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Softcomputing approaches for detection of mental health

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***Abstract*: We have simulated a dataset[21] using two most promising deep learning algorithms viz: Recurrent Neural Network (RNN) and Long short-term memory (LSTM). The accuracy reported by the RNN model is 0.78 whereas LSTM resulted in 0.82 accuracies. In conclusion, deep learning has the potential to provide early detection and treatment for mental health issues. However, further research is needed to improve the accuracy and reliability of these models and to evaluate their potential for widespread use in clinical settings. Deep learning techniques have shown great promise in the field of medical diagnosis, including the detection of mental health problems. This research aims to investigate the use of deep learning algorithms for the detection of mental health disorders, such as depression, anxiety and stress. The study will gather a large dataset of mental health-related data, including demographic information and self-reported symptoms. The data will then be processed and analyzed using deep learning algorithms, such as Convolutional Neural Networks and Recurrent Neural Networks, to build models that can accurately predict the presence of mental health disorders. The results of this research will contribute to the development of more efficient and effective mental health screening methods, which could greatly improve the early detection and treatment of mental health problems.**

***Keywords*:** Deep learning, Mental health, Anxiety, RNN, LSTM, Machine Learning**.**

I. Introduction

Mental illness is a category of medical disorder that alters a person's thoughts, feelings, or behavior (or all three), and research has proven that it can have an effect on one's physical health[1] Multimodal Deep Learning Framework is a state-of-the-art technique that utilizes multiple modalities of data to recognize mental disorders. This approach combines the power of deep learning and multiple data sources to provide a more comprehensive and accurate diagnosis of mental health conditions[2]. Users of social media often share their feelings or emotional. states through their posts. In this study, we developed a deep learning model to identify a user's mental state based on his/her posting information. y collecting various mental-health-related data from social media, we aim at developing a deep learning model that can identify a user's mental disorder, including depression, anxiety, bipolar, borderline personality disorder (BPD), schizophrenia, and autism[3] This can include analyzing large amounts of patient data to identify patterns and predict outcomes, developing personalized treatment plans based on individual patient data, and using natural language processing to analyze patient-provider communication. The hope is that deep learning can improve the accuracy and efficiency of mental health assessments and treatments.

1. Image analysis [4]: Using deep learning algorithms, medical images such as brain scans can be analyzed to detect signs of mental health disorders.[4,5,6]
2. Speech and language analysis [7]: Speech and language patterns can provide insight into a person's mental state. Deep learning algorithms canbe trained on large datasets to identify speech and language patterns associated with mental health disorders.
3. Text analysis [8]: Natural language processing techniques can be used to analyze written text, such as electronic health records, to detect signs of mental health disorders.
4. Wearable data analysis [9]: Wearable devices can collect data on a person's physical and physiological state, which can provide insight into their mental health. Deep learning algorithms can analyze this data to detect signs of mental health disorders.

II. Literature Review

The paper "Multimodal Deep Learning Framework for Mental Disorder Recognition" by Zhang et al. (2020) presents a deep learning framework for recognizing mental disorders using multimodal data. The authors aim to improve the accuracy of mental disorder recognition by utilizing multiple modalities such as speech and facial expressions[10] In conclusion, this paper presents a novel and effective approach for recognizing mental disorders using multimodal deep learning. The authors demonstrate that combining speech and facial expression data can lead to improved accuracy in mental disorder recognition. To quickly and automatically identify seafarers who need psychiatric counseling and

