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AI-POWERED INTELLIGENT SYSTEM FOR STUDENT DROPOUT PREDICTION & MENTAL HEALTH COUNSELLING

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Abstract: Student dropout and declining mental health are major challenges faced by educational institutions worldwide, leading to academic underperformance and decreased student wellbeing. This study proposes an AI-powered intelligent system for the early prediction of student dropout and provision of personalized mental health counselling. The system integrates machine learning algorithms to analyze multi-dimensional data, including academic performance, attendance records, online engagement patterns, and socio-demographic information, to identify students at risk of dropout. Simultaneously, it applies natural language processing (NLP) and sentiment analysis to evaluate students' psychological well-being based on survey responses, messages, and activity logs. The system presents the results via a comprehensive dashboard for educators and administrators, highlighting high-risk students and providing actionable recommendations for timely intervention. Experimental results demonstrate the system's high predictive accuracy in identifying at-risk students and its effectiveness in monitoring mental health trends.

Index Terms - Component, formatting, style, styling, insert.

I. INTRODUCTION

In recent years, student dropout and mental health challenges have emerged as critical issues affecting educational institutions worldwide. High dropout rates not only result in academic and financial losses for institutions but also have long term social and psychological impacts on students. Simultaneously, the increasing prevalence of stress, anxiety, and depression among students highlights the urgent need for timely mental health support. Traditional approaches to identifying at risk students often rely on manual monitoring, which is time consuming, reactive, and prone to , online payment system.

Real-time notifications are integrated to improve accuracy and user experience. The methodology also explains how different users such as customers, shop owners, and delivery partners interact with the application. Each module is designed to reduce manual work, minimize errors, and improve transparency in the system This paper proposes an AI-powered intelligent system that combines dropout prediction and mental health counselling in a single platform. The system provides real-time insights to educators and administrators, enabling timely interventions and personalized support for students. By leveraging predictive analytics and AI-driven counselling, the system aims to improve student retention, enhance academic performance, and support mental well-being, addressing both educational and psychological challenges in a holistic manner..

RESEARCH PROBLEM

High dropout rates lead to academic, financial, and social challenges for students and institutions. Declining mental health among students often remains undetected due to lack of systematic assessment. Existing solutions are fragmented, addressing either academic performance or mental health, but not both. Integrating and analyzing diverse data (grades, attendance, engagement, surveys, messages) is challenging. Ensuring accurate prediction and actionable interventions while maintaining privacy and ethical standards is essential.

A comprehensive approach is needed to address student success by combining technology, data analytics, and human support systems. By using advanced models, institutions can identify patterns and trends that indicate potential risks at an early stage. This allows educators and counselors to take proactive steps such as personalized guidance, mentoring, and timely interventions. At the same time, maintaining transparency, data security, and ethical practices ensures that students' trust is preserved while improving their overall academic and personal well-being.

OBJECTIVES

The proposed system leverages advanced machine learning algorithms to predict students at risk of dropout by analyzing multidimensional academic and behavioral datasets. It incorporates Natural Language Processing (NLP) and sentiment analysis models to perform continuous assessment of student mental health using unstructured textual data. Based on predictive insights, the system generates personalized intervention strategies and adaptive counselling recommendations. An interactive data visualization dashboard supports educators with real-time, data-driven decision-making capabilities. Furthermore, the framework ensures data privacy, security, and ethical compliance through robust data governance mechanisms and responsible AI practices.

PROPOSED METHODOLOGY

1. Heterogeneous Data Integration (HDI)

In this phase, multidimensional data is collected from various sources to understand student behavior and performance. Academic records such as grades, attendance, and assignments are gathered along with LMS activity data. Mental health indicators are obtained through surveys, self-assessments, and textual inputs. Both structured and unstructured data are integrated into a centralized system for analysis.

2. System Architecture Design

This phase focuses on designing the overall architecture of the intelligent system. The system is structured into frontend, backend, and database layers for scalability and efficiency. Data Flow Diagrams (DFD) and workflow models are created to represent system processes. Database schema is designed to store student data, predictions, and counselling records.

3. Model Development and Implementation

In this stage, machine learning and NLP models are developed and implemented. Supervised learning algorithms like Random Forest, XGBoost, and ANN are used for dropout prediction. NLP techniques such as sentiment analysis and text classification are applied for mental health assessment. The system is integrated with a backend database (Firebase/MySQL) for real-time data processing.

4. Testing and Performance Evaluation

Testing ensures the reliability and accuracy of the system. Unit testing is performed for individual modules such as prediction and NLP components. Integration testing validates communication between modules and database systems. Model performance is evaluated using metrics of accuracy, precision, recall, F1-score, and ROC-AUC.

