

Knowledge based smart health care system: A survey

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Abstract:

Life is the most precious gift to man and safeguarding this gift is of utmost importance. With increasing number of diseases and fast paced lives, people have less time to look after themselves and their family members or to even visit the doctor for regular check-ups. Our E-Health patient monitoring system can remotely monitor the health of the patients and intimate the doctor of critical conditions without human intervention. Some of the existing E-Health systems include telemedicine network for Francophone African countries (RAFT) and LOBIN. RAFT is implemented in java and uses asymmetric public – private key encryption, however it is expensive, does not support mobility and is not a context aware system. LOBIN is a hardware/software platform to locate and monitor a set of physiological parameters and context parameters of several patients within hospital facilities. Although it is a context aware system it cannot handle high and concurrent data traffic load.

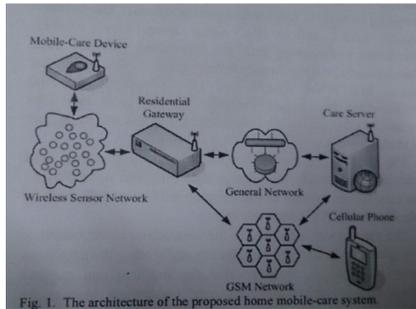
To overcome the above flaws, our proposed system puts forward an idea of patient monitoring using various knowledge based techniques like K-means clustering, Gaussian kernel function, ANN and Fuzzy inference engine. In our project we intend to do remote patient health monitoring in which we will be using three-four machines which will send various sensed health parameters to the centralised server that will make clusters of the sensed health parameters based on criticality of the health condition. Then depending upon clusters formed and on comparison with the threshold values appropriate reports will be generated and send to the doctors and caretakers.

Keywords — **Wireless sensor networks, E-Health K-Means clustering, Gaussian kernel function,**

Introduction:-

E-health is basically a concept where electronic processes and communications are used for monitoring the patient's health. Due to the busy schedules of people in today's times, it is difficult to take care of patients suffering from long-term diseases, senior citizens and children. Now-a-days many people suffer from chronic diseases. In such cases it is difficult for patients to take care of

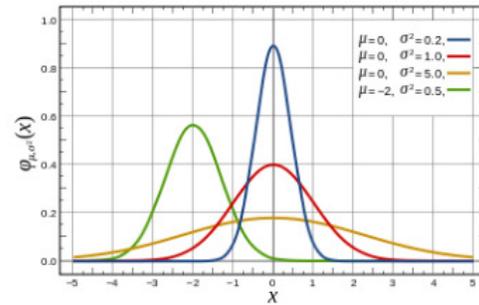
themselves. They need constant health monitoring and that's where e-health comes into picture. For these kind of illnesses, it is sometimes unaffordable to use expert medical appliances or employ home nurses. Thus e-health systems can be used as a cost effective alternative for continuous and remote monitoring of patient health.



This paper proposes the design of an e-health monitoring system which mainly concentrates on the aspect of remote health monitoring. The proposed design aims at the use of sensors for collecting vital health parameters of a patient along with the use of short range wireless communication that allows frequent patient monitoring even though the patient is moving, however within a specified range. The newly sensed data is sent to the local server. The server then analyses the sensed data, processes it, compares with threshold values and decides the criticality of disease. Depending upon the abnormality of patient's sensed health condition, appropriate health reports are generated and sent to the concerned doctors and care-takers, thereby enabling remote health monitoring in cases where it is not possible for doctors to visit their patients regularly.

To handle the concept of e-health, there are many intelligent knowledge based methodologies that are supporting this idea of Home-Mobile-Care-System such as Gaussian kernel function, K-means clustering, Artificial neural network and Fuzzy inference engine. In Home-Mobile-Care-System, mobile care devices are deployed on patient's body to collect the viable data. This data is sent to residential gateway (RG) through short-range wireless network in device to monitor patient's condition. To overcome the short-range transmission it uses same sensors deployed in the system to form long-range network using concept of multi-hop, which will help in continuous monitoring of patient irrespective of location.

Gaussian kernel



$$f(x) = a \exp\left(-\frac{(x-b)^2}{2c^2}\right)$$

Where a -> height of peak of curve

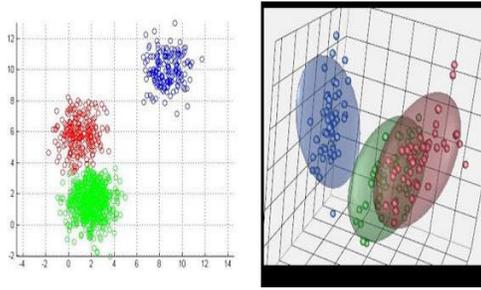
b -> position of centre of peak

c -> standard deviation.

