Fall Detection – Dopple & Hanze

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This project is a collaboration between the company Dopple[1] and the Hanze professorship Sensors and Smart Systems. In a previous collaboration the involved parties developed a system that can create 3D models of human ears using standard smartphone imagery as input, for the purpose of creating customized earbuds for individual end users. This thesis work was well received by everyone involved. In this document a next collaborative project is laid out with the purpose of fall detection.

Background

Falls are a major health risk, particularly for elderly individuals and those with mobility challenges. According to the World Health Organization, falls are the second leading cause of unintentional injury deaths worldwide [1]. Effective and affordable fall detection systems can significantly improve the quality of life and safety for individuals in in-home and assistive care settings. Current fall detection solutions often rely on expensive or complex setups, making them inaccessible for widespread use [2].

Dopple's wireless earbuds can include a large variation of sensors that can potentially assist in multiple scenarios, such as Freeze of Gait and Hypokinetic Dysarthria in patients with Parkinson's disease, and reducing intensity of sudden sounds for dementia patients. Moreover, the expected demographic is typically acquainted with the usage of hearing aids, which too could be included in the product, contributing to user familiarity and acceptance. These aspects, combined with the high variation of provided solutions would help the accessibility and widespread use of the product without relying on expensive and complex setups, solving the hurdles faced by other fall detection solutions as described in [2].

In addition to the available sensors, the earbuds can be equipped with built-in or companion edge computing processing power. Benefits of this can include: (i) reduced dependence on external technology; (ii) faster response times; and (iii) increased privacy and security.

[1] https://www.dopple.nl/
[2] https://earsonly.nl/

Research Goal

To design and implement an edge-computed fall detection algorithm for Dopple's wireless earbuds.

What is expected

The student group will receive Dopple's EarsOnly Protect[2], which includes the LIS2DW12 accelerometer, along with the necessary tools and resources to collect and store the relevant sensor data. The students are tasked to craft a dataset, carefully considering false positives and subsequent project steps. This dataset must then be used to research and develop a software solution (e.g. machine learning model) to detect the falls. Ultimately, the intend is for these computations to be performed by the earbuds themselves.

What's after?

It is to be noted that both Dopple and the professorship Sensors and Smart Systems will have continued interest in this project as well similar projects. Therefore this project poses an interesting opportunity for future work, for example in the form of a master thesis.

Future continuations of this project specifically focus on fall prevention, as preventing a fall not only reduces the risk of injury but also promotes overall safety and well-being. While detecting a fall is valuable for timely response and recovery, preventing the fall altogether eliminates the physical, emotional, and financial consequences that can arise from such incidents, making it a more proactive and desirable approach.

References

[1] World Health Organization. Falls. https : / / www . who . int / news - room / fact - sheets /detail/falls. Accessed: November 27, 2024. 2021.

[2] Nirmalya Thakur and Chia Y. Han. A Simplistic and Cost-Effective Design for Real-World Development of an Ambient Assisted Living System for Fall Detection and Indoor Localiza-tion: Proof of Concept. 2022. arXiv: 2207.11623 [cs.CY]. URL: https://arxiv.org/pdf/2207.11623.

[1] https://www.dopple.nl/
[2] https://earsonly.nl/