Mental Health Treatment Prediction Using Machine Learning

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ABSTRACT:

A review that we conducted revealed that neither conventional nor modern methods for improving mental health assessment and treatment are adequate in the IT industry. We aimed to develop a significantly improved framework for identifying and addressing mental health issues, starting within the IT sector. Currently, the surveying approach stands as the most innovative method, boasting an accuracy rate of approximately 81%. In contrast, other electronic methods such as facial recognition and sentiment analysis, due to their low precision or implementation challenges, are not viable options. Leveraging the OSMI 2018 dataset and a similar surveying methodology, we constructed and evaluated nine machine learning models. Among these, in terms of accuracy, the Random Forest model performed exceptionally well of approximately 96%. In light of this achievement, we formulated a 15-item questionnaire that proves highly effective in assessing whether a tech professional exhibits signs of mental instability, both in their interactions with colleagues and in their personal life.

Keywords – Mental Health Treatment, Machine Learning Models, Random Forest.

1.   INTRODUCTION:

The World Health Organization defines personal health as "a state of well-being in which an individual realizes their own abilities, can manage life's typical stresses, can work successfully, & can participate meaningfully to both their own and their community's well-being." When it comes to serious illnesses, mental disorders such as depression do not discriminate based on social status, wealth, or fame. Therefore, individuals should not take solace in the belief that they are immune to these conditions. Those grappling with mental health issues may find life to be challenging [1].

These problems have the potential to impact society as a whole, especially if they are overlooked or if attention is delayed. Our objective is to determine whether an individual requires assistance for a mental illness [2].

The World Health Organization reports that approximately one million people take their own lives each year, equating to one person passing away on Earth every minute. Given these statistics, one might argue that physical health takes precedence over mental well-being. However, primarily due to

treatable illnesses, the average American adult with a mental disorder passes away 25 years earlier than their counterparts [3].

Furthermore, 37% of high school students experiencing mental health issues drop out of school prematurely, and over 90% of children who take their own lives do so because of mental health struggles. "Some of the most severe mental illnesses, such as schizophrenia, bipolar disorder, and depression, do not suddenly manifest but rather tend to progress gradually over time. Even in their earliest stages, identifiable symptoms begin to emerge [4].

There are strategies available for the prevention and improved management of these conditions. Identifying abnormal mental states in their early stages allows for the provision of additional treatment and care. Consequently, deducing individuals' mental states solely from their outward appearance or behavior is a highly nuanced aspect of psychology that has yet to be mechanized [5].

While the prospect of screening tests offers a potential solution, their implementation on a large scale becomes impractical due to constraints related to time and finances. Additionally, reliance on diagnostic processes often deters individuals who are suffering from participating [6].

Consequently, many people endure unaddressed or untreated mental health issues in silence."
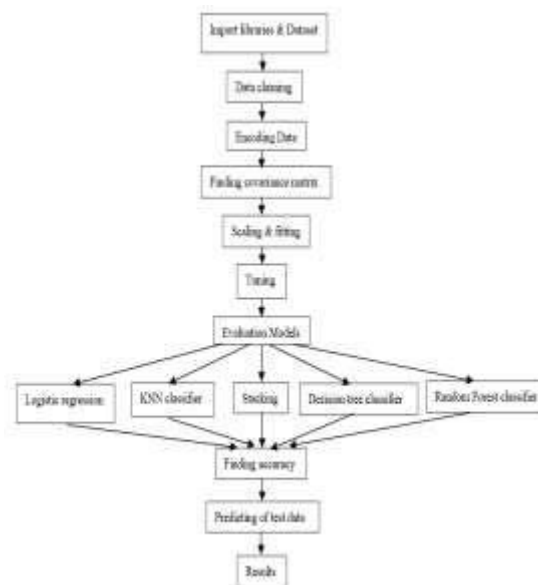

Figure 1: System architecture.

"Anxiety and depression represent global public health crises with far-reaching effects on individuals and communities & the basic system architecture is shown in Figure 1. These conditions can affect individuals of all ages, from infants to the elderly. The impact of anxiety and depression disorders on health and overall quality of life is multifaceted, encompassing a broad spectrum of psychological and physical symptoms. These symptoms include but are not limited to low spirits, retreat from social situations, lower workplace productivity, suicidal ideas or attempts, and distractions. Ischemic heart disease, high blood pressure, diabetes, accidents, and self-inflicted wounds are only a few of the many health problems linked to depression and anxiety [7].

