MACHINE LEARNING-BASED CLINICAL DECISION SUPPORT SYSTEM

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ABSTRACT

This article aims to design a self-organizing decision support system for early detection of important physiological events. The proposed system consists of pre-processing, clustering and diagnostic systems based on self-organizing fuzzy logic modelling. Clustering methods have been used in empirical pattern analysis. Especially when the available information is incomplete or the data model is subject to ambiguity. This applies primarily to medical/clinical data. A clustering engine can be viewed as unsupervised learning from a given data set. This module analyses a patient's vital signs to identify important relationships, patterns, and clusters among medical data. Then, use self-organizing fuzzy logic modelling to detect symptoms and events early. Based on the clustering results, we observed a high degree of agreement between the system's interpretation and the human expert's diagnosis of physiological events and signs in abnormal sign detection.

Keywords: Patient monitoring; Early diagnosis of clinical events; Clinical decision support system; Self-organising fuzzy system; Machine learning; Clustering analysis.

I. INTRODUCTION

In the last two decades, the development of patient monitoring system has been significantly increased especially in the area of general drug, vital sign monitoring, clinical decision support systems, smart alarm monitoring and other computer backed individual systems. presently, clinical decision support systems and expert systems are considered as the most common areas used by clinicians to make better opinions. Meanwhile, the number of people who bear nonstop health monitoring has risen with the increase in population and multiple habitual complaint, which may lead to the rise in global healthcare cost. Case monitoring systems can play a major part in perfecting healthcare, particularly in the aged community including impaired and chronically ill cases. These systems bring implicit benefits to both cases and croakers in terms of furnishing remote monitoring, decision support and reducing the work cargo of medical staff. Clinical decision support systems (CDSS) and expert systems have been employed in the design of patient monitoring systems to reduce crimes, increase delicacy and deliver precise care with quality outgrowth. Fuzzy sense was introduced as a way of landing crucial rules associated with clinical decision making in a machine- readable format so that advanced literacy algorithms could be employed for better and accurate CDSS Machine literacy (Fuzzy sense) systems are true advancement towards supporting the operation of complex treatments in the ferocious care unit, reducing insecurity between croakers' opinion and helping to achieve better clinical endpoints. Fuzzy sense proposition delivers an effective approach for designing a system that's too complex or vague to admit precise fine analysis. It builds a flexible information processing platform for the purpose of soft decision approach through approaching mortal decision timber. This exploration aims to support clinical opinion using machine literacy for early discovery of several physiological events, similar as, Bradycardia, Tachycardia, Hypotension, Hypertension and Hypovolaemia.

II. ROLE OF CDSS IN PATIENT MONITORING

The CDSS are useful in early discovery of colourful case specific health downfalls and help croakers with prescribed medical treatment to conduct detailed examinations. still, a recent study set up that despite society support for information technology, only limited substantiation agrees that CDSS ameliorate case reported issues and quality of life and thus, further exploration on CDSS and case reported issues are demanded. A recent review recommended that every healthcare association should have a CDSS in place with workflow for automated monitoring of case's vital signs. The part of CDSS is considered as one of the most critical aspects of patient monitoring and decision support when using cautions and monuments. It's established that early discovery of critical illness constantly demonstrates the benefit of an early intervention, which may reduce fatal hassles. A common illustration of a CDSS system enforced in a clinical setting for monitoring outpatient's vital signs for early identification is called the Early Warning Score (EWS). The EWS score can be calculated from common physiological parameters described in this paper. Derangement in any of the parameters is assigned a number and the sum of these is used to calculate an overall EWS. There has been rapid-fire growth in machine literacy- grounded CDSS and other complaint-specific decision support tools to help clinicians make better and informed decision.

III. THE PROPOSED MONITORING AND DIAGNOSIS SYSTEM

Main factors of the proposed system include; input data collection, pre-processing, clustering, fuzzy modelling and opinion affair are shown in Figure 1. also, Table I, shows the relationship between the possible symptoms and physiological parameters.

