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Predictive System for Students Stress Health Using Machine Learning

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Abstract: The increasing pressure of academic life significantly affects students mental health, making early detection of stress essential to prevent long-term consequences. Extended exposure to academic pressures can negatively impact students' emotional health and impede their academic development. This research presents a system aimed at recognizing early signs of stress in students prior to any decline in their mental health. Methodology utilizes a mix of machine learning algorithms and analysis of multimodal data. We examine audio recordings through Natural Language Processing (NLP) techniques, concentrating on identifying stressed and not stressed words to assess emotional tone and stress indicators derived from speech. Visual information, obtained through student photographs, is analyzed by a Convolutional Neural Network (CNN) to identify subtle facial expressions linked to stress. Additionally, student responses to structured questionnaires are examined using a Random Forest algorithm to identify behavioral patterns linked to stress. By integrating insights from audio, visual, and questionnaire data, the system enhances accuracy in stress prediction across various academic settings. This tool can help educational institutions track student well-being, facilitating prompt interventions to foster a healthier learning atmosphere.

Keywords: Facial Expression Recognition, Audio Analysis, Natural Language Processing (NLP), Stress Prediction, Image-Based Stress Analysis.

I. INTRODUCTION

In the rapidly evolving academic landscape, student mental health has become a pressing issue. The increasing demands of academic achievement, combined with personal and social difficulties, have resulted in a notable escalation of stress among students. Stress not only interferes with academic performance but also poses a serious threat to their overall health, making it crucial to identify and address it early. In light of this escalating concern, educational institutions are increasingly turning to technology-based solutions to assess and manage student stress. This project centers on creating a non-intrusive, multimodal system for detecting stress in students by analyzing audio recordings, facial images, and behavioral responses from surveys. The system employs sophisticated machine learning techniques, using Natural Language Processing (NLP) for feature extraction and analysis from audio data, Convolutional Neural Networks (CNNs) for interpreting facial expressions from images, and Random Forest algorithms to evaluate responses from surveys. The uniqueness of this method lies in its capacity to gauge stress levels through various data sources without encroaching on students' personal space. By combining audio, visual, and behavioral data, the system delivers a thorough evaluation of stress, providing more precise predictions than single-modality systems. This research highlights the necessity of addressing student stress as a worldwide issue, due to its direct effect on academic success and mental health. By leveraging advanced machine learning methods for real-time stress monitoring, this study seeks to contribute to ongoing initiatives aimed at enhancing mental well-being in educational environments. The solution presented in this research emphasizes the potential of technology to tackle critical challenges such as student stress, ultimately promoting a healthier and more nurturing educational atmosphere.

II. LITERATURE SURVEY

[1] The paper emphasizes the role of wearable sensors in continuous stress monitoring through real-time physiological data collection. It categorizes stress detection methods based on environments like academic settings and techniques involving Electrocardiogram (ECG), and Photoplethysmography (PPG). Key machine learning models such as Random Forest and Support Vector Machine are highlighted for their accuracy in in stress prediction.

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[2] Based on information gathered from students' questionnaires, the study examines the application of Random Forest and Decision Tree models to forecast students' stress levels. Academic achievement, personal information, and stress-related answers are all included in the dataset. The study shows that Random Forest performs more accurately than Decision Trees.

[3] The paper proposes a stress recognition system leveraging social media and facial image analysis. It integrates deep learning techniques to extract features from posts and images, categorizing users based on depression or stress levels. Key algorithms such as Convolutional Neural Networks and Random Forest were used, achieving substantial accuracy in predicting mental health conditions. The work underlines the importance of integrating datasets with real-time observations for reliable stress evaluation.

[4] The paper utilized the WESAD dataset, a comprehensive array of physiological and motion information gathered through wearable sensors, to differentiate stress levels. Methods including Random Forest, K-Nearest Neighbors, and Support Vector Machines were applied, reaching a binary classification accuracy of as much as 93.20%. Deep learning approaches outperformed traditional machine learning techniques, achieving a binary classification accuracy of 95.21%. The research highlights the importance of combining various physiological indicators (such as ECG, EDA, and TEMP) to ensure accurate stress detection.