Depressive symptoms and suicidal ideation often co-occur, with one exacerbating the other. Individuals experiencing these conditions are also at heightened vulnerability to airborne infections like tuberculosis and HIV. Regrettably, those grappling with mental health issues such as depression or anxiety often face stigma from their communities and even their own families, leading to challenges in meeting societal and educational expectations, both formal and informal. Consequently, their economic and social opportunities are constrained, resulting in a diminished standard of living [8].

The stress induced by financial difficulties is substantial and its quantifiable impact can be elusive. It's important to note that the majority of individuals impacted are children from low- and middle-income families. Technology advancements in areas such as smartphones, social media, neuroimaging, and wearables have facilitated the rapid collection of data that is vital to the study and treatment of mental health. In recent years, machine learning has matured into a trustworthy method for delving into this trove of data [9].

Machine learning allows computers to act autonomously by utilizing complex probabilistic and statistical methodologies acquire knowledge from data and the basic accuracy is shown in:

Table 1:

Methods	Accuracy
Logistic regression	79.84
KNN Classifier	80.41
Decision Tree	80.46
Random Forest	81.89
Stacking	81.56

"To enhance predictive capabilities using data sources, machine learning has played a pivotal role. It has significantly benefited domains features of artificial intelligence include natural language processing, speech recognition, computer vision, and machine learning [10].

Insights can be mined from massive databases, user experiences can be customized, and intelligent systems can be built with the help of this technology. Biologically speaking, machine learning has made substantial strides by enabling rapid and comprehensive analysis of intricate datasets. Similarly, analogous analytical tools are being employed to investigate mental health data, potentially resulting in improved patient outcomes and a deeper understanding of mental illnesses and their treatments."

2.   LITERATURE REVIEW:

Analysis of Machine Learning & Deep Learning Techniques for Psychological Testing and Diagnosis battling psychological sicknesses like compassion and stress has turned into a worldwide

issue. ML approaches have been coordinated to clinical consideration structures to assist with recognizing mental prosperity concerns and foresee that they are so inclined to answer treatment because of the necessity to track down serviceable method for controlling these issues. More individuals are getting intrigued by simulated intelligence and profound learning strategies, hence it's essential to analyze how this has been utilized to illuminate future exploration. This literature search identified 33 articles utilizing the Methods for reviewing studies using recommended reporting elements for systematic reviews & meta-analyses (PRISMA) the complexities of schizophrenia, depression, anxiety, bipolar disorder, PTSD, anorexia, and ADHD. These articles were picked in view of their imaginative utilization of profound learning and AI. Their proposed approaches were then ordered by the many kinds of issues that this exploration analyzed. Moreover, an outline of a few accessible information is given, alongside a conversation of the issues the researchers experienced [1].

The Impact of Mental Health Problems & Social Support on Life Happiness 18 Months After Beginning Gender-Confirming Hormone Therapy: A Longitudinal Study Despite the fact that gender-affirming hormone therapy (GAHT) has been displayed to work on profound prosperity, the effect of mental wellbeing and social help preceding GAHT on treatment results is as yet not completely perceived. A retrogressive longitudinal arrangement was utilized to address this, with 137 patients finishing up proportions of social help, stress, and issue before to GAHT (T0) and a proportion of life fulfillment 1.5 years post-GAHT (T1). As per the outcomes, there were no massive contrasts in the members' degrees of joy at T1 and T0 corresponding to their degrees of stress or compassion. Furthermore, it was shown that social help, hatred, or stress at T0 didn't demonstrate how content an individual was with their life at T1. In contrast with mental prosperity before to GAHT, there were no critical enhancements in life fulfillment one and a half years after GAHT, and there was no verification that social help could foresee life satisfaction. This recommends that these elements are not fundamental for long haul bliss throughout everyday life. Trusting that GAHT will happen may essentially affect somebody's psychological wellness. That being said, this ought not be viewed as an indication of additional critical issues. In light of everything, individuals ought to have the decision to look for help for their mental wellbeing and for shaping social associations while they sit tight for GAHT [2].

Employees in the mechanical & non-mechanical fields: Predicting Mental Fitness Disorders with Machine Learning Emotional well-being has forever been a serious and tricky issue, particularly for the individuals who are utilized. Individuals in the long run get exhausted by their bustling ways of life and weighty obligations, which unavoidably prompts psychological well-being concerns and uneasiness problems. Working specialists will subsequently unavoidably disapprove of their emotional wellness. Associations give advantages to mental health care to their laborers trying to control what is happening, however this is lacking. They use information from the 2019 Close to home Wellbeing Survey, which remembers data from laborers for both tech and non-tech associations, in their exploration. We use data taking care of to distinguish the individual or master components that influence a worker's personal wellbeing or that might assist with foreseeing a representative's close to home wellbeing. To pick the most dependable model, we utilize an assortment of machine learning methods. To look at the exhibition of unmistakable machine learning models, we measure their precision and audit [3].

