

Classification Algorithms based Mental Health Prediction using Data Mining

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Abstract— The emotional, psychological and social welfare of a person is revealed by their mental health. It influences how an individual will think, feel or handle a situation. Positive mental health helps an individual to work productively and achieve their full potential. At each point in life, mental health is vital, from childhood to adulthood. Numerous factors contribute to mental health issues which lead to mental illness like stress, social anxiety, depression, obsessive compulsive disorder, drug addiction, workplace issues and personality disorders. The onset of mental illness should be determined without flaws for maintaining an appropriate life balance.

We have collected data from online available datasets. The data has been label encoded for better prediction. The data is being subject to various machine learning techniques to obtain labels. These classified labels will then be used to build a model to predict the mental health of an individual. The accuracy of the algorithm will be analysed before it is used to build the model. We planned to implement classification algorithms such as Decision Tree, Random Forest and Naïve Bayes. Our target population is in the working class i.e people above the age of 18. Once the model is built, it will be integrated to a website so that it can predict the outcome as per the details provided by the user.

Keywords— Random Forest, Decision Tree, health, stress, employee.

I. INTRODUCTION

Mental wellness of an individual is the state of mind of that person and also provides an indication of his/her general nature. Mental illness is an outcome of imbalances in brain chemistry. The evaluation of mental wellness is extremely critical to understand and suggest therapies for patients with a deviated mental behavior. Most individuals are prone to stress while some are affected by depression due to various reasons. An administrative panel of World Health Organization (WHO) assessed in 2011 that, by 2030, depression will be the chief source of worldwide disease burden [1]. There is a

fundamental change to incorporate the mental fitness outline of an affected individual by healthcare providers and it will be made obligatory in the approaching years to deliver improved medication and also promote speedy recoveries.

Since similar aspects and indications can point to multiple mental health issues, the diagnosis is a complex task and misdiagnosis can happen sometimes. The patient must co-operate for effectively identifying an issue. Detecting mental problem is a difficult task as a misdiagnosis can cause serious issues. Hence, appropriate care must be taken to recognize and treat the mental health issue precisely.

For our project, we have collected data from online available dataset, provided by an OSMI (Open Sourcing Mental Illness) survey. The dataset mainly consists of data of working individuals. It will predominantly be beneficial for employers and employees by creating greater awareness about work related mental illness [2]. We have applied machine learning algorithm to create a model. It has been implemented on a website for users to get knowledge about their mental illness. The webpage shows a probability and recommendation to the user based on the inputs provided.

II. RELATED WORK

In [3] U. S. Reddy et al. have applied various algorithms to find the most accurate one and compared the relationship between various parameters in the dataset.

In [4] M. P. Dooshima et al. have used demographic, biological, psychological and environmental factors for prediction. Different mental health experts were consulted to validate the obtained parameters.

In [5] M. Srividya et al. have used a questionnaire to obtain values for different attributes that can be helpful for prediction of mental health. The motive of this paper was to analyze different algorithms and predict the most accurate one. Various classification algorithms such as Decision Tree, Naïve Bayes as well as SVM were used in this paper. The labels

form the data collected were used to compute a MOS. The above algorithms were then applied to find the most accurate one. The paper concluded that Support Vector Machine, K-Nearest Neighbour and Random Forest are the most accurate algorithms with similar accuracy results.

In [6] D.Filip & C. Jesus. have used Neural Networks to predict the psychological conditions of humans such a depression, PTSD, anxiety etc. They also studied the effect of concussion or injuries on sportspersons.

In [7] S. G. Alonso et al. have conducted extensive review of different algorithms used for mental health prediction. Different techniques such as Association Rule Mining and Randomization were studied and their predictions were noted for our project. This paper also reviewed other algorithms such as SVM, Decision tree, KNN, ANN, Naïve Bayes.

Table 1. Comparison of existing systems

#	Paper	Algorithms used	Scope
1	U. S. Reddy et al.	Logistical regression, Decision Tree, Random Forest.	Finds only the accuracy of algorithm. Not implemented.
2	M. P. Dooshima et al.	Decision Tree Naïve Bayes.	Used WEKA Data of only 30 patients Does not focus on work predominantly.
3	M. Srividya et al.	Naïve Bayes KNN Decision Tree Logistical regression Random Forest	Focuses mainly on depression, stress and anxiety Some aspects of work related stress considered.
4	D. Filip et al.	Decision Tree SVM, Random Forest	Considers Stress, PTSD, Traumatic brain injuries related to sports.

There are different kinds of systems that currently exist. Most of them use different methodologies to predict mental illness. Some of the current systems include an online survey which predicts whether the user has mental illness or not. These surveys are illness specific i.e. a different survey for depression, a different one for stress and so on. All these surveys are available online and anyone can fill them [8].