therapy, machine learning technologies can be deployed. In terms of accuracy and precision, Catboost scored the highest, with 82.6% and 84.1%, respectively. Nijhawan in (2022) [11] used NLP and machine learning to detect stress levels through analysis of social media interactions. The study found that the NLP-based features and machine learning algorithms were effective in detecting stress, with high accuracy rates. The use of social media interactions is novel and provides a promising approach to non-intrusive stress detection, however, further research is needed to validate the findings and explore the potential of NLP and machine learning in other forms of language and communication. Sherman in (2022) [12]. explored the use of machine learning for mental stress detection through real-time EEG analysis of the frontal lobe. The study found that the machine learning algorithms were effective in detecting stress with high accuracy. However, further research is needed to validate the findings and explore other EEG analysis techniques. The study highlights the potential of machine learning for non-intrusive stress detection. The authors used machine learning algorithms, including decision trees and support vector machines, to analyze data collected from students in higher education institutions[13]. The data included demographic information, academic performance, and mental health status. The results showed that the machine learning algorithms were effective in predicting mental health outcomes, with high accuracy rates. Tate (2020) [14] used machine learning to predict mental health problems in adolescents using demographic, behavioral, and psychiatric information. Results showed high accuracy in predicting mental health problems, highlighting the potential of machine learning for early detection and intervention. However, the study had limitations, such as a small sample size, and further research is needed to validate the findings and explore the potential in larger and diverse populations. Uddin (2022) [15] used deep learning on a large textual dataset to predict depressive symptoms with high accuracy. The study highlights the potential of deep learning in predicting depression, but further research is needed to validate the findings and explore its potential in larger and diverse populations. Chen (2022) [16] used machine learning to identify predictors of psychological distress from an online survey of demographic, behavioral, and psychological measures. The models showed high accuracy in identifying predictors, highlighting the potential of machine learning in early identification and intervention of psychological distress. However, limitations such as self-reported data and lack of external validation require further research in larger and diverse populations to fully explore the potential of machine learning in this field. This paper presents a critical assessment analysis of mental health detection in Online Social Networks (OSNs) based on data sources, machine learning techniques, and feature extraction methods. The objective of this systematic.SGD, with an overall F1 score of 89.42%, came in the first place. SVM, LR, and MNB were closely behind with scores of 89.39%, 89.37%, and 89.07%, respectively[17].The paper "Deep learning for depression detection from textual data" by Amanat et al. (2022) proposes a deep learning approach for detecting depression from textual data. The authors collected a dataset of online posts and comments written by individuals and used deep learning techniques to train a model to identify patterns in the text that are indicative of depression[18].Rezapour and Hansen's (2022) [19] study analyzed the impact of COVID-19 on mental health through machine learning. The study found that COVID-19 had a significant impact on mental health, with individuals with physical health conditions and financial difficulties having worse outcomes. Access to resources such as support from friends and family and mental health services were positively associated with better mental health outcomes. The study's results provide valuable insights into the impact of pandemics on mental health and highlight the importance of addressing physical and financial needs. The use of machine learning allowed for the analysis of a large dataset and demonstrated the potential of this approach in the analysis of mental health data. The main objective is [20] to aim to measure vital signs and gain patient-related information in clinicsThe research methodology will be discussed, including the technical details of data collection and data modeling. , the research set a path to analyze dynamic moving RFID tags and builds an RPM system to help retrieve patient vital signs such as heart rate. The results show that when the maximum depth parameter is 8, the model has the best performance—least mean absolute error and mean squared error (MSE). The decision tree was fit with the specific data set to train the model

III. Models

A. Convocational Neural Network

A CNN is a type of deep learning model that is commonly used for image and signal processing tasks. In the context of mental health outcome research, CNNs have been used to analyze and predict outcomes based on physiological signals such as EEG and fMRI.In a typical CNN, the input data is transformed through a series of operations that involve convolution, pooling, and activation functions. The convolutional layers are responsible for learning spatial relationships between features in the data, while the pooling layers reduce the spatial dimensionality of the data and help to extract important features. The activation functions introduce non-linearity into the model, allowing it to learn complex patterns in the data. The final layer of a CNN is typically a fully connected layer, which outputs a prediction or classification of the input data. The weights of the CNN are trained using a supervised learning approach, where a large dataset of labeled examples is used to update the weights in order to minimize the prediction error. Convolution Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to implement their multimodal deep learning framework. The CNNs were used to analyze physiological signals, while the RNNs were used to analyze demographic information

