IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 7, July 2020

Approaches for Dengue Fever Prediction: A Survey

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Abstract: Epidemics are one of the major reasons for death of many people with major impact on population. Hence it is very important to identify the cause and predict the spread of epidemics so as to reduce the threat that may be caused. In recent years, Dengue is one of the most commonly found epidemics in several developed and also developing countries like India. Since its mortality rate is high, it should be detected in advance to facilitate for proper medical arrangements and thereby decrease the mortality rate.

Keywords: Epidemics, Dengue, prediction, forecasting, fatality, classifier.

I. INTRODUCTION

In developing countries like India having more population, healthcare is of at most concern. The medical resources provided by the government cannot meet the demands of such a huge population. Further the rural people are adversely impacted because of the deficit of medical resources. Most of the people cannot afford private hospitals thereby increasing the load on government health sector. Due to lack of easy access to medical resources to the public, the fatality rate is high in case of an epidemic. Whenever an epidemic occurs it is essential to make arrangements for medical resources since most of the people in India lives in rural areas. Dengue is found to be the one of the most commonly occurring epidemics in many developed and also developing countries. In India dengue was first detected in Kolkata during the year 1963. Due to its high mortality rate, it has to be detected in advance to facilitate arrangement of proper medical in time and thereby decreasing the mortality rate. People of varying age groups ranging from children to elderly persons can be affected by dengue. Furthermore, since it has no specific treatment, it is very important to detect and treated it in time. Dengue is caused by virus and Aedes Aegypti and Aedes Albopictus are the two kinds of mosquitoes that transmit the disease. When a person is bitten by these mosquitoes, he or she gets infected by the virus when it reaches the blood stream. The best way to prevent dengue is to control or wipe out these mosquitoes.

More than two million people are getting affected by dengue fever every year. According to National Vector Borne Disease Control Program, in the year 2017 a total of 188,401 were registered and in 2018 a total of 89,974 cases registered were in India [6]. Dengue has spread more tremendously in the past fifteen years. Every year lakhs of dengue cases are detected, and around 20,000 patients are dying annually.

The tropical regions are more prone to dengue due to the highest mosquitoes-sustaining environment; especially the female mosquitoes are the cause for the spread of that disease. Dengue fever is also called as breakbone fever since it causes pain like that of a breaking bone. Every individual can keep themselves away from this disease by safeguarding oneself from the mosquito bites. The main symptoms of dengue tend to appear after about three to fifteen days from the mosquito bite. Some of the general symptoms of dengue fever are high fever, severe headache along with severe pain behind the eyes while moving the eyes. The other related symptoms are: bone pain, muscle pain, joint pain, rashes, mild bleeding, low back pain, reduction in WBC and platelets. Depending on the extent of these symptoms the dengue fever can be categorized as either dengue fever or dengue hemorrhagic fever. It is hard to differentiate among these in the initial stages. The physical examination for dengue fever involves measuring physiological variables such as body temperature, blood pressure and heartbeat rate whereas the laboratory examination involves blood test analysis of the counts of hematocrit, platelet and white blood cell. The patient is likely to have high fever when gets infected by dengue fever. When the temperature of body falls below 38ºC, it means that it is the starting of the critical stage. At this stage, the patients may enter into severe dengue wherein severe plasma leaking or bleeding may happen. The severe dengue is also indicated by a fast heart rate or tachycardia. In serious cases the platelet count drops down continuously. With regard to blood pressure, plasma leakage is likely to occur when there is an increase in diastolic pressure and narrow down of pulse pressure. The increase in hematocrit above the median baseline which is 46% for males of age less than or equal to 60 and 40% for females along with a fast decline in platelet count is the substantiation of plasma leakage[4]. When there is a significant amount of loss of plasma through leakage it results in shock to the patient and with undetectable blood

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 7, July 2020

pressure hypotensive or decompensated shock is intense, causing reduction in hematocrit, increase in white blood cell count and BT to become subnormal.

II. LITERATURE REVIEW

Researchers have done a lot of works in predicting dengue fever using different techniques. Some of the techniques are as mentioned below:

A. Bayesian classification: This method is based on the finding an approximation of the joint probability distribution $P(c,a_{1,\ldots,}a_k)$, where c is a random variable indicating the class, and $a_{1,\ldots,}a_k$ are random variables representing the attributes. Hence in Bayesian classification the learning is based on the evaluation of the joint probability distribution. Upon constructing this estimate, a new instance can be classified by finding conditional probability c for the given value of the attribute and finally returning the class that has the highest probability.

