Nocturnal Hypoglycemia Detection using 3D Radar Sensor Data

Background
To date more than a third of patients in long-term care suffer from diabetes. Diabetes is a chronic metabolic disorder that affects the way the body processes glucose. Diabetes is associated with a high risk for long-term complications such as cardiovascular diseases, kidney disease, diabetic retinopathy and neuropathy. In order to reduce these severe long-term complications, the blood glucose of people with diabetes must be tightly controlled – in most cases using insulin injections. The tight glycaemic control leads to an increased risk for hypoglycaemia (low blood glucose). Most hypoglycaemic phases occur at night and lead to a significant reduction in quality of life, can induce falls, and cardiac arrythmias which can be potentially deadly. Hypoglycaemia symptoms are diverse and include tremor, irregular heartbeat, changed breathing patterns and abnormal movements. In elderly people and patients in long-term care the management of diabetes is difficult due to the presence of comorbid conditions, functional and cognitive impairment, frequent change in care provider, and variable appetite and nutritional intake. Thus, this population is under an increased risk to develop hypoglycaemia. In a recent pilot study, we are investigating whether we can use a room-based radar sensor [1] to develop a new warning system for hypoglycaemia during sleep.

Aim
In this project, the student will develop and implement new concepts to detect and identify nocturnal hypoglycemia symptoms based on 3D radar signals.

Materials and Methods
For this project, the student will research signal and image processing techniques that can be applied to radar data to detect and identify nocturnal hypoglycemia symptoms. This will involve using techniques such as 3D points with corresponding velocity information (point cloud) and range-doppler maps to analyze the data. The student will then develop a predictive model based on a conventional workflow for predictive analytics, including feature engineering, variable selection, and model estimation. The model will be trained and evaluated using radar data collected in the research lab, and the goal is to create a non-invasive, anonymous warning system for hypoglycemia during sleep.

Nature of the Thesis:
- Literature research: 10%
- Experimental: 20%
- Data and image processing and programming: 60%
- Documentation: 10%

Requirements:
- Motivation to work in a multidisciplinary team
- Programming skills in python for data processing and AI
- Familiarity with movement science is a plus

Fig. Patient with overlaid point cloud and the radar sensor [1].

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References:
[1] https://qumea.com/

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