Effects of Covid 19, a Machine Learning-Based Screener for Mental Illness because of the many requests that come from both inside and beyond individuals during this Covid plague, stress has turned into a huge piece of individuals' lives. For this situation, Covid is a profoundly normal and perilous issue around the world. Notwithstanding, since they are distant from everyone else at home, individuals will encounter changes in their mental wellbeing, like nervousness, strain, and profound explosions. To decide how pushed individuals are, we will along these lines use machine learning (ML) approaches in our audit, for example, K-Closest Neighbor, Backing Vector Machine, Gullible Bayes, and Counterfeit Brain Organizations [4].

Researching the Psychological Well-Being of Workers in High-Tech Industries Using Machine Learning representatives in the development business are sure to confront an assortment of mental wellbeing worries as the quantity of laborers in the area rises. Likewise, more devices are being made accessible to help those impacted, and individuals are turning out to be more ready to discuss it and offer their encounters. To explore the profound prosperity of development laborers in more detail, this examination uses AI procedures to dismantle review information from Open-Source Mental Illness (OSMI), a non-benefit association. Independent AI was utilized to distinguish bunches and conceivable cases shared by OSMI respondents, and a counterfeit brain network was utilized to explore the possibility of expecting profound prosperity issues [5].

3.   METHODOLOGY:

In the review "Recognizing Despairing in Virtual Diversion Posts Utilizing ML," opinion examination procured 81% accuracy, but face examination in the review "Arranging a Design for Evaluating Sorrow Seriousness from Facial Picture Investigation" just scored 56% precision. The down to earth utility was confined by the small example set of tweets. Exploring options, for example, facial cuts and individual markers is urgent since most of feeling examination utilizes data from web-based entertainment locales like Twitter.

Disadvantages:
- This proposes that we approach information from Twitter clients.
- Decision Trees, K-Nearest Neighbors (KNN), and Support Vector Machines (SVM) can be used to determine an individual's level of disability. The person should also tweet regularly and keep in mind elements that would discourage readers. The result is a further reduction in attendance at our meeting.
- Also, there are issues with this procedure, for example, populace inclination, little example size, and client insurance.
- An extra thought was the investigation of looks.
- It sees no difference amongst pity and languishing.
- Individuals could frequently conceal their anguish, so it tends to be hard to tell whether somebody is discouraged by simply checking them out.
- Our main goal is to help representatives who frequently ignore their emotional wellness. We constructed a framework that gets some information about their occupations and psychological

wellness, then utilizes an assortment of characterization calculations to assess their emotional wellness hazard and status utilizing the OSMI Dataset from Open Sourcing Mental Illness, Illinois (OSMI). The discoveries are shipped off the fitting email tends to in a confidential way, safeguarding their security and bringing down disgrace.

- Advantages:
- With surveys, individuals might offer their viewpoints straightforwardly and in certainty, eliminating the challenges that accompany more customary sorts of care.
- Not at all like contingent just upon face looks or close to home assessments, surveys take into account the examination and understanding of model outcomes, which works with the assessment of essential points.
- Overviews are a helpful instrument for gathering significant information on psychological wellness issues, which empowers more intensive investigation and intercession strategies.

Logistic Regression:

The connection 'tween a collection of free (descriptive) factors and a unconditional weak changeable is examined utilizing logistic regression reasoning. When there are only two likely principles for the dependent changing, Yes/No, or a degree of 0 and 1, logistic regression is used. When the unexpected happens, in the way that married, alone, separated, or widowed, has three or more obvious principles, the term multinomial logistic reversion is typically silent for that position. While the helpless variable's dossier type disagrees from multiple reversion's, the process's efficient application is corresponding.

Random Forest Classifier (rf):

Random forests, as known or named at another time or place random decision forests, are an ensemble education technique that builds a a lot of resolution trees all along the preparation point for problems containing regression, categorization, and other uses. The output of a random forest for classification problems is the category chosen by the trees' elders. Regression tasks benefit from the average prediction produced by each seedling. Overfitting to the training set is a problem with decision trees, although random choice forests solve this problem. In spite of this, are less correct than slope enhanced trees, chance forests still perform better than decision trees private cases. Their act, however, can be jolted by the characteristics of the data.

Adaboost Classifier (ada):

For classification problems, AdaBoost (Adaptive Boosting) is a well-liked ensemble machine learning technique. To construct a powerful classifier, it combines many weak learners, usually decision trees or other basic models. In each iteration, AdaBoost gives misclassified data points a larger weight, enabling future models to concentrate on fixing those errors. The total of the weighted outputs from each learner makes up the final forecast. AdaBoost is a strong and efficient classification method because of its iterative approach, which increases classification accuracy.

