

ARTIFICIAL INTELLIGENCE IN MEDICAL DIAGNOSIS

(Use of Algorithms & Software to Approximation Human Cognition in the Analysis of Complex Medical Data)

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ABSTRACT - In the field of medicine, predictions are of great significance. In recent times, intelligent systems play an important role. The techniques of the user interface are built on the ever-increasing and progressing areas such as Artificial Intelligence (AI) and Artificial Neural Networks (ANN). The mechanism of artificial intelligence provides substantial assistance in healthcare. Considering these optimistic aspects, a combination of accuracy of mathematics and the potentiality of automation results in a robust system. In this paper, our aim is to develop a healthcare interface web application that will aid the user and enable them to issue their symptoms of common diseases or issues faced by the user to generate a prognosis. The primary objective is to develop a machine learning system that utilizes AI and deep learning to help people to keep a check on their health with the ease of a web application. Artificial intelligence (AI) aims to bring a revolutionary change to the healthcare sector, reinforced by the increasing availability of healthcare from hospitals which acts as a catalyst to the rapid progress of analytics techniques.

Key Words: Prediction, User Interaction, Artificial Intelligence, Artificial Neural Networks, Prognosis, Machine Learning.

1. INTRODUCTION

Artificial intelligence is a cohesion of multiple technologies grouped together. Medical diagnostic applications utilize the AI approach to diagnose disease. These technologies have a vast variety of immediate relevance to the field of healthcare and nutrition, but the specific ways in which they process may vary widely. Today, the swift evolution and innovation of applied science have altered the perspective and the way

information is preceded. Artificial Intelligence has the capability to predict results and diagnose illness at a rate which is higher than most medical professionals. and A healthcare decision-making interface can make use of technology and enhance the diagnosis process.

An AI-powered medical diagnosis system can rapidly store an immense amount of data and can make intricate connections between them. Medical diagnosis applications incorporate different mechanisms from the large domain of artificial intelligence, highlighting the vast amount of benefits they have been able to achieve to the field of medical decision making and also these mechanisms come with their own drawbacks which has been discussed as it is essential to emphasize them to decide a favorable AI method for a specific task. Some of these features (pros and cons) are present in the literature survey of the domain which act as a strong evidence by the decisional systems presented. Some others have been noticed once these systems were developed [5].

This paper proposes a system that is used for the prognosis of the users experiencing symptoms which may cause discomfort to the user but can be quickly analyzed with the help of a self-service web application to diagnose the issue and if severe, contact a medical professional. The system is trained and tested using machine learning based on a dataset of symptoms faced by the users from the UCI Machine Learning Repository [6].

The paper is constructed as follows: Section II discusses the survey which was conducted, Section III and Section IV talks about the proposed system and Section V concludes the paper.

2. LITERATURE SURVEY

The purpose of carrying out a Literature Survey is to demonstrate and develop our familiarity with the existing work relevant to the focus of our study.

Prediction Techniques

Machine learning algorithms are used to analyze data again and again to produce the most effective results. It can be used for the analysis of medical data and it is helpful in medical diagnosis for sensing different diagnostic problems.

A useful method called the decision tree is used to formulate an expression which is used and incorporated in such mappings and also consists of test which may also be attributed to multiple nodes which are linked to two sub-trees or more and the leaf-nodes which is the decision is linked with the help of a labeled class.

The decision trees though being very accurate and also efficient often suffer from excessive complexity. In the case of an unsupervised evaluation the function can become inappropriate easily which in result will result in a bad solution [7]. Over fitting is one such term where the novice decision tree creators can unintentionally create over-complex trees which doesn't generalize the data well and has problem in doing so. Population size is also quite important: if the solution is very large then it will improve very slowly through the generations.

Bayes Theorem utilizes vital information which is already known about the predictive value of an observation which is relative to the given outcome to modify the probability of a known particular outcome [8]. Naïve Bayes classifier is probabilistic in nature which is primarily based on applying the Bayes theorem which have strong independence assumptions between the parameters. Bayes theorem can be deployed used for prediction of the diseases as a classifier's decision rule. The probability of the disease according to its number of symptoms can be predicted using Bayes algorithm [9]. One of the disadvantages that is considered as a choice is that Bayes theorem expresses the probability based on three other probabilities.

Neural networks are algorithms designed based on the

human brain. It can be used to cluster unlabeled data and if labeled can help to classify them. The basic structure of ANN consists of four parts which can be represented in the figure 2 below as we can see it is segregated into the Input, Middle and Output layer as well as sensor nodes which help in providing the data.[1]

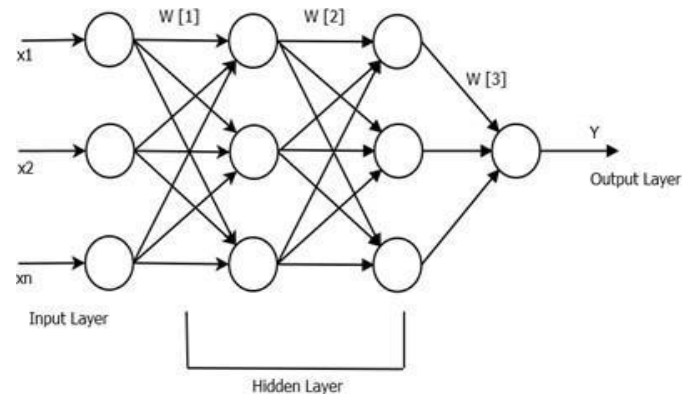


Figure -1. Basic Structure of ANN

The gathering of information is done using the sensor nodes.

