Sparkle Edu- EASY & HEALTHY LEARNING PLATFORM FOR HIGH SCHOOL EDUCATION

Project ID: 2023-042

Project Final Report

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B.Sc. (Hons) in Information Technology

Specializing in SoftwareEngineering

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DECLARATION

I declare that this is my own work, and this Thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out this research thesis for the Degree of Bachelor of Science (honors) Information Technology (Specializing in Software Engineering) under my supervision.

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(Dr. Sanvitha Kasthuriarachchi) Date

Signature of co-supervisor

(Ms. Karthiga Rajendran) Date

ABSTRACT

Since most institutions and schools are switching to online or hybrid techniques due to the COVID-19 epidemic, the use of e-learning has been expanding rapidly. The primary goal of this research study is to improve the effectiveness of the online educational system by addressing key research problems within four integral components. The first component focuses on enhancing student engagement and well-being during online learning, seeking solutions for stress detection, drowsiness prevention, and attention monitoring. The second component aims to optimize user authentication in online education, differentiating between students and teachers through facial recognition, age, and gender attributes to tailor the learning experience. Recognizing the critical importance of mental health in education, the third component explores the potential of an AI-driven chatbot to provide timely support and guidance, thereby addressing the mental health challenges faced by students and educators.

Finally, the fourth component addresses the research problem of document reconstruction, with the goal of predicting and restoring missing words and letters in educational materials to enhance content accessibility and comprehensibility.

This thesis documents the development, implementation, and evaluation of Sparkle Edu, showcasing innovative solutions for these e-learning challenges and their potential to enhance the efficiency and quality of online education in the post-COVID era.

Keywords- E-Learning, Deep Learning, Facial Emotion Analysis, Easy Authentication, Mental Health Chatbot, Document Reconstruction

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Abbreviations	Description
ML	Machine Learning
DL	Deep Learning
AI	Artificial intelligence
CNN	Convolutional Nural Network
NLP	Natural Language Processing

1 INTRODUCTION

1.1 Background Study and Literature

1.1.1 Introduction

In the wake of the COVID-19 pandemic, the global educational landscape underwent a seismic transformation as institutions and schools swiftly adopted online and hybrid learning modalities to ensure continuity in education. This rapid shift to digital platforms highlighted the pressing need for innovative solutions to enhance the effectiveness of the online educational system. Recognizing this imperative, the present research study embarks on a comprehensive exploration of Sparkle Edu—a pioneering web application designed to revolutionize the e-learning experience.

As the pandemic forced educators and students alike to navigate the uncharted waters of online education, it became evident that the virtual classroom posed unique challenges. Engaging students, maintaining their well-being, ensuring secure access to course materials, addressing mental health concerns, and enhancing content accessibility all became pivotal concerns in the transition to digital learning environments. Sparkle Edu emerged as a response to these multifaceted challenges, offering a holistic approach to tackle these issues through four distinctive components.

The first component of Sparkle Edu delves into the realm of emotion analysis, harnessing the power of facial recognition and machine learning to detect and manage stress levels, monitor drowsiness, and gauge attention during live video classroom sessions. This innovation seeks to create an emotionally intelligent and focused learning environment, transcending the limitations of physical classrooms.

User authentication takes centre stage in the second component, reimagining the way students and teachers access course materials. Through facial recognition technology, along with age and gender attributes, Sparkle Edu tailors the educational experience to the unique needs of each user, fostering personalized engagement and secure interactions.

In recognition of the escalating importance of mental health in the educational ecosystem, the third component introduces an AI-driven mental health therapist chatbot. This chatbot provides timely,

confidential support, addressing the emotional distress experienced by students and educators, thereby promoting holistic well-being within the educational community.

Finally, the fourth component addresses the challenge of content accessibility by employing advanced text analysis and reconstruction techniques. This component predicts and restores missing words and letters within educational materials, ensuring that course content is comprehensible and inclusive to all users.

This thesis document serves as a comprehensive investigation into the development, implementation, and evaluation of Sparkle Edu, showcasing the innovative solutions devised to overcome the multifaceted challenges in the e-learning landscape. Through rigorous analysis and empirical testing, this research demonstrates the efficacy of each component and the holistic impact of Sparkle Edu on the future of education in a digitally connected world.

