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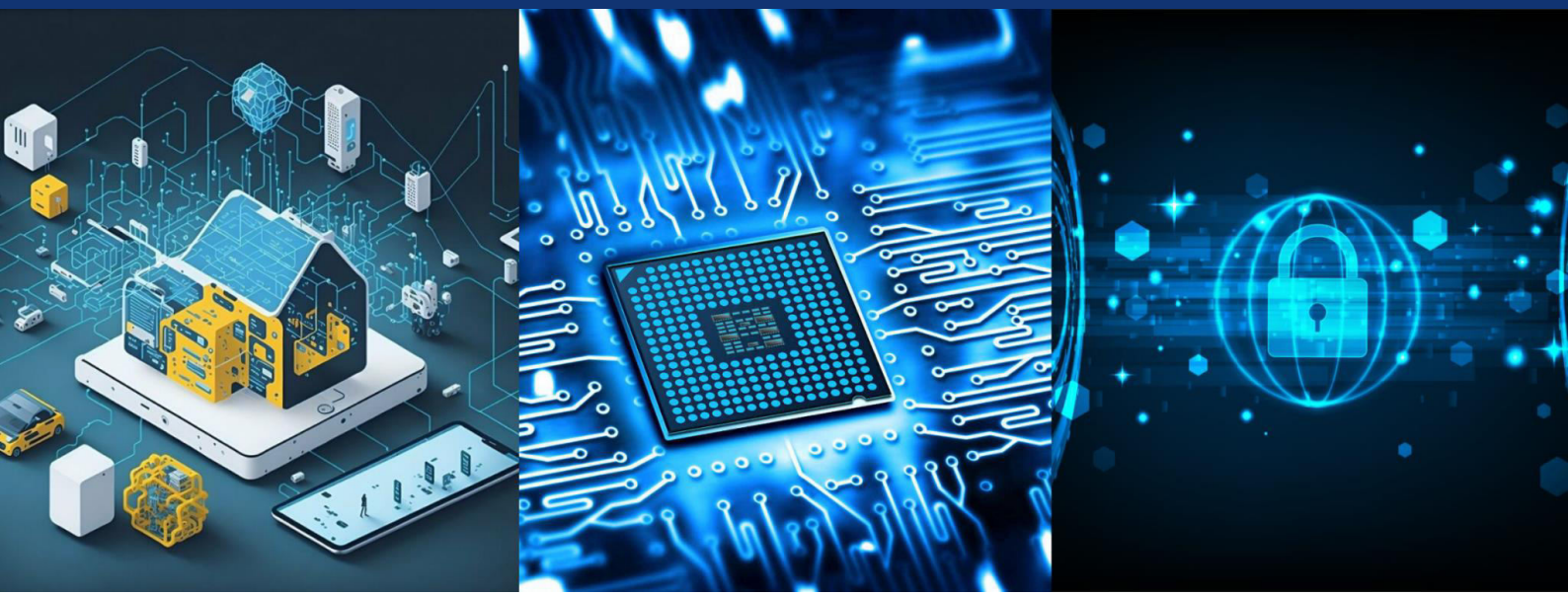