Gaussian filters try to minimize the overhead of input for step function and this is done by minimizing rise and fall time.

K-means

K-means algorithm is widely used algorithm for clustering of data sets based on their similarities. In this algorithm, initially arbitrary data sets are considered as a centroid and using Euclidean distance measure, distance between all data sets and centroids are found. Based on this distance, again data sets are classified such that data sets having minimum distance form one cluster. Then again, centroid is calculated for new clusters and process is repeated until there is no change in any cluster. In our project we will be using K-means clustering for clustering various health parameters so that it will be easy to compare these parameters with threshold value.



Artificial Neural Network:

Artificial Neural Network is a combination of decision making and self-learning, which learns from previously generated data and tries to give accurate decision for new data. Every time it enhances its ability of generating accurate decision as it learns from its past experience. In our system ANN will be useful for taking decision about abnormality of patients health depending upon the past input and historical data of patient given to the machine as training data

Fuzzy logic:

Fuzzy logic produces definite output even though input is incomplete, ambiguous or inaccurate. Fuzzy logic works on levels of possibilities of input and tries to generate definite output such as true or false. It can be used to control machines and to deal with uncertainties. So in this system every time input may not be accurate so fuzzy logic can be used to produce acceptable response. In our project we will be using fuzzy logic to decide the category of health condition as to whether it is highly critical, moderate or normal.

This paper has been classified in different sections where section I contains introduction, section II discusses Related work and Section III is dedicated for conclusion

Section II

Related Work:

“The Applications of Mixtures of Normal Distributions in Empirical

Finance: A Selected Survey”, Tony S. Wirjanto andDinghai Xu

This paper, mostly concentrates on area of empirical finance which uses mixture of normal (MN) models for development of application. The Gaussian mixtures are increasingly used because it can approximate finite continuous distribution accurately. There are wide applications of Gaussian mixtures in the field such as biology, economics and engineering.

Gaussian GARCH and SV are widely used for generating heavy tail feature, however they fail to produce required amount of leptokurtosis related data.

“The Rectified Gaussian Distribution”, N. D. Socci, D. D. Lee and H. S. Seung

The rectified Gaussian distribution can be considered as an improved version of standard Gaussian. Although standard Gaussian restricts variables to be non-negative, rectified Gaussian distribution can accepts negative variables. Also it supports discrete and continuous variability representation. It is undirected graphical models and represents probability models in better way.

It is difficult to find tractable learning algorithm thus the practical application of rectified Gaussian theorem is limited.

“Incorporating Side Information in Probabilistic Matrix Factorization with Gaussian Processes”, Ryan Prescott Adams* George E. Dahl.

This paper illustrates Probabilistic matrix factorization (PMF). It is process used for combining data association along with pair wise relationship. PMF finds applications in many domains such as computational biology, collaborative filtering and other areas. Gaussian process is applied for searching dependencies between observations made by

PMF. GP is affordable because it uses cubic computational complexity.

One of the major issue discussed in this paper is Gaussian process can be applied only for smooth variation curves.

“Mode-finding for mixtures of Gaussian distributions”, Miguel A. Carreira-Perpiñan, March 31, 1999 (revised August 4, 2000)

Gaussian mixtures are generally used for probabilistic models for calculating the density in machine learning application. This paper considers the issue of calculating modes for multiple variables in Gaussian distribution which has applications in regression and clustering. Some of the advantages of Gaussian distribution such as it can be used in analyzing different types of computation and scaling of data dimensions. Gaussian kernel can resemble any continuous density given to the kernel. Gaussian mixture efficiently represents multiple modal distribution thus this algorithms are beneficial for various applications in machine learning.

K-means:

“Selection of K in K-means clustering”, D T Pham, SS Dimov, and C D Nguyen

K-means algorithm is well known algorithm for data clustering. The prerequisite for using k-means algorithm is specifying number of clusters. Initial step in this algorithm is to arbitrarily choose clusters for given datasets. This is a trial and error method if correct clusters are not chosen then it becomes very tedious and time consuming task of creating cluster. This paper suggests a method to select number of clusters which uses information gained during k-means clustering operations. An objective evaluation measure is applied in this method for calculating suitable values of K which avoids trial and error mechanism.