B. LSTM Model

The use of Long Short-Term Memory (LSTM) networks in mental health detection has gained significant attention in recent years. LSTM is a type of Recurrent Neural Network (RNN) that is well-suited for processing sequences of data, such as time-series data in mental health assessment. Studies have shown that LSTM can be used to detect various mental health conditions, such as depression and anxiety, by analyzing patients' speech, text, or physiological signals. The models are trained on large datasets of labeled data, allowing them to learn patterns and correlations that are indicative of mental health issues. For example, LSTM has been used to analyze speech patterns in patients with depression and anxiety and detect changes in tone, pitch, and rhythm that are

indicative of these conditions. In another example, LSTM has been used to analyze written text, such as social media posts, to detect signs of depression and other mental health conditions

C. Random Forest

Random Forest[7] is a type of machine learning algorithm that can be used in mental health deep learning. It can be used for tasks such as predicting the likelihood of a mental health condition, identifying risk factors for mental illness, or for the classification of different mental health disorders. In these applications, Random Forest can learn from a large dataset of patient information and symptoms, using the decision tree algorithm to identify the most important predictors of a mental health condition. The algorithm combines the results of many trees to produce a more accurate and stable prediction, making it well-suited for complex problems in mental health deep learning. Random Forest[16] is a popular machine learning algorithm that is used for both regression and classification problems. It is an ensemble learning method, which means it combines multiple decision trees to produce a more robust prediction. Random Forest was used to identify the predictors of psychological distress by creating a decision tree for each sample in the dataset. The final prediction was made by combining the predictions from all the decision trees. This can help to improve the overall performance and robustness of the mental health detection system. This can allow deep learning to handle the complex feature extraction, while the Random Forest provides a more interpretable model for making the final prediction. Another approach could be to fine-tune a pre-trained deep learning model on a mental health dataset and then use the resulting model's predictions as input features to a Random Forest. This can help to improve the overall performance and robustness of the mental health detection system.

D. Deep Neural Network

The deep neural network (DNN)[17] is a machine learning technique used in these papers for detecting depression and predicting depressive symptoms in individuals. The DNN model is trained on textual data, such as social media posts or electronic health records, to identify patterns and relationships between language and mental health. The DNN consists of multiple hidden layers that extract and analyze complex features from the input data, and then use them to make predictions about an individual's mental health status. The authors found that the DNN was able to achieve high accuracy in depression detection and predicting depressive symptoms, demonstrating the potential for DNNs to be used in precision mental health care

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F. SVM

Support Vector Machines (SVMs) can be used for the detection of mental health. SVMs are a type of supervised machine learning algorithm that are commonly used for classification problems. In the context of mental health, SVMs could be used to classify individuals as having a certain mental health condition or not, based on a set of features. The training process for an SVM involves finding the best boundary, or hyperplane, that separates the data points into different classes. In order to use an SVM for mental health detection, a labeled dataset with information on individuals' mental health status and relevant features must be collected. This dataset can then be used to train the SVM, after which the model can be tested and evaluated on a separate dataset.

G. Logical Regression

Logistic regression is a type of supervised machine learning algorithm that can be used for the detection of mental health. Logistic regression is a type of regression analysis that is used for binary classification problems, where the target variable has only two possible outcomes, such as "positive" or "negative". In the context of mental health, logistic regression could be used to predict whether an individual has a certain mental health condition or not, based on a set of features.The training process for a logistic regression model involves finding the best coefficients that can be used to calculate a predicted probability of the target variable. This predicted probability is then threshold to make a binary prediction. The coefficients are found by optimizing a loss function that measures the difference between the predicted probabilities and the true target labels. It’s important to note that the use of logistic regression for mental health detection is just one of the many potential applications of the algorithm, and that other machine learning models, such as decision trees or support vector machines, could also be used for this task. Additionally, it's crucial to consider the ethical implications of using machine learning for mental health assessment and to ensure that the models are trained and validated in a responsible and rigorous manner.

