SMART CONNECTED BIKES

Smart Connected Bicycles Project

CROW Kenniscafe Fiets & Wetenschap

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UNIVERSITY OF TWENTE. TU Delft SAXION ACCELL GROUP TNO innovation for life

SMART CONNECTED BIKES

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Jongeren onderschatten de gevaren van telefoongebruik op de fiets, blijkt uit onderzoek van **Interpolis**. Maar liefst 3 van de 5 jongeren is de afgelopen twee jaar betrokken geraakt bij een gevaarlijke verkeerssituatie, omdat ze afgeleid waren door hun mobieltje.

De 'MisNiks-campagne' die vandaag gelanceerd wordt, moet het bewustzijn onder jongeren vergroten.

#verkeersveiligheid #campagne

Mobielgebruik op de fiets brengt drie op de vijf jongeren in gevaar

verkeersnet.nl • Leestijd: 1 min.

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deVolkskrant

REPORTAGE

Met een app, trilsignalen en een control room hoopt Amsterdam de supersnelle fiets te temmen

Veel Amsterdamse fietsers voelen zich onveilig op het fietspad, vooral door de grote snelheidsverschillen tussen gewone en elektrische fietsen. Technische innovaties kunnen helpen, zegt de gemeente. 'Maar een fiets wordt nooit zo slim als een auto.'

Elsbeth Stoker 20 december 2022, 17:40

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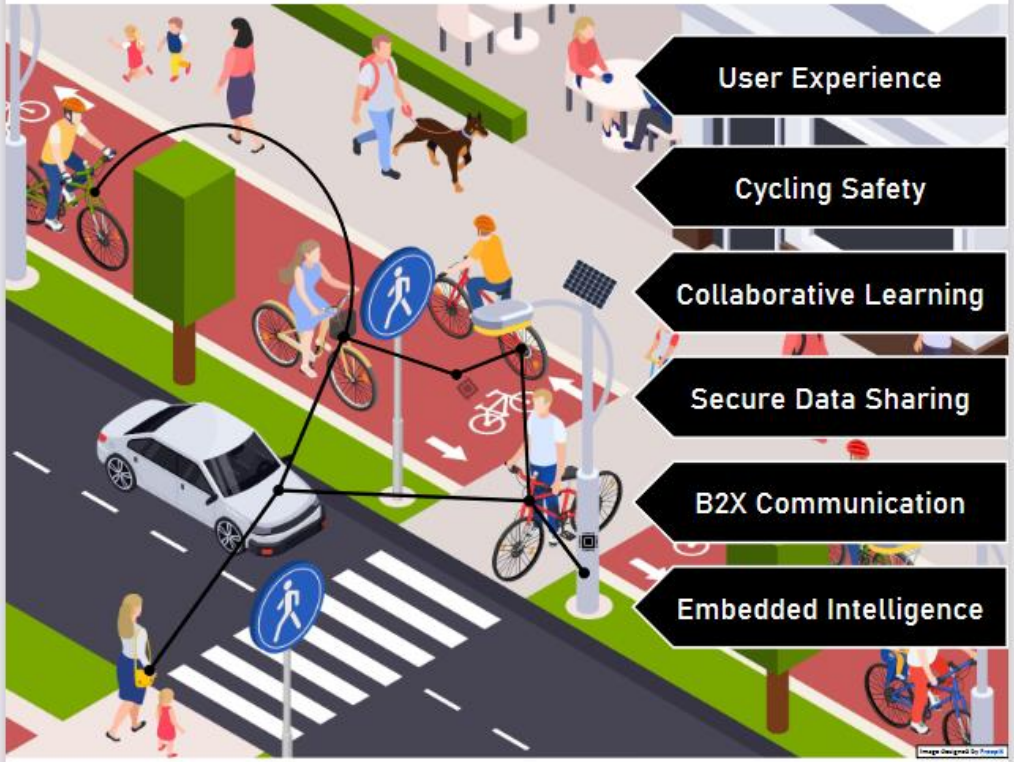
SMART CYCLING ECOSYSTEM

Towards safe, sustainable and accessible cycling



Understanding the cyclist's needs to design the way the bike interacts with the cyclist.

Evaluating user acceptance and traffic safety impact of new technologies on bikes.

Enabling wireless communication for smart bikes to communicate with other road users and infrastructure.

