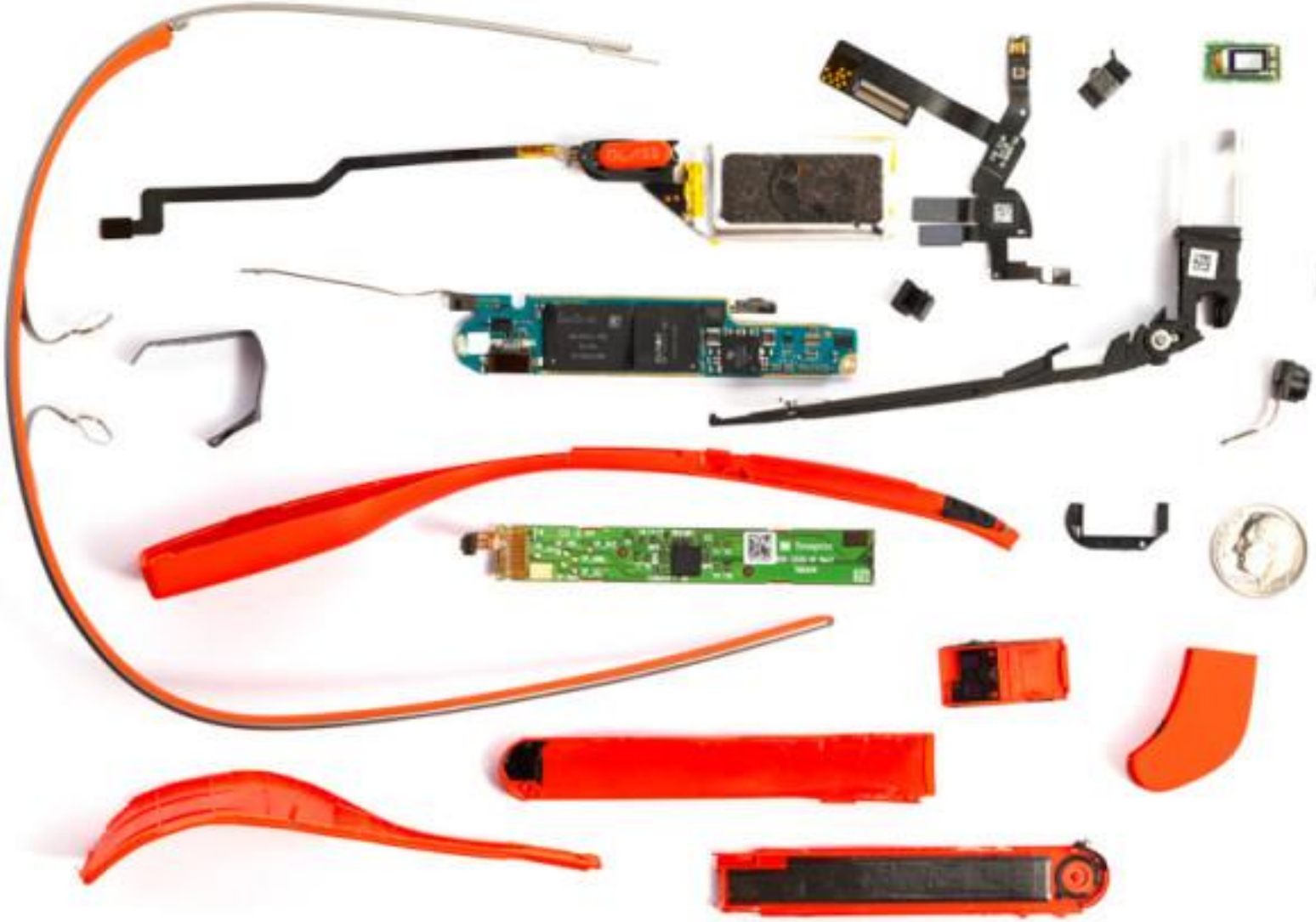


Image from http://andrewhy.de/what-is-inside-google-glass/

Glass Hardware

- **Processing**

  roughly equivalent to *iPhone 4* or *Samsung Galaxy Nexus*

  Texas Instruments OMAP 4430 SoC: 1.2 GHz Dual-core ARM Cortex-A9 CPU, PowerVR SGX540 GPU, 16GB storage, 682MB RAM, Android 4.0.4 OS (API 15)

- **Camera**

  cell-phone equivalent, 5MP still (2528x1856 pixels) or 720p video, no flash

- **Display**

  upright, color, prisma projector, 640 × 360 pixels, focused at a distance

- **Sensors**

  touchpad (long and narrow, 1366x187pixels), microphone, accelerometer, gyroscope, compass, GPS via phone