F. Linear Regression

Linear regression is a type of supervised machine learning algorithm that can be used in the context of mental health, although it may not be the most appropriate choice for certain mental health applications. Linear regression is a type of regression analysis that is used for predicting a continuous target variable based on a set of features. In the context of mental health, linear regression could potentially be used to predict a continuous outcome related to mental health, such as a symptom severity score. However, it's important to keep in mind that linear regression assumes a linear relationship between the features and the target variable, which may not be appropriate for many mental health applications Deep learning refers to a family of machine learning algorithms that use artificial neural

networks with multiple layers to model complex relationships in data. Deep learning algorithms, such as Convolutional Neural Networks (CNNs) or Recurrent Neural Networks (RNNs), are well-suited for tasks involving image, audio, or text data, and have been applied to various mental health problems, such as depression detection and suicide risk assessment. In summary, while linear regression could potentially be used in the context of mental health, it may not be the most appropriate choice for certain mental health applications. Deep learning algorithms, on the other hand, have shown promise in various mental health applications and may be more suitable for certain tasks

IV. Dataset Description

The dataset[21] consists of a survey that measures attitudes toward mental health and the prevalence of mental health issues in the tech industry. The dataset contains the following data such as age is used for age classification, and the country state refers to which country the employee lives. The important part of the dataset is the family history of mental health and treatment seeking of mental health conditions. The work interface for employees' mental health conditions at work. The information on how many employees are working in the organization. The survey consists of approximately 1450 respondents from various companies and countries. The survey questions cover various aspects of mental health, including current mental health status, work-related stress, seeking help, and treatment options. The data includes demographic information such as age, gender, and country of residence, as well as information on the respondent's current employment status, company size, and role. The survey results provide valuable insights into the mental health challenges faced by employees in the technology industry and can be used to inform policies and initiatives aimed at promoting mental wellness in the workplace. The data is presented in a CSV format and can be easily imported into a data analysis software for further analysis. Some data asked were the employees had any mental health benefits or any discussion about mental health issues in the organization. Important for the employee ease of taking a medical leave for a mental health condition. Comforting the employee, coworker, and supervisor to discuss mental health consequences. There is data containing mental health interviews that would state that it would bring up a mental health issue in the discussion. Data where employer faces between mental and physical health. Finally, data consist of adding additional notes or comments to the employes.

V. Proposed Model

RNN is used in the model to predict the mental health of people incompany who have gone through mental health checkups. RNN is one of the most precise models used in the detection of mental health. We have used a tech survey dataset adapted from open source Kaggle Repository [21]-

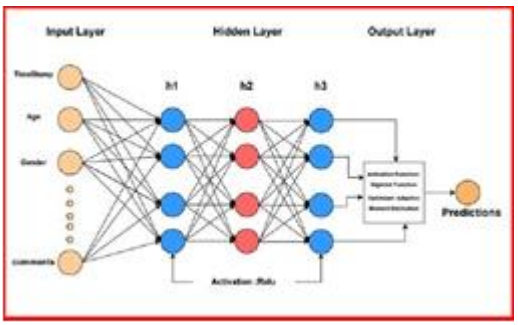

Fig:1. TensorFlow RNN Survey Model [22]

