Predicting Treatment Success in Mental Health: A Machine Learning Approach

Name: Anurag Sharma Pendyala

Literature Review

Introduction

In this ever-changing world there is a rising concern about mental health issues. With the surge of these issues arises the substantial need for cure. To achieve this many mental healthcare centers are striving hard to predict cures for some common mental health issues. Formulating an effective treatment plan is very important to cure the patients in a short span of time. For this reason, measuring the success of existing treatment plans is crucial. Using Machine Learning for predicting treatment success makes the life of the health care practitioner easier. To achieve this many studies have attempted to develop such Machine Learning algorithms. This part of the paper reviews exactly five of these studies.

Related Works

Thamaraimanalan et al. addresses that mental health issues are the lion's part of the medical industry and needs a practical way to cure [1]. They proposed predicting mental health using the "Radial Basis Function Network (RBFN)" and "Spectral Clustering". The data points are partitioned into clusters using the Spectral clustering while RBFN provides accuracy and improves the learning speed. Upon delving into the key findings, the algorithm is successfully implemented in predicting mental health. It also provides specific steps that RBFN employs along with data preparation techniques. Although, the limitation is availability of high-quality data and potential model overfitting.

As mental health issues are becoming common all over the world, they influence a person's everyday life, relationships, and work performance. Due to lack of understanding of the root cause of these issues many health issues are left uncured [2]. Madhvan et al. proposed usage of statistical methodologies with some machine learning algorithms to estimate the chance of individuals requiring medical intervention. The dataset is preprocessed where mean or median is used to impute missing values and data inconsistencies are deleted. Several models are evaluated from Random Forest, KNN, Logistic Regression and Decision Tree to detect the cure for a particular mental health issue. Upon comparing they found that Random Forest algorithm and Decision Tree are best for identifying mental health issues and have a great potential to treat the patients.

For knowing the mental conditions in prior Jage et al. proposes Support Vector Machines (SVM) algorthim based on quetionnaire responses. Upon training the model on several machine learning algorithms they found SVM (Support Vector Machine) is one of the most accurate models for mental health prediction. It encompasses the tracking of mental health of the user. While it provides valuable insights, further testing and validation are required, with implications for enhancing mental health outcomes in context of social media use and remote working environments.

In response to the rising concerns of mental health issues there is a need for early detection and an effective treatment plan for these issues. Yifan addresses this issue using the machine learning techniques particularly Cross Gradient Booster (Random Forest) model [4] by analyzing the data from OSMI Mental health survey to predict mental health disorders. The findings upon successfully training the model show promising accuracy and performance by using above mentioned machine learning algorithms. The strengths include the detailed analysis of machine learning model and data preprocessing challenges is a notable limitation. But the findings underline that machine learning algorithms are potent to improve mental health outcomes and inform commercial as well as clinical strategies for early treatment and support.

In final effort to predicting cure of health issues Manivannan et al. addresses how stress affects students' mental health focusing on early identification of such issues in prior to lowering the severity. They proposed a survey and machine learning algorithm to predict health issues [5] like bipolar disorder, anxiety, depression, eating disorders and sleep problems highlighting how machine learning is helpful to help them. Even if the work gives acceptable results further improvement is needed in the machine learning models utilized in each of health issues addressed and suggested to utilize this for early detection and support students facing mental health challenges.

Conclusion

Upon reviewing studies [1]-[5], all the authors focus on the growing concern of mental health issues and adopting a machine learning approach to predict treatment patterns for some common mental health disorders. They all accept that machine learning makes the prediction of cure easier rather than performing traditional diagnosis and proposed different approaches to achieve this Thamaraimanalan et al. performed RBFN algorithm [1] on dataset that is collected from different health databases used the spectral clustering from different iteration values from 0 to 100.

Utilizing the students' dataset that contained 4269 students Jage et al. and Yifan Li discussed the model analysis metrics (accuracy, precision, F1 score) for various ML algorithms like "SVM", "Naive Bayes", "Decision Trees", "KNN" and "Random Forest". As the SVM algorithm has high accuracy, precision, F1 and recall scores that is 1.00 it is trained to find patterns in replies of the patients suffering from health issues like "depression, bipolar disorder and anxiety". Analyzing all the responses of the questionnaire given to fresh participant a hyperplane is generated that separates the data points into two classes, the SVM can be used to predict the mental health disorders based on this split.