- **Communication**

  Bluetooth tethering through mobile phone, direct WLAN 802.11b/g,

  no cellular modem

Slide contents from Mark Levoy and from Wikipedia

Micro Interactions

- Tap to wake up
- Swipe down for standby
- Tap to select
- Swipe to navigate on timeline
- „OK, Glass…” to give voice commands
- Look up and nod to dismiss

User Interface Design

A Glass application IS NOT

- An immersive augmented reality application
- A data-intensive application
- A highly engaging application

A Glass application

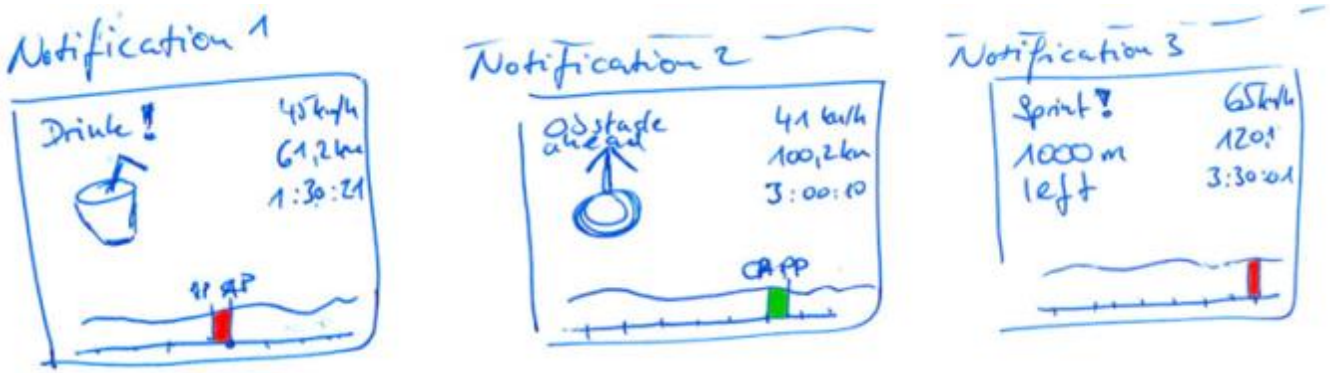
- Delivers small bits of relevant information

- Requires minimal user interaction:
  - Simple swipe gestures
  - Head nod
  - Voice recognition

Planning the Cyclo Experience

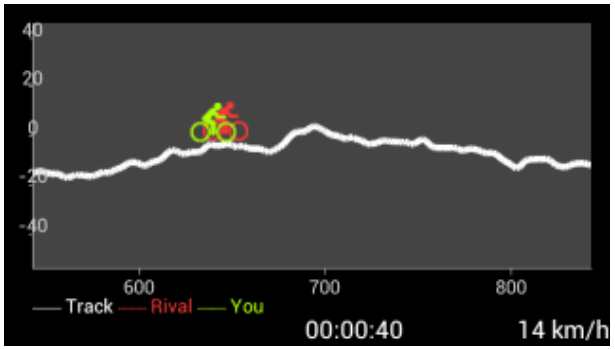
- Data to deliver
  - Continuous status updates
  - Contextual notifications

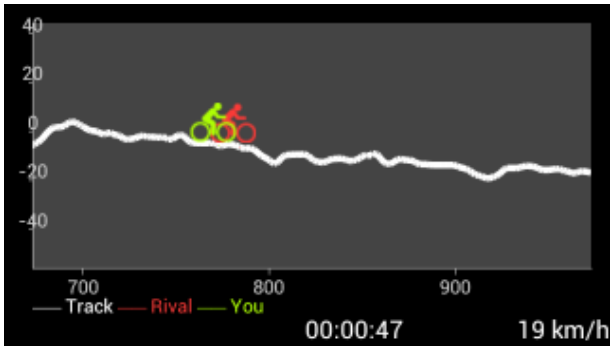
- Design Constraints
  - Minimal amount of Information
  - Hands-free interaction

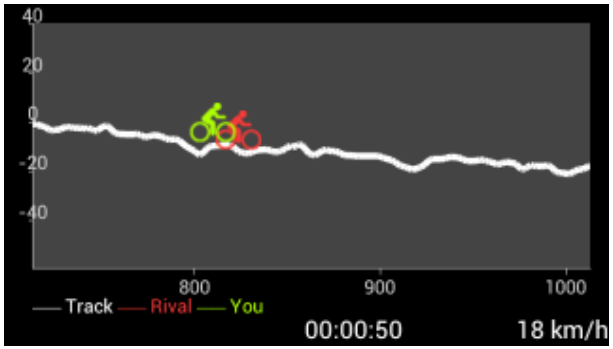


Continuous Status Display

- Constantly displayed, no interactions necessary.
- Real time update:
  - Speed
  - Distance
  - Time
  - Progress compared to virtual partner

