Involving physical activity in insulin recommender systems with the use of wearables

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Introduction

Type Diabetes Mellitus 1 (TDM1 patients are able to determine the amount of insulin to be injected in a dose according to the most recent food ingest and other factors such as physical activity, or menstruation. Recently, other elements such as stress, have been determined as key factors too, which influence this decision. Dealing with all these factors is a complex task, and patients suffering this illness are very active in looking for tools that can help them in these daily decisions.

In that regard, insulin recommender systems are decision support system (DSS) designed with the aim of providing the appropriate insulin dose to a given patient in a given moment. Moreover, the deployment of such kind of DSS in mobile devices is offering the opportunity to use new sensors that may provide additional information to improve the recommendations. For example, some researchers are exploring mobile cameras to process the food ingested in order to automatically count the carbohydrates to be considered. Other sensors, like smartwatches or wrist bands offer the opportunity to track patients' physical activity or even their stress level in order to feed the next insulin recommendation decision with this information.

Our work concerns the development of an adaptive recommender system that exploits the information from wearables, in order to improve the recommendation provided to TDM1 patients.

Method

The system relies on case-based reasoning methodology. This methodology has been proved to be useful in medical domains, since it is able to provide personalized recommendation to patients. In our approach, the four traditional steps of the case-based reasoning methodology (retrieve, reuse, revise, retain) are decoupled in two different asynchronous stages: retrieve-reuse in a mobile phone, and revise-retain in a server side. On the one hand, the retrieve-reuse stages exploits the information from a patient that has been validated by a physician. On the other hand, in the revise-retain stage a clinician reviews the evolution of the system recommendations regarding a given patient in order to validate the adaptation of the system to the particularities of the individual.

The recommendations are based on several parameters such as carbohydrates and fats ingests, recent and future physical activity, stress, etc. Most of them have to be provided by the patient, however, past physical activity can be estimated (for example in METs) by a smartwatch as well as the stress.

Results

The system has been implemented using the eXiTCBR tool. The first prototype will be tested in the next 2017.

Discussion

In order to deal with the cold-start problem (initial data from which start the recommendations), a community based data has been proposed. Other considerations to be taken into account, in order to exploit mobile devices, is contextual information.

Conclusion

Providing useful insulin recommendations requires the management of several parameters. Wearables offer the opportunity for acquiring them automatically, freeing the user from this tedious task. On the other hand, case-based reasoning is providing the support for obtaining a personalized and adapted recommendation.

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