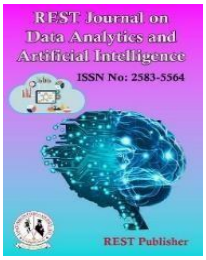
REST Journal on Data Analytics and Artificial Intelligence
Vol: 4(1), March 2025
REST Publisher; ISSN: 2583-5564
Website: http://restpublisher.com/journals/jdaai/
DOI: https://doi.org/10.46632/jdaai/4/1/93



Prediction of Student Anxiety

***Manisha, Sairam, Deepthi, S. Rajeshwar**
Anurag University, Hyderabad, India.
*Corresponding Author Email: 21eg107b55@anurag.edu.in

Abstract*. This research focuses on predicting student anxiety using advanced machine learning algorithms, aiming to enhance prediction accuracy and robustness. Anxiety is a prevalent issue among students, significantly impacting their academic performance and mental well-being. Traditional methods for identifying anxiety, such as self-reported surveys, lack real-time analysis and can be subjective. To address this, the proposed project leverages various machine learning techniques to develop more reliable predictive models. These models utilize diverse datasets, including academic performance, behavioral data, and socio-emotional factors, providing a comprehensive approach to anxiety prediction.The study explores traditional algorithms like Support Vector Machines (SVM) and Decision Trees (DT) alongside advanced methods such as AdaBoost, Gradient Boosting Machines (GBM), and deep learning models like Artificial Neural Networks (ANN). A comparative analysis will be conducted to evaluate the effectiveness of each model, measuring key performance metrics such as accuracy, precision, and recall.*

Keywords: *Subjectivity, Predictive Models, Behavioral Data, Socio-emotional factors, Support Vector Machines (SVM),Decision Trees (DT),AdaBoost,Gradient Boosting Machines,Deep learning,Artificial Neural Networks (ANN)*

1. INTRODUCTION

Student anxiety is a growing concern in educational institutions worldwide, impacting academic performance, social interactions, and overall well-being. With the increasing pressure to excel academically, students are more prone to anxiety, which can lead to serious mental health issues if not addressed early. Traditional methods for identifying anxiety, such as surveys and clinical assessments, often rely on self-reporting, which may be subjective and fail to capture real-time emotional states [1-4]. Consequently, there is a need for more effective tools that can predict and manage anxiety proactively.In recent years, machine learning (ML) has emerged as a powerful tool for predicting mental health conditions [5]. By analyzing patterns in large datasets, ML algorithms can identify key predictors of anxiety, such as academic performance, behavioral metrics, and socio-emotional factors, to provide real-time, data-driven insights. The application of advanced machine learning techniques holds promise for early detection of student anxiety, allowing for timely interventions [6-9].

2. BACKGROUND

I. Traditional Methods for Predicting Student Anxiety

Early methods for identifying student anxiety were primarily based on self-reported surveys, psychological assessments, and expert evaluations. These approaches relied on students answering standardized questionnaires that measured anxiety levels based on predefined psychological scales [10]. While these methods provided valuable insights, they suffered from several limitations:

- **Subjectivity:** Responses could be influenced by a student's mood, willingness to disclose information, or misunderstanding of the questions.
- **Lack of Real-Time Monitoring:** Traditional methods failed to provide continuous tracking of anxiety levels, making it difficult to detect fluctuations over time.
- **Limited Generalizability:** Since these methods relied heavily on predefined psychological models, they might not account for new or emerging stressors affecting students.

To improve early detection, researchers explored statistical models that correlated academic performance, attendance, and behavioral patterns with self-reported anxiety. However, these models struggled with complex, nonlinear relationships and lacked adaptability to diverse student populations [11-13].

II. Emergence of Machine Learning in Anxiety Prediction

As traditional methods proved inadequate in capturing the complexity of student anxiety, machine learning (ML) techniques emerged as a more data-driven and scalable approach [14]. ML algorithms could analyze diverse datasets, including:

- **Academic Records:** Grades, exam performance, and assignment completion rates.
- **Behavioral Patterns:** Attendance, engagement in class activities, and participation in extracurriculars.
- **Socio-Emotional Factors:** Sleep patterns, social interactions, and online activity.