TABLE I. Relationship between diagnosed symptoms and physiological data

Events/Parameters	Heart Rate	Blood Pressure	Pulse Volume
Bradycardia	L	H, N, L	H, N, L
Tachycardia	H	H, L	L, N
Hypotension	H, N	L	L
Hypertension	H, N, L	H	H, N
Hypovolaemia	H	L	L

Where H is high, N is normal, L is low and a combination of H, N, L shows that depending on the age and patient's condition, either one is possible.

A. Pre-processing

To remove the noise and vestiges we enforced low pass filtering, removing missing values (bottoms or negative), testing the data, checking and removing outliers from the data set, and calculating statistical/ descriptive values similar as; maximum, minimal, mean, median, mode, standard divagation and range, in order to have a regularized data set throughout the opinion.

B. Clustering

The proposed CDSS espoused two most common clustering mechanisms, in order to classify data with high delicacy and trust ability. Due to the nature of the clinical data, which is complex and frequently deficient, the proposed system employed patterns of clinical data in order to established decision support model by using training and literacy dataset in an unsupervised literacy approach. For assessing and system confirmation, two fuzzy clustering ways including fuzzy c- means clustering (FCM) and fuzzy k- means clustering (FKM) were espoused. Data clustering/ bracket was performed after applying most common pre-processing styles used in big data operations and healthcare system analysis.

C. Diagnosis Output

The proposed individual system, grounded on tone- organizing fuzzy sense modelling, has been proposed using vital signals. The system detects abnormal signs which are directly related to five crucial symptoms; Bradycardia, Tachycardia, Hypotension, Hypertension and Hypovolaemia. During the training phase, we set the affair grounded on the following training rules conditions:

1. If (HR is L) and (BP is L) and (PV is H) then (Bradycardia)

2. If (HR is H) and (BP is H) and (PV is N) then (Tachycardia)

3. If (HR is H) and (BP is L) and (PV is L) then (Tachycardia)

4. If (HR is N) and (BP is L) and (PV is L) then (Hypotension)

5. If (HR is N) and (BP is H) and (PV is H) then (Hypertension)

6. If (HR is H) and (BP is L) and (PV is L) then (Hypovolaemia)

7. If (HR is L) and (BP is L) and (PV is L) then (Low vital-signs)

8. If (HR is H) and (BP is H) and (PV is H) then (High vital-signs)

9. If (HR is L) and (BP is L) and (PV is N) then (Low vital-signs)

10. If (HR is H) and (BP is H) and (PV is N) then (High vital-signs)

IV. SYSTEM RESULTS

To measure the position of acceptance between the system generated outgrowth and the mortal expert's opinion, we used Kappa analysis (i.e., as the measure of how directly the system can mimic mortal performance). The proposed system raised an aggregate of 52 admonitions and out of these, 47 admonitions matched with the expert's opinion. Table III shows the system generated admonitions related to vital signs data collated from 30 rehabilitated aged grown-ups and medical expert's opinion for the same cases' dataset.

TABLE II. System Generated Alarms

Physical Signs	*Proposed System*	*Medical Expert*
Hypotension	8	8
Hypertension	11	9
Tachycardia	12	12
Hypoxaemia	15	15
Hypothermia	6	3
Total	52	47

V. CONCLUSION

The clinical decision support system was trained offline for performance evaluation purpose using clinical normal threshold- grounded values and roughly abnormal value datasets. Two styles have been enforced and tested against MIMIC II dataset for medical opinion using HR, BP and PV. It's also proven that FCM can be used in this type of medical data where following the relationship between data and a particular physiological event is essential. The FCM algorithm will be modified using new fuzzy rules and class functions to cluster more classes. The clustered data will be fed to the fuzzy neural module for tone- organizing the limits, rules and enrolments to descry several events.

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