5. Deployment and Visualization

After validation, the system is deployed on a cloud-based platform for accessibility. A Business Intelligence dashboard is implemented to visualize dropout risk and mental health insights. Educators and counsellors can monitor students through real-time analytics. The system provides actionable recommendations for timely intervention.

6. Maintenance and Enhancement

Post-deployment, the system is continuously monitored for performance and accuracy. Feedback loops are used to retrain models and improve predictions over time. Regular updates and enhancements are implemented based on user needs. Advanced features such as AI-based counselling recommendations and adaptive learning can be integrated in future versions.

METHODOLOGY

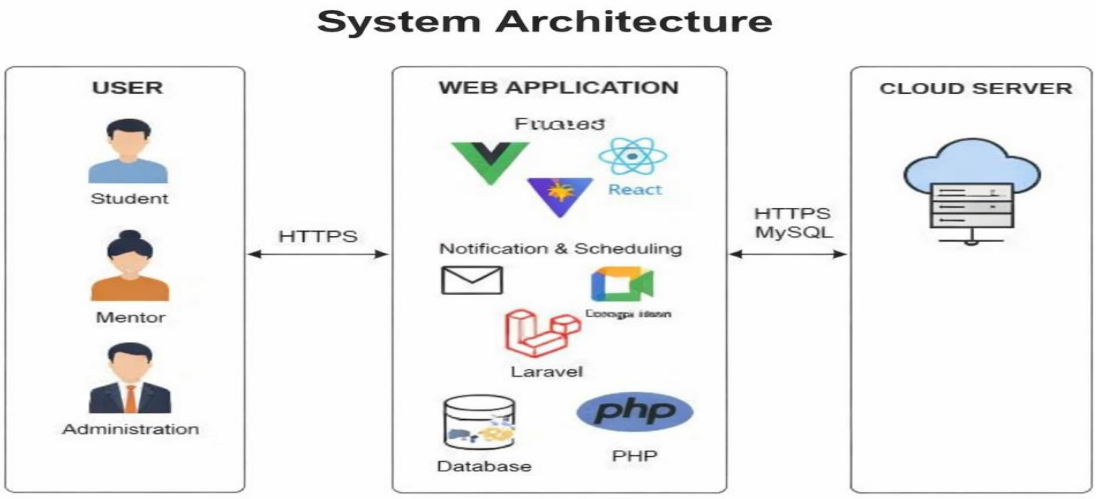
The methodology adopts a **data-driven, AI-enabled framework** to predict student dropout risk and deliver personalized mental health counselling. It integrates **Machine Learning (ML), Natural Language Processing (NLP), and Predictive Analytics (PA)** to generate real-time, actionable insights for educators, counsellors, and administrators. The system begins with **multisource data acquisition**, aggregating high-dimensional datasets from academic records (grades, attendance, assignment submissions), Learning Management System (LMS) interactions, socio-demographic attributes, and mental health indicators collected through surveys and self-assessment tools.

This heterogeneous data is processed through a robust **data preprocessing pipeline**, including data cleaning, normalization, missing value imputation, and transformation of unstructured textual data into numerical representations using techniques such as **TF-IDF and word embeddings**. Advanced **feature engineering and selection methods** are applied to identify key predictors influencing both academic performance and psychological well-being.

Dropout prediction, the system employs **supervised learning algorithms**, including **Random Forest (RF), Extreme Gradient Boosting and Artificial Neural Networks (ANN)**, to perform classification and probabilistic risk scoring.

These models are trained on historical datasets and evaluated using **performance metrics** such as accuracy, precision, recall, F1score, and **Receiver Operating Characteristic–Area Under Curve (ROC-AUC)** to ensure high predictive reliability. Concurrently, the **Mental Health Assessment Module** utilizes NLP-based models for **sentiment analysis, emotion detection, and text classification** to extract psychological insights from student-generated textual data. This enables early identification of

stress, anxiety, and depressive patterns, facilitating proactive intervention strategies.



All analytical outputs are integrated into an interactive **Business Intelligence (BI) dashboard**, providing **real-time visualization, risk stratification, and trend analysis**. The system generates **personalized, data-driven recommendations** to support targeted counselling and timely academic interventions. Furthermore, the architecture incorporates a **continuous learning mechanism** with feedback loops, enabling dynamic model retraining and performance optimization over time. From an implementation perspective, the framework ensures **data privacy, security, and ethical AI compliance** through encryption, access control, and responsible data governance practices.

The system delivers significant benefits by enhancing **student retention, academic performance, and mental well-being** through early risk detection and intervention. It empowers institutional stakeholders with **decision intelligence capabilities**, enabling efficient resource allocation and proactive student support.

