Survey on Heart Failure Prediction Techniques Based on Complex Event Processing

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Abstract - Nowadays, chronic heart failure (CHF) affects an ever-growing segment of population, and it is among the major causes of hospitalization for elderly citizens. The actual out-of-hospital treatment model, based on periodic visits, has a low capability to detect signs of destabilization and leads to a high re-hospitalization rate. Heart failure or congestive heart failure occurs when the heart is not capable of pumping enough blood in the cardiovascular system that is crucial for other body organs to work. This paper we present health analysis approach for heart failure prediction. It is based on the use of complex event processing (CEP) technology, combined with statistical approaches. A CEP engine processes incoming health data by executing threshold-based analysis rules. Proposed statistical algorithm automatically computes and updates thresholds according to recorded historical data

Index Terms - Chronic Heart Failure (CHF), Heart Failure Prediction, Complex Event processing, and cardiovascular system.

I. INTRODUCTION

Real-time health data collection is very common today and with the omnipresence of a variety of inexpensive health surveillance systems. These data are then exploited by various algorithms of signal processing and machine learning. The extraction and inference steps are similar in different applications. Researchers and engineers working with real-time signals perform similar preprocessing and processing steps before making inferences1. The collected data can be used both in real-time and offline to infer multiple inferences about the patient's condition [2]. However, applications in the health field are quite limited due to network processing and demand on the support infrastructure. A real-world healthcare application requires the simultaneous analysis of high-resolution, real-time sensor data, as well as data from other sources, for many users. Processing all data on a single machine locally is not practical due to computational constraints, reliability, scalability, power consumption issues, and recovery/ failures.

The analysis of health data is usually based on the comparison of health measures extracted at predefined thresholds. Symptoms can be detected when a measurement is above or below a threshold. Early detection of heart failure symptoms reinforces the prediction of stroke and can therefore prevent it. The most important task is therefore to define "precise" thresholds. The accuracy of an analysis strongly depends on the precision of the thresholds used.

According to existing medical surveys, telemedicine has been adopted to treat patients with heart disease, diabetes, hypotension, hypertension, hyperthermia and hypothermia [4]. The most promising application is real-time monitoring of chronic diseases such as cardiopulmonary diseases, asthma and heart failure in patients located far from healthcare facilities through wireless surveillance systems. Heart disease has become one of the leading causes of death in men worldwide. For example, about 2.8 million people die each year from overweight or obesity, because obesity can have adverse metabolic effects on blood pressure and cholesterol, ultimately increasing the risk of coronary heart disease, ischemic stroke, and common cancers. According to the WHO, the rate of heart disease could reach 23.3% worldwide by 2030. The treatment of these chronic diseases requires continuous and long-term monitoring to control the threat.

To present new alternative user interfaces to the doctors. We look at possibilities for patient monitoring with the help of Wireless technology. The purpose is to find solutions for the utilization of remote patient monitoring system. The objective of Patient Monitoring system is to have a quantitative assessment of the important physiological variables of patients during critical periods of biological functions; this system is used for measuring continuously automatically the values of the patient's important physiological parameters such as blood pressure, body temperature, heart activity, and other health-related criteria. When patient is connected to life support apparatus like heart lung machines correct functioning has to be monitored by doctors in hospitals.

II. LITERATURE REVIEW

Here we discussed the literature review of existing techniques:

In this paper [1], they present a review of the literature on health care analysis using data mining and big data. In accordance with the PRISMA guidelines (preferred reporting articles for systematic reviews and Meta-analyzes), they searched the database between 2005 and 2016. Essential elements of selected health sub-domains for studies, techniques Data mining, types of analysis, data and data sources were extracted to provide a systematic view of development in this area and possible future directions. They discover that the existing literature mainly examines analysis in clinical and administrative decision-making. The use of human-generated data is predominant given the widespread adoption of the electronic medical record in clinical care.

The use of automated instruments for real-time monitoring of biological parameters is a valuable tool for improving the quality of life of the patient. The integration of mobile communications with wearable devices has facilitated the shift from health support to clinic-based surveillance to patient-centered surveillance. In this paper [2], a real-time monitoring system is proposed. The system is designed to provide patients with an instrument to easily monitor analyze and record their own vital signs using portable sensors and an Android device, such as a Smartphone or tablet, providing a solution effective in terms of time, human error and cost.

