

Ambient and Wearable Computing for Digital Health

A new Chair at FAU

Prof. Dr. Oliver Amft

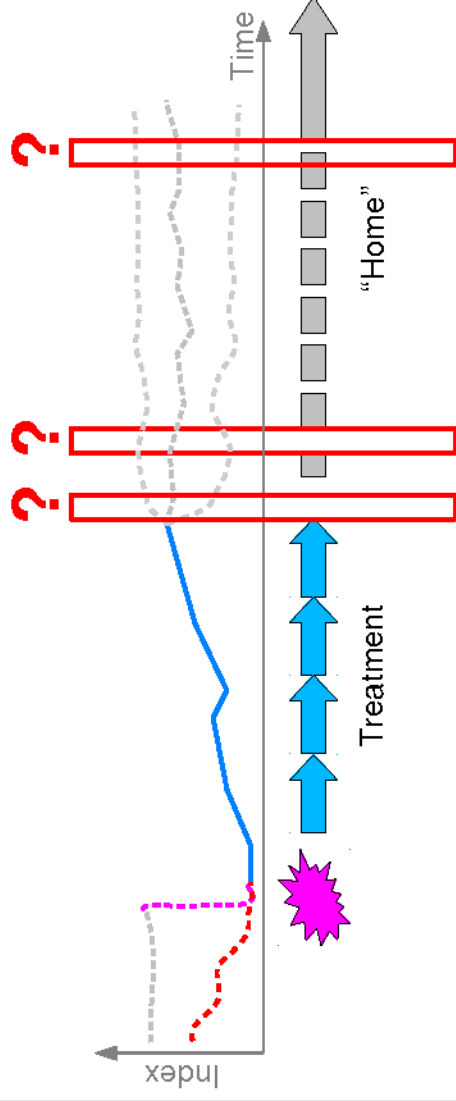
Chair of eHealth and mHealth
Friedrich Alexander University Erlangen-Nürnberg
(FAU)