As the digital transformation of education accelerates, Sparkle Edu stands as a beacon of progress, promising a more engaging, empathetic, and inclusive e-learning environment. This research marks a significant milestone in the quest for a brighter educational future.

1.1.2 Background survey

As WHO says, “Stress is a mental health problem affecting the life of one in four citizens” [2]. In most cases, mental health therapists or physiologists are needed to find stressed people. However, automatic stress detection minimizes the risk of health issues mainly among students. Because students are the pillars of the future world. Normally, for stress detection, there are so many external factors that are needed like ECG, and blood pressure. Ekman’s six basic emotions such as Happiness, Sadness, Anger, Surprise, Disgust, Fear, and neutral expression [3] will be considered to find the emotions [1]. Then using that the stress will be detected. Figure 1 illustrates the classification of emotions.

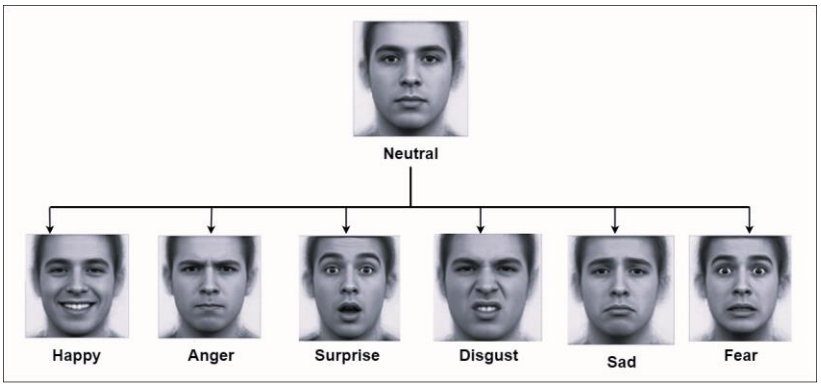

Figure 1: Emotion Classification

Most of the existing research papers focused on this stress detection using image processing instead of real-time video processing [4]. They focused on getting the image of the person and applied some algorithms to find the emotions of that person. Even though there are some researchers focused on emotion detection, a low number of researchers focused on stress detection. However, the domain is not in e-learning. Use a face detection algorithm to detect and extract the face regions from each frame of the video.

Popular classification algorithms for emotion detection are Support Vector Machines (SVM), Random Forests, and Neural Networks. Using these emotions, stress will be identified. If the emotions are Anger, Disgust, Fear, or sadness, the system will consider the student is under stress [3].

Several researchers have made significant efforts to enhance the accuracy of drowsiness-detecting systems. Mardi et al. introduced a model that identifies tiredness based on electroencephalography (EEG) data [5]. They extracted chaotic characteristics and the logarithm of energy from the signals

to distinguish between drowsiness and alertness. The proposed model achieved an accuracy rate of 83.3% using an artificial neural network for categorization. In another study, Noori et al. proposed a drowsiness detection model based on Quality Signals, EEG, and Electrooculography [6].

Krajewski et al. developed a tiredness detection model based on steering patterns [7]. They utilized advanced signal processing techniques to create three feature sets capturing the steering patterns. The yawning detection method was based on identifying the face with the largest gap, indicative of yawning. In summary, various techniques such as EEG data analysis, feature selection, signal processing, and yawning detection have been explored by different researchers to improve the accuracy of drowsiness detection systems. Each approach contributes to the field's advancement and provides valuable insights into identifying and mitigating drowsiness-related issues.

Age and gender prediction from images has garnered significant attention in recent years due to its wide-ranging applications in various fields, including computer vision, biometrics, and social sciences. Researchers have explored different methodologies to tackle this problem, and Convolutional Neural Networks (CNNs) have emerged as a powerful tool for image-based classification tasks. Several studies have successfully predicted age and gender using CNN architectures. A multi-task CNN was suggested in a study by Park et al. (2018) to simultaneously predict age and gender from facial images [8]. The model used multiple convolutional and fully connected layers to classify ages and genders with high accuracy. Like this, Rothe et al. (2015) proposed the "DEX" model, a deep CNN architecture that displayed promising age estimation results [9].