Supervised learning models, such as Support Vector Machines (SVM) and Decision Trees (DT), became popular for classifying students based on their risk of anxiety. These models learned patterns from labeled datasets and could generalize better than traditional statistical approaches. However, they faced challenges in handling high-dimensional and noisy data [15].

III. Advancements with Deep Learning

The real breakthrough in anxiety prediction came with the adoption of deep learning models, particularly Artificial Neural Networks (ANNs) and Gradient Boosting Machines (GBM). These models offered several advantages:

- **Automatic Feature Extraction:** Unlike traditional ML models that required manual feature selection, deep learning could identify hidden patterns in student data.
- **Handling Nonlinear Relationships:** Anxiety is influenced by multiple interrelated factors. Deep models captured these complex dependencies more effectively.
- **Improved Generalization:** By training on large datasets, deep learning models could recognize anxiety patterns across different student demographics.

Among deep learning techniques, Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks showed promise for tracking anxiety trends over time, allowing for early intervention based on real-time monitoring [16-18].

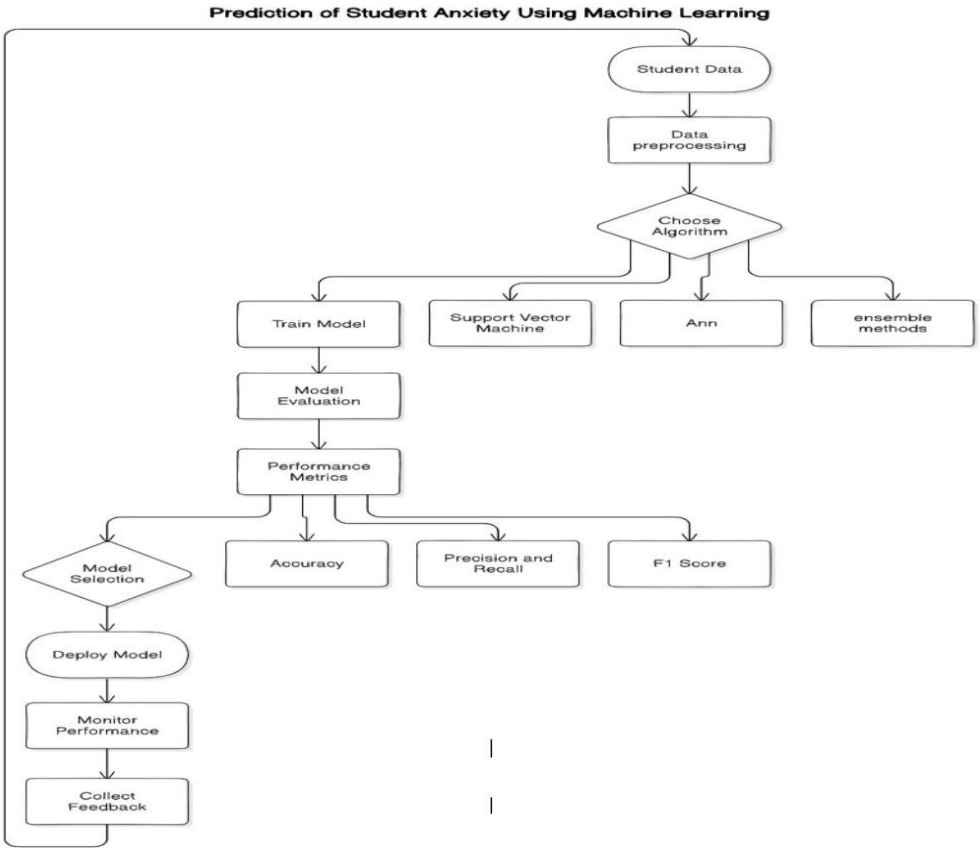


FIGURE 1.

3. LITERATURE REVIEW

TABLE 1.