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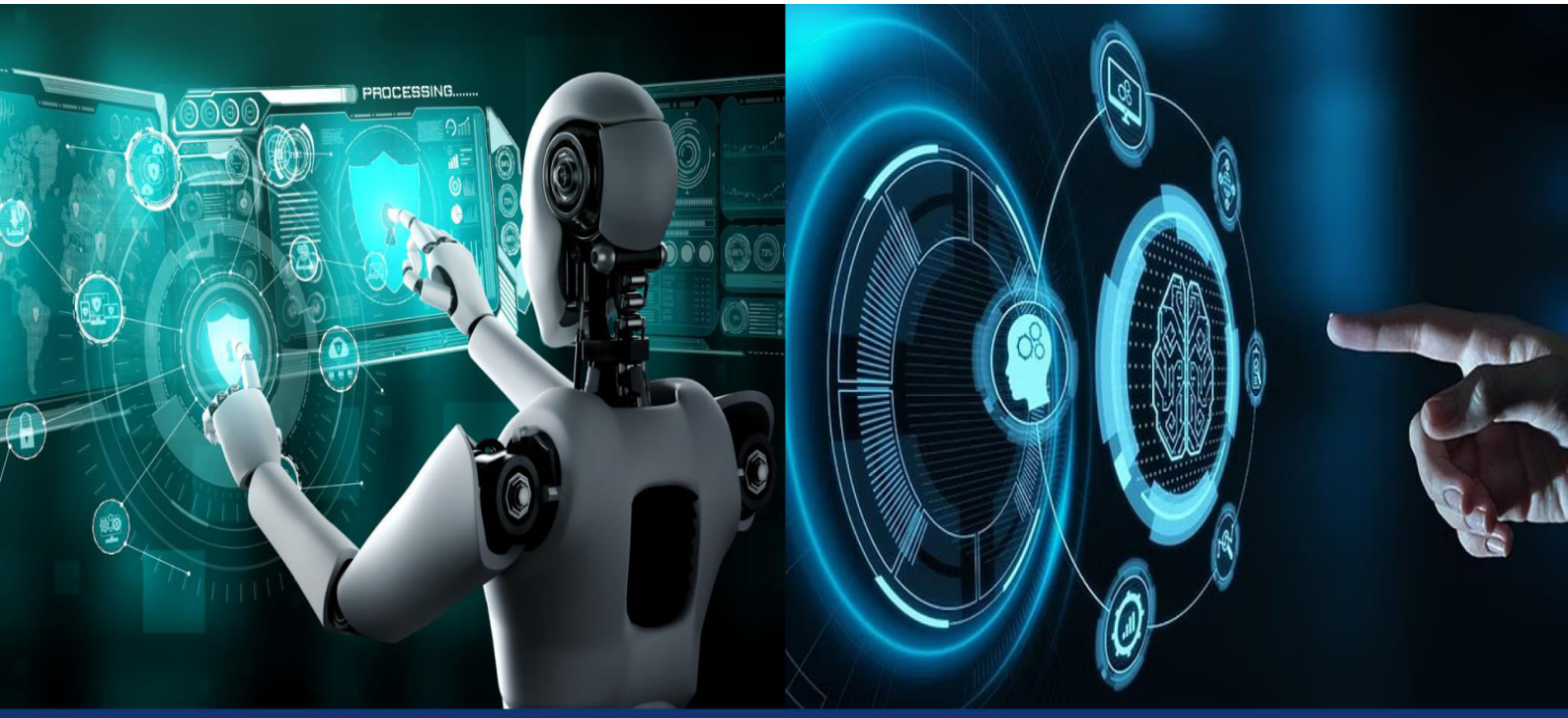

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Develop A Model/Software Which Will Help Students to Assess Mental Health of Students, Build Methods to Find Out and Provide Solution for The Improvement

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ABSTRACT: Mental health issues among children and adolescents have become a global public health concern, exacerbated by factors like academic pressure, social comparison, and the post-pandemic impact. This project aims to develop a software-based mental health surveillance platform to assess and track the psychological well-being of students, offering early detection and personalized intervention recommendations.Built using Python, HTML, CSS, JavaScript, and Flask, the system leverages AI and machine learning, including XGBoost for classification and K-Means Clustering for grouping students based on mental health data such as academic performance, attendance, behavior, and mood. The platform predicts risk levels ("Low Risk," "Moderate Risk," "High Risk") and suggests timely interventions for counselors, educators, and parents.The system is accessible via a secure web portal and does not require high-end infrastructure, making it suitable for schools with varying economic backgrounds. Data privacy and ethical AI standards are prioritized to ensure secure, anonymized data storage.The ultimate goal is to create a scalable solution for early intervention, contributing to emotionally resilient youth in line with India's National Education Policy (NEP) and digital health initiatives.

KEYWORDS: Mental Health Assessment, AI in Education, Predictive Analytics, XGBoost, K-Means Clustering, Flask Web Development, Early Detection, Behavioral Health Monitoring, Child Mental Health Solutions, NEP-Aligned Programs.