There are a few systems which use chatbots to predict mental illness by questioning a user and then analyzing their response. Some systems also use Image Processing to monitor the facial expressions of users, analyze their behavior to a particular question to help in more accurate prediction of

mental illness. Most of these surveys include the behavioral and physical aspects of an individual but not any work-related issues. Hence very minimal amount of research has been done on work related mental illness [9].

Most of these systems are aimed at the general aspects of mental illness. They include the most common parameters to evaluate the result. Systems that focus on the employees and work-related mental illness are not available on a greater scale.

Machine Learning algorithms:

- Decision tree:

Decision tree algorithm is a supervised learning algorithm. It can be used to solve both regression and classification problems. It uses the tree representation to solve the problem in which each leaf node corresponds to a class label and attributes are represented on the internal node of the tree. The selection is done on Entropy or Gini value [10,11].

- Random Forest:

Random forest algorithm, like its name implies, consists of a large number of individual decision trees that operate together. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model's prediction [12].

III. IMPLEMENTED SYSTEM

Based on the above survey, we have designed a system with the primary goal of developing a website where users can enter values in a form and get results about potential or current mental illness based on their input. Firstly, we have collected a dataset which is available online. The data gathered is analysed and pre-processed. The data contains different labels such as age, gender, distance of workplace from home, previous mental illness, family history etc. [13]. We have label encoded the data for better prediction. We implemented the Decision Tree and Random Forest algorithms for testing the data and to find the more accurate algorithm. We have applied Decision Tree classification algorithm for classification of the data as it was found to be more accurate. We analysed the data with the help of this algorithm to find various insights that the data revealed. We then created a model based on the decision tree algorithm and used it on the website we designed.

According to our goal, we have designed a website where a user shall login and fill up a form which has questions based on the dataset gathered. The user will answer the questions and a result about his/her mental condition will be provided on the website as per the inputs provided. The website makes use of the model that we have built using the machine learning algorithms to provide the output. Since this project makes use of a dataset related to workplace mental illness, it will help raise awareness among employees and employers to provide greater attention to work related stress, depression and proper benefits can be provided to employees suffering from a mental illness.

Figure 1. shows the block diagram of the implemented system. It illustrates the various modules and phases of the system and

the flow in which they are carried out through the course of the project.

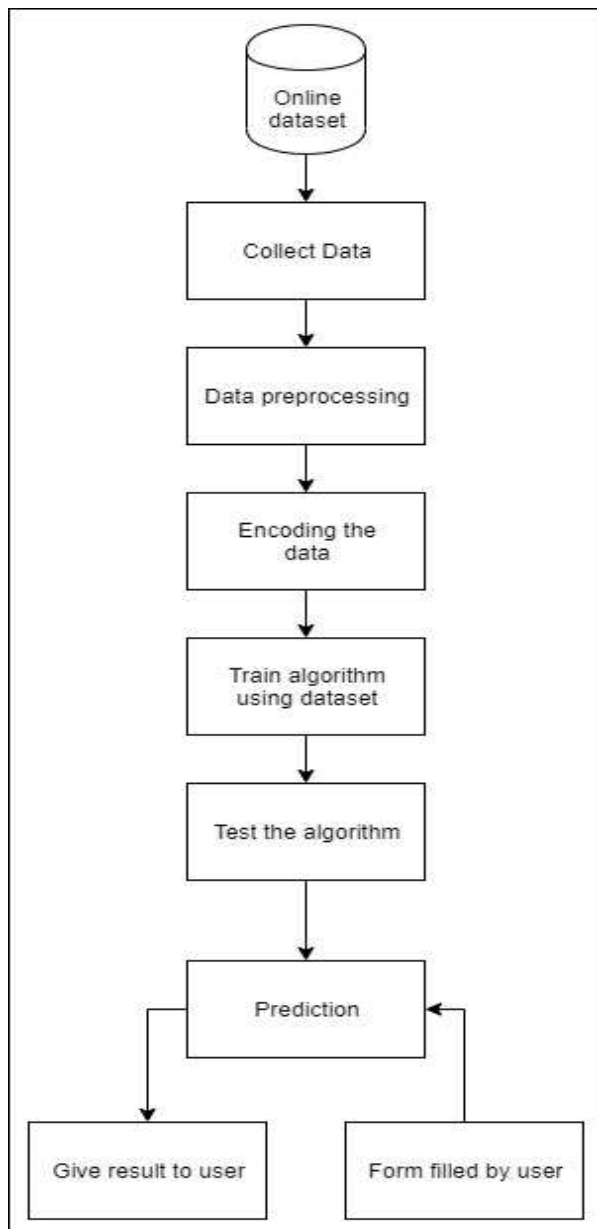


Figure 1: System Block diagram

IV. RESULTS AND ANALYSIS

We have collected data from online available dataset, provided by an OSMI (Open Sourcing Mental Illness) survey. The dataset mainly consists of data of working individuals. The data consists of string attributes which we later encoded to numeric attributes for better prediction. It consists of 26 attributes for prediction and 1 predicting label. Since the dataset also consists of data collected for a survey, not all the parameters are useful for the prediction. Hence, we have selected appropriate parameters that we have shown in the table.