Studying and optimizing experiences using bio-signals and empathetic user research.

Gaining high-level insights from multiple data sources in a secure, collaborative and privacy-protected manner.

Gaining local intelligence and control using on-board sensors, processors and actuators.

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Team Striving for Smart Connected Bikes

Image Source –POP Scotland

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Engineering Technology
Transport Planning Group

&

Computer Science
Pervasive Systems Group

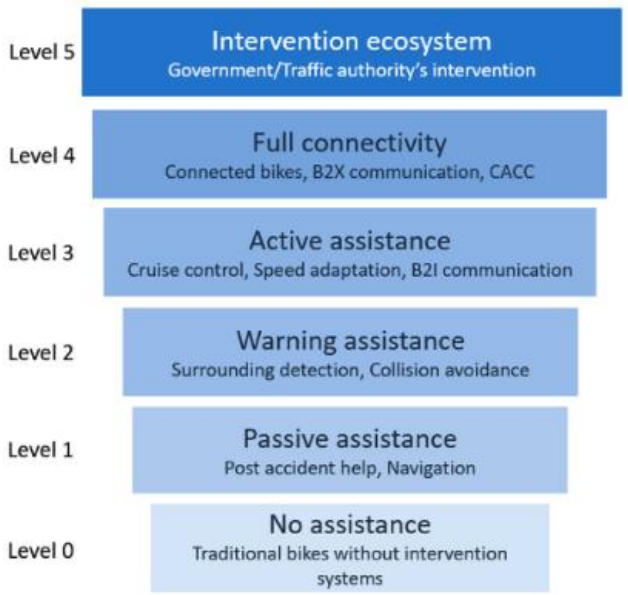
ACCELL GROUP — THE PREMIER EUROPEAN CYCLE GROUP

TU Delft

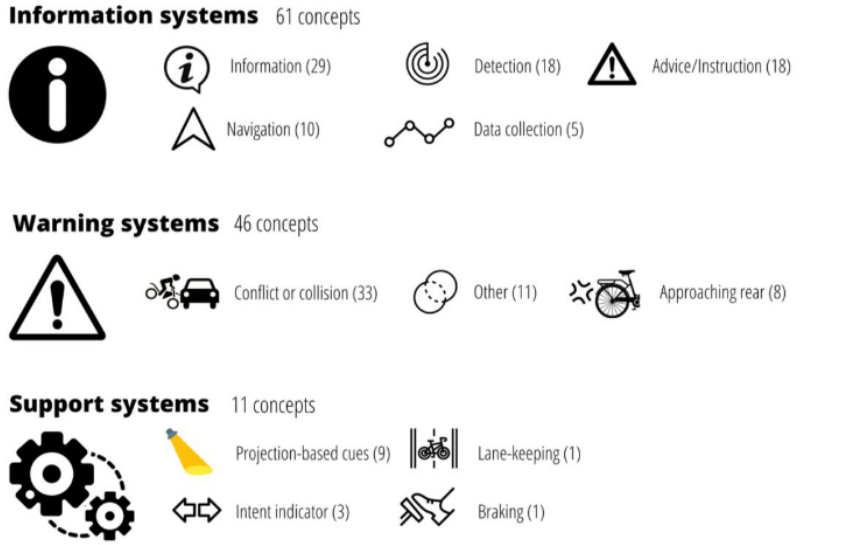
UNIVERSITY OF TWENTE.

SAXION HOGESCHOOL

Technologies for Smart Connected Bicycles



Georgios Kapousizis, Mehmet Baran Ulak, Karst Geurs & Paul J. M. Havinga (2022): A review of state-of-the-art bicycle technologies affecting cycling safety: level of smartness and technology readiness, Transport Review



Note. n=92. As a concept could have more than one function, a concept can be categorised into more than one category.

Berge, S. H., de Winter, J., & Hagenzieker, M. (2022, Preprint). Support systems for cyclists in automated traffic: A review and future outlook.

Technologies for Smart Connected Bicycles

Andres, J., Schraefel, M., Semertzidis, N., Dwivedi, B., Kulwe, Y. C., von Kaenel, J., & Mueller, F. F. (2020). *Introducing Peripheral Awareness as a Neurological State for Human-Computer Integration*. Paper presented at the CHI Conference on Human Factors in Computing Systems 2020.