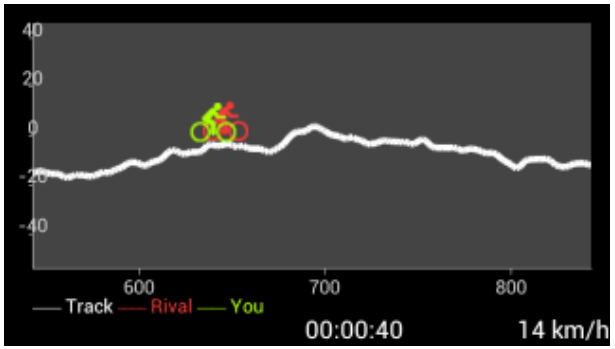


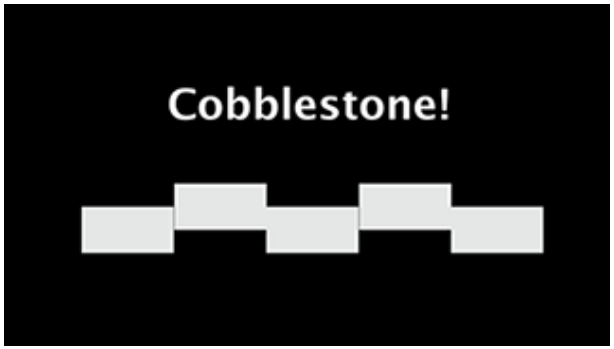


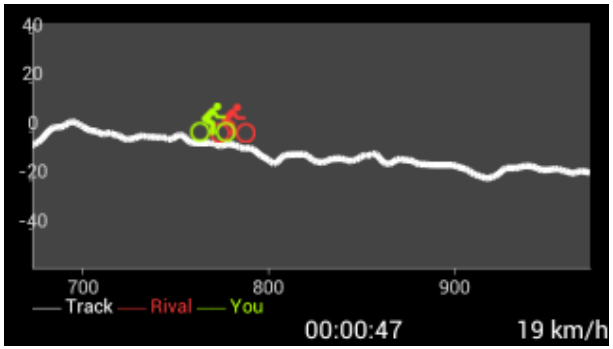


Notifications

- Prepare points of interests (POIs) in advance on the map:
  - Checkpoints
  - Warnings
  - Nutrition Plan
  - ...
- Display proximity notifications when getting close to POIs
- No interactions necessary







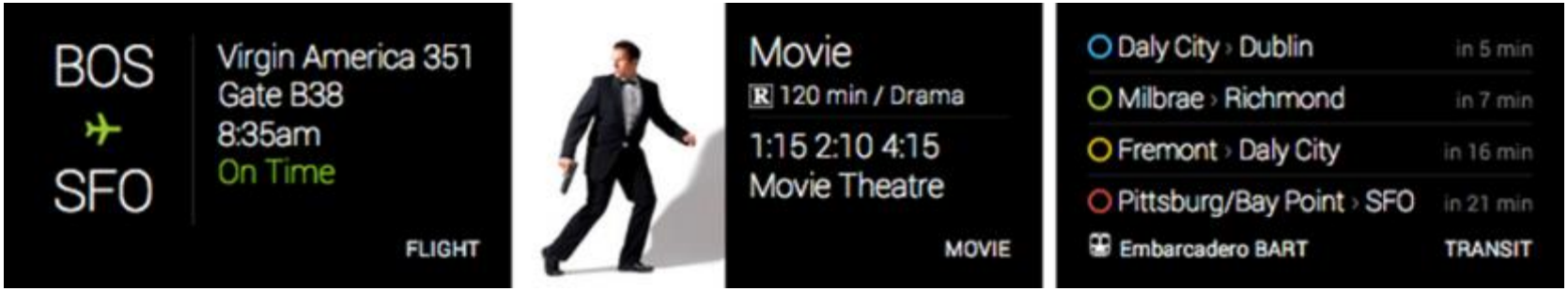
Implementation

Implementation Strategy

- **Glass Mirror API**
- **Standalone Android application**

Mirror API

- The only official, google supported, method of implementing a Glass application
- A cloud service that accepts RESTful messages and relays them to the user's glass device
- Messages appear as **timelines cards** on the user's glass



Mirror API

- Pros
  - Well formatted timeline cards
  - Convenient distribution
- Cons
  - Custom GUI is hard/impossible to achieve
  - Requires network connectivity
  - Official documentation is sparse
  - Small developer community