Table 2. Data provided as input

Age	Gen	self_emp	fam_hist	work_int	past	diag	Treat
37	F	N	N	Often	Y	Y	Y
44	M	N	N	Rarely	Y	Y	N
32	M	N	N	Rarely	Maybe	N	N
31	M	N	Y	Often	Y	Y	Y
31	M	N	N	Never	Y	Y	N
33	M	N	Y	Sometimes	N	N	N
35	F	N	Y	Sometimes	N	N	Y
39	M	N	N	Never	Y	Y	N
42	F	N	Y	Sometimes	Y	Y	Y
23	M	N	N	Never	Y	Y	N

As represented in Table 2, our dataset consists of various parameters to predict mental illness of an employee. Some of the parameters are age, gender, work interference, family history, seeking help, remote work, past mental illness history, past diagnosis, anonymity, consequences etc. and the predicting label is treatment. Most data consist of 2 to 3 attributes (Yes, No, Maybe) however some parameters contain 5 attributes as well e.g. work_int. The data mainly consists of values in terms of Yes and No, which means whether an individual should seek treatment or not. The WEKA tool was used to conduct the preliminary analysis of the data.

Table 3. Performance of Machine Learning algorithms

Algorithm	Accuracy %	Mean Absolute Error	Precision	Time Taken
Decision Tree	82.2	0.256	0.827	0.3 sec
Random Forest	79.3	0.316	0.793	0.6 sec
Naïve Bayes	78.7	0.24	0.787	0.5 sec

Table 3 shows the performance of various algorithms, we have found that the most optimal algorithm is Decision Tree because of its low execution time and high accuracy. The above analysis was done using WEKA [14].

The Decision Tree algorithm uses this dataset and selects the splitting nodes as per the entropies. The node with the lowest entropy is chosen as the root node. As per execution in WEKA, we found that work_int is the root node of the tree. The tree is further split by family history and gender.

We found that people whose work is affected due to stress or depression need to consult a mental health professional. However, if the work life of an employee is unaffected, then he/she does not suffer from mental illness. Furthermore, employees whose work is sometimes affected and having a history of mental illness in the family, should seek treatment.