Technologies for Smart Connected Bicycles

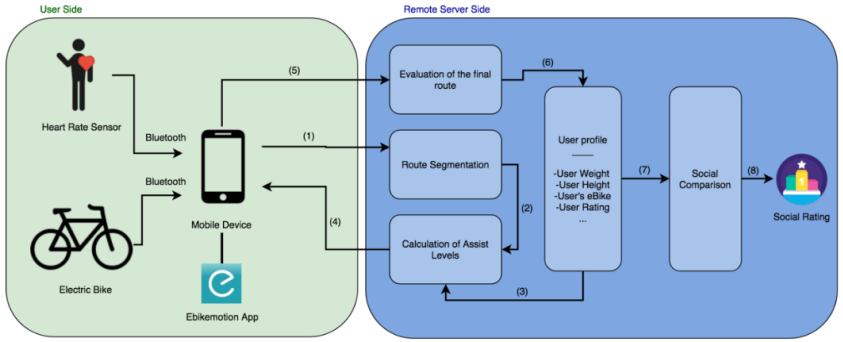


Figure 1. Overall architecture of the system: (**1**) the route selected by the user; (**2**) segmented route; (**3**) user profile data; (**4**) calculated assist levels; (**5**) data collected over the course of the route; (**6**) score obtained on the route; (**7**) comparison of the scores of other users; and (**8**) final social rating.

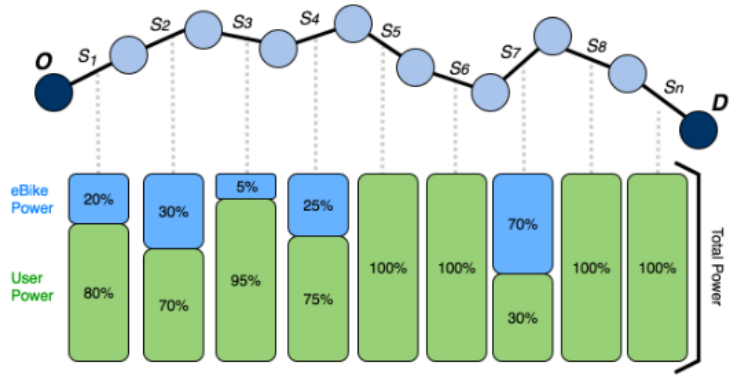


Figure 6. Example of how power is distributed for each of the segments of a route.

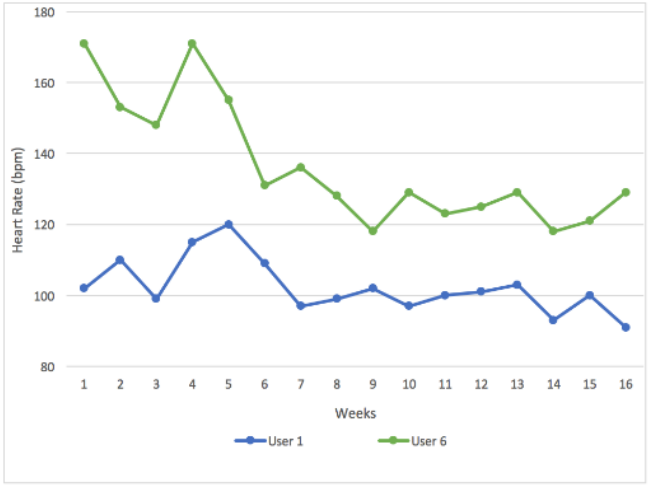


Figure 11. The evolution of the user's heart rate during exercise, over the course of the case study.

De La Iglesia, D. H., De Paz, J. F., Villarrubia González, G., Barriuso, A. L., Bajo, J., & Corchado, J. M. (2018). Increasing the intensity over time of an electric-assist bike based on the user and route: The bike becomes the gym. *Sensors, 18*(1), 220