Standalone Android Application

- Glass runs a standard android distribution (Android Ice Cream Sandwich - 4.0.3)
- As such, it can run applications built for Android

Standalone Android Application

- Pros
  - Direct access to all the device's sensors
  - Rich GUI library
  - Offline work
  - Extensive set of development tools
  - Strong community support

- Cons
  - No official method of distribution (No Play Store on glass)
  - The official glass launcher does not support 3rd party standalone android apps

Cyclo - Implementation highlights

1. **Load route**
   Route and POIs are loaded as GPX (GPS eXchange format) data

2. **Start ride**
   Location event loop - with each new GPS coordinate, the stats are re-calculated and the status display is refreshed

3. **Get notifications**
   A proximity alert is set on all POI locations, when these are triggered, a short message will appear for a short time

4. **Testing**
   Route simulation is created with a separate GPX file which emits fake locations into the location event loop

Conclusion

- HUD devices present a promising opportunity for a range of apps that allow hobbyist/semi-professional athletes to improve their skills.

- Google Glass applications still have some challenges to face due to form factor and implementation difficulties.

Outlook: Killer App for Wearable Computers?

Recon JET

GlassUP

Optinvent

Florian Daiber

Gábor Sörös

Tomer Weller

Thank You

多謝

Backup Slides

Motivation

- sporting functions converge in our smartphones but while smartphones have excellent sensing and processing capabilities, they are cumbersome to interact with when our hands are occupied during sports

- → extend the smartphones with input and output that is better suited for sports

Wearable displays

GlassUp

Spring 2014 from 230 EUR Italy

only optional camera, monochrome display 320x240, middle of the view, Android OS, touchpad, Bluetooth LE

Google Glass

Spring 2014 unknown USA

display 640x360, WiFi, Bluetooth

Optinvent ORA-S

Jan 2014 from 700 EUR France

display 640x480, large FOV, full eye coverage, WiFi and Bluetooth connectivity, front facing camera 640x480, 9 axis motion sensor, ambient light sensor, microphone, loudspeaker, and a high capacity rechargeable battery, light reflectors in front of the eye, flip between AR mode (in front of eye) or dashboard mode (below eye)

Wearable displays

Recon JET

available now 450 EUR Canada

display 400x240, accelerometer, gyroscope, magnetometer + temperature, pressure sensor, touchscreen for all-weather and gloves too, eye gaze tracking, camera, dual-core 1GHz CPU, 1GB RAM, 8GB flash memory, Android OS, Bluetooth 4.0, ANT+

Spaceglasses META.01

Jan 2014 500 EUR Israel

Vuzix M100

End 2013 400 EUR USA

display 400x240, 4 buttons (no touchpad), 1Gbyte RAM, OMAP4430 - 1GHz

Kopin Corp. Golden-i

9-axis head tracking, 14MP camera, display 960x540, compass, Nuance's speech recognition engine (38 languages), Bluetooth, WiFi, Windows CE

Recon Instruments JET

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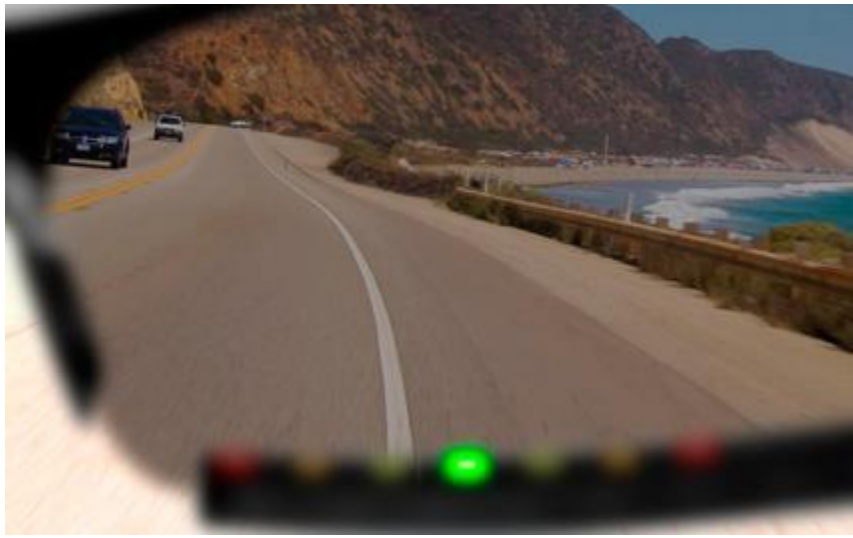

Golden-i