2018

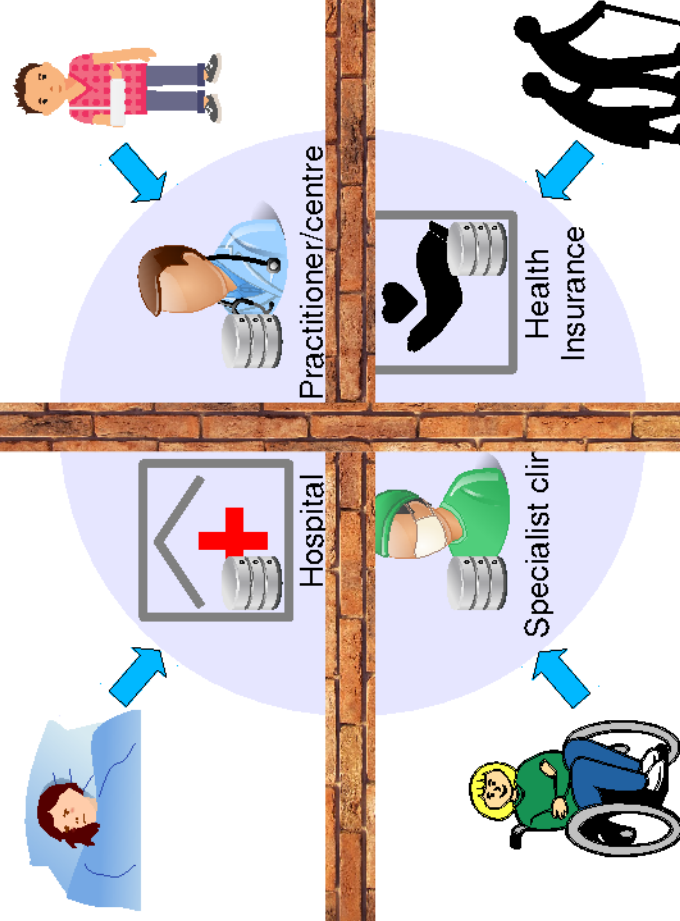


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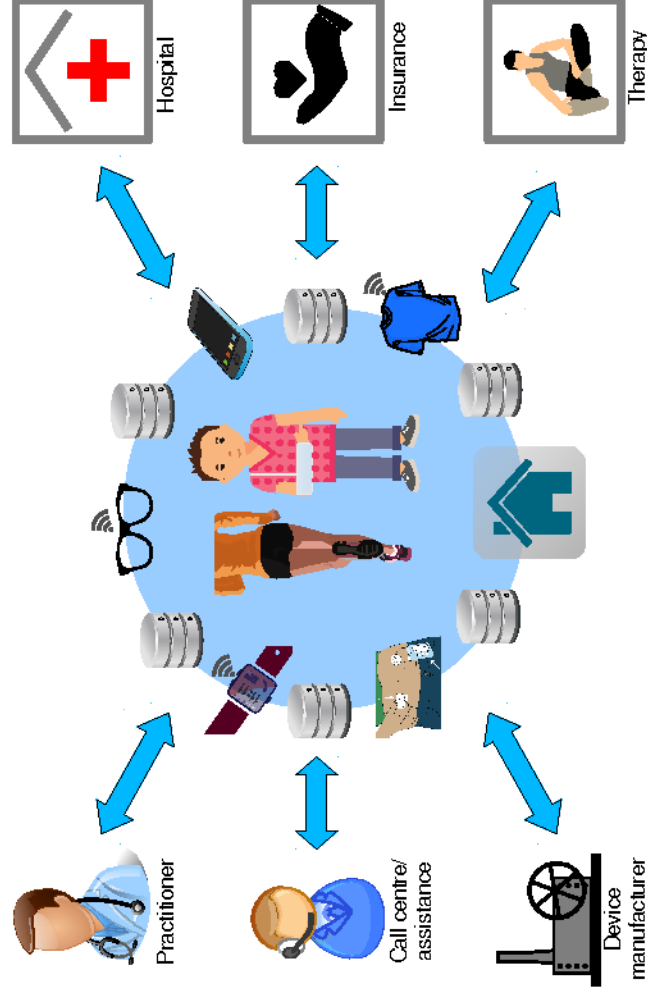
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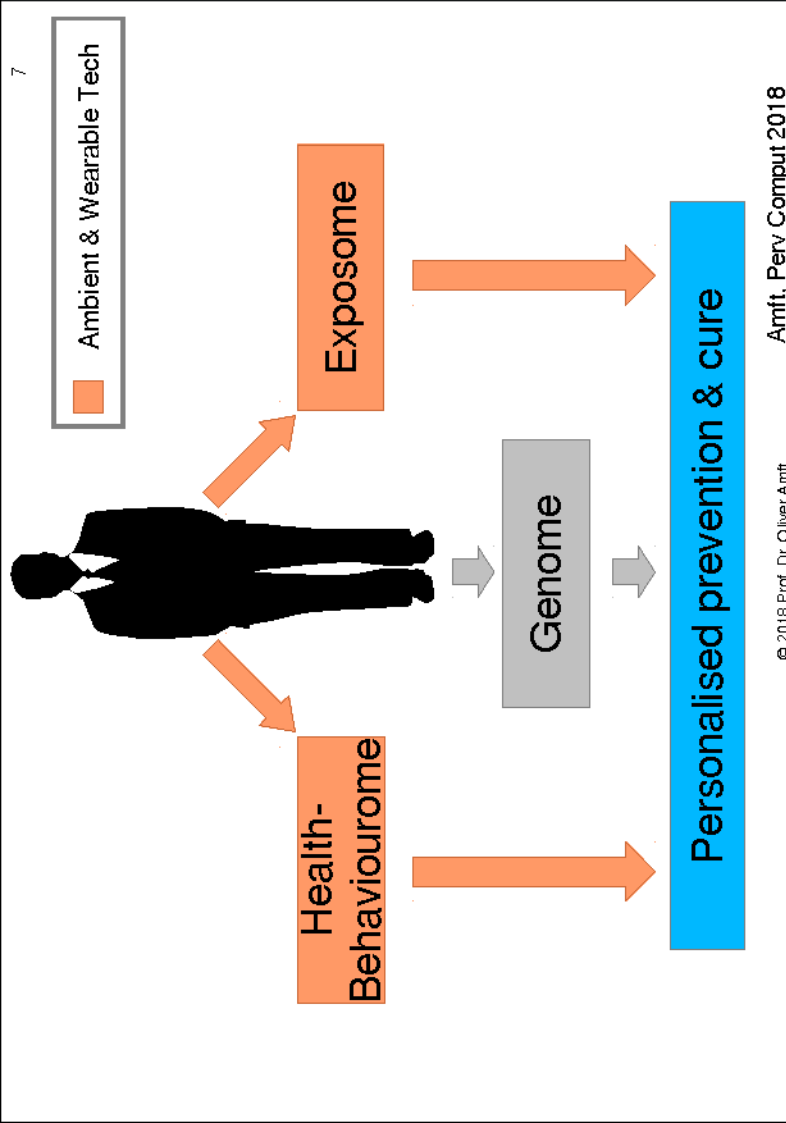
ver Amft

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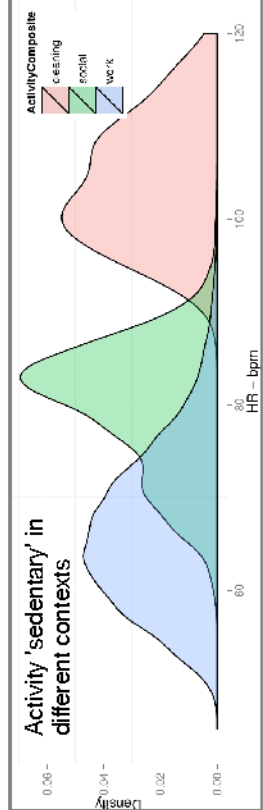
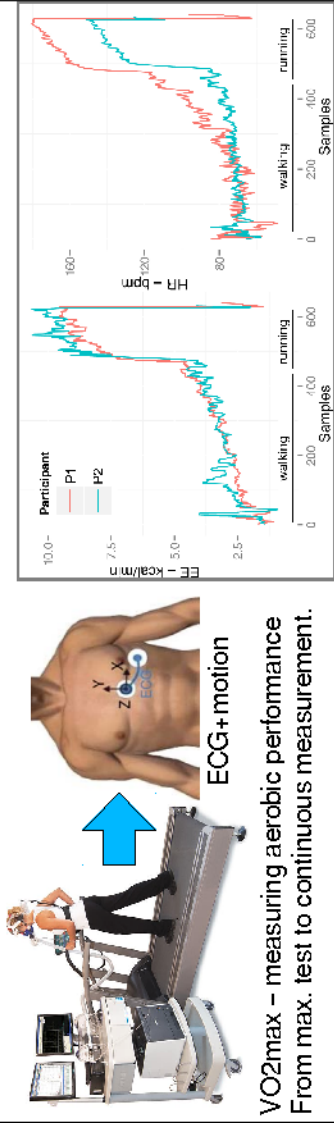


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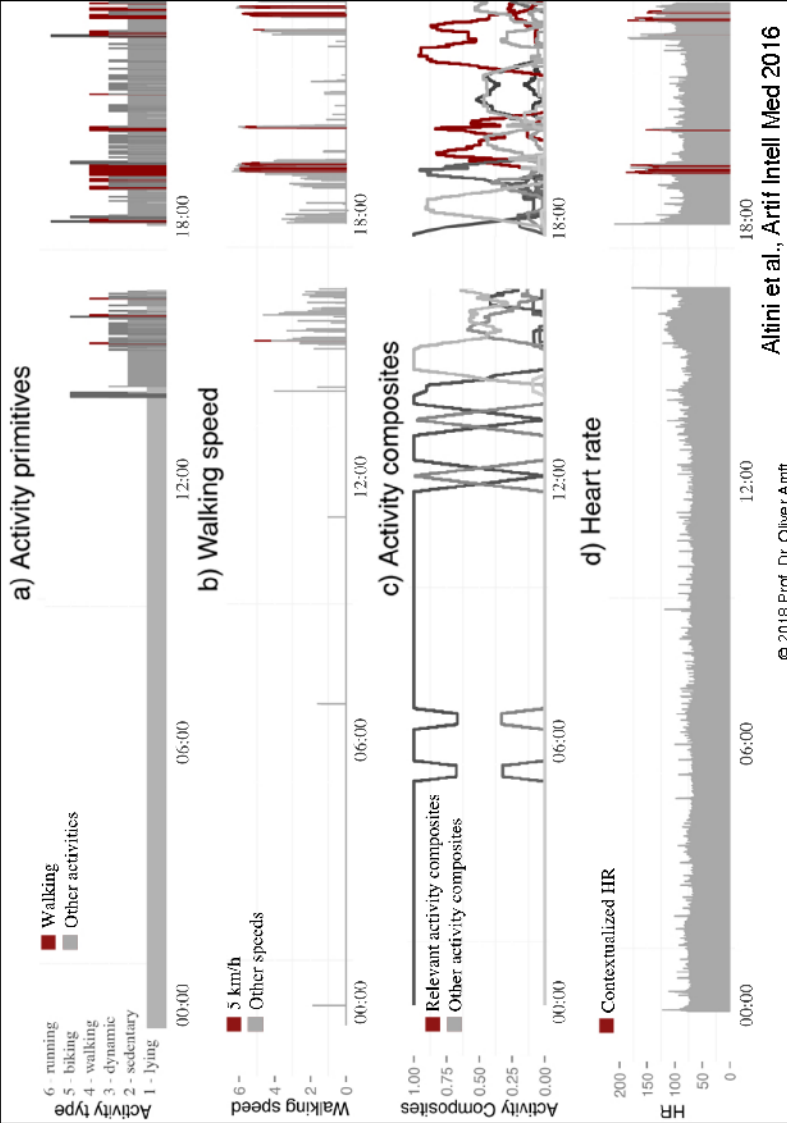
Amft, Perv Comput 2018