Year	RF.No	Author	Title	Source	Key Findings
2024	[1]	A. Almadhor et al.	Multi-Class Adaptive Active Learning for Predicting Student Anxiety	Recognition accuracy	Proposed an adaptive active learning approach for multi-class anxiety prediction, improving classification accuracy with minimal labeled data.
2021	[2]	M.D. Nemesure et al.	Predictive Modeling of Depression and Anxiety Using Electronic	Accuracy, Robustness	Utilized electronic health records and AI-driven models for predicting anxiety and depression, demonstrating the effectiveness of deep learning for mental health assessment.
2023	[3]	V. Sireesha et al.	Anxiety Prediction Using Machine Learning	Accuracy, Training time	Explored ML-based anxiety prediction, emphasizing feature selection and dataset preprocessing for improved accuracy.
2023	[4]	Mitra, A., Chakraborty, A., & Dutta, S.	Machine Learning-Based Anxiety Detection Among Students Using Psychosocial Data	Accuracy, Precision	CFocused on the impact of psychosocial factors (peer pressure, academic stress) in predicting student anxiety using ML models.
2020	[5]	V. M. Khatik et al.	Predicting Student Anxiety through Behavioral Data	Accuracy, Training loss	Investigated behavioral indicators (attendance, engagement) for anxiety prediction, highlighting the role of real-time data analysis.
2023	[6]	M. S. Ram et al.	Machine Learning-Based Student Anxiety Prediction	Accuracy, Loss	Developed an ML-based anxiety detection framework integrating physiological and academic data for early intervention.

4. METHODOLOGY

Machine learning methodology for predicting student anxiety includes several steps: data collection, preprocessing, feature selection, model selection, training, evaluation, and deployment. First is to collect relevant datasets constituted of various factors like academic performance, behavior patterns, and socio-emotional factors. Then preprocessing of the data is done to handle missing values, outliers, and imbalanced classes. Feature-selection techniques are applied at this stage to arrive at the most relevant predictors of anxiety. Support Vector Machines, Decision Trees, AdaBoost, Gradient Boosting Machines, and Artificial Neural Networks are those upon various machine learning [19-20], each trained and optimized through hyperparameter tuning. Accuracy, precision, recall, and F1-score are some of the foremost evaluable indices through which a model's efficacy can be gauged. The thus trained best one will go on to make its way into a real-time anxiety-monitoring system, for early detection and intervention strategies of student mental-health support.

5. RESULTS

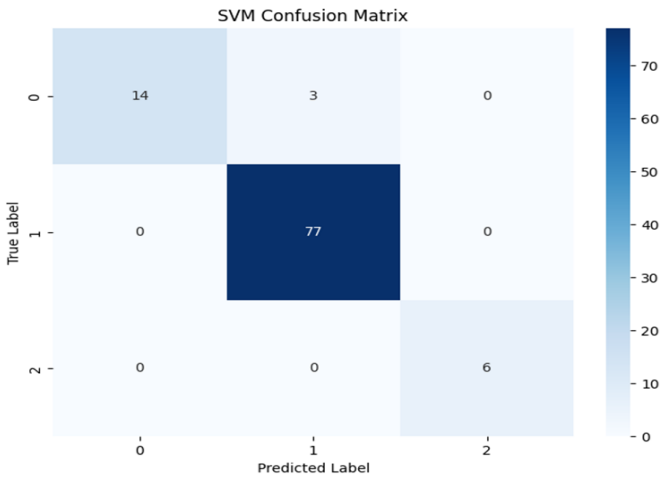


FIGURE 2.