I. INTRODUCTION

Mental health has emerged as a crucial public health challenge worldwide, especially among children and adolescents. According to the World Health Organization (WHO), 10-20% of children and adolescents experience mental health conditions, yet these often go undiagnosed and untreated. In India, the situation is further complicated by academic pressure, social competition, peer conflicts, familial expectations, and the psychological after-effects of the COVID-19 pandemic. These stressors collectively impact children's emotional well-being, leading to anxiety, depression, behavioral issues, and in severe cases, self-harm or dropout.

Schools are in a unique position to play a pivotal role in early detection and intervention. However, current systems in educational institutions often lack structured, technology-driven mechanisms to continuously monitor and address students' mental health. Teachers and parents may overlook early warning signs, leading to delayed interventions when conditions have escalated. This gap in mental health support demands an innovative solution that is proactive, data-driven, and accessible across schools with varying resources.

To address this challenge, this project proposes a **Mental Health and Well-being Surveillance Assessment and Tracking Solution** targeted at school-aged children. The solution is a software platform powered by Artificial Intelligence (AI) and Machine Learning (ML) techniques to monitor, assess, and predict the mental health risk levels among students. Using a combination of classification and clustering models, the system provides actionable insights to counsellors, educators, and parents, helping them intervene at the right time with personalized care strategies.

The proposed solution is built using Python, HTML, CSS, and JavaScript for frontend development, while Flask serves as the backend framework. Machine learning models like XGBoost and K-Means clustering are employed to predict risk levels and group students based on mental health traits. The platform is designed to be cost-effective, scalable, and compliant with privacy norms, making it an ideal fit for deployment in schools across different socio-economic

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settings.

By integrating AI-powered surveillance and predictive analytics, this project aligns with India's **National Education Policy (NEP)** and digital health initiatives, aiming to nurture emotionally resilient youth equipped to thrive in both academic and social domains.

II. LITERATURE SURVEY

Current Status of Child Mental Health

Research indicates that mental health problems among school children have been rising globally. Studies by the WHO and UNICEF highlight that mental health conditions often begin before the age of 14, but most go undetected until they become severe. In India, reports suggest that 56 million people suffer from depression and 38 million from anxiety disorders, many of whom are children. Despite increasing awareness, the infrastructure for mental health assessment and intervention in schools remains underdeveloped.

Existing Solutions and Gaps

Traditional approaches for mental health support in schools rely on manual observation by teachers, counsellors, and periodic assessments. These methods are subjective, time-consuming, and often fail to capture early signs of distress. Existing digital solutions like mobile health (mHealth) apps focus on general well-being but lack personalization and real-time tracking features suitable for school environments.

In terms of technological intervention, there are few school-specific platforms that leverage AI and ML for predictive analysis of mental health. For example:

Some research has employed **Support Vector Machines (SVM)** and **Decision Trees** for depression detection in social media texts.

Others have used **Random Forest** models for classifying anxiety levels based on questionnaires.

However, these models often suffer from scalability issues and lack interpretability for non-technical users like teachers and parents.

Role of Machine Learning in Mental Health

Machine learning has shown promise in mental health detection through predictive analytics.

XGBoost, a scalable gradient boosting algorithm, has been widely used for high-accuracy classification tasks, including medical diagnoses.

K-Means Clustering has been effective in segmenting patients based on hidden behavioral patterns, which helps in crafting customized treatment plans.

Recent studies have demonstrated ML models' potential in early detection of anxiety, depression, and stress by analyzing diverse data such as academic performance, behavioral logs, and mood diaries. However, few systems have integrated these models into an end-to-end school deployment framework.

AI-Powered Mental Health Surveillance

AI-powered surveillance systems combine real-time monitoring with predictive capabilities, allowing institutions to act on early warnings rather than wait for clinical symptoms. Tools using Natural Language Processing (NLP), image analysis, and wearable sensors have been tested in healthcare settings but are yet to be adapted extensively for school-based solutions.