Estimating cardiorespiratory fitness



Context-dependent analysis



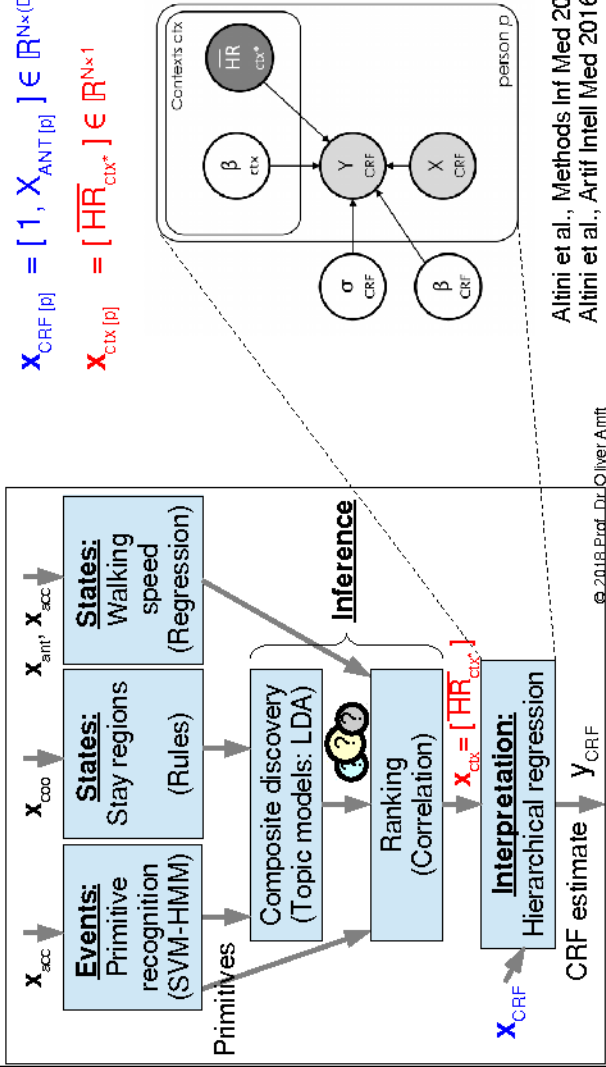
Estimating cardiorespiratory fitness

Hierarchical Bayesian regression model:

$$Y_{CRF}[p] \sim \mathcal{N}(\beta_{CRF}[p] + \mathbf{x}_{ctx}[p] \beta_{ctx}[p], \sigma_{CRF}^2); \quad p = 1, \dots, N$$

$$\mathbf{x}_{CRF}[p] = [1, \mathbf{x}_{ANT}[p]] \in \mathbb{R}^{N_x(D+1)}$$

$$\mathbf{x}_{ctx}[p] = [\overline{HR}_{ctx^*}] \in \mathbb{R}^{N_x+1}$$



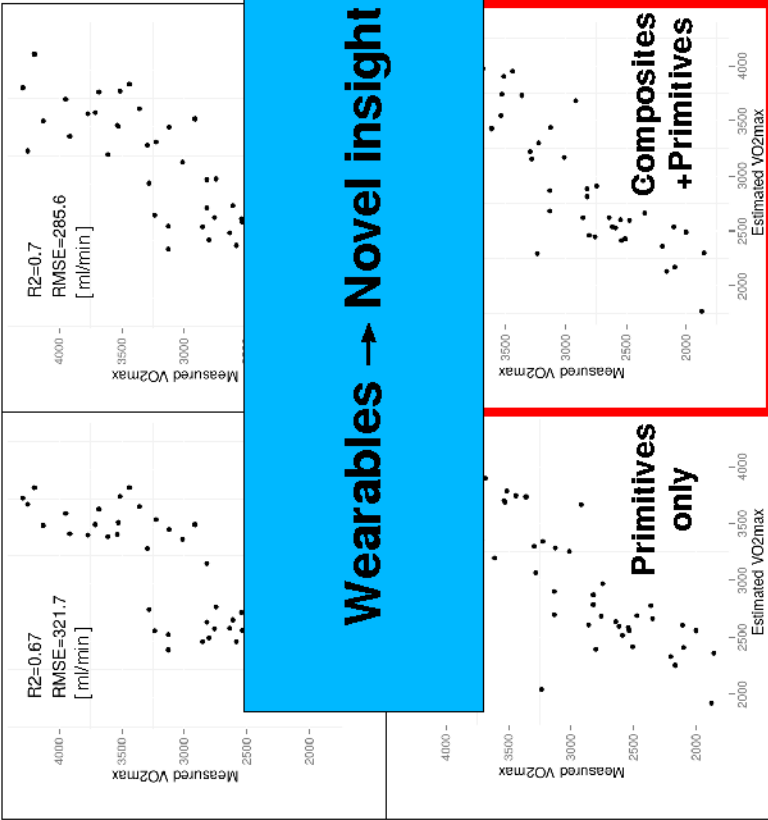
Altini et al., Methods Inf Med 2014
Altini et al., Artif Intell Med 2016

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The wearable devices wave



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Altini et al.,
Appl Physiol 2016