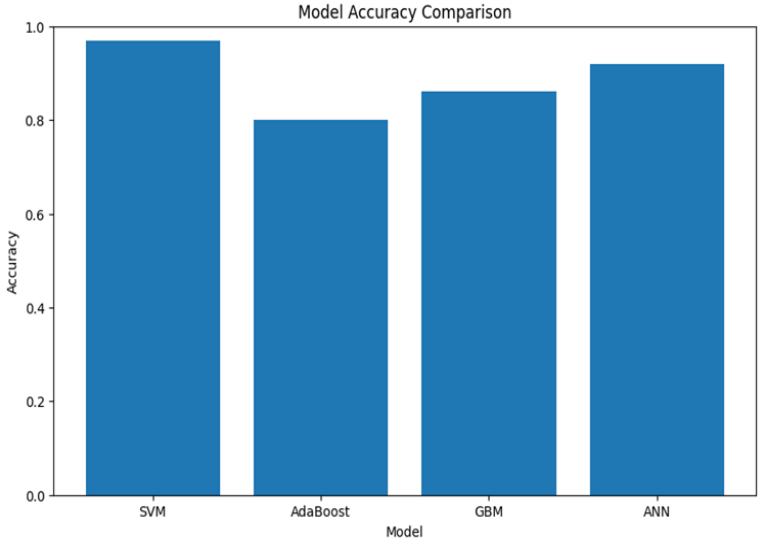


FIGURE 3.

Predicting the anxiety of students might consider building on deep learning models, like CNN and RNN, to discover the patterns in missing or lagging data that allow real-time updates for prediction accuracy. Tuning the hyperparameters through methods like Random Search, Bayesian Optimization, and Genetic Algorithms could improve model performance but guard against overfitting or underfitting. Enhancing the time-dependent prediction capacity by incorporating real-time monitoring of behavioral data could facilitate steady performance assessment and live updates among anxiety trends pertaining to academic performance. Deployment on the AWS or Google Cloud service provides the possibility of extending the accessibility of the model. It would allow for scalability and wide use in higher education institutions, hence applicability for remote use. Feature engineering should also focus more on context-sensitive approaches through the integration of domain knowledge for a more accurate representation of student behavior with respect to anxiety and model interpretability.

6. CONCLUSION

The prediction of student anxiety using machine learning models involves leveraging a well-structured design that analyzes various student-related factors such as demographic information, academic performance, and mental health indicators. Anxiety in students is a growing concern as it can significantly affect both their academic success and overall well-being. By using machine learning algorithms, we can create an efficient system that aids in early detection and intervention. The project uses a dataset that includes various features like survey results and behavioral indicators. Through machine learning techniques, the system can predict whether a student may be at risk of anxiety. Various algorithms were applied, and the evaluation process allowed us to assess their accuracy and effectiveness. Python, being a flexible and open-source language, was used for developing and testing these models, with cost-effective implementation.

REFERENCES

[1]. A. Almadhor, S. Abbas, G.A. Sampedro, S. Alsubai, S. Ojo, A. Al Hejaili, and L. Strazovska, "Multi-Class Adaptive Active Learning for Predicting Student Anxiety," *IEEE Access*, vol. 12, no. 1, pp. 58097-58105, April 2024, doi: 10.1109/ACCESS.2024.3391418.

[2]. M.D. Nemesure, M.V. Heinz, R. Huang, N.C. Jacobson, "Predictive modeling of depression and anxiety using electronic health records and a novel machine learning approach with artificial intelligence", Scientific Reports, vol. 11, no. 1980, pp. 1-8, Jan. 2021, doi.org/10.1038/s41598-021-81368-4

[3]. V. Sireesha, M. Mohammed, K. R. Prasad, and K. Jeevitha, "Anxiety Prediction Using Machine Learning," 2023 International Conference on Mental Health and AI Systems, Coimbatore, India, 2023.