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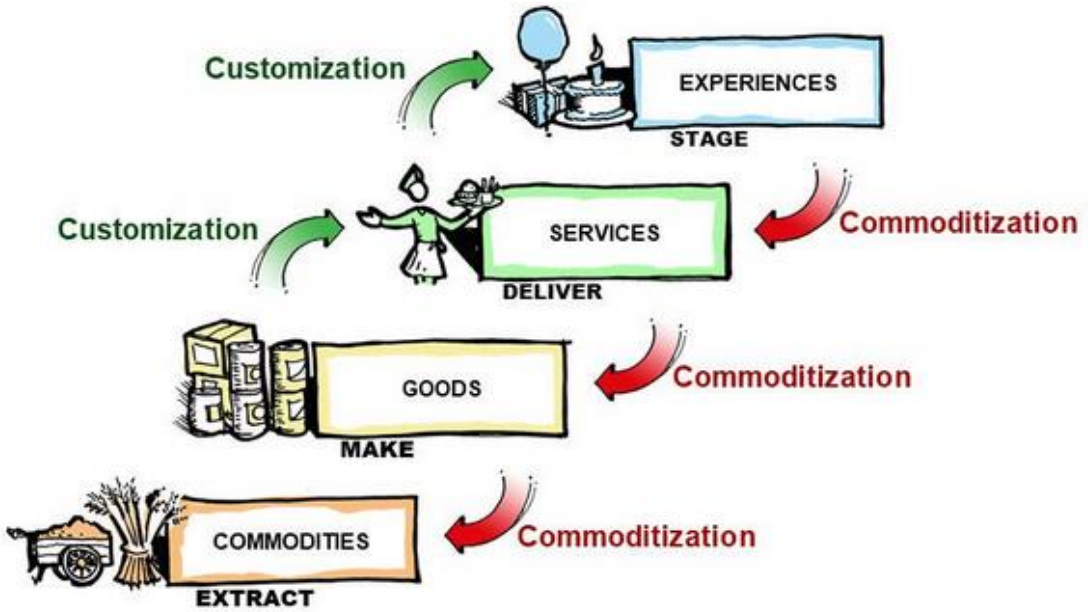


Problem

- Dominant **focus on behavior**; experience is under-researched
- Unknown impact on experiences
- Lack of **suitable method** to evaluate impact

Goal

- **Understand impact** of smart bicycle technology on experience
- Develop **quantitative experience evaluation** method

Value

- Optimize **fit to customer wants & needs**
- **Data-driven input** for control systems, design, roadmaps, policy

Challenges in existing evaluation methods

Surveys

- Intercept survey: disrupt cyclist's flow
- Post-ride surveys: memory bias

Interviews

- Rich insights, but very subjective and not well scalable

Crash data

- Reactive, reflective of past events

Traffic counts

- No insight in subjective experience

Results & challenges

Physiology

- Excitement, arousal
- Complex to analyze causation

Brain activity

- Attention, distraction
- Input for brain-computer interfaces
- Complex data analysis

Eye Tracking

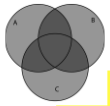
- Visual attraction & distraction
- Risk perception
- Visual behavior