To improve the performance of age and gender prediction models, researchers have explored different techniques, such as data augmentation and transfer learning. Huynh-The et al. (2020) augmented the training dataset by applying geometric transformations, random cropping, and noise injection, leading to improved accuracy in age and gender classification. Transfer learning, as demonstrated by Antipov et al. (2017), has been shown to be effective in leveraging pre-trained CNN models for age and gender prediction, especially when limited labeled data is available [10]. Bias and fairness in age and gender prediction models have also been the subject of investigation. Buolamwini and Gebru (2018) found that commercial gender classification systems exhibited higher error rates for darker-skinned females, highlighting the potential biases in these models [11].

Additionally, some studies have explored the fusion of multiple modalities, such as facial images

and textual data, for age and gender prediction. Zhang et al. (2017) combined facial images and user-generated tags to improve the accuracy of age and gender estimation. The model jointly learned from both modalities, capturing complementary information for better predictions [12].

This software not only aids in the diagnosis and prevention of particular illnesses, habits, or situations, but it also supports desirable good traits. They can therefore assist users in acquiring emotional stability, coping mechanisms for difficult circumstances, or the discipline to beat procrastination. They can serve as a coach in this way, urging users to move outside of their comfort zone or gradually form positive habits [13].

The use of libraries like CNN (Convolutional Neural Network) and NLP (Natural Language Processing) in this development has made it simpler to assist students in recognizing their problematic thinking and communication patterns. This software was created with the usage of a conversational chat box to encourage dialogue with the students and allow them to express their true ideas.

In addition to connecting students with mental health professionals as needed, this research attempts to help students manage and understand their mental states as much as possible on their own. A Chabot is a computer program that can have verbal, written, and visual conversations with users. Chatbots may make mental health interventions more widely available. Chatbots, in particular, may promote contact among people who have historically been hesitant to seek mental health counseling owing to stigma. Several Chatbots have been created to offer interventions for mental health. Much research has been done to evaluate the effectiveness, acceptability, usability, and adoption of Chatbots for mental health. Bringing together this knowledge is crucial in order to educate users and providers of mental health services about the major characteristics of Chatbots and prospective applications, as well as to guide future studies concerning the main gaps in the existing literature [14]. The ability of humans to understand one another and respond appropriately is fed into Chabot systems, or systems designed to speak with a user, with the aid of artificial intelligence. The bot recognizes the user's request and generates an appropriate response.

Reconstructing damaged or destroyed documents holds immense importance across various fields, including forensics and archaeology, as it unveils invaluable educational, cultural, and historical significance. However, this process is considerably more intricate than assembling jigsaw puzzles, as some fragments may be irrecoverable, leading to gaps in the information.

The system employs a novel approach for reconstructing torn documents by calculating

characteristic snippets based on shape and other pictorial aspects. This method proves effective in solving the challenging problem of paper tearing. The key techniques utilized in this document are skew and segmentation, which play a crucial role in content analysis and shape matching. By extracting relevant features, the system can cluster different types of torn snippets efficiently.

While these methods showcase promising results, it is worth noting that their practicality might be limited in large-scale scenarios. Moreover, using them for shredded pieces from different documents could be challenging [17].

To address the reconstruction of cross-cut shredded documents, a splicing-driven memetic algorithm is introduced [18]. This algorithm focuses on the pixel data of shredded edges or cuts, and its objective is to achieve splicing center perspective novel crossover and other mutation operators. These operations help check the pixel information of the shredded pieces, facilitating their accurate rejoining process. Some methods were discussed in research papers with machine learning [20].

Overall, these advanced techniques present significant potential in automating the document reconstruction process and can be valuable tools in various fields, ranging from forensics to historical preservation. However, further research and development might be needed to make them more scalable and adaptable to diverse scenarios.

1.2 Research Gap

Figures 2, 3, 4 and 5 illustrate the research gap of each of the components.