We have used the tech survey dataset, the features of the tech survey dataset are discussed in the dataset description section. As the data was not suitable to directly train the RNN-based model there was a requirement for data wrangling. The proposed RNN model works on real number data whereas the dataset in hand included categorical, ordinal, and numeral types of information. We have used Python's Panda library function to import the dataset into the pandas' data frame. After analyzing the dataset we understood that There were many null values in the various features. We have filled the null values with mode or average values. As the data is collected using Google forms the timestamp was a combination of Year, month, day, hour, minute, and seconds. We have separated all the time components from the Timestamp feature and created them as separate features. The values added by the respondent were not in similar text for example we found that for gender there were 49 unique values where it can have a max of three unique values. To handle such inconsistency in the dataset we have converted the feature and their values into required unique values. Values of data in the used dataset are converted into binary features, ordinal features, and nominal features as per feature categories. All the values were now converted to numbers to transform the dataset from hybrid values to numerical values only. The number-based dataset is normalized using the Standard Scaler method. The data wrangling process converted the dataset into the desired format so as to be used with RNN-based modeling. Our dataset now has 1263 instances and 27 features. The Numerical dataset is given as input to the proposed vanilla RNN model. A vanilla RNN is a straightforward implementation of an RNN architecture that is frequently used as the foundation for more intricate RNN models. Each neuron in a hidden layer of a standard RNN receives input from the layer below it and the current input layer before producing an output that is passed to the next hidden layer. Every time a step in the sequence is completed, the RNN's hidden state is updated, enabling it to keep track of what it has already seen.Our proposed model gave the best results with ReLU as the hidden layer activation function and Sigmoid as the output layer activation function. We implemented the adaptive optimizer ‘adam’ and the loss function used is binary cross entropy. The dataset was split into 80% training and 20% testing set. We achieved an accuracy of 70% at the 5th epoch with a batch size of 50. We also had implemented the LSTM model in order to compare the results. Surprisingly we had achieved an accuracy of 82% at the 5th epoch with a batch size of 50 . The model used binary features for the rest of the data of the normal range; the term used the nominal data name. Binary values used the +ve and -ve functions. The function uses the encoded values as the input layer. The Model also used an optimizer as

Adaptive Moment Estimation [adam]. There was the loss function which was used by categorical cross-entropy. The Sigmoid function is used by the output layer to give the results.

VI. Proposed model result description

The model is a Recurrent Neural Network (RNN) that is being used to classify categorical data. The loss function used for training the model is categorical cross-entropy loss. Cross-entropy loss is a commonly used loss function for classification problems, as it measures the difference between the predicted class probabilities and the true class labels. The categorical cross-entropy loss is used when the target data is categorical, or in other words, belongs to one of several possible categories.In addition to RNN, the model is also using Long Short-Term Memory (LSTM) cells. LSTMs are a type of RNN that are particularly well-suited for modeling sequential data and have the ability to learn long-term dependencies. The total number of parameters in the model is 2,702 and all of them are trainable. This means that during the training process, all parameters can be updated to minimize the categorical cross-entropy loss and improve the model's accuracy in classifying the data. The absence of non-trainable parameters indicatesthat the model is flexible and can adapt to the training data effectively. In summary, the model is a Recurrent Neural Network that uses Long Short-Term Memory cells to classify categorical data. The loss function used for training the model is categorical cross-entropy, and the model has 2,702 trainable parameters, giving it the ability to learn and adapt to the training data.

VII. Result

The proposed model is a tech review survey and the results are discussed in this section. From the output of the proposed model where we can see that the model has successfully predicted Mental health Checkups and the accuracy was observed to be 82%. As we see fig.2 represents the epoch vs loss graph, We can infer that at epoch 50 the model achieved 0.54% loss. As the number of epochs increases, the validation loss increases

RefNo.	Model	Result in accuracy
[2]	Decision tree and SVM	70%
[4][5]	KNN and Random Forest	90%
[7]	Linear Regression	71%
Proposed Model	RNN	70%
Proposed Model	LSTM	82%

VIII. Conclusion

In this study, we used and RNN-based model as a data wrangling strategy to handle a tech survey's data. Both numerical and category data were present. The outcome showed whether or not the IT business employees had undergone any mental health screenings within the organisation. In the future, machine learning algorithms may make it easier for mental health professionals to determine whether a patient is at risk of developing a certain mental health problem.. The algorithms may also help in monitoring a treatment plan's efficacy. Based on the studies listed above, it can be concluded that deep learning and machine learning techniques have been widely researched and applied in the field of mental health. These techniques have been used for recognizing mental disorders, detecting stress levels, and predicting mental health outcomes. The studies suggest that the use of these techniques have the potential to aid mental health professionals in their diagnoses and treatment planning. However, it is important to note that these techniques are still in their early stages of development and more research is needed to validate their accuracy and effectiveness. Furthermore, ethical and human-centered considerations must also be taken into account when developing and using these systems.