Sorting information is also a challenge because of the high volume of sensor data generated by each sensor. In this model [3], they propose the Health Event Aggregation Lab (HEAL) model, a platform that provides developers with services to take advantage of similar previously processed data and corresponding detected symptoms. The proposed architecture is cloud-based and provides services for input sensors, Internet of Things devices, and context providers. The ultimate goal of the system is to bridge the gap between symptoms and diagnostic trend data in order to predict health anomalies accurately and quickly.

In this paper [4], it has been proposed to develop a real-time cardiac monitoring system that takes into account cost, ease of application, accuracy, and data security. The system is conceptualized to provide an interface between the physician and patients for bidirectional communication. The purpose of this article is to help distant cardiac patients obtain the latest health services, which may not be possible otherwise because of the low physician-to-patient ratio. The performance analysis shows that the proposed system is reliable and useful because of its high speed.

The PhysioDroid, featured in this article [5], provides a personalized way to remotely monitor and evaluate user conditions. The PhysioDroid System provides ubiquitous and continuous vital signs analysis, such as electrocardiogram, heart rate, respiratory rate, skin temperature, and body movements, to help patients become empowered and improved their clinical understanding. PhysioDroid consists of a portable monitoring device and an Android application providing functionalities for collecting, storing and processing physiological sensor data. The versatility of the developed application allows its use by both average users and specialists, and the reduced cost of PhysioDroid puts it within the reach of most people. Two examples of use for health assessment and sports coaching are presented to illustrate PhysioDroid's capabilities.

The CEP (Complex Event Processing) uses an event-driven approach and correlates different sensor flows with spatio-temporal constraints for the detection of anomalies. This paper [6] proposes a health status monitoring system based on the named CEP (CRHMS). The proposed CRHMS uses biosensors (heart rate, respiration rate, blood pressure and ECG) to collect vital parameters and environmental sensors (accelerometer, global positioning system (GPS)) to identify the context of the elderly patient who is alone at home. These sensor settings are collected on an Android phone and sent as a stream to the proposed system to identify vital sign abnormalities and generate an alert.

According, different systems have emerged and competed in recent years, namely information flow processing systems (IFPs). In this paper [7], they propose how semantic technologies can contribute to the field of complex events and study their support in the field of health surveillance. Complex event processing systems (CEP) combine precise semantic information with information being processed. The proposed approach combines semantic Web methodologies and the CEP model into a health monitoring platform.

III. COMPARATIVE ANALYSIS

Table.1 Survey Table

Sr. No	Paper Name	Author	Method Proposed	Limitations
1.	A Systematic Review on Healthcare Analytics: Application and Theoretical Perspective of Data Mining.	Md Saiful Islam, Md Mahmudul Hasan, Hayley, and Md Noor E-Alam,	Informed decision-making framework stems from the growing concern of ensuring a high value and patient-focused health care system.	Loss of information in pre-processing.
2.	A Real-time m-Health Monitoring System: An Integrated Solution Combining the Use of Several Wearable Sensors and Mobile Devices	Salvatore Naddeo, Manolo Forastiere, and Giovanna Sannino	Physiological monitoring application designed for Android mobile devices.	Performance of this method is not good.
3.	Healthcare event aggregation lab (HEAL), a knowledge sharing platform for anomaly detection and prediction	A. Manashty, J. Light, and U. Yadav	Healthcare Event Aggregation Lab (HEAL), a knowledge sharing platform for anomaly detection and prediction	The system could produce similar results in the above real-time context with the data being sent from the Raspberry Pie device.
4.	A real-time health monitoring system for remote cardiac patients using smart phone and wearable sensors	P. Kakria, N. K. Tripathi, and P. Kitipawang	Real-time heart monitoring system is developed for chronic disease management.	False alarms can be generated due to the battery issues of sensors and Smartphone

5.	PhysioDroid: Combining wearable health sensors and mobile devices for a ubiquitous, continuous, and personal monitoring	O. Banos, C. Villalonga, M. Damas, P. , Pomares, and I. Rojas	Portable physiological and behavioral monitoring system devised for people health and wellbeing empowerment.	Performance of system is not good.
6.	Complex event processing based remote health monitoring system	Y. Deng and Q. Dai	CEP (Complex Event Processing)based Remote Health Monitoring System named	This techniques is not fast enough to detect the abnormality

IV. CONCLUSION

In this we present predictive analysis approach for cardiovascular diseases, called CEP4HFP. It can be used to predict heart failure strokes. CEP4HFP is based on using a CEP engine to continuously run analysis rules on collected health data. The used analysis rules are defined on the basis of several discussions with cardiologists and typically rely on comparing extracted health parameters to thresholds. The novelty of CEP4HFP is that thresholds are automatically calculated and updated at runtime, while using our threshold customization approach.

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