[4]. Manoranjan Dash, N.D. Londhe, S. Ghosh, et al., "Hybrid Seeker Optimization Algorithm-based Accurate Image Clustering for Automatic Psoriasis Lesion Detection", Artificial Intelligence for Healthcare (Taylor & Francis), 2022, ISBN: 9781003241409
[5]. Manoranjan Dash, Design of Finite Impulse Response Filters Using Evolutionary Techniques - An Efficient Computation, ICTACT Journal on Communication Technology, March 2020, Volume: 11, Issue: 01
[6]. Manoranjan Dash, "Modified VGG-16 model for COVID-19 chest X-ray images: optimal binary severity assessment," International Journal of Data Mining and Bioinformatics, vol. 1, no. 1, Jan. 2025, doi: 10.1504/ijdmb.2025.10065665.
[7]. Manoranjan Dash et al.," Effective Automated Medical Image Segmentation Using Hybrid Computational Intelligence Technique", Blockchain and IoT Based Smart Healthcare Systems, Bentham Science Publishers, Pp. 174-182,2024
[8]. Manoranjan Dash et al.," Detection of Psychological Stability Status Using Machine Learning Algorithms", International Conference on Intelligent Systems and Machine Learning, Springer Nature Switzerland, Pp.44-51, 2022.
[9]. Samriya, J. K., Chakraborty, C., Sharma, A., Kumar, M., & Ramakuri, S. K. (2023). Adversarial ML-based secured cloud architecture for consumer Internet of Things of smart healthcare. IEEE Transactions on Consumer Electronics, 70(1), 2058-2065.
[10]. R. S. Kumar, K. K. Srinivas, A. Peddi and P. A. H. Vardhini, "Artificial Intelligence based Human Attention Detection through Brain Computer Interface for Health Care Monitoring," *2021 IEEE International Conference on Biomedical Engineering, Computer and Information Technology for Health (BECITHCON)*, Dhaka, Bangladesh, 2021, pp. 42-45, doi: 10.1109/BECITHCON54710.2021.9893646.
[11]. Vytla, V., Ramakuri, S. K., Peddi, A., Srinivas, K. K., & Ragav, N. N. (2021, February). Mathematical models for predicting COVID-19 pandemic: a review. In Journal of Physics: Conference Series (Vol. 1797, No. 1, p. 012009). IOP Publishing.
[12]. S. K. Ramakuri, C. Chakraborty, S. Ghosh and B. Gupta, "Performance analysis of eye-state charecterization through single electrode EEG device for medical application," *2017 Global Wireless Summit (GWS)*, Cape Town, South Africa, 2017, pp. 1-6, doi:10.1109/GWS.2017.8300494.
[13]. 1. Gogu S, Sathe S (2022) autofpr: an efficient automatic approach for facial paralysis recognition using facial features. Int J Artif Intell Tools. https://doi.org/10.1142/S0218213023400055
[14]. 2. Rao, N.K., and G. S. Reddy. "Discovery of Preliminary Centroids Using Improved K-Means Clustering Algorithm", International Journal of Computer Science and Information Technologies, Vol. 3 (3), 2012, 4558-4561.
[15]. 3. Gogu, S. R., & Sathe, S. R. (2024). Ensemble stacking for grading facial paralysis through statistical analysis of facial features. Traitement du Signal, 41(2), 225–240.
[16]. Vinayasree, P., Mallikarjuna Reddy, A. A Scalable, Secure, and Eficient Framework for Sharing Electronic Health Records Using Permissioned Blockchain Technology, International Journal of Computational and Experimental Science and Engineering, 2024, 10(4), pp. 827–834.
[17]. Cheruku, R., Hussain, K., Kavati, I., Reddy, A.M., Reddy, K.S. Sentiment classification with modified RoBERTa and recurrent neural networks, Multimedia Tools and Applications, 2024, 83(10), pp. 29399–29417
[18]. Daniel, G.V., Trupthi, M., Reddy, G.S., Reddy, A.M., Sai, K.H. AI Model Optimization Techniques, Model Optimization Methods for Efficient and Edge AI: Federated Learning Architectures, Frameworks and Applications, 2024, pp. 87–108.
[19]. Srinivasa Reddy, K., Brahma Naidu, K., Adi Narayana Reddy, K., Mallikarjuna Reddy, A. Automatic speech recognition for cleft lip and cleft palate patients using deep learning techniques, Research Advances in Intelligent Computing: Volume 2, 2024, 2, pp. 10–27.
[20]. Mamidisetti, S., Reddy, A.M. Correlation-Based Attention Weights Mechanism in Multimodal Depression Detection: A Two-Stage Approach, International Journal of Intelligent Engineering and Systems, 2024, 17(5), pp. 350–365