IX. Future Scope

The future scope of deep learning in mental health detection is promising and has the potential to significantly impact the field. Some possible areas of future research and development include

1. Early Detection and Diagnosis: Deep learning algorithms can be used to analyze data from various sources, such as brain imaging, speech patterns, and physiological signals, to detect signs of mental illness in its early stages.
2. Personalized Treatment: Deep learning algorithms can be used to create personalized treatment plans for mental health patients by analyzing theirindividual characteristics, symptoms, and responses to treatments.
3. Monitoring and Assessment: Deep learning algorithms can be used to continuously monitor and assess the mental health of patients, providing early warnings of any changes in their condition and enabling more proactive treatment.
4. Predictive Analytics: Deep learning algorithms can be used to predict the likelihood of a mental health condition developing, based on various factors such as genetics, lifestyle, and environmental factors.

Overall, the use of deep learning in mental health has the potential to revolutionizethe field by providing more accurate, personalized, and effective treatments for mental health conditions.

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Author Biographies

Rani Pacharane Rani Pacharane is currently pursuing a Bachelor's Degree in Computer Science from Sheth LUJ & Sir MV College, Mumbai University, Mumbai, Maharashtra. Her current focus is on developing a machine learning approach for the detection of mental health issues. She believes her work can significantly contribute to the field and help clinicians in the diagnosis and treatment of these disorders. Along with mental health research, she is exploring data science and data analytics. She is committed to making advancements in the field of mental health detection. . She is driven by the belief that her work can help improve the lives of those struggling with mental health issues, and she looks forward to the opportunities and experiences that lie ahead in her career

Keshav Mishra Keshav Mishra received his HSC in 2020 and is currently pursuing a Bachelor's Degree in Computer Science from Sheth LUJ & Sir MV College, Mumbai University, Mumbai, Maharashtra, India. His current research focuses on deep learning, machine learning, machine translation for Sanskrit language, facial emotion detection using YOLOv5, transformer models for Sanskrit to English translation, machine learning techniques for detecting mental health issues. In addition, he is also exploring the field of data science and data analytics. This event sparked his interest in research, which led him to explore more career options in this area. He feels grateful for the opportunities and experiences he has had so far and looks forward to seeing what the future holds

Sumit Kumar Tripath started as an Assistant Professor at Sheth L.U.J. College of Arts and Sir M.V. College of Science and Commerce in Mumbai. With over five years of experience, he believes in sustaining an effective learning environment through prepared classes and relevant assignments, achieving academic goals and classroom management. He has successfully completed certification courses like NEP and FDP and served as a B.Sc. examiner and in-charge of various college committees. According to him, "Computers are our best weapons to fight problems." He takes pride in supporting students and preparing them for personal and professional success in today's world.

Dr Mahendra Kanoji Dr.Mahendra Kanojia Currently employed as I/C Principal and HOD of the Department of Computer Science and Head of the Computer Education Centre in Sheth L.U.J. and Sir M.V. College, Mumbai, India. He completed his Ph.D. in year 2020 and M.Phil in Computer Science in year 2017. His current research of interest focuses on the detection of cancer using machine learning and deep learning techniques. He is also interested in the paradigm of medical diagnosis using digital image processing and AI approaches. He is exploring the field of data science and data analytics after receiving his PhD in Computer Science on Breast cancer detection using deep learning methods. Studies of IoT and chatbots are also part of his current projects. He is emerging as a multidisciplinary computer science research scientist.