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CASE STUDY AND REPORT

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Proposed Design for Future Ailment Prediction using Posture Mapping

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Abstract: E-Health is a blooming flower in the fields of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. Posture has a dramatic effect on health. When a bad posture is intentionally or unintentionally repeated, body's structure slowly changes and adapts to it, resulting in misalignment and pain, but it is often unclear which specific posture causes most problems and which mechanisms underlie the pain. In order to increase the knowledge in this field, it is crucial to analyze, different postures. The aim of this study is therefore to test the reliability of using such a system to assess various postures and make an efficient mapping of the postures of a person and the possible effects on health they may lead to in the future. The era of machine learning and data analytics have now made it possible to make an efficient mapping of the postures of a person and the possible effects on health they may lead to in the future. This can be of invaluable help to various classes of users ranging from General Practitioners to Orthopedic surgeons. The prediction of possible future ailments can also help to warn people well in advance about the problems they might be inviting due to their prolonged incorrect postures. The result and analysis can be shown to different users through graphical and multimedia features. This can include visualization tool such are bar graph, pie chart, histogram, curves etc.

Keywords: ailment prediction, back-propagation neural network, e-health, posture analysis, predictive diagnosis, musculoskeletal

I. INTRODUCTION

Most of the people worldwide are accustomed to carry out their day to day activities with body postures most suitable to them. However the posture suitable may not always be the right one. When a bad posture is intentionally or unintentionally repeated, the body will slowly start adapting to the structural changes that may lead to misalignment and pain. This drove us to take up our project, which proposes a system that collects minute posture configurations of an individual and based on that, predicts the ailment that the individual is most likely to suffer due to bad posture. Our system proposes an algorithm that takes in the pre-defined inputs from the user which are then mapped onto the training data set of the neural network [1]. A person can suffer from a body ailment due to various factors. It may be due to an improper diet coupled with long working hours in uncomfortable positions. The occurrence of such body ailments can be categorized based on the type of work/labor done by a person. It may involve maintaining an incorrect posture for long hours, thus causing pain in the body after a long period of time. Taking into consideration all such varied factors we propose a system that will predict any future occurrence of a body ailment.

II. RELATED WORK

Various Neural Networks have been widely used on a large scale by many organizations. Neural Network can deliver a study of which course of action proves effective by analyzing the input data and associating the symptoms into item sets and courses of treatments. These are some applications that are in the proof-of-concept stage that accepts a neural network that will make a decision whether a loan can be granted or not, something that has been used more successfully than many humans. Image compression is another application of neural networks due to its ability to process huge amounts of data at once. With the Internet expanding on an unbelievable rate and an increasing number of sites using large amount of images, use neural networks for image compression on a huge scale. The daily business of the stock market is a complex venture. The price of the stock is governed by various factors and a change in anyone of the factors can cause the stock prices to fluctuate. The ability of neural nets to exam and sort huge amounts of information in a split second they can be used to predict stock prices. They have become increasingly popular, especially in healthcare owing to a wide variety of applications. The healthcare industry generates huge amounts data on patient records, statistics, and medical test reports and so on. A major chunk of this data could be used as training and testing data for neural network algorithms. Artificial Neural Networks could thus be very helpful in avoiding the unsought problems due to bad postures, before they turn into something severe. Tony Hao WU, et al proposed a method to predict the systolic blood pressure of a patient using neural networks [2]. The prediction of systolic blood pressure was done by using correlated factors (serum cholesterol, fasting blood sugar, gender and electrocardiographic signal) as input to the NN. Neural network algorithms such as the back-propagation neural network and RBF neural network were used to construct and validate the biomedical prediction system. The database of raw data was divided into two parts: 80% for training the neural network and for testing the performance the rest 20% was used [2].

A study performed by Sam Murphy, Peter Buckle, David Stubbs records postural behavior in normal lessons using a previously validated observation method. They identified the extent of upper back pain, neck pain and lower back pain experienced by school-going children. This study mapped a relation between the pain in the spinal area and the sitting position [3].

A study was conducted to assess self-reported health data and posture in a directly observed sample. The sample was taken from a larger group of children (n=679) who completed

a questionnaire on back pain and school activities [3]. The Portable Ergonomic Observation method was used in the study to record the posture of the children in real-time in the classroom. All postures were recorded in relation to an upright sitting posture, i.e. trunk flexion >20 were activated when the subject's torso was at an angle of 20 or more from the vertical.

In another study, a breast cancer diagnosis system based on rough set theory, SOM neutral work, and Genetic Algorithm is proposed. With this system, data is transformed to knowledge which is very important to early diagnosis and further medical research of breast cancer. Randomly drawing 100 samples from Breast Cancer Wisconsin Dataset and exerting them on the system, 48 rules are derived. Just putting original data into system, we can get diagnosis rules such as "if a cell's mean fractal dimension is less than 13.54, then it is considered to be malignant" [4]. These simple and readable rules are practical in real disease diagnosis procedure. Since all these rules come from data itself, the result is more objective and accurate than other diagnosis methods. In fact, this system can also be applied to other diseases.

Another research provides a robust approach to various applications of machine learning in medical domain problems. This experiment shows a composite neural network model trained using the Levenberg-Marqadt algorithm [5].

This research classifies the data set of the patient's records at an earlier stage, based on the amount of dose a patient will need to take. Strong and robust classification systems can be created using Machine learning techniques for using training datasets, based on the past patient's record that have been gathered from a hospital [5].