	Stress Detection	Stress Alerting	Stress Management	Real time Monitoring	Online Classroom
zoom	NO	NO	NO	NO	YES
Google Classroom	NO	NO	NO	NO	YES
Lockdown Browser	NO	NO	NO	NO	YES
Driver Drowsiness Detection	NO	NO	NO	YES	NO
Sparkle Edu- Stress Detection	YES	YES	YES	YES	YES

Figure 2: Research Gap for Stress Detection

	Normal Login	Facial Recognition	Facial Navigation
Udemy	YES	NO	NO
Google Classroom	YES	NO	NO
coursera	YES	NO	NO
SLIIT UNI CourseWeb	YES	NO	NO
Sparkle Edu- Easy Login	YES	YES	YES

Figure 3: Research Gap for Facial Authentication

	Stress Detection	ChatBot	Counselling	AI Mental Health Chatbot
	NO	NO	NO	NO
Google Classroom	NO	NO	NO	NO
coursera	NO	NO	NO	NO
Seneca	NO	YES	NO	YES
Sparkle Edu- Mental Chatbot	YES	YES	YES	YES

Figure 4: Research Gap for AI Mental Health Chatbot

	Image-Text	PDF Generation	Document Re-construction
Smallpdf	YES	YES	NO
Google Classroom	NO	NO	NO
I ♥ PDF	YES	YES	NO
SLIIT UNI CourseWeb	NO	NO	NO
Sparkle Edu- Document Re-construction	YES	YES	YES

Figure 5: Research Gap for Document Reconstruction

1.3 Research Problem

E-learning is an educational tool that uses technology to facilitate learning. It involves the use of online materials, such as videos, websites, and webinars, to deliver educational content to students. However, E-learning is still in an early stage with many uncertain issues to be clarified and investigated. Anyhow, this E-learning platform should be very easy to access anywhere anytime by legitimate users. Even though E-learning is having many advantages, it is a platform to isolate the students, and it increases some mental or health problems among the students. So, this research carried out aims to provide some features for easy learning and healthy learning. Using the easy learning features, users can avoid some common problems and use the platform very easily. On the other hand, by using healthy learning features, students can learn and manage their mental health problems on their own using this healthy platform. So, this is an Easy & Healthy learning platform.

Nowadays, students are facing an unprecedented level of stress. This stress is caused by a combination of factors, such as the pressure to succeed in school, the pressure to be socially accepted, the increasing competition for university admissions and jobs also some drug addiction. With the rise of technology and social media, students are also increasingly exposed to information overload and cyberbullying, adding to their stress. Furthermore, the uncertainty of our current times due to the COVID-19 pandemic has further increased stress levels among students of all ages. Some students drop their education in the middle of school and some students commit suicide due to stress. To cope with this stress, it is important for students to prioritize their mental health, find healthy outlets for stress relief, and seek assistance from trusted adults and mental health professionals as needed. So, video classrooms much have a system to identify the stressed students to prevent them.

However, the students who are under stress, are identified, and the teachers or school management don't have a proper system for counselling the students to treat them properly. Therefore, school management or teachers take an additional responsibility to take care of that student as additional work. Also, students need proper continuous guidance to overcome stress or depression. Therefore, e-learning should have a proper mental health therapist system.

Most of the applications have a normal authentication flow to navigate their services. Therefore, in e-Learning, there should be a simple login system to navigate their responsible portals

like Student Portal, Teacher's portal, or Parent's portal. This system is used to distinguish the user types to navigate the respective portal. This login system will be used for the common pages such as Notice Page, and Events Page. Therefore, the identified users will redirect to the student page or teacher page to display the contents.

The main and important information gathering is done manually as documentation gathering. Even though the world is becoming digitalized and there is much valuable information in paper documents. But many documents can be easily torn or damaged because of natural (environmental factors) or intentional. Most of the hard copies will be older according to the time and environmental factors. So, the student's or teacher's study materials are affected partially (some words or letters will be deleted or torn from the paper). Therefore, it will be a major issue while checking that document again. Also, if the document is damaged partially with missing words or letters, or if the document is blurred, there should be a recovery system to get the proper finalized document. There are lot of methods and types for document reconstruction. But there are fewer systems with accurate tone reconstructions and text prediction where the missing details in documents are automatically predicted. Most of the systems are reconstructed using the physical shape and other attributes and there no many of systems to predict missed text in these types of documents.

Even though there are many e-learning systems exist, none of them focus the above-mentioned problems. These 4 main issues should be handled in the e-learning system to provide the better platform to the students, teachers, and other legitimate users.