A notable gap is the absence of platforms that combine:

Real-time data input from teachers, parents, and students

ML-based risk prediction

Clustering for personalized intervention

Web accessibility for easy deployment in resource-constrained schools

Policy and Ethical Considerations

India's **National Education Policy (NEP) 2020** emphasizes holistic development, including emotional well-being. Digital health initiatives like the **National Digital Health Mission (NDHM)** also encourage technology-driven

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healthcare solutions. However, any mental health surveillance system must address concerns around privacy, data security, and ethical use of AI.
Studies stress the need for anonymization, secure storage, and transparency in AI models to build trust among users and avoid stigmatization of at-risk students.

III.OBJECTIVES

The primary aim of this project is to develop a scalable, AI-powered software platform for the early detection, assessment, and personalized intervention of mental health issues among school-aged children. The detailed objectives are as follows:

Early Detection of Mental Health Risks
To identify early warning signs of mental distress among students based on multiple data points such as academic performance, attendance, behavioral patterns, and self-reported mood indicators.

AI-Driven Risk Classification
To implement machine learning models (XGBoost) that categorize students into risk levels: **Low Risk**, **Moderate Risk**, and **High Risk** for mental health concerns.

Behavioral Clustering for Personalization
To apply clustering algorithms (K-Means) to group students based on hidden behavioral and psychological patterns, enabling customized and targeted intervention strategies.

Development of a Web-Based Portal
To design and deploy a secure, user-friendly web portal where educators, counselors, and parents can input data, view student reports, and receive actionable recommendations.

Ensure Data Privacy and Ethical AI Use
To implement data anonymization and secure storage mechanisms, ensuring compliance with privacy standards and ethical considerations in handling sensitive mental health data.

Scalable and Cost-Effective Solution
To create a solution that does not rely on expensive infrastructure, enabling easy adoption in schools with limited resources, including those in rural and economically weaker sections.

Alignment with National Policies
To align the solution with India's **National Education Policy (NEP)** and digital health initiatives, contributing to the nationwide mainstreaming of mental well-being in schools.
individuals and can hence be employed for school and higher education usage of teaching ISL.

Scalability and Future Expansions
Design the system for scalability. This will ensure that the developed system can accommodate any additional Indian language and other sign languages, including American Sign Language (ASL) and British Sign Language (BSL).

IV. PROPOSED METHODOLOGY

The proposed methodology outlines the technical approach and implementation strategy for the development of the mental health surveillance system. The solution combines machine learning, data analytics, and web-based deployment, ensuring an efficient, scalable, and user-friendly platform.

1. Data Collection and Preprocessing
The first step in the methodology involves gathering a diverse dataset of student mental health attributes. This dataset includes parameters such as:
Academic performance: Grades, assignments, and school performance.
Attendance records: Frequency of absenteeism, tardiness, and irregular school attendance.
Behavioral patterns: Observations from teachers regarding student behavior in class.

Mood fluctuations and stress indicators: Periodic surveys, self-reported mood, and stress levels through questionnaires.
Social interactions: Peer relationships, social media use (if applicable), and group dynamics.
This data will be gathered through teacher inputs, surveys, student self-reports, and parental feedback. Once collected, the data will be normalized and preprocessed using libraries like **Pandas**, **NumPy**, and **Scikit-learn** to handle missing values, standardize formats, and scale the input features to be used in machine learning models.

2. Machine Learning Model Development
The core of the system is based on **Machine Learning (ML)** models, which will be responsible for analyzing the collected data and providing actionable insights.
XGBoost for Classification: The XGBoost model will be employed for classification tasks to categorize students into **risk levels** (Low, Moderate, High) based on their mental health data. XGBoost is chosen because of its efficiency and high performance in handling structured data.
The classification task will predict the likelihood of a student suffering from mental health challenges, such as depression or anxiety, based on historical data. For instance, students with a significant decrease in academic performance, irregular attendance, and increased behavioral issues might be classified as at **High Risk**.
K-Means Clustering for Grouping: In addition to classification, **K-Means Clustering** will be used to group students based on similarities in their mental health attributes. This will allow the system to identify hidden behavioral traits and develop **personalized intervention strategies** for different clusters of students.
Model Evaluation and Tuning: Both models will be evaluated using standard metrics such as **accuracy**, **precision**, **recall**, and **F1 score** for classification, and **silhouette score** for clustering. Hyperparameter tuning will be performed using techniques such as grid search and cross-validation to ensure optimal model performance.