The actual processing starts with the input layer. The input layer applies an activation function over the input nodes. The input layer data is multiplied with weights before forwarding it to the next layer and so on as shown in the figure. The hidden layer does the work of processing and is the main reason for the acceleration of processing work. The output layer gives the final result.

In the proposed paper, the author tried to apply a heart diagnostic system to detect a synergy in the cardiac muscles using neural networks and fuzzy logic [2]. In the proposed paper the author built a self-diagnosis system for detecting cervical cancer with the help of artificial neural network [6]. In this paper the author tried an experiment of testing an ANN based diagnostic model. The author described about the architecture of ANN being used and came to a conclusion of the accuracy and reliability of a typical architecture after performing several experiments on the model [1].

In the following paper the author did a review of the technologies being used in the field of medicare. The author also described the implementation of numerous AI technologies in the field of medical sciences and tried to conclude the accuracy of techniques being used in the medical diagnosis [3].

A. Medical Self-Diagnosis Systems.

As we all know the major areas in medical fields where decisions play a vital role especially in the medical diagnostic analysis and process as there are several studies on medical diagnostics. To determine or interpret the illness based on the symptom/s experienced by an individual is known as medical diagnosis.

A user-interface application which may be in any form such as a mobile application or web application aims just to do that: the individual enters the symptoms that they're experiencing into the app and a prognosis is generated which is made possible with the implementation of intelligent machine learning algorithms some of which are incorporated in the proposed system.

A chatbot called as Babylon Health's symptom checker is one such application where the user can interact with the system and generate a prognosis on the input given by the user, the system follows a general QnA (Question and Answer) format to collect information from the user.

Also, there exist several systems such as Mayo Clinic (<https://www.mayoclinic.org/>) and Cura (<http://cura.healthcare/en/>), usually these systems are affiliated to certain hospitals and only available for the patients of these hospitals. Also, many of these systems are not free [7].

Table 1 shows a list of medical self-diagnostic systems. The table presents the system name, whether it is free or not, whether it is attached to a specific hospital. The last row shows the features of the proposed system as compared to the existing ones.

Name	Free	Attached to a Hospital
Mayo Clinic	No	Yes
Babylon	No	Yes

Cura	No	Yes
Proposed System	Yes	No

Table -1: Trait of the existing self-diagnostic systems and the proposed system.

In reference to the table, the following observations can be concluded:

Most of the systems are not free.

Most of the systems are attached to a hospital.

Features are restricted to the users which results in a lack of flexibility and individuality. An easy to use user interface is much appreciated that is freely available.

B. Contemplated Model.

Medical care is vital for all humans. This paper attempts to fill these gaps and proposes a system that is free, general, i.e., not attached to a specific hospital. A simple automated system that diagnosed symptoms. Also, assimilate several classifier techniques to aim for better accuracy of the system.

METHODOLOGY

Front End

The system proposed here is deployed as a Web Application which is enabled with the help of web development tools like HTML, CSS and JavaScript in the front-end which is incorporated with a back-end that uses a machine learning model for symptom diagnosis. The web application greets the user with a minimalistic yet simple user interface that can be easily navigated by users of all age groups since the web application is clutter-free as it just takes user symptoms and provides a diagnosis to the user. While using the web application the users should provide accurate information to get the correct diagnosis. The web application is integrated with text fields in which the user can increase or decrease depending on the symptoms experienced. Designing the graphical user interface (GUI) was preferred over a chatbot as having an easy to use interface is the priority as mentioned earlier.

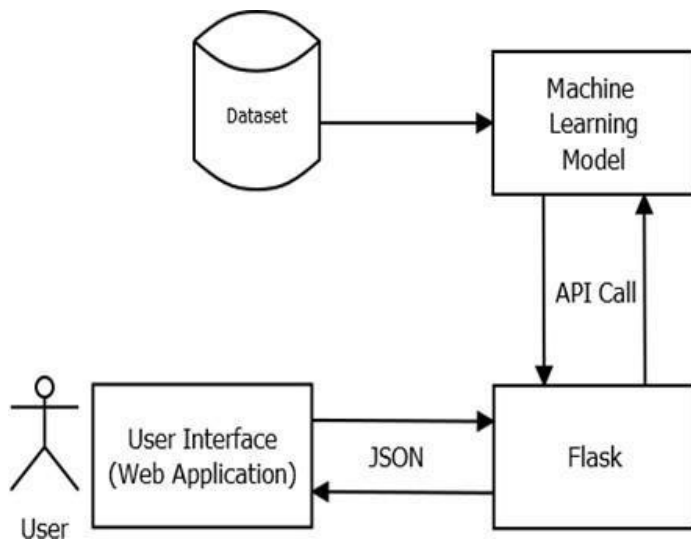


Figure -2. Block architecture of the system.

