Novelty Detection using Deep Learning-based Methods in Intensive Care Data

(Master Thesis)

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Motivation

Within the SMITH project (Smart Medical Information Technology for Healthcare), the use case *Algorithmic Surveillance in Intensive Care* (ASIC) aims to improve individual patient care by supporting physicians to increase the diagnosis rate of *Acute Respiratory Distress Syndrome* (ARDS). In order to substantially improve patient care, it is of great importance to collect and evaluate the measured intensive care data. Resulting secondary data can be used in research for example for the classification of diseases, where it is important to work with high quality data. During the collection of the data in secondary databases, it is possible that the data streams contain data points, that deviate from known behavior, so called novelties. Novelties mainly occur due to measurement errors like sensor errors that are not annotated in the data. Filtering out novelties by hand is a time-consuming process, so by developing reliable algorithms that efficiently detect data novelties, high data quality can be ensured.

State of the Art

There are various methods to detect novelties. Besides traditional novelty detection there are, among others, statistical, distance-based, density-based, and deep learning-based methods. Statistical and distance-based novelty detection methods regarding intensive care data have already been implemented and integrated in a novelty detection analysis system (NDAS) at the Embedded Software chair. Other published methods often make use of video or image data sources but only a few approaches deal with time-series data. The approaches that do, use newer techniques that go beyond statistical or simple predictive methods, such as neural networks. But until now, there is no publication that applies neural network-based novelty detection approaches to intensive care data specifically.

Objective

The main objective of this thesis is the algorithmic data plausibility check of secondary databases to enhance the data quality for further use in research. Newer novelty detection techniques like deep learning-based methods will be considered in the context of intensive care data and will be integrated in NDAS. With NDAS new methods will be evaluated and compared with all currently implemented novelty detection algorithms.

Planned Procedure

The first two steps will be a comprehensive literature review to identify potential novelty detection methods that can be applied to intensive care data and the familiarization with the existing analysis system and associated novelty detection methods. Subsequently, suitable novelty detection methods will be implemented and integrated into NDAS. All existing and newly implemented methods will be validated with a dataset that is annotated by two physicians. For a final comparison between all novelty detection methods, the results of the performed methods are collected and evaluated.

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