[5] The paper presents a framework for identifying stress in college students through supervised machine learning methods. It categorizes stress into acute, episodic, and chronic levels based on survey responses. Various machine learning algorithms, such as Random Forest and Logistic Regression, were assessed, with Random Forest attaining an accuracy of 99%. The research emphasizes efficient pre-processing and feature extraction methods, aiding in the automation of stress prediction to enhance student well-being.

III. SCOPE AND METHODOLOGY

Scope

The objective of the project is to create a system that identifies stress in students by examining their speech, with an emphasis on recognizing both positive and negative language through Natural Language Processing (NLP). Facial expressions will be evaluated utilizing Convolutional Neural Networks (CNNs), and responses from questionnaires will be reviewed to uncover behavioral trends. The primary aim of the system is to deliver precise stress detection, aiding educational institutions in their efforts to support students mental well-being and academic achievement.

Methodology

The objective of the project is to forecast student stress by combining data from three primary sources: audio recordings, facial images, and responses to questionnaires. The audio data is examined to pinpoint the presence of positive and negative vocabulary, which act as indicators for stress levels. These identified words are then assessed to determine whether a student is classified as stressed or not. Facial images are collected and analyzed to recognize stress-related expressions, such as indications of tension or unease, using a categorized dataset specifically designed to identify visual stress cues. Simultaneously, a structured set of questionnaire responses is leveraged to assess academic, behavioral, and psychological factors that might play a role in stress levels. Each answer is scrutinized to recognize trends commonly linked to increased stress. The system integrates findings from these three separate data sources speech, facial expressions, and questionnaire answers—to offer a thorough and unified prediction of stress. By utilizing this multimodal strategy, the system improves the accuracy of stress identification and provides real-time assessments. This capability allows for prompt intervention and support, making it a significant resource for fostering mental health awareness and enhancing student welfare in educational settings. Potential future enhancements may include broadening the datasets and improving the integration methodology to achieve even higher precision and adaptability across varied student groups.

IV. SYSTEM ARCHITECTURE

The student stress prediction system is designed to identify stress by integrating and evaluating data from multiple sources, including responses to questionnaires, facial images, and audio recordings. The process starts with the questionnaire module, where students share information regarding academic, behavioral, and psychological elements that could contribute to stress. We gathered datasets for this questionnaire by creating a Google Form, which was distributed to students and featured questions aimed at pinpointing possible stress triggers. The collected responses are examined to reveal patterns and classify students as either potentially stressed or not. Concurrently, the facial image module employs a face detection system to capture and analyze the students' facial expressions. Key features such as eye strain, frown lines, and mouth placement are evaluated to recognize stress-related expressions, including tension, discomfort, or fatigue.

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At the same time, the audio module assesses speech recordings to identify the presence of positive and negative language, which act as indicators of emotional states. Natural Language Processing (NLP) techniques are utilized to analyze tone and word patterns, enhancing the overall evaluation of the student's stress levels.