III. PROBLEM STATEMENT

We intend to build a system that will map the postures that are most frequently adopted by a person over long durations and predict the future implications they have. This system will be trained using datasets collected from experienced physiotherapists.

IV. METHODOLOGY

A Neural Network (NN) is an important tool used for data mining, classification and clustering. A neural network attempts to mimic the human brain and learn from past experiences. This neural net will learn based on a proper set of examples supplied to it. If it is provided with enough examples, it has the capability to identify patterns or discover novel trends in data or even classify it. There are various types of neural networks, such as KNN, BPNN, m-RNN etc. This project uses the following NN algorithm:

Backpropagation Neural Network:

Backpropagation is a frequently used method of training a neural network. A gradient descent algorithm is used to optimize the results. In this method the gradient of the loss function is calculated from the error in the network. This gradient is then fed as an input to the optimization method or back propagated to the input layer, which is later used to update the weights. This also helps in minimizing the loss function. It is a systematic method for training a multi-layered artificial neural network [2, 6].

A Backpropagation network consists of three basic layers:

- an Input layer
- at least one intermediate Hidden layer
- an Output layer

Clustering:

Clustering involves grouping of unlabelled data into meaningful clusters. These clusters are then labelled with data driven categories. It is most useful with data that has very less prior information, which makes it suitable for exploratory pattern-analysis. Clustering is an unsupervised technique that identifies certain inherent categories present in the data set depending on a similarity or proximity measure [6].

As all the classification procedures look for an accurate function that is the basis of the functional relationship between different categories present in the dataset, neural net proves to be a good choice as it is capable of approximating a function with certain accuracy.

V. TECHNOLOGIES USED

A. *R Programming:*

R is a language and environment for statistical computing and graphics. R provides a wide variety of and graphical statistical (linear and nonlinear modeling, time-series analysis, classical statistical tests, classification, clustering) techniques, and R is highly extensible.

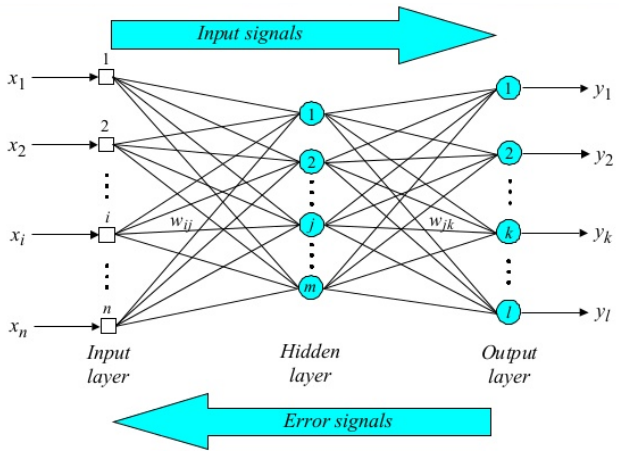

Figure 1: Clustering Network for the proposed system

B. *NeuralNet:*

Package for training of neural networks using back-propagation, resilient back-propagation with weight backtracking.

C. *RGtk2*

RGtk2 works as a GUI toolkit for R. It binds GTK2 library and its dependent libraries to R. This package provides facilities in R language for programming graphical user interfaces with the help of GTK, the Gimp Tool Kit.

D. *cairoDevice:*

It is a graphic device. In coordination with GTK it provides a graphical representation of a simulated neural network.

VI. PROPOSED MODEL

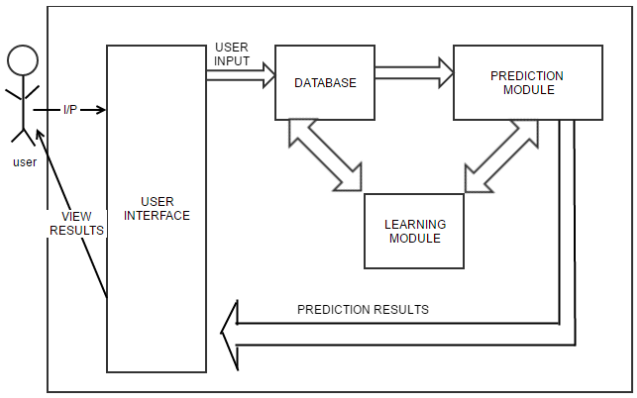

Figure 2: Activity Diagram of the proposed model

The proposed model uses clustering for classifying the dataset and back propagation neural network for training the neural net. Clustering is achieved using Self organising feature maps, which consists of two layers, an input layer and a competition layer. The neuron in the competition layer is chosen whose reference vector is closest to the input pattern. For the model, dataset used is collected from a generic group of people with the help of an online survey. The dataset is divided in a 5:1:1 ratio for training, testing and validation respectively. The neural network is trained with the following set of inputs. For each iteration the loss function calculates the error, which is used to optimize the network and thus update the weights to minimize the loss function. Once the network is trained and tested it is used to perform prediction for real time user inputs. The model provides a statistical representation of all the possible ailments the user may suffer in the future along with tips and recommendations to avoid them.

The system aims at handling huge amounts of data without a drop in performance. The system is modeled to be as user friendly and interactive as possible.

VII. CONCLUSION

Our system would exist to provide the users a detailed implication of their daily posture and steps to remedy the same. The proposed system will be unique in every aspect though there will always be a scope for improvement. The proposed back-propagation neural network to be used makes the system highly efficient and accurate and versatile. Also, depending on the time constraints we also plan on using different types of neural networks to provide a comparison between them based on their accuracy and efficiency.

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