1.4 Research Objectives

1.4.1 Main Objective

Our main objective is to provide a platform to students and teachers for easy and healthy education to increase the efficiency of the online education system.

1.4.2 Specific Objectives

a. Provide a platform to identify the student's mental health state and inform them to avoid the mental health issues like stress or depression. (Healthy Learning)
b. Provide a feature for easy authentication according to the user type without any unwanted authentication mechanism. (Easy Learning)
c. Provide a platform for the stressed or depressed mindset students to overcome the stress level by their own as a mental health therapist. (Healthy Learning)
d. Provide a feature for document restoring for the old documents with deleted letters or words to re-construct the document as a complete one. (Easy Learning)

1.4.3 Business Objectives

1. Improve User Retention and Satisfaction:
    - Increase user engagement and satisfaction by offering a more personalized and emotionally intelligent learning experience.
    - Reduce drop-out rates by providing timely mental health support and enhancing content accessibility.
2. Attract and Retain Educational Institutions:
    - Position Sparkle Edu as a preferred e-learning platform for educational institutions by emphasizing its ease of use and well-being features.
    - Establish long-term partnerships with educational institutions to ensure platform sustainability.

2. METHODOLOGY

2.1 Introduction

This part illustrates the methodology for approach the proposed system's related functions. This is a methodological way of research. Follow the software lifecycle model to implement the system. Research has conducted more studies on the above research area. Hence, the gathered information will be used to achieve the main objectives and sub-objectives.

2.2 System overview

Figure 6 shows the system diagram of the system.

