Minitrack: Healthcare Applications for Personal Vehicles

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Abstract

The minitrack explores the evolving landscape of engine-powered personal vehicles, covering both traditional and electric options such as e-scooters and pedelecs. It highlights changing mobility patterns among different age groups, with the elderly favoring pedelecs and the youth embracing shared mobility applications like e-scooters. Beyond driving assistance, the minitrack delves into healthcare applications, where vehicles now feature monitoring systems and sensors measuring vital signs. In shared mobility applications, the integration of health-monitoring technology raises privacy and security concerns. The minitrack addresses key challenges, including sensor configuration, data platforms, energy efficiency, privacy protection, security management, and the integration of artificial intelligence.

Keywords: Personal Mobility, Health Monitoring, Health Sensors, Data Analytics, Shared Mobility

1. Introduction

Engine-powered personal vehicles include not only cars and motorcycles but also increasingly electrical vehicles like e-scooters and pedal electric cycles (pedelecs). Therefore, the number of people using such devices as well as the individual utilization time increases. E.g., the elderly shift their primary way of mobility from bicycles to pedelecs whereas the young use applications for shared mobility with e-scooters and other personal vehicles as their primary means of transportation.

Recent research addressed healthcare applications for personal vehicles beyond driving assistance, e.g., for levels 3 to 5 of autonomous driving. Individuals can therefore take advantage of technology benefits to improve their health and well-being with monitoring systems integrated into personal vehicles providing long- and short-term warnings of potential health issues.

The vehicles are equipped with sensors to measure vital signs such as heart rate, respiratory rate, blood pressure, body temperature, and other biomedical parameters like electro-dermal activity or glucose level. In shared mobility applications, health data is subject to special privacy and security concerns as well as particularly designed analysis. Further challenges arise from sensor calibration, network acceptance and success models connectivity, and energy efficient. This includes the topics:

- Privacy protection, security management, authentication sensors, and wireless networking
- Data analytics, data integration, and cross-domain data usage
- Artificial intelligence (AI) and explainable/understandable AI
- Shared mobility applications

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- Health sensors configuration and coupling, signal/sensor fusion, digital imaging for health sensing, and hardware technologies

- System architectures, data platforms, healthcare ecosystems, and energy efficiency

Addressing these challenges is crucial for successfully implementing health-monitoring technology in personal vehicles and maximizing its impact on individual well-being.

2. Papers in the Minitrack

The minitrack contains the paper:

Continuous Health Monitoring on Shared Mobility Devices: A Health-eScooter Prototype

Authors: Joana M. Warnecke, Christian Baumgartner, Michael H. Breitner, Dominique F. Briechle, Thomas M. Deserno, Maximilian Heumann, Martin Johns, Alexander Picker, Andreas Rausch, and Lars Wolf

Abstract: With the growing significance of preventive medicine, the healthcare field is developing innovative technologies to support continuous health monitoring and personalized healthcare. Therefore, we equip an eScooter with sensors for electrocardiography, photoplethysmography, and a camera for indirectly monitoring vital signs. Personal eScooters and those shared can be used for health monitoring. Combining rental identity management with biomedical data analytics allows a secure and privacy-protecting collection of personal health information from multiple rental devices. We demonstrate recordings during a ride and discuss privacy protection, cyber security, and artificial intelligence challenges. Our Health-eScooter enables individual health monitoring conveniently, unobtrusively, and mobile.

Key contributions: 1. The first contribution centers on the development of the Health-eScooter, which captures vital signs during rides and employs data analytics and artificial intelligence (AI) to detect patterns, issuing alerts or recommendations. Two key research questions are addressed: (i) technically implementing continuous health monitoring on shared mobility devices, specifically eScooters, and (ii) ensuring robust data and privacy protection alongside cyber security measures.

2. Our second contribution revolves around showcasing the Health-eScooter as a practical use case. The prototype demonstrates the seamless integration of advanced monitoring technologies and sensors into a commonly used mode of transportation. This integration extends continuous health monitoring beyond traditional healthcare settings, facilitating early symptom detection, such as atrial fibrillation. Notably, the system outperforms typical smartwatches by conducting ECG measurements for durations exceeding 30 seconds.

3. The third contribution emphasizes the practical benefits of real-time data provided by the Health-eScooter. Riders gain insights into vital signs, activity levels, and various health metrics, empowering them to make informed decisions about their lifestyle. Additionally, the continuous monitoring facilitates the timely seeking of medical assistance and enables necessary adjustments to improve overall well-being.