Y.Li utilized the raw dataset from a Tech Survey, comprising 1,433 rows and 63 columns. The dataset was employed to execute various machine learning algorithms including "GBRF", "XGBoost", "Stochastic Gradient Descent", and "Random Forest". These algorithms were evaluated based on metrics such as "Accuracy", "Sensitivity", "Precision", "Specificity", and "F1 score". The "Cross Gradient Booster (Random Forest)" machine learning model demonstrated highest performance among all other algorithms indicating 78.7% accuracy, 71.8% precision, 74.11% sensitivity, 74.11% specifity and 74.9% F1 score out of 100%.

 M. Karunakaran worked on the MHS questionnaire, 1253 out of 1269 collected samples were deemed suitable for analysis. These valid samples were processed using the Logistic regression algorithm. All the algorithms are compared, and a review of these samples is done manually to validate the model's accuracy. The findings suggest that "Logistic Regression" is the most suitable choice for this questionnaire within supervised machine learning, given the survey's binary nature. Among the 1253 valid samples, 111 individuals exhibited general symptoms of mental health issues.

M. Bajaj worked on various factors such as age, gender, location, job type, family background, and past medical history. Based on the algorithm's "KNN", "Decision Tree", "Random Forest" and "Logistic Regression" algorithms were utilized to assess the necessity for medical intervention in mental health cases. The results revealed that all four algorithms demonstrated promise in detecting mental health issues due to their high levels of accuracy, precision, and AUC metrics. While there is room for enhancement in reducing false positives, the accuracy rates of the models remained relatively favorable. Particularly, the decision tree and random forest models exhibited the highest accuracy and cross-validation AUC scores. It is essential to carefully evaluate the assumptions and constraints of each algorithm when addressing specific mental health identification challenges, weighing the benefits of recognizing individuals in need of medical support against the potential drawbacks of false positive outcomes. The following are frequent themes observed they are:

1. Survey based data: Most of the studies used survey-based data to extract the dataset and predict the cure for mental health illness.

2. Supervised Algorithms: Most of these studies encompasses the supervised type of machine learning algorithms to predict the cure for health.

3. Logistic Regression and Classification Algorithms: Except [1] studies [2]-[5] strongly recommended to use Logistic Regression and Classification to predict the cure for some common health issues.

This review underlines the importance of machine learning approach to treatment success highlighting the efforts of various studies ranging from Regression to RBFN approach. Finally I learned that any machine learning algorithm cannot fit the data and a proper machine learning algorithm should be chosen based on the data and real-time applicability rather than focusing more on accuracy and precision while finding the right cure for mental health disorders.

References

[1] T. Thamaraimanalan et al., "Machine Learning based Patient Mental Health Prediction using Spectral Clustering and RBFN Algorithms," 2022 8th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2022, pp. 1840-1843, doi: 10.1109/ICACCS54159.2022.9785142.

[2] S. Jage, S. Chaudhari, M. Jatte, A. Mhatre and V. Mane, "Predicting Mental Health Illness using Machine Learning," 2023 3rd Asian Conference on Innovation in Technology (ASIANCON), Ravet IN, India, 2023, pp. 1-5, doi: 10.1109/ASIANCON58793.2023.10270445.

[3] Y. Li, "Application of Machine Learning to Predict Mental Health Disorders and Interpret Feature Importance," 2023 3rd International Symposium on Computer Technology and Information Science (ISCTIS), Chengdu, China, 2023, pp. 257-261, doi: 10.1109/ISCTIS58954.2023.10213032.

[4] M. Karunakaran, J. Balusamy and K. Selvaraj, "Machine Learning Models based Mental Health Detection," 2022 Third International Conference on Intelligent Computing Instrumentation and Control Technologies (ICICICT), Kannur, India, 2022, pp. 835-842, doi: 10.1109/ICICICT54557.2022.9917622.

[5] M. Bajaj, P. Rawat, Diksha, S. Vats, V. Sharma and L. Gopal, "Prediction of Mental Health Treatment Adherence using Machine Learning Algorithms," 2023 International Conference on Computational Intelligence, Communication Technology and Networking (CICTN), Ghaziabad, India, 2023, pp. 716-720, doi: 10.1109/CICTN57981.2023.10141520.