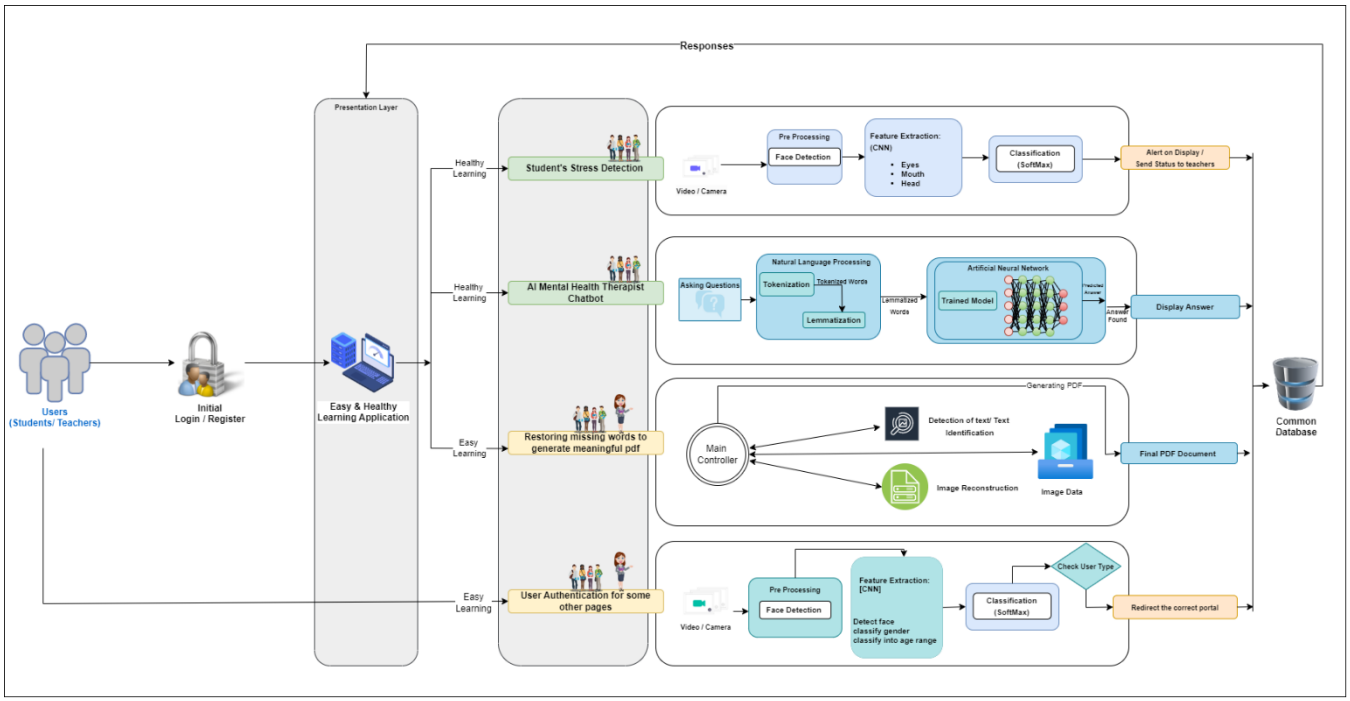

Figure 6: Component Details in system

2.3 Component overview

Figure 7 shows the component details of the system.

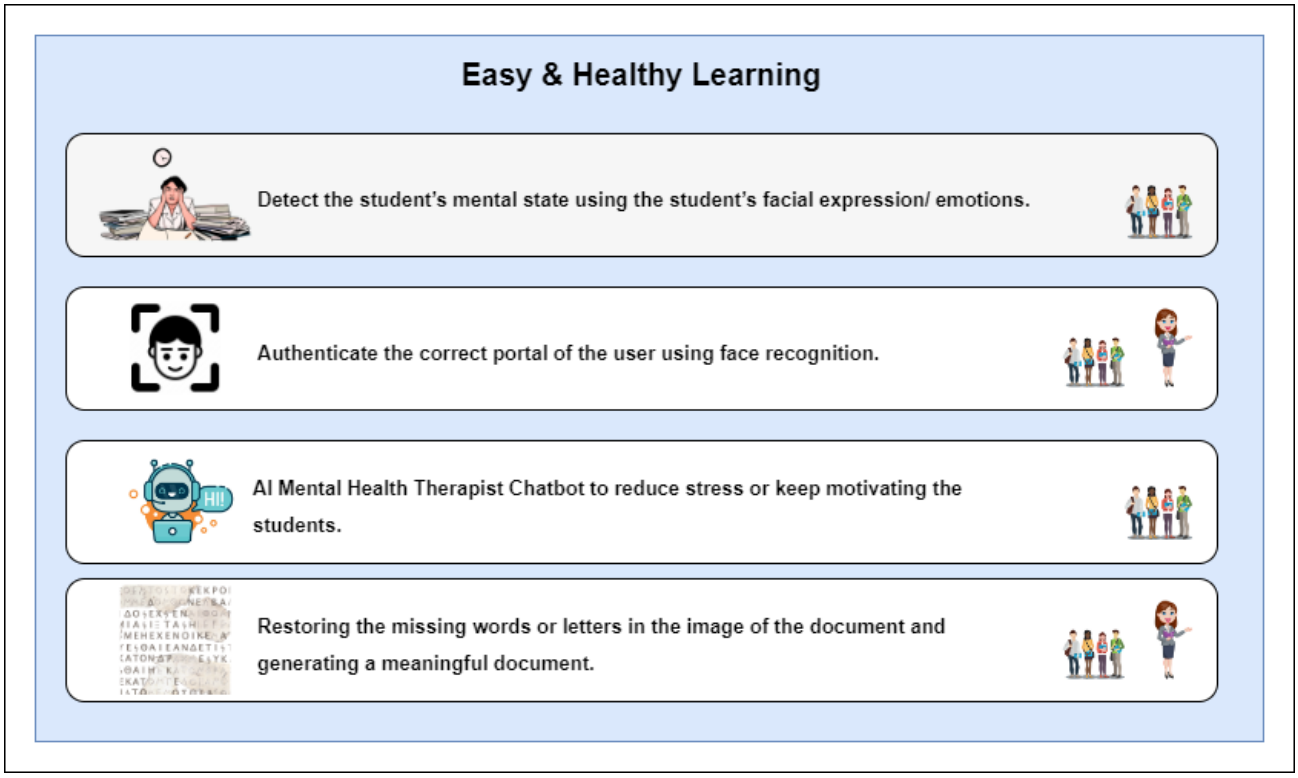

Figure 7: Component Details

Component 1: Emotion Analysis for Student Engagement and Well-being

This component is designed to enhance student engagement and well-being during online learning by leveraging facial emotion analysis. It utilizes advanced computer vision and machine learning techniques to analyse the facial expressions of students during video classroom sessions. The primary goal is to detect and manage stress levels, monitor drowsiness, and gauge attention levels in real-time. Figure 8 illustrates the system overview of this component.