B. Decision tree classification: The decision tree contains three categories of nodes: root node, internal node and leaf node. The root node has no incoming edges but contains zero or more outgoing edges; the internal node has exactly one incoming edge but two or more outgoing edges; and the leaf node also called terminal node consists of exactly one incoming edge with no outgoing edges. Every leaf node is assigned with a class label. The records having different characteristics are segregated based on the attribute test conditions specified at the root node and across the internal nodes. After constructing the decision tree the next stage involves classification of the test record which is relatively straightforward. For the given test record, the tree is traversed from the root at which the condition specified at that node is applied to the test record; depending on the result of the test, appropriate branch is selected and traversed. The selected branch in turn may direct towards another internal node where another test condition is applied to the record, or lead to a leaf node wherein the test record is finally given the class label associated with that leaf node.

C. k Nearest Neighbours Algorithm: In this approach, each characteristic from the training set is taken to be a different dimension in some space, and the value of an observation for that characteristic is considered as its coordinate in that dimension, resulting in a set of points in that space. The distance between any two such points in that space gives a measure of the similarity between those points. Since the algorithm considers the k data points from the training set which are closest to the new observation, it is named as k Nearest Neighbours Algorithm. Finally, the algorithm selects the most common class among these as the class for the new observation.

D. Support Vector Machine: The support vector machine (SVM) is a binary classifier which is of non-probabilistic nature. The distinguishing characteristic of SVM is its non-probabilistic feature unlike the other probabilistic classifiers such as the Naïve Bayes. The SVM uses only a small portion of the data which are called as feature vectors to segregate the data across the decision boundary. This subset of data that supports for making the decision boundary is called the support vectors. The rest of the dataset do not contribute to determine the decision boundary position in the feature space. While SVM uses only a small portion of data, the probabilistic classifiers use all the data in a best way to develop a model and hence the probabilistic classifiers are expected to require more computing resources.

E. Recurrent Neural Networks: The Recurrent Neural Network **(**RNN) is a model that uses the concepts of machine learning. It is based on supervised learning technique. It is made up of artificial neurons and consists of one or more feedback loops. RNN can be trained in a supervised manner using a training dataset consisting of pair of input data and the corresponding target. The main goal is to optimize the weights of the network in order to reduce the difference between the output and target pairs. A simple RNN comprises 3 layers: an input layer, recurring hidden layer, and output layer. The activation function has to be selected based on the problem at hand and the nature of the data. One of the most important challenges in training RNNs is to learn the long-term dependencies among the data. This is mainly because of the fact that during training of the RNN for longer periods of time, there is a need for optimizing a huge number of parameters. The comparison of the various methods used is as depicted in the following table:

Table 1: Summary of the different approaches to Predict Dengue Disease

Authors	Objectives	Models used	Outcomes
R. Anusha	Predicting dengue fever and expressing it in terms of yes or no	Different classifiers such as k nearest neighbor (knn), Naive bayes, rule based classifier, id3, and decision tree	The accuracies of Rule based classification, K nearest neighbor, naïve bayes algorithm, decision tree, and ID3 algorithm were found to be 64.71%, 50%, 72.2%, 55.56% , 66.67% with Naive bayes algorithm being the best with an accuracy of 72%

Loshini Thiruchelvam, et al.	To predict dengue occurrence in Petaling district of Selangor state in Malaysia.	Prediction models built using k-steps ahead prediction with one & multiple step ahead predictions	• It was observed that the one-step ahead prediction model captures pattern of dengue incidences very well
Prashansa Taneja, et al.	To perform prediction analysis of dengue fever	Multiple classifiers such as SVM, and the combination of naïve bayes and decision tree termed as the hybrid classifier	• The performance of SVM classifier & the hybrid classifier are compared • The SVM classifier has less accuracy - 82% whereas the hybrid classifier resulted in accuracy of 92%.
Dr. A. Anitha, et al.	To develop a framework to predict dengue for its early diagnosis	j48 algorithm	• The dengue prediction using j48 algorithm was achieved with an accuracy rate of 86.13%. • The knowledge extracted was useful for predicting dengue in its initial stage.
Harshada Somwanshi, et al	To predict dengue disease	Naive Bayes algorithm	To find whether the patient is infected by Dengue or not
Kamran Shaukat, et al.	To predict dengue disease	J48, Naive bayes technique, Sequential minimal optimization REP tree, and Random Tree	• The different classification techniques are compared. • Naive bayes with accuracy of 92% and J48 with accuracy of 88% are the top performance classifier techniques taking less time to run & smallest error rate.

III. CONCLUSION

The dengue disease is caused by a virus of the family Flaviviridae. Aedes Aegypti and Aedes Albopictus are the two kinds of mosquitoes that spread that virus. Even though dengue has no specific treatment, it is very important to detect and treat the dengue patients on time. Lot of works are carried out in predicting Dengue using different techniques in other countries but works are yet to be carried out in developing countries like India.

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