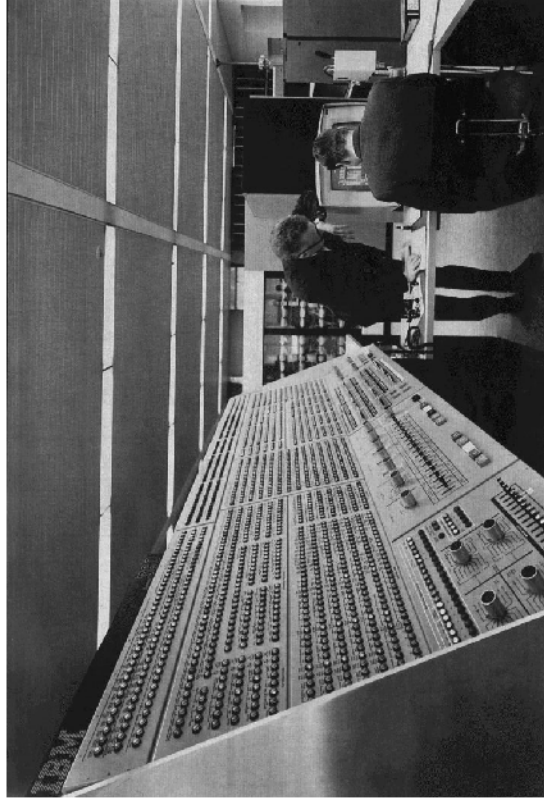
Altini et al.,
Artif Intell Med 2016

Why are so many
wearable projects
vaporware?

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Study:
>50 participants,
14d free-living,
LOPO validation

Wearables → Novel insight



The U.S. Justice Department accused IBM of intentionally announcing its **System/360 Model 91** computer in 1964, three years early to hurt sales of its competitor's computer.

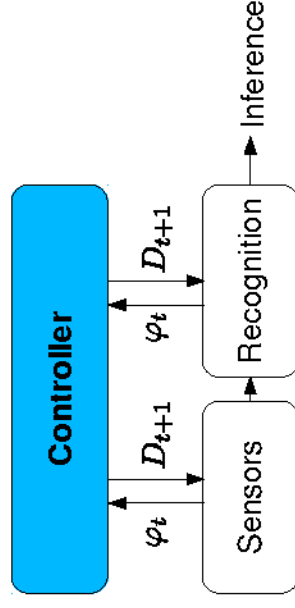
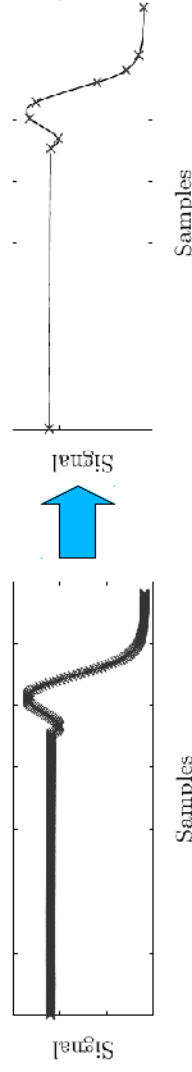
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Source: Wikipedia, PD

Problems

- Power
- Reliability
- Personal solution

Sparse sampling

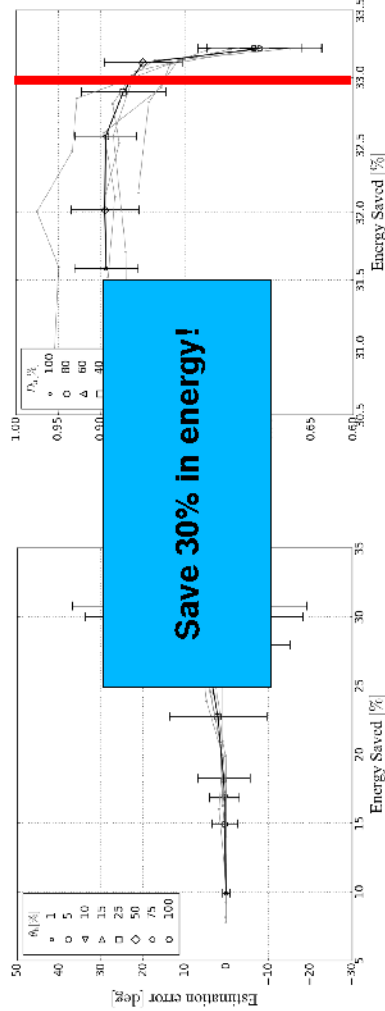


Power-aware Context Recognition



Power-aware context recognition

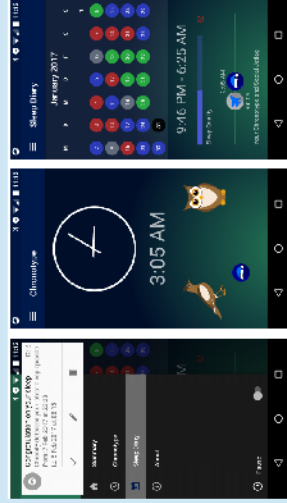
- Proportional controller
- Typical power values for inertial sensors, processing, storage.
- Evaluation for drink + food intake gestures in free-living data (5 days, 6 participants, 300 hours of annotated data)



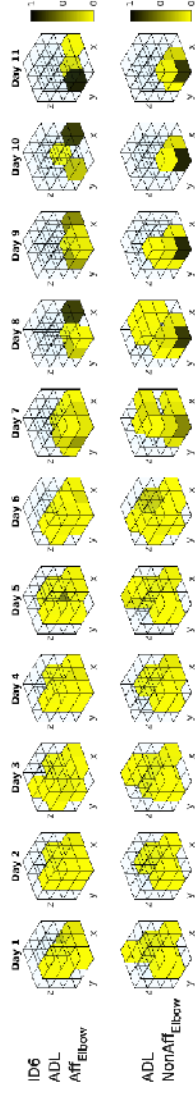
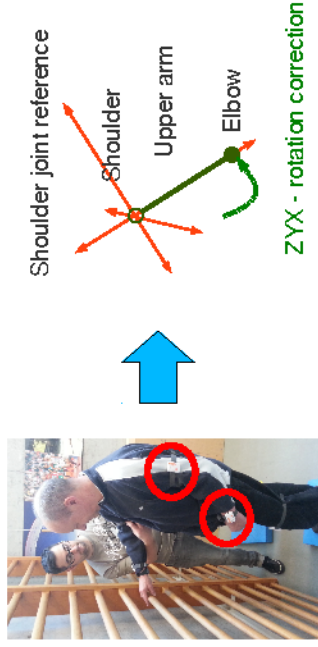
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Schiboni & Amft, BSN 2018

