Personalised Monitoring and Recommendation Services for At-Risk Individuals Employing Machine-Learning and Decision Support

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Abstract— **Within the context of the AEGIS Big Data project [1], a technological solution empowered by an appropriate business service delivery scenario has been delivered, facilitating the provision of personalised health related services exploiting Big Data analytics, aiming to improve the everyday living and enhance the wellbeing of vulnerable individuals such as chronic disease patients.**

I. Introduction

The use of wearables has increased significantly during the last few years, collecting a plethora of health and activity related information, which could be exploited by a multitude of applications and services, but instead are used mostly for self-monitoring by the wearables' individuals. Nevertheless, such health (e.g. heart rate, blood pressure, etc.) and activity (e.g. steps walked, calories burnt, etc.) related information hold the potential of being combined with other types of data (including e.g. ambient and outdoors environmental data) for the extraction of insights as well as for the delivery of advanced health related services (e.g. monitoring and personalised recommendation services) to at-risk individuals.

II. Methodology

Within the context of the AEGIS project, a technological solution has been delivered, facilitating the provision of advanced health related services such as the ones aforementioned, exploiting Big Data analytics, aiming to improve the everyday living and enhance the wellbeing of vulnerable individuals such as chronic disease patients, focusing mainly on patients suffering from COPD and/or CVD. To this end, a data model for collecting the information from the diverse information sources (including information from wearables such as heart rate, SpO2 and blood pressure, indoors conditions such as humidity, temperature, and VOC, and outdoors environmental conditions such as humidity, temperature, and concentration of fine particles, O3, NO2 and SO2) has been devised, and APIs to automatically fetch data have been implemented. Medical knowledge from health service providers has been incorporated in the solution, so as to generate a series of personas (groups of anonymized users) which are used in order to classify individuals into groups, so as to facilitate the delivery of group-wide notifications (e.g. adults at risk of CVD of seniors suffering from COPD or asthma, etc.). On top of that, different machine learning algorithms have been used to verify the validity and to train this model for the future inclusion of additional individuals. In close collaboration with medical doctors and healthcare service providers, health and wellbeing rules for the personas identified have been drawn, integrating the limitations of the measurements of the aforementioned information sources (e.g. 55<external PM2.5 concentration<110 and external temperature>30), and a rule engine has been employed, responsible for supporting decision making in the case of the delivery of personalised, proactive recommendations (e.g. "You should consider reducing physical activity and prolonged stay outdoors). Additional machine learning algorithms have been employed in order to proactively detect the predisposition of individuals falling within one persona, to slide into another persona (e.g. a normal, healthy adult running the risk of becoming an overweight adult with increased risk of CVD because of regular increase of his/her BMI and stable increase of his/her heart rate). Respecting GDPR regulation, information has been properly anonymized excluding sensitive data and keeping approximate geographical area information only for geo-referenced services (e.g. percentage of humidity which affects COPD patients). The solution is based on Apache SPARK running on top of HOPSWORKS for all machine learning tasks, with DROOLS rule engine integrated for decision support.

Results

The first release of the platform demonstrated the increased potential of the exploitation of big data, advanced machine learning and decision support tools in the correlation of until recently un-correlated datasets for the extraction of hidden insights and for the delivery of personalised services and the impact that the exploitation of such tools can have in the domain of healthcare, both from a scientific as well as from a financial perspective. Finally, it validated the increased interest of all stakeholders involved in this value chain.

Discussion

Proactive recommendations and reliable and accurate health status monitoring hold the potential of significantly decreasing costs for the national healthcare systems, and the minimization of hospital visits for at-risk individuals (e.g. individuals suffering from chronic diseases etc.), which also implies reduced healthcare service acquisition costs.

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References

[1] Available at AEGIS Big Data project website, accessed on 17-03-2019