XGB Classifier (xgboost):

XGBoost, short for "Extreme Gradient Boosting," is a robust machine learning method that has been shown to be effective in regression and classification & classifications challenges. It makes use of a

gradient boosting framework, which iteratively improves the predictions of weak models. Regularization methods are used by XGBoost to avoid overfitting and reduce loss functions, which makes it a popular option in both real-world applications and data science contests.

Gradient Boosting Classifier (grad):
Among other things, regression and categorization problems engage the gradient boosting approach. Gradient-boosted trees is the name given to the training method that is often superior to random forest when a decision tree is used as the weak trainee. As with previous boosting methods, gradient-boosted trees are built in a stage-by-stage fashion; however, they generalize the supplementary methods by allowing the development of a dictatorial differentiable deficit function. Prediction is handled via a mashup of various, mostly decision-tree-based models.

Algorithm:

Input

X - A matrix containing patient features (e.g., demographics, symptoms, medical history).

y - A vector of treatment outcomes (e.g., binary values indicating success or failure of treatment).

X_{new} - New patient data for prediction.

Output:

y_{pred} - Predicted treatment outcome for X_{new}

Algorithm Steps:
Data Preprocessing:
- Handle missing values in X and X_{new}
- Encode categorical variables if necessary.
- Normalize or scale numerical features.

Feature Selection (Optional):
Select relevant features from X using feature selection techniques.

Data Splitting:
Divide X and Y into a training set and a testing set for model evaluation.

Model Selection:
Choose a machine learning algorithm, M prediction (e.g., logistic regression-LR, decision tree_DT, support vector machine_SVM).

Model Training:
Train M on the training data (X_{train}, Y_{train}) to learn the underlying patterns.

Model Evaluation:
Assess the performance of M on the testing data (X_{train}, Y_{train}) using evaluation metrics (e.g., accuracy, precision, recall, F1-score).

Hyperparameter Tuning (Optional):

Fine-tune the hyperparameters of M for better performance.

Cross-Validation (Optional):

Perform k-fold cross-validation to ensure model robustness and avoid overfitting.

Prediction:

Use the trained M to predict treatment outcomes Y_{pred} for new patient data X_{new}.

Interpretability (Optional):

Depending on the algorithm used, analyze the model's coefficients or feature importances to understand the factors influencing treatment predictions.

Deployment (Optional):

Once the model has demonstrated satisfactory performance and adherence to ethical standards, it should be implemented inside a clinical environment to facilitate real-time predictions.

Monitoring and Maintenance (Optional):

It is imperative to consistently assess the functioning of the model and make necessary updates. it was needed with new data, and ensure compliance with healthcare regulations.