Combining data-driven and expert models



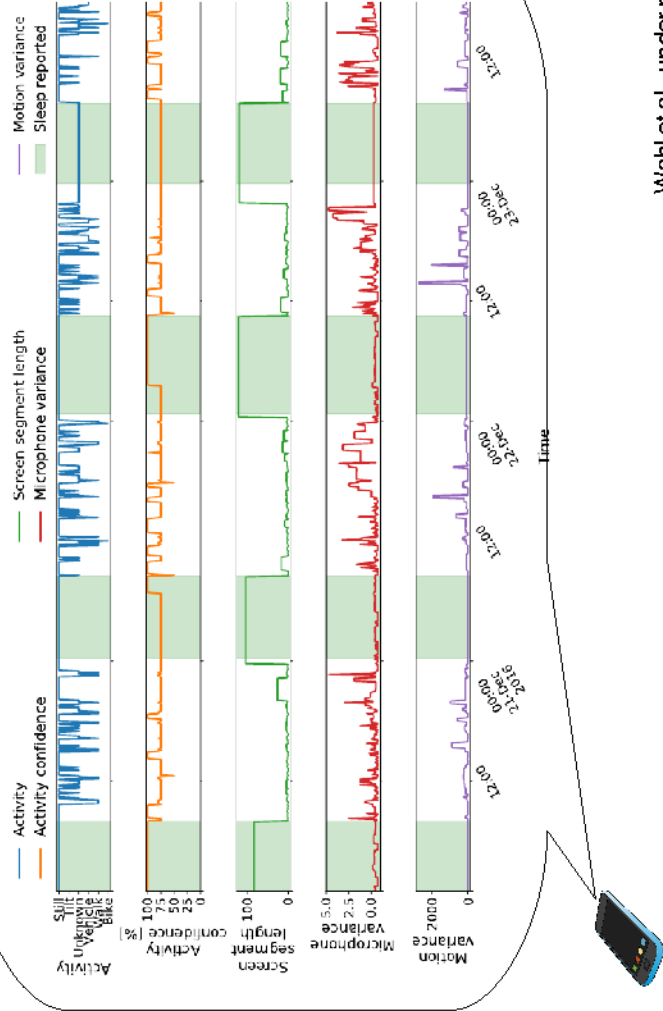
Motion in stroke patients



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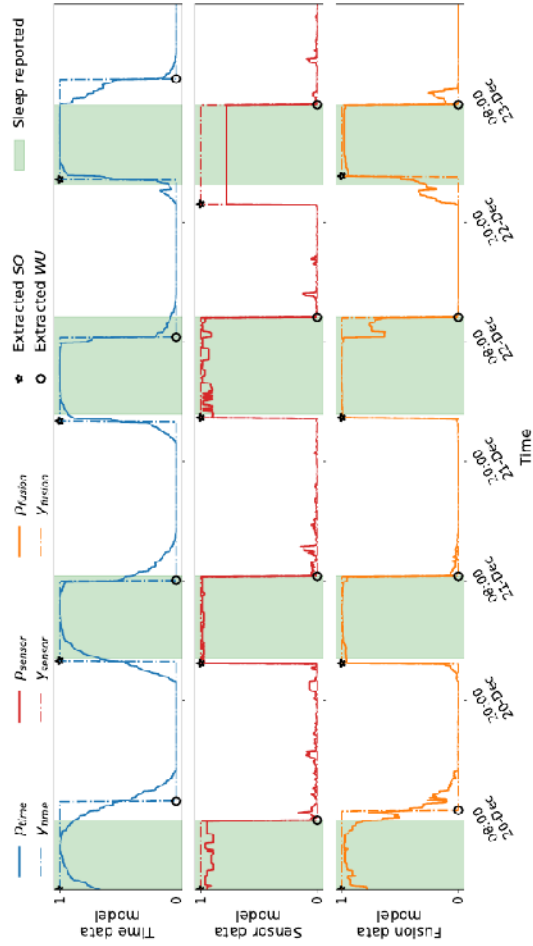
Derungs et al, BSN 2018