3. Web-Based Platform Development
The system will be developed as a **web-based application** to make it accessible across multiple devices (PCs, tablets, etc.). The front-end will be built using **HTML**, **CSS**, **JavaScript**, and **Bootstrap** for responsive design. The backend will be implemented using the **Flask microframework** in Python to serve dynamic content and manage user interactions.
The key features of the platform include:
User Authentication and Access Control: The system will provide different user roles such as teachers, counsellors, and administrators. Each role will have specific permissions to view, input, and analyze data.
Data Entry Forms: Authorized personnel (teachers, counsellors) will input student data through forms. These forms will include fields for entering academic performance, attendance records, and mood reports.
Real-Time Analytics and Reports: The platform will generate real-time reports based on model predictions and clustering results. These reports will provide insights into individual students' mental health status and risk level, allowing timely interventions.
Recommendation Engine: Based on the risk level and clustering results, the system will suggest personalized intervention strategies, such as one-on-one counselling, peer support groups, or extracurricular activities.

4. Data Privacy and Ethical Considerations
Given the sensitive nature of the data, ensuring **data privacy** and **ethical AI practices** is a top priority. All student data will be **anonymized** to prevent personal identification. The system will comply with privacy regulations such as **GDPR** (General Data Protection Regulation) and **HIPAA** (Health Insurance Portability and Accountability Act), ensuring that data is securely stored and only accessible by authorized users.
The machine learning models will be designed to be **transparent and interpretable**, allowing non-technical users (such as teachers and parents) to understand how decisions are made. The platform will also incorporate an **opt-in** consent mechanism to ensure that parents and students are fully aware of the data being collected.
5. System Deployment and Evaluation
The final step involves deploying the platform in a real-world educational setting. The system will be tested in pilot schools, and feedback will be collected from users (teachers, counselors, students, and parents). The effectiveness of the system will be evaluated based on criteria such as:
User Satisfaction: Ease of use, accessibility, and reliability of the platform.
Impact on Early Detection: The system's ability to identify students at risk early enough for effective intervention.
Accuracy of Predictions: Performance of the machine learning models in predicting mental health outcomes.Based on the feedback and evaluation results, the system will be refined and scaled for broader deployment in more schools.

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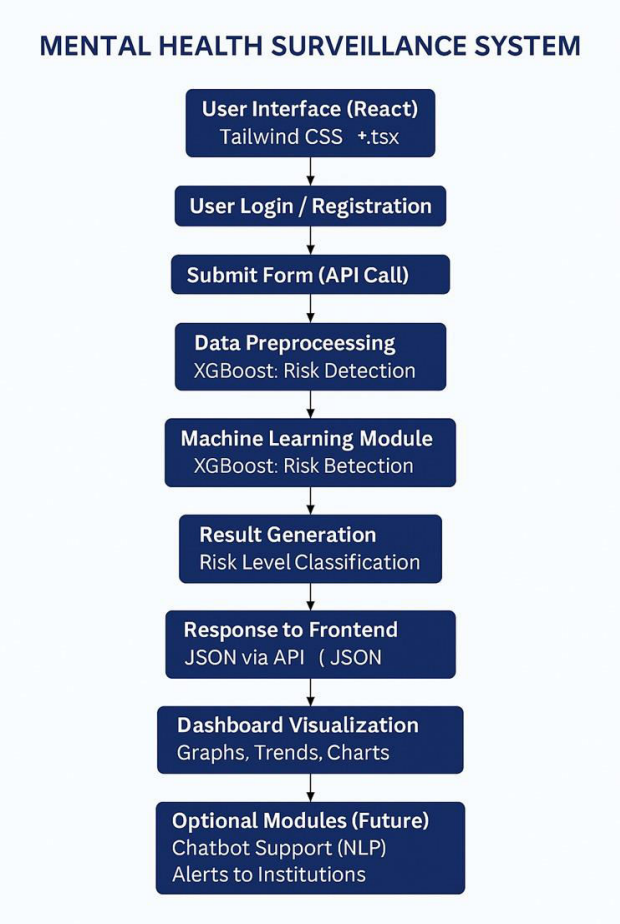
V. SYSTEM ARCHITECTURE