4.   EXPERIMENTAL RESULTS:

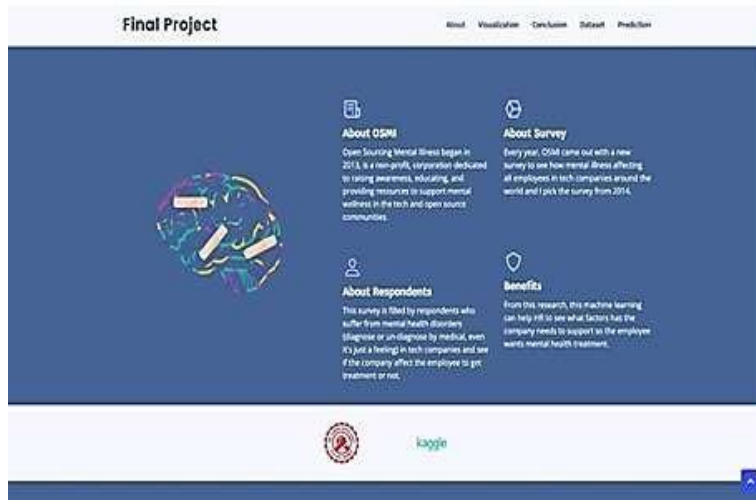
Figure 2: Home Page

Figure 3: About Section

Figure.4: Visualization Section
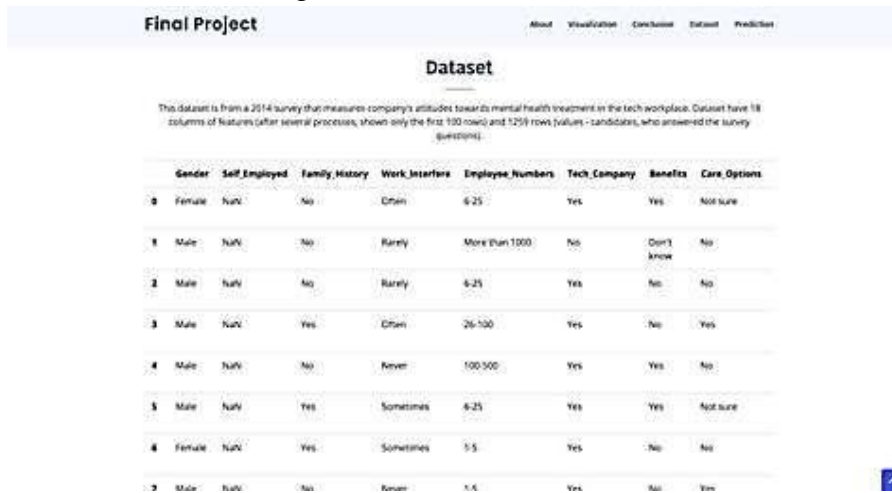

Figure 5: Graphs

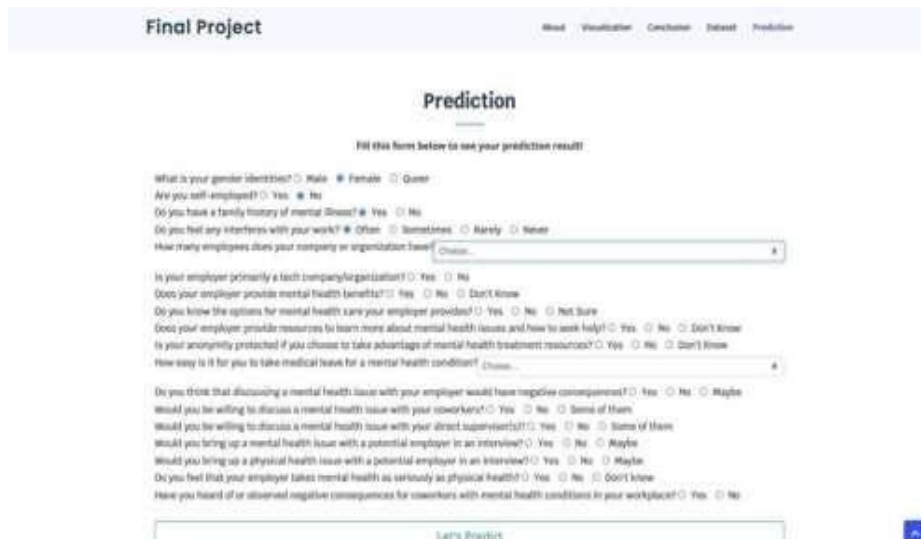Figure 6: Conclusion Section

Figure 7: Dataset Section

Figure 8: Prediction Section

Figure 9: Result Section

The above figures how the outcomes of our proposed approach like the fig2 displays the home page and then the fig 3 shows the way of selection of the content. And then the fig 4 displays the visual selection process like that the fig 5 displays the graphical representation of the proposed outcom and the fig 6 displays the conclusion section and then the Fig 7 displays the dataset selection process and then the fig 8 displays the prediction process finally the fig 9 displays the result section.

5.   CONCLUSION:

Based on the data, it becomes evident that employing a combination of AI and surveys to develop a mental health screening system is the most effective approach. In comparison to our baseline assessment, we achieved a 21% improvement in accuracy. This improvement may be attributed to our altered approach to the problem. Notably, target encoding played a pivotal role as it preserved the relationships within the data even after encoding. Furthermore, employing Randomized Search for hyperparameter tuning yielded more accurate results than alternative methods. As our understanding of empathy continues to evolve, AI-driven methods for identification and intervention become increasingly effective. We did not explore deep learning-based options extensively, as our non-linear Random Forest model proved sufficiently effective for our purposes. However, as deep learning technologies advance, they may indeed become a valuable technique for detecting emotions such as hatred.

6.   FUTURE WORK:

The technique should initially be scrutinized in certifiable settings prior to being set free from the IT business and made accessible to the overall population. In principle, this will work on individuals' mental wellbeing overall and push humankind toward better close to home medical care. We can likewise incorporate an element that, in light of the data the delegate gives and the open-door number the individual gets, can likewise suggest suitable meds and expert assistance for the delegate's disease. We can likewise give agents choices other than proficient direction to converse with others about their close to home wellbeing. We may likewise offer them the choice to contact a "warmline," which is a telephone number where prepared volunteers give online help, or to join a free consideration bunch.

7.   REFERENCES:

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