Context sampling on smartphone

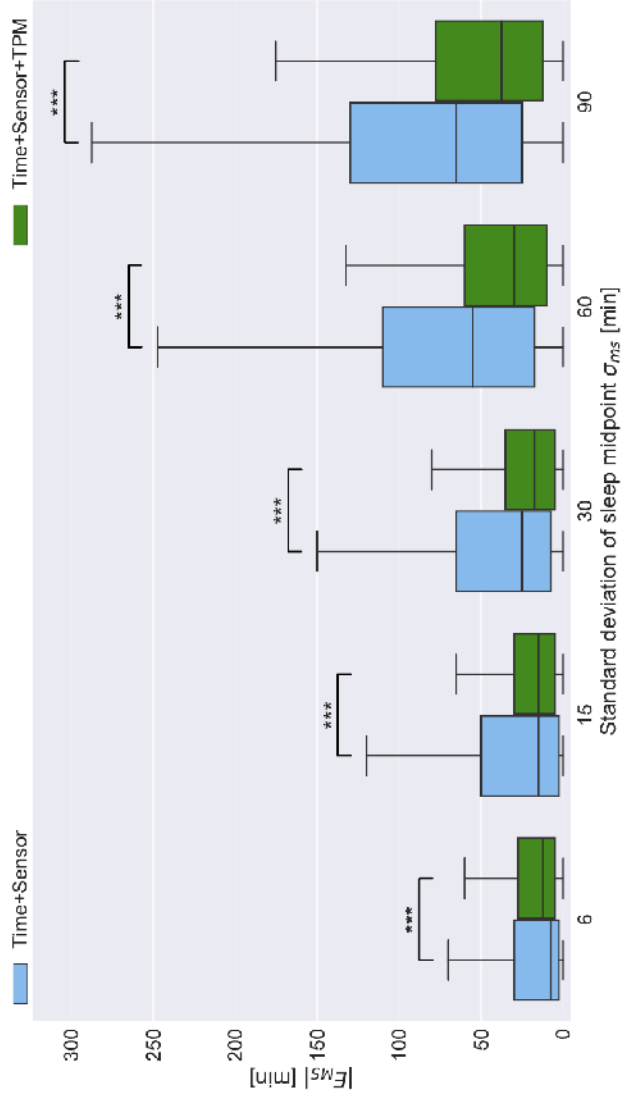


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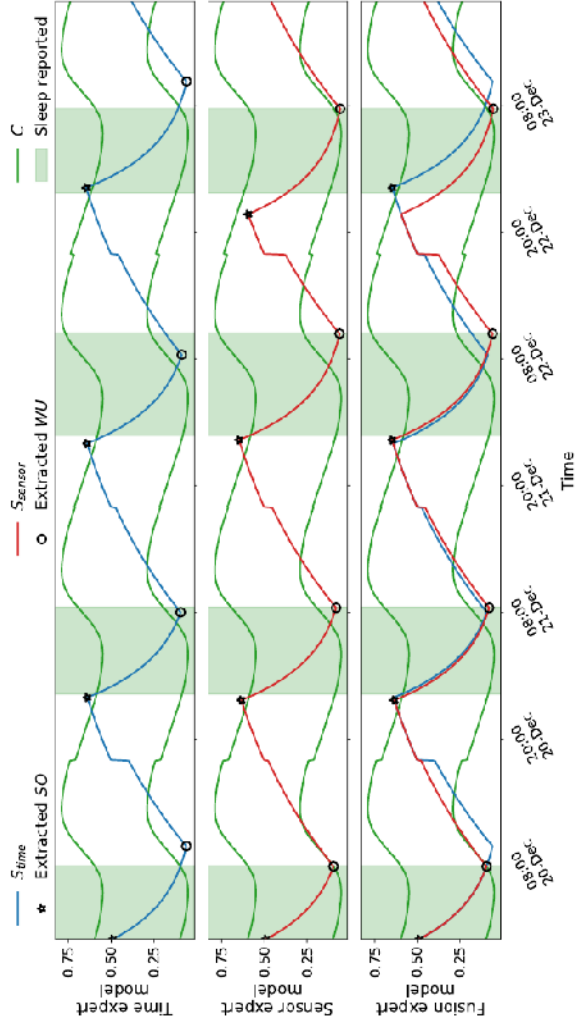
Wahl et al., under review



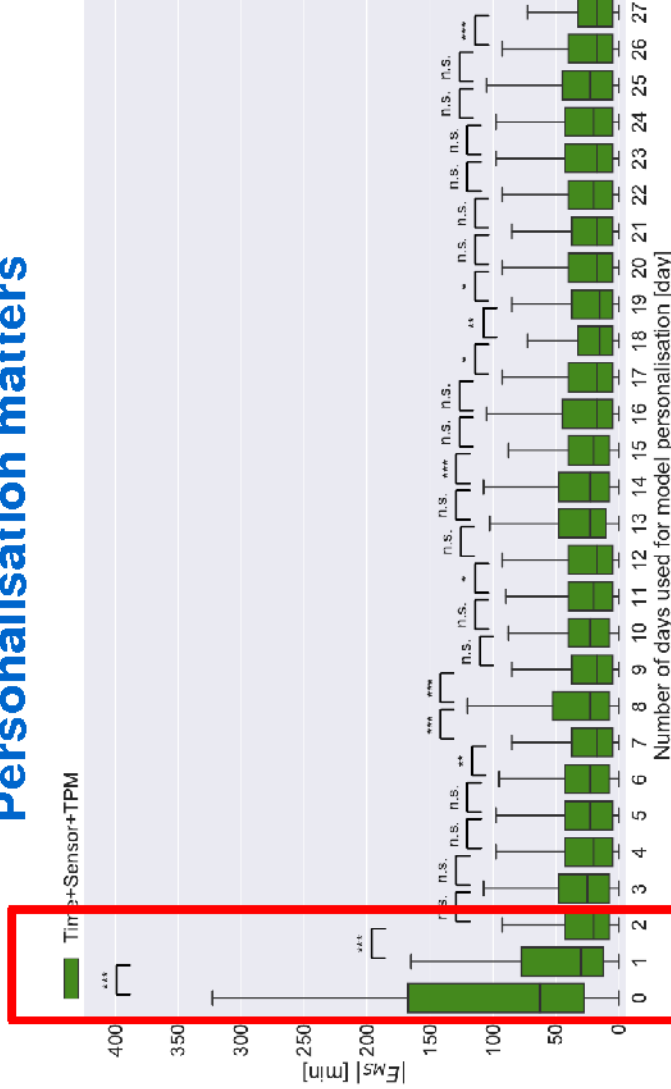
Sleep estimation error



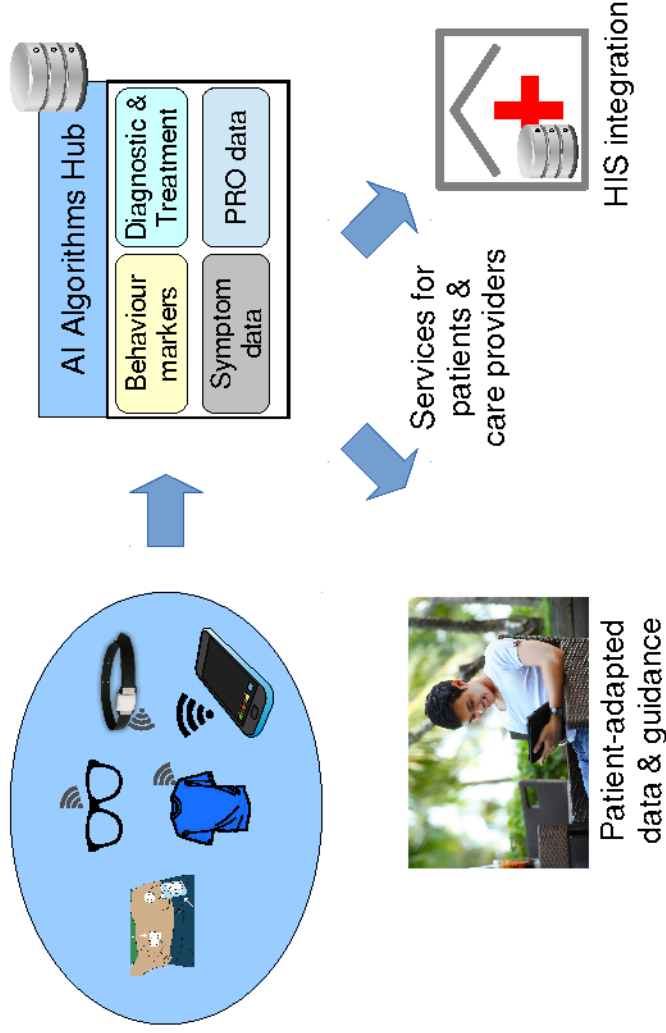
Circadian + homeostatic process model (Daan et al., 1984)



Personalisation matters



Data integration



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Computing in Eyeglasses

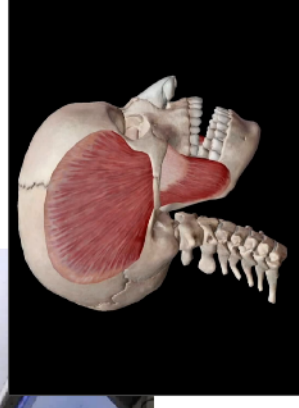


Personalised solution



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Electromyography (EMG) monitoring



More smart eyeglasses software apps...



