Topic: Machine Learning-Based Investigation of Overall State of Health Using Toothbrushing Behavior

Maschinelles Lernen zur Untersuchung des allgemeinen Gesundheitszustands anhand des Zahnputzverhaltens

A major issue in modern palliative medicine is the lack of objective and continuous assessment of the health status of patients. This status can be classified by measurement tools such as the Karnofsky index or ECOG (Eastern Cooperative Oncology Group) score [1]. The suitability of patients for certain therapies is influenced by this measurement [2]. The score of a patient within these scales is largely determined by the ability to perform so-called activities of daily living (ADL) [3]. At the moment, physicians largely rely on questionnaires to assess performance of those ADL. However, this bears the risk that the examination is not representative, as it is collected at a single moment and the patient's statement may be influenced by the presence of the doctor, and only reflects one point in time. In order to be able to get a more accurate and detailed overview of the current state of health, a passive and continuous assessment of these conditions would be beneficial [4].

Previous work from the Machine and Data Analytics Lab at FAU has developed a novel ubiquitous approach to measure a number of these activities. One of the selected activities was mboxtoothbrushing, which was assessed with a "smart" toothbrush. The device incorporates low power mboxmicrocontrollers and sensors (accelerometer/gyrometer). Thus, the device passively records toothbrushing behavior.

The aim of this thesis is to: i) continue a longitudinal observational analysis with patients with reduced overall state of health using the device, ii) analyze the toothbrushing data to see if individual brushing patterns can be used for participant classification, and iii) analyze the toothbrushing data to investigate whether there is a correlation between toothbrushing and overall state of health.

The underlying research question is whether it is possible to determine a deterioration in a patient's general state of health by analyzing toothbrushing behavior.
In the light of that objective, this work consists of the following parts:

- Continue and support the study with patients in the palliative care unit in order to collect toothbrushing data and the corresponding health data for comparison.
- Analyze the recorded toothbrushing data of at least 50 healthy participants over a period of one week to see if individual brushing patterns can be used to classify the participant. As part of this task, apply at least five different machine learning algorithms, specifically incorporating a minimum of three traditional machine learning algorithms and at least two deep learning algorithms.
- Analyze the recorded patient toothbrushing data to see if a deteriorating state of health in palliative care is detectable and if the toothbrushing behavior correlates with the overall status of health.

The thesis must contain a detailed description of all developed and used algorithms as well as a profound result evaluation and discussion. The implemented code has to be documented and provided. An extended research on literature, existing patents and related work in the corresponding areas has to be performed.

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References

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