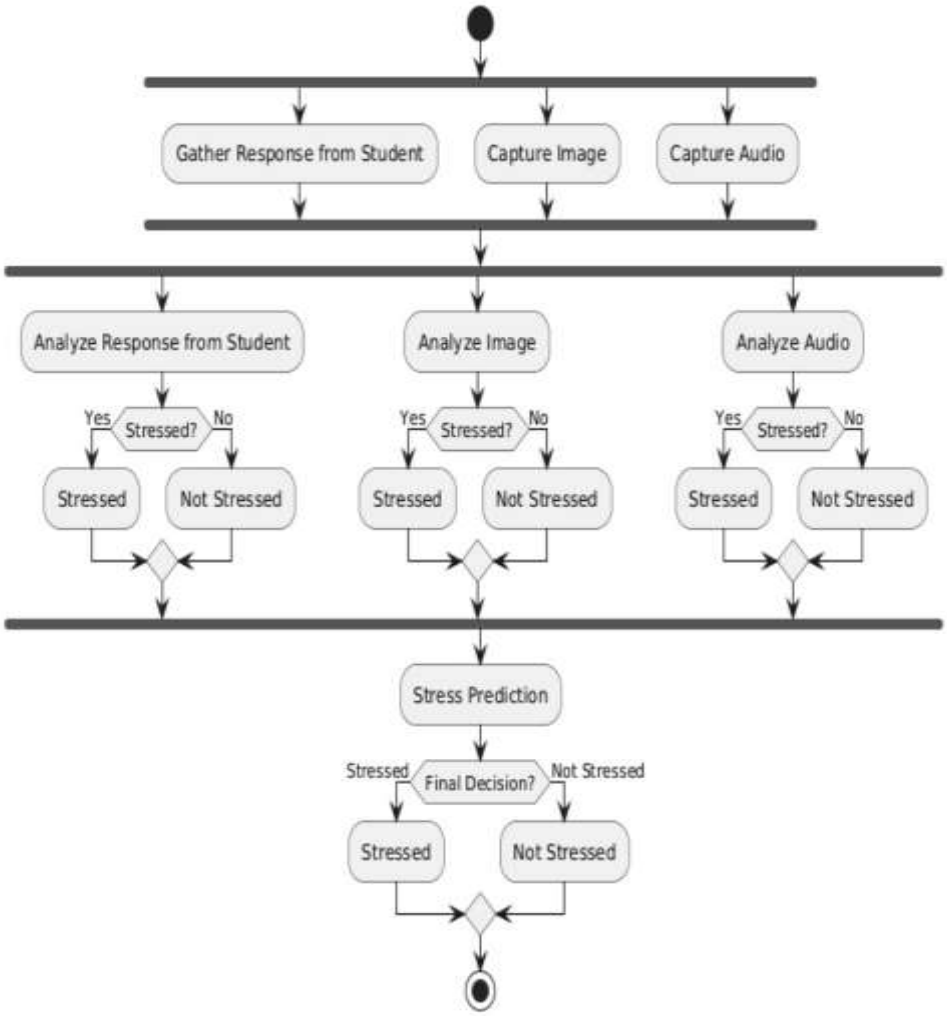

Fig. 1 System architecture

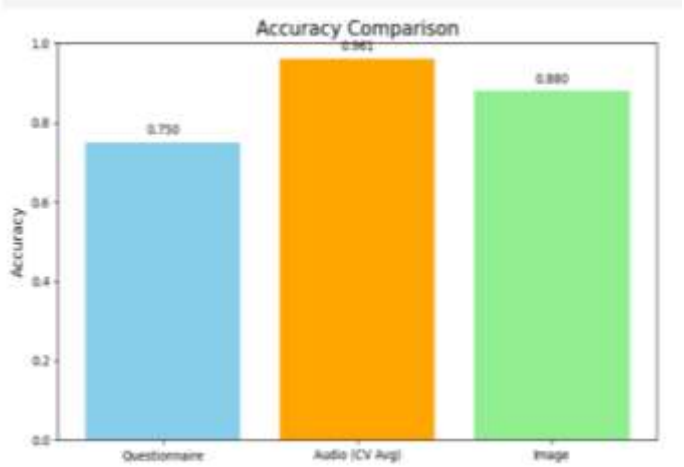

Fig. 2 Accuracy Comparison

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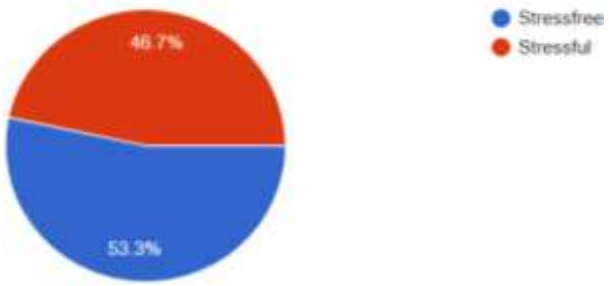

Fig. 3 Students Survey on Stress

V. CONCLUSION

The student stress detection system demonstrates significant potential as an effective tool for monitoring and assessing stress in students in real time. Its performance was evaluated using audio, facial image, and questionnaire data, showing promising results in determining stress. By integrating these three data sources, the system offers a comprehensive approach to identifying stress and providing timely support. This system, alongside other mental health initiatives, has the potential to promote mental well-being and intervention in educational settings. Future work should focus on improving accuracy, expanding the dataset diversity, enhancing real-time processing capabilities, ensuring privacy protection, refining the integration of different data modalities, and incorporating additional features such as motivational videos and counselor recommendations. These advancements will lead to more efficient and scalable solutions for addressing student stress and promoting mental health awareness.

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