Diet / Nutrition



Sleep/wake rhythm



Hydration



Respiration



Movement / Activity



Heart arrhythmia



Fitness marker

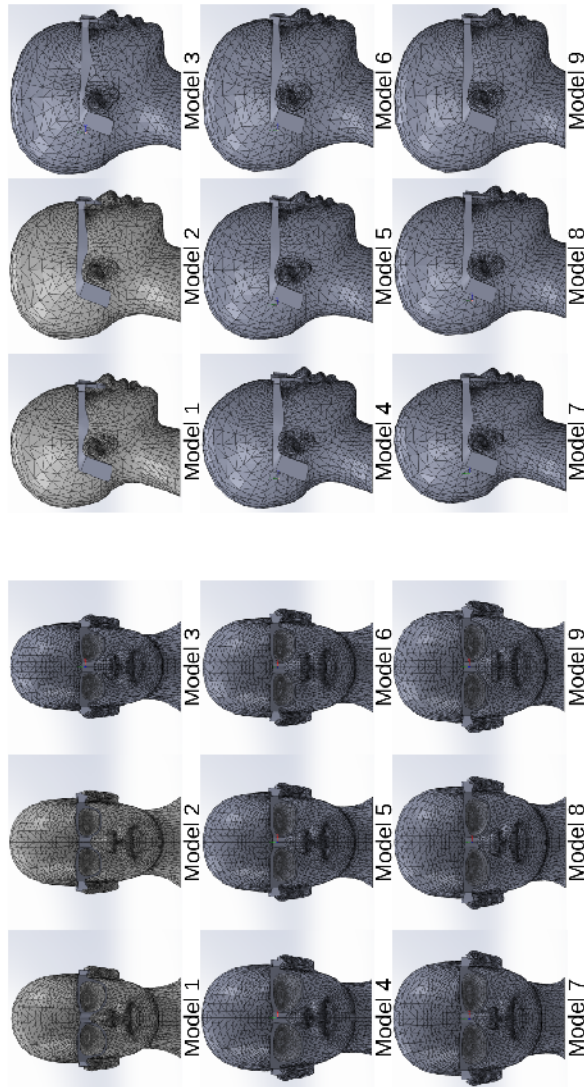


Remote monitoring

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Amft et al., Perv Comput 2015

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Wahl et al., Computer 2017



Diet Eyeglasses: Recognising Food Chewing Using EMG and Smart Eyeglasses
Rui Zhang, Steven Bhandari and Oliver A. mtt
IEEE SPECTRUM

ag scientist. In the US, about 25% of the population are obese. A recent study found that people who are obese are more likely to have heart disease, diabetes, and other health problems. Smart eyeglasses that can monitor food intake and chewing patterns could help people lose weight and improve their health. The researchers used a combination of sensors and algorithms to track food intake and chewing patterns. They found that people who wore the smart eyeglasses for a week lost an average of 1.5 pounds. The researchers also found that the smart eyeglasses could detect when a person was chewing, which is a key indicator of food intake. The researchers plan to use the smart eyeglasses to help people lose weight and improve their health in the future.

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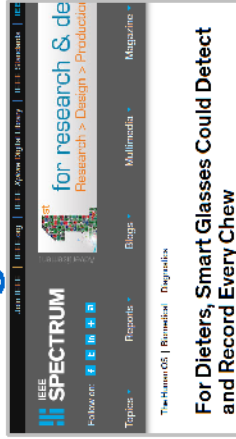
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Press coverage



For Dieters, Smart Glasses Could Detect and Record Every Chew

by Lisa Stokich

Smart glasses could help people lose weight by detecting when they are chewing, according to a new study.

The study found that smart glasses could detect when a person was chewing, which is a key indicator of food intake.

The researchers used a combination of sensors and algorithms to track food intake and chewing patterns.

They found that people who wore the smart glasses for a week lost an average of 1.5 pounds.

The researchers also found that the smart glasses could detect when a person was chewing, which is a key indicator of food intake.

The researchers plan to use the smart glasses to help people lose weight and improve their health in the future.

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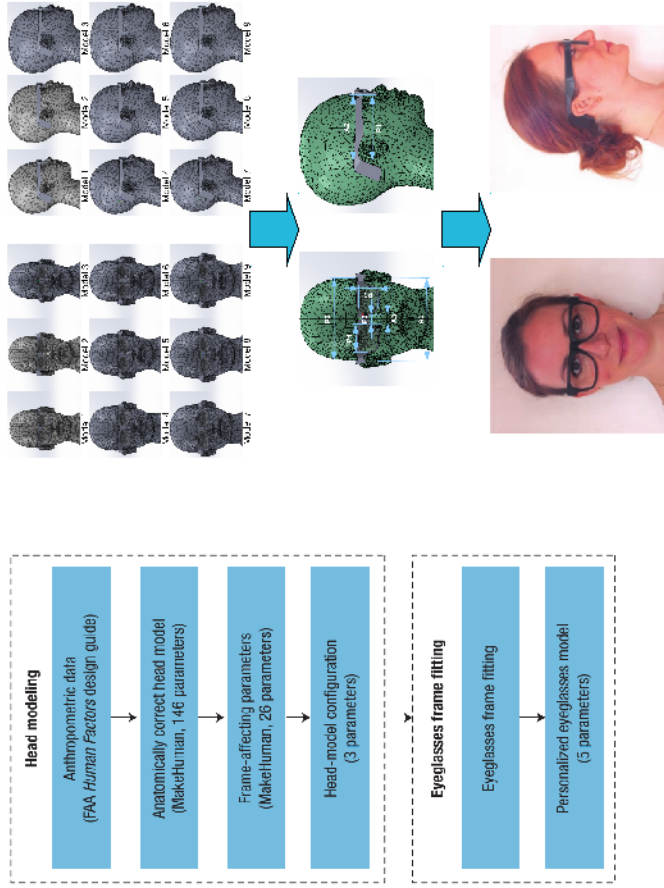
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Digital development of eyeglasses