The system architecture of the proposed Mental Health and Well-being Surveillance Assessment and Tracking Solution is designed as a modular, multi-layered framework to ensure scalability, security, and ease of deployment in school environments. The architecture is divided into four major layers: **Data Collection Layer**, **Machine Learning Layer**, **Web Application Layer**, and **Security & Privacy Layer**. Each component interacts seamlessly to provide a smooth, real-time, and actionable user experience.

1. Data Collection Layer

This layer forms the foundation of the system, where data is gathered from various sources related to students' academic, behavioral, and emotional indicators. Data points include academic scores, attendance records, behavioral observations, stress indicators, and mood tracking inputs. These inputs are provided by authorized users such as teachers, school counsellors, and parents through an interactive web portal. This layer ensures structured and consistent data collection, serving as the input for further processing and analysis.

2. Machine Learning Layer

The core intelligence of the system resides in the Machine Learning Layer. This layer performs two primary tasks: **Risk Classification** and **Behavioral Clustering**. The classification model, built using the XGBoost algorithm, processes the collected data and predicts the mental health risk category for each student — Low Risk, Moderate Risk, or High Risk. Parallelly, the K-Means clustering algorithm segments students into distinct behavioral clusters based on hidden patterns in the data. These clusters assist counsellors in devising personalized intervention strategies. The machine learning models are pre-trained using normalized datasets and are integrated into the backend for real-time prediction when users input new data.

3. Web Application Layer

The Web Application Layer acts as the user interface for the system, developed using **HTML, CSS, JavaScript**, and powered by the **Flask** framework on the server side. This layer provides a secure, role-based access portal where educators, counsellors, and parents can log in to submit student data, view individual reports, and access actionable recommendations. The user interface is designed to be intuitive, allowing non-technical users to easily interpret AI predictions through visual elements like colored risk indicators, charts, and cluster-based reports. Real-time communication between the frontend and the backend ensures seamless interaction and instant feedback.

4. Security & Privacy Layer

Given the sensitivity of mental health data, the architecture incorporates a dedicated Security & Privacy Layer. All personal and sensitive data undergoes anonymization during processing, ensuring that student identities are protected. Data storage is managed through secure databases with access control mechanisms in place to prevent unauthorized usage. Additionally, encryption protocols are used for data transmission between the frontend and backend to maintain confidentiality. This layer ensures compliance with ethical AI practices and data protection standards, fostering trust among users.

5. Deployment Considerations

The entire system is designed to run efficiently on standard computing infrastructure without requiring high-end GPUs or costly cloud services. This makes the solution scalable and adaptable for deployment in schools across urban as well as rural areas. By keeping the system lightweight, schools with limited IT resources can still benefit from the platform, aligning with the broader goal of democratizing mental health care through technology.

Overall, the system architecture enables the smooth integration of AI-driven analytics with user-friendly interfaces while prioritizing data security and privacy. It forms a scalable prototype for potential nationwide implementation in collaboration with educational institutions and mental health professionals.

VI. CONCLUSION

The Mental Health and Well-being Surveillance and Tracking Solution offers an effective way to detect early signs of mental distress among school children using AI and machine learning. By classifying students into risk levels and providing personalized intervention suggestions, the system helps educators, counsellors, and parents take timely action to support student well-being.

Designed to be scalable and accessible, the solution works on standard school infrastructure, making it suitable even for institutions with limited resources. It ensures data privacy and follows ethical AI practices, building user trust and aligning with national education and health policies.

Overall, this project demonstrates the power of AI in improving student mental health and sets the stage for wider adoption in schools. By enabling early detection and support, it contributes to nurturing emotionally resilient students who can thrive both academically and socially.

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