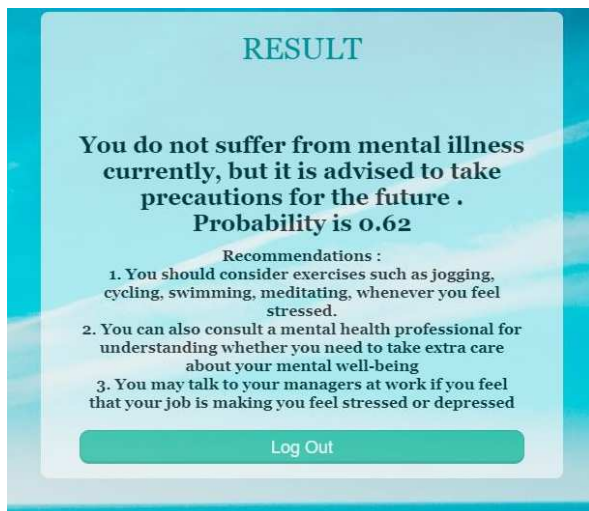


Figure 2. Output with probability 0.62

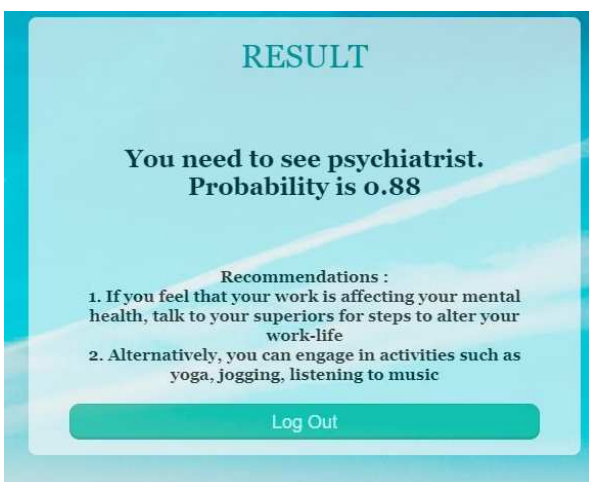


Figure 3. Output with probability 0.88

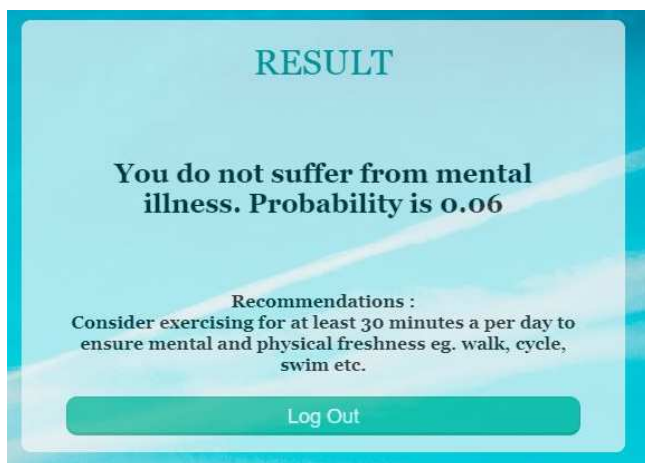


Figure 4. Output with probability 0.06

Figures 2,3 and 4 are the outputs based on different inputs that are provided by the user to the website. There is a different recommendation for different values of the probability of mental illness. We have designed the system in a way that a probability less than 0.30 indicates that the user does not

suffer from a mental condition. Probability between 0.3 and 0.63 indicates that the user may face a mental illness in the future and a probability greater than 0.63 shows that he/she suffers from mental illness.

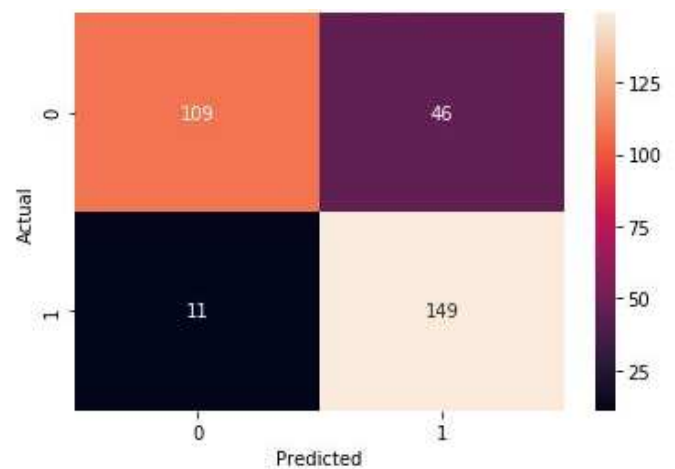


Figure 5. Confusion Matrix of testing data.

Figure 5 shows the confusion matrix denoting the accuracy of the algorithm. It shows that 149 instances have been correctly classified as Positive while 109 have been correctly classified as negative.

$$\text{Accuracy} = \frac{(TP+TN)}{(TP+TN+FP+FN)} \quad (1)$$

Using the values in figure 5 and (1), we get the accuracy of the Decision Tree algorithm as 0.82 i.e. 82%.

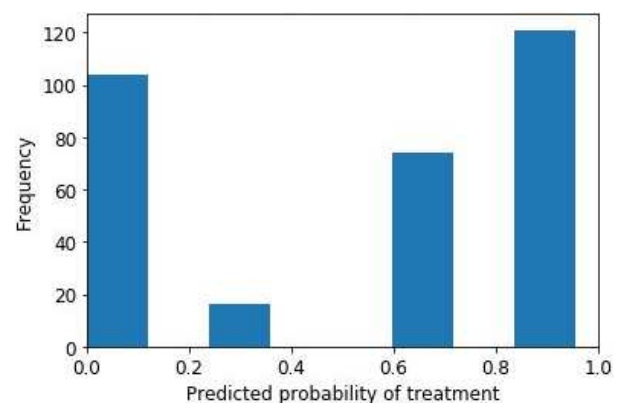


Figure 6. Histogram of prediction

Figure 6 depicts the histogram of the predicted probabilities. One can conclude that there are more positive results than negative based on the histogram and the confusion matrix.

V. CONCLUSION AND FUTURE SCOPE

Mental health is an extremely sensitive and important topic currently. It is integral for living a healthy and balanced life. Mental health impacts one's thoughts, behaviour and

emotions. It can affect the productivity and effectiveness of an individual. As per the study by WHO, depression will be a major cause of mental illness in the world and people need to take more care about their mental well-being for a balanced social and professional life. People who are hesitant to approach humans for diagnosis can make use of online predictors for results.

To do the prediction, we have encoded the data first. We have then used the decision tree algorithm and trained a model which we have used on our website. The accuracy we received with decision tree was 82% with 258 instances of data being classified correctly out of 315 instances. When the user answers the questions on our webpage, he/she gets a probability of their mental health condition as well as recommendations. Due to the accuracy we achieved, it can be concluded that the output displays the correct result and the chance of the illness being misclassified is minimal.

In the future, we can create a system which predicts a specific mental illness that a person suffers from, however extensive data collection needs to be carried out for it.

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