The web application is designed using basic web programming languages such as HTML, CSS and JavaScript. The middleware used for connection is Flask. Flask is a python framework which provides with libraries and tools for developing web application. In the system proposed the data from the user interface is transferred to the backend using flask which helps in making API calls to the model for prediction and the predicted result is fetched and displayed on the GUI.

Request is used for making API calls when triggered by the interface, jsonify is used for fetching the data collected from the UI and render template is used for displaying results on the web application.

Back End

The backend of the application is a supervised machine learning model.

Based on the literature survey and the dataset considered the following two classifiers can be used:

1. Naive Bayes Classifier
2. ANN Classifier

A simple probabilistic classifier known as the Naïve Bayes Classifier is based on applying Bayes theorem with strong independence between the features. They are one of the simplest Bayesian network models but can achieve greater accuracy by combining them with Kernel Density Estimation. Bayes theorem calculates the posterior probability, $P(c|x)$, from $P(c)$, $P(x)$, and $P(x|c)$. Class conditional independence is one of the assumptions made by Naïve Bayes classifier which assumes that the effect of the value of a predictor (x) on a given class (c) is independent of the values of other predictors.

$$P(c|x) = \frac{P(x|c)P(c)}{P(x)}$$

Likelihood
Class Prior Probability
Posterior Probability
Predictor Prior Probability

$$P(c|X) = P(x_1|c) \times P(x_2|c) \times \dots \times P(x_n|c) \times P(c)$$

Figure -3. Naïve Bayes Theorem

For applying this algorithm on python we can use multinomial naive bays classifier from sklearn python library. The following algorithm can be applied using multinomial NB classifier on the train-test split format of dataset where 80% is recommended for training and the remaining for testing the accuracy of the ML algorithm trained.

Another supervised learning algorithm that can be applied is Artificial Neural Network (ANN) classifier which is based on neural networks. Neural networks are algorithms designed based on the human brain. It can be used to cluster unlabeled data and if labeled can help to classify them. As the dataset used is in a labeled form, we can use ANN as a classifier on it. The basic structure of ANN consists of four parts: sensor nodes, Input layer, Middle layer, and Output layer as shown in figure 2.[1]

The gathering of information is done using the sensor nodes. The actual processing starts with the input layer.

The input layer applies an activation function over the input nodes. The input layer data is multiplied with weights before forwarding it to the next layer and so on as shown in the figure. The hidden layer does the work of processing and is the main reason for the acceleration of processing work. The output layer gives the final result. In our project, the dataset is provided to the input layer where symptoms become the input nodes, and prognosis becomes the nodes in the output layer. The hidden layer nodes are adjusted based on the input and output nodes.

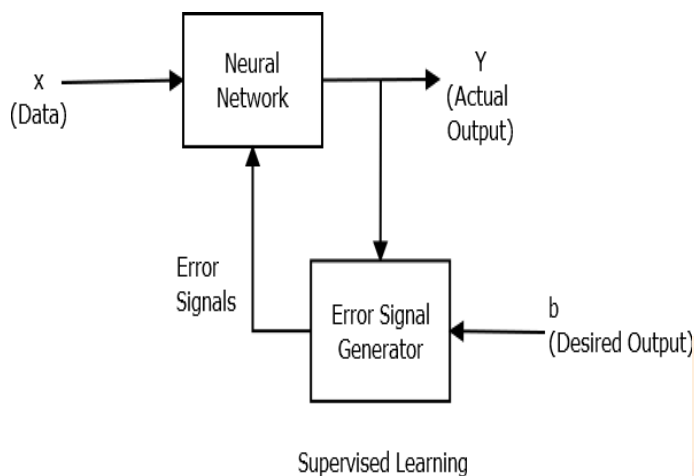


Figure -4. Functioning of a Supervised Neural Network.

For creating the model dense and sequential are the functions of the keras library used.

Sequential specifies that the model being formed is in sequential format and the output of the layer which have been added is the input to the next layer which is going to be added. As a supervised model is being applied the actual result is compared with the desired one to give the error signals which in succession are used to adjust the weights as shown in the figure 4. In this way after several epochs the model is finally trained which can be used for prediction.

4. CONCLUSION

Thus, this paper represents a supervised machine learning algorithm driven system for simple medical diagnosis of the user. The result of applying the algorithms on the dataset used suggests that the ANN

classifier model's accuracy to be 91.4% and that of Naive Bayes to be 86.3%. Based on the accuracy scores ANN classifier provides more accurate predictions for the selected dataset. This system would be beneficial for the users to take pre- diagnosis so that it can gauge the severity of the symptoms being experienced. By applying this system as a web application, the hassle of downloading the app and the barrier of the technology used in the user's devices are eliminated. In future the data fetched by the user (using only the symptoms and predictions excluding the user's personal information) could be updated in the dataset and the model could be retrained at regular intervals to get better accuracy of the model.

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