Existing method for k-means clustering uses trial and error technique for initially choosing clusters which increases the time complexity of an algorithm.

“How Slow is the k-Means Method?”, David Arthur, Sergei Vassilvitskii

K-means algorithm is preferred because of its simplicity. In this paper run time complexity of algorithm is studied using various experiments. In the worst case k-means algorithm has superpolynomial running time while calculating K values and accordingly forming the clusters. This paper illustrates although initial clusters are chosen uniformly it requires same superpolynomial runtime.

“The Planar k-means Problem is NP-hard”, MeenaMahajana, PrajaktaNimbhorkara, KasturiVaradarajanba

In K-means algorithm, finite set of points and integer value for k is given which is greater than k, and task of this algorithm is to find k point from given data sets which is helpful in minimizing the square of Euclidean distance. Minimization is done by smallest value of Euclidean distance and accordingly clusters are formed such that distance between every point to the centroid is minimum. This paper proves that the method discussed above is NP hard problem. Some of the unresolved problems about hardness are whether the algorithm becomes tractable if some associated natural parameters are restricted.

A Comprehensive Study Of Artificial Neural Networks:

In this paper the importance of ANN for artificial intelligence and other business applications is explained. ANN has great parallel processing property. It makes use of distributed memory. It has great learning ability, is a fault tolerant

system and gives a collective output of various inputs.

ANN cannot be used for general problem solving, its output quality is unpredictable and the system is prone to over fitting.

Research Paper on Basic of Artificial Neural Network:

This paper gives an overview of ANN working and its training. ANN performs supervised and unsupervised or adaptive training. It supports self organisation and real time operations. ANN works well with non linear or dynamic relationships unlike other conventional techniques. ANN trains well according to the nature of applications and the strength of the internal data patterns.

Although ANN is said to be self learning, it is still not fully understood and does not completely work. ANN seems to have a bright future however the key to the whole technology lies in hardware development.

Application Of Artificial Neural Networks In Estimating Participation In Elections:

This paper explains the use of a two layered feed forward network with tan-sigmoid transmission function in input and output layer that anticipated the participation of citizens in the presidential elections of Iran with 91% accuracy. Confusion matrix and ROC diagrams were used as assessment standards.

Designing neural networks for high efficiency is difficult. Although it provides good anticipation for long time periods, the results for short term time series are

the best. Obtaining 100% accuracy in the prediction is difficult.

Guest Editorial Applications of Artificial Neural Networks to Image Processing:

The purpose of this issue is to discuss the success of the use of ANN for character recognition, image prediction and compression, object identification, classification and segmentation, and automatic target recognition. The paper emphasises the use of artificial neural network for solving real world image processing problems.

Is there a need for fuzzy logic? :

The objective of this paper is to explain what fuzzy logic is, its unique features why it is needed and why it is likely to grow significantly in terms of visibility, importance and acceptance in the coming years. This paper clears the misconception that Fuzzy logic is not fuzzy. It actually aims at formalization of human capabilities such as reasoning, conversing, making rational decisions in an environment of imprecision and uncertainty, and performing various physical and mental tasks without complex measurements and computations. Fuzzy logic is a concept of a linguistic variable, if-then rules, possibility theory and a modelling language.

Fuzzy Logic Based Method for Improving Text Summarization:

This paper explains the use of Fuzzy logic in an experiment for improving text summarisation. In this experiment 125 test documents were used

pre-processed by eliminating stop words, words stemming, segmentation and tokenisation. 8 important features were selected and sentences were scored. On the basis of scores, the best sentences were selected for summarisation.

Feature-Based Sentence Extraction Using Fuzzy Inference rules:

This paper describes automatic summarisation of texts by sentence selection using fuzzy inference tools. The results of the experiment conducted for the same show that the best average precision, recall and f-measure of the summaries produced, are obtained using fuzzy method. For very large datasets, it is preferable to combine fuzzy logic and other learning methods as well.

As discussed above, some of the related existing systems like RAFT and LOBIN do not support certain features such as context awareness and high, concurrent traffic load. These systems are also expensive. Therefore, in our project we intend to overcome these limitations.

Conclusion:

To overcome the major disadvantages of the existing patient monitoring systems, this paper proposes a method using K-Means clustering, Gaussian Kernel function, ANN and Fuzzy Inference Engine. In this paper, many of these knowledge based techniques studied by different authors is analysed in section 2 to nourish our idea of E-Health patient monitoring.

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