Muscle activity

- Muscle fatigue
- Little research available

Movement

- Balance, comfort, vibrations
- Little research available



Mixed Method

- Higher validity in results
- Complex and resource-intensive

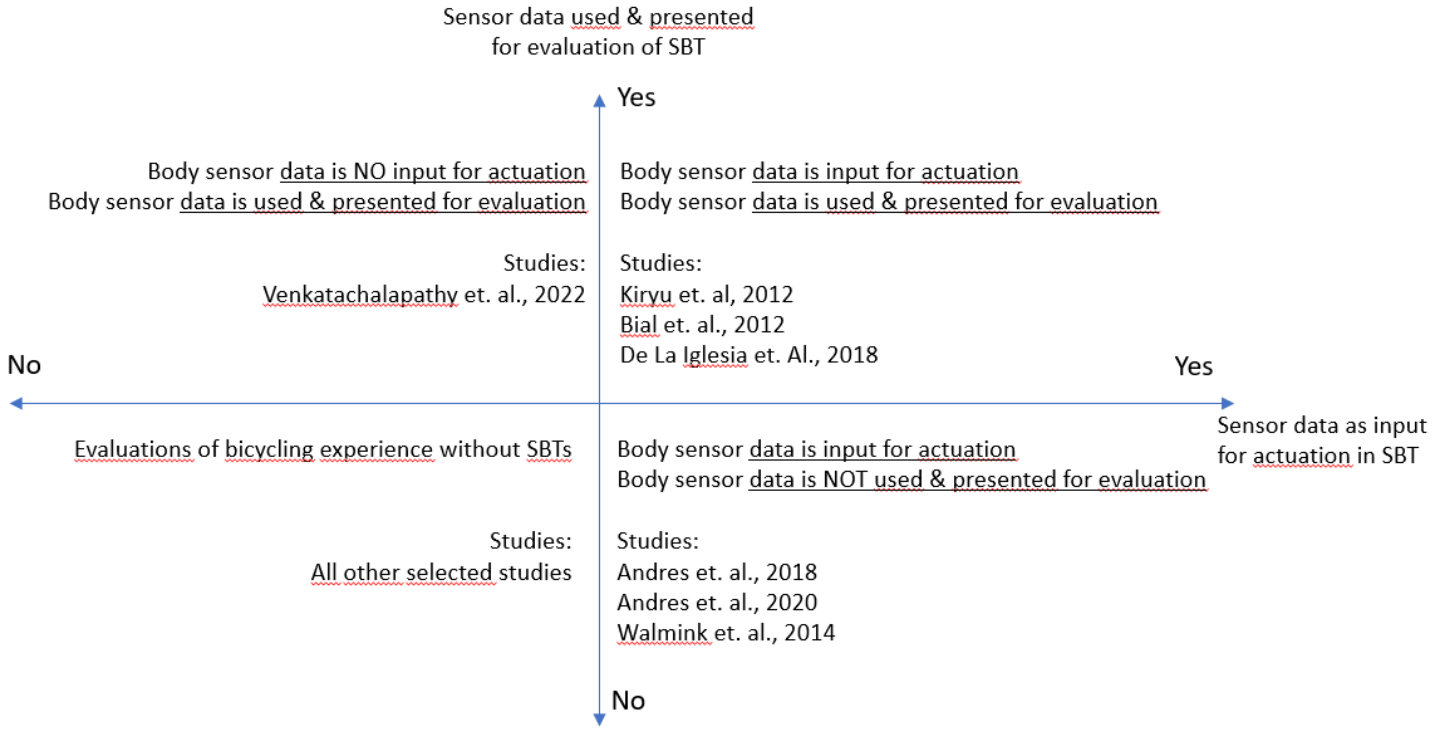
+ Other data sources e.g. video, IMUs, GIS, weather, surveys

+ Qualitative validation e.g. interviews, focus groups

Results & challenges

Step-wise guidance for preparing and conducting evaluations		
1	Define interest	Which experience type to explore?
2	Decide way of using sensor data	As input for expert evaluation, actuation, or both?
3	Balance participant burden	Which data collection- and analysis methods?
4	Labeling & ground truthing	Meaning of data?
5	Analysis of causes	What caused experiences?

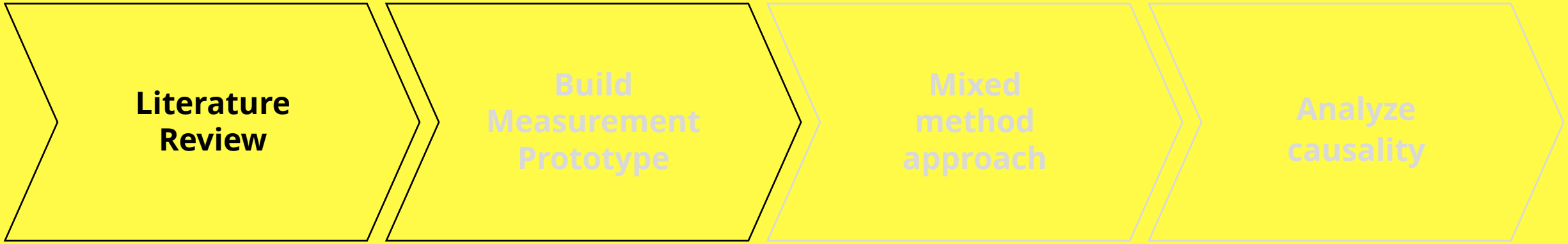
Results & challenges



Recent student theses

- Forward Collision Warning System with visual distraction detection in bikes
- A Low-Budget, End-To-End Warning System for Bicycles using Monocular Vision and Vibrating Handlebars
- Early Warning System for Safe Lateral Maneuver of Bicycles
- Balancing of Motor Assistance to Support Psychological Flow in Cyclists

Next Steps



Question: which synergies can we find?

(apart from e.g. Dutch Cycling Intelligence, MegaBITS project)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Thanks!