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A Personal Bike Coach Through the Glass
Introduction & Motivation
Cycle training today
Scenario – Cycle training tomorrow
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, 1366x187 pixels), microphone, accelerometer, gyroscope, compass, GPS via phone

- **Communication**
  Bluetooth tethering through mobile phone, direct WLAN 802.11b/g, no cellular modem
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

![Graphs showing real-time updates for speed, distance, and time compared to virtual partner and self.](images)
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
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.
Thank You

多謝
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

- Dual Core CPU
- Bluetooth
- Wi-Fi
- ANT+
- GPS
  - WITH ON BOARD GYROSCOPE, ACCELEROMETER, MAGNETOMETER, ALTIMETER AND THERMOMETER
- Optical Touchpad
- HD Camera
  - WITH MICROPHONE AND SPEAKER
- Polarized Lenses
- Changeable Battery
- High Resolution Display
  - WITH IR GAZE DETECTION

(left to right: 988 x 733 pixels)
4iiii Sportiiis

Universal mount attaches to virtually any pair of glasses

Built-in speaker for audible updates

Flexible boom with multi-colored LEDs guides you to target zones