Title: Complex Event Processing in an AI System for Healthcare

Keywords: Complex Event Processing, AI System, Healthcare Data, Digital Twin, Data Stream Processing, Root Cause Analysis, Counterfactual Analysis.

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Context

The PhD will take place in the European THCS “Transforming Health and Care Systems” project RENEW which means “Reshaping data-driven smart healthcare to optimize resources and personalize care for hypertensive patients through AI and digital twin models”. The RENEW project has started in June 2024 for 3 years long. It involves 9 partners from Romania, Suede, Switzerland, Poland, Italy, Slovenia and France. The LS2N partner leads the work package about the smart data processing, the personal profiles and digital twin design.

Objectives

Health and well-being at home require to monitor in near-real time a bunch of measures and raw events at a large scale and a high frequency, coming both from the individuals and their environment. Focusing on hypertensive patients only, it is well-known that lifestyle (diet, physical activity, tobacco, alcohol, overweight) plays a crucial role in risk assessment.

Thus, the PhD aims at building, maintaining and analyzing digital twins for healthcare [1]. As part of the RENEW project, the ultimate goal is to give feedback to individuals on their practices and lifestyle based on IA models [2] and stream processing [3,4]. Also, health institutions should be able to conduct real-time analyzes and gain insights from personal models of a large cohort of patients. All in all, it is then necessary to develop an online architecture capable of continuously collecting, preparing and analyzing health and care data from multiple sources.

Guidelines

The PhD line of work should consider that each patient willingly operates self-quantification with activity tracking technologies and wearable devices [5]. The many low-to-high rate signals would be aggregated locally and updated online using *unsupervised Machine Learning* [6] to draw a sketch of a personal *digital twin*, still *preserving privacy* [7] of the individuals. Those raw models may be continuously scanned to extract useful “patterns” such that it raises the scientific issue of applying complex event processing on the latent space of the models.

At a larger scale, personal model and patterns of each patient would be streamed to a central node where the all collection of *digital twins* is expected to consistently describe the population of individuals with interesting properties. Hence, it provides the material to conduct online predictive analyzes regarding the health of the population. It also allows for *counterfactual scenarios, root cause analyzes* and *prescriptions* [8] back to each patient.

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