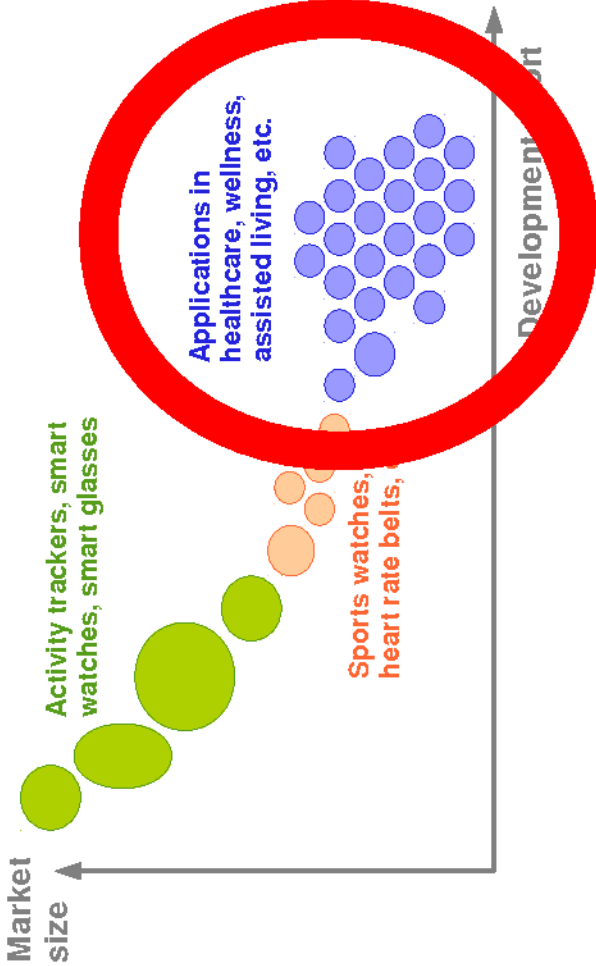
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Wahl et al., Computer 2017

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Wahl et al., Computer 2017

Market size vs. development effort



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Amft & v. Learchoven, Perv Comput 2017

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What if... ?



<http://www.instructables.com/id/3D-Printing-Health-Custom-DIY-Orthotics/>



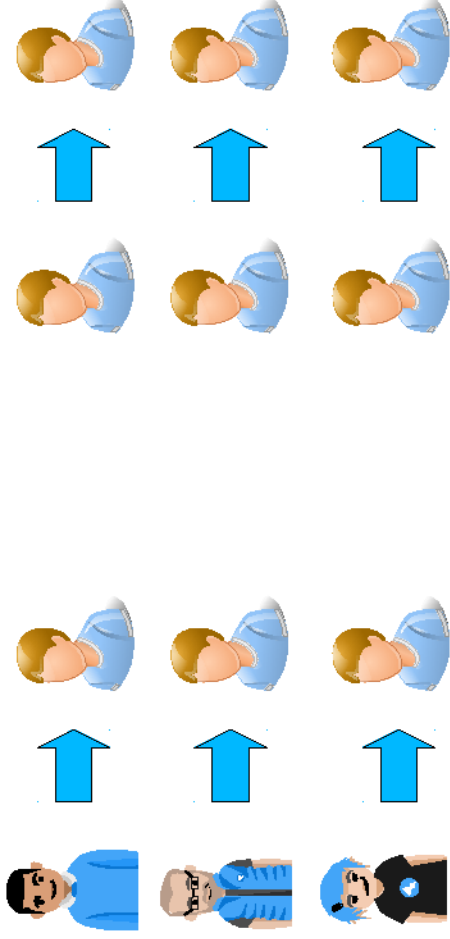
Exo-leg concept by William Root.
<https://www.ausmed.com/articles/3d-printing-in-healthcare/>

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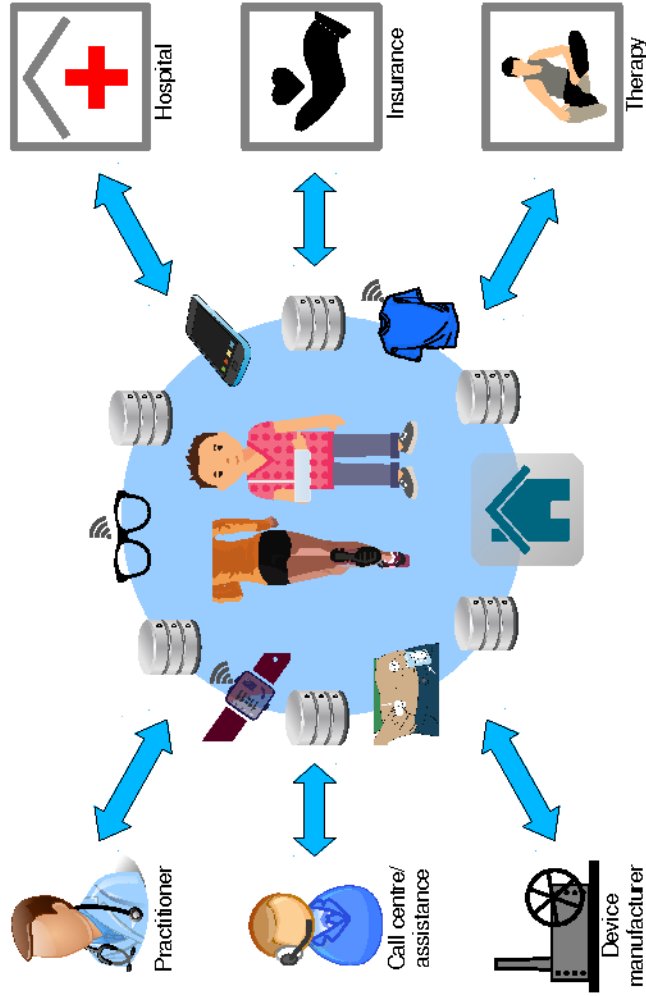
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Openness vs. ???

Models?



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Openness matters

- Open AI algorithms platform
- Open designs
- Software APIs
- Communication standards

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<http://www.emh.med.fau.de>