In terms of future scope, the platform can be extended with **Explainable AI (XAI)** for model transparency, real-time emotion recognition using multimodal data (voice and facial expressions), and integration with wearable devices for continuous health monitoring. Overall, the proposed system establishes a **scalable, intelligent, and holistic student support ecosystem**, To provide a registration system for farmers and customers.

1. To perform **multi-source data integration** by aggregating academic, behavioral, and psychological datasets.

2. To apply **data preprocessing techniques** such as normalization, missing value imputation, and feature engineering.

3. To develop **supervised machine learning models** for predictive dropout risk classification.

4. To implement **Natural Language Processing (NLP)** with sentiment analysis for mental health evaluation..

5. To generate **personalized intervention strategies** using predictive analytics and risk profiling.

6. To design an **interactive data visualization dashboard** for real-time monitoring and analytics..

7. To enable **data-driven decision-making (DDDM)** for educators and counsellors.

8. To ensure **data security, privacy preservation, and ethical AI compliance**.

9. To build a **scalable and adaptive AI system** with continuous learning and model optimization.

Overall Objective

The overall objective of the project **"AI-Based Student Dropout Prediction and Mental Health Counselling System"** is to develop an intelligent, data-driven platform that integrates **Machine Learning (ML), Natural Language Processing (NLP), and Predictive Analytics** to identify at-risk students and provide timely interventions. The system aims to enhance student retention by analyzing academic performance, behavioral patterns, and psychological indicators.

It empowers educators and counsellors with **real-time decision support** through interactive dashboards and actionable insights. Ultimately, the project focuses on improving **academic outcomes, mental well-being, and institutional efficiency** through a scalable and ethically compliant AI framework.

FUTURE SCOPE

The project **"AI-Based Student Dropout Prediction and Mental Health Counselling System"** has strong potential for future expansion and technological enhancement. The following improvements can be implemented in upcoming versions of the system:

1. Explainable AI (XAI) Integration

- Implement **Explainable AI models** to improve transparency and interpretability of predictions.
- Enable educators to understand key factors influencing dropout risk decisions.

2. Advanced Mental Health Prediction Models

- Utilize **Deep Learning (DL)** architectures such as LSTM and Transformer models.
- Improve accuracy in detecting complex emotional and psychological patterns.

3. Real-Time Behavioral Analytics

- Integrate r**eal-time data streaming** from LMS and student interaction platforms.
- Enable continuous monitoring and early risk detection.

4. Multi- Modal Emotion Recognition

- Incorporate **voice, facial expression, and text analysis** for comprehensive assessment.
- Enhance detection of stress, anxiety, and emotional states.

5. Mobile Application Integration

- Develop a **cross-platform mobile application** for accessibility and user engagement.
- Provide real-time alerts, counselling support, and progress tracking.

6. Privacy-Preserving AI Techniques

- Implement **Federated Learning (FL)** and data anonymization methods.
- Ensure enhanced data privacy, security, and regulatory compliance.

7. Personalized Learning Recommendation System

- Use **Recommender Systems (RS)** to suggest adaptive learning resources.
- Improve student engagement and academic performance.

8. Institutional-Level Analytics and Reporting

- Provide **macro-level analytics dashboards** for administrators
- Support policy-making, resource allocation, and performance optimization.

9. Integration with Wearable Devices

- To enable **continuous, real-time mental health monitoring**, the system can integrate **physiological data streams** (e.g., heart rate and stress indicators) using wearable sensor technologies and advanced analytics.

CONCLUSION

The project **"**AI-Based Student Dropout Prediction and Mental Health Counselling System**"** successfully presents an AI-driven, data-centric solution to address challenges in student retention and psychological well-being within educational institutions. By integrating multi-dimensional datasets including academic performance, behavioral patterns, socio-demographic attributes, and mental health indicators, the system enables early risk identification and proactive intervention. The implementation of Machine Learning (ML) models for predictive analytics and Natural Language Processing (NLP) for sentiment and emotion analysis ensures accurate classification of at-risk students and timely counselling support.

The system provides an interactive Business Intelligence (BI) dashboard that delivers real-time insights, risk stratification, and actionable recommendations for educators and counsellors. Its continuous learning framework, supported by model retraining and feedback mechanisms, enhances prediction accuracy and intervention effectiveness over time. Furthermore, the platform emphasizes data privacy, security, and ethical AI compliance, ensuring responsible handling of sensitive student information.

Furthermore, the project contributes to improved academic performance, reduced dropout rates, and enhanced mental health support, while enabling institutions to adopt a data-driven decision-making approach. By leveraging advanced technologies and scalable architecture, the system promotes a holistic and intelligent student support ecosystem.

In conclusion, the **"AI-Based Student Dropout Prediction and Mental Health Counselling System"** serves as a robust, scalable, and efficient AI-powered platform that bridges the gap between academic analytics and mental health management, fostering a sustainable and future-ready educational environment.

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