Methodology:

- ✓ Facial Emotion Analysis: Implement computer vision algorithms to detect facial expressions and emotions of students.
- ✓ Stress Detection: Develop a stress detection model that identifies signs of stress in facial expressions, such as furrowed brows or tense muscles.
- ✓ Drowsiness Detection: Utilize eye-tracking and facial movement analysis to identify drowsiness in students.
- ✓ Attention Monitoring: Employ gaze tracking and facial cues to assess student attention levels, identifying instances of distraction or disengagement.
- ✓ Real-time Feedback: Provide real-time feedback to both students and teachers to help them stay engaged and alert during online classes.

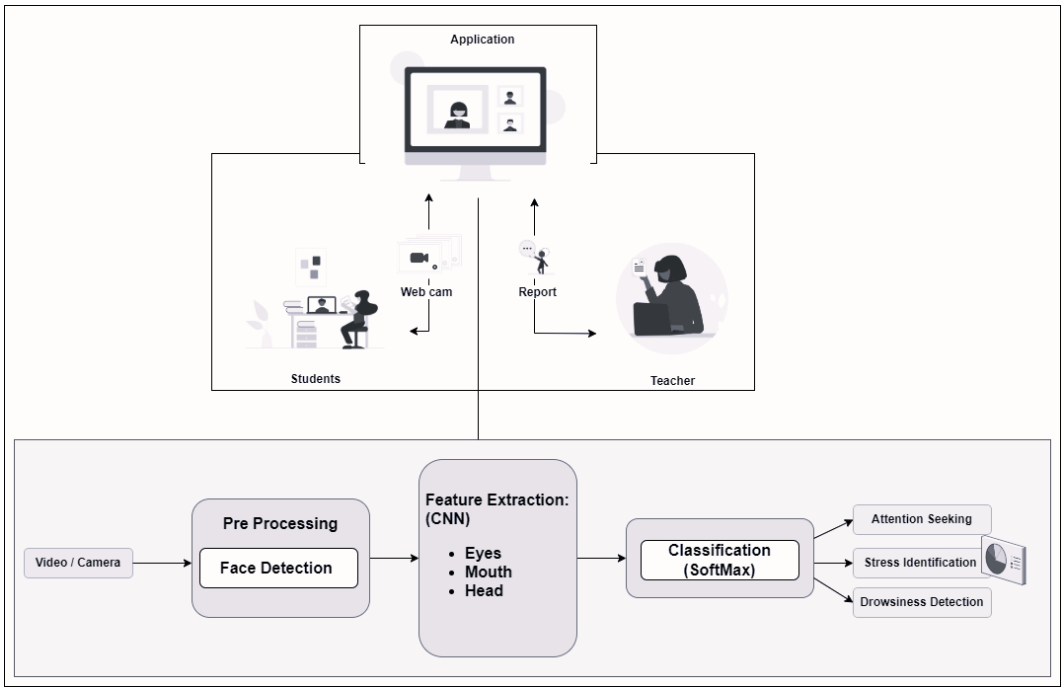

Figure 8: System diagram for Stress Detection

Component 2: User Authentication and Personalization

This component focuses on user authentication and personalization within the Sparkle Edu platform. It aims to differentiate between students and teachers while ensuring secure access to course materials. The component leverages facial recognition technology and additional attributes like age and gender to create user profiles and tailor the educational experience. Figure 9 displays the system overview diagram of this component.

Methodology:

- ✓ Facial Authentication: Implement facial recognition algorithms to verify the identity of users during login.
- ✓ User Profiling: Create user profiles based on attributes such as age and gender to understand user demographics.
- ✓ Access Control: Configure access permissions based on user roles (student or teacher) to provide tailored content and features.
- ✓ Security Measures: Implement robust security measures to protect user data and ensure the privacy of biometric information.
- ✓ User Experience Enhancement: Personalize the platform's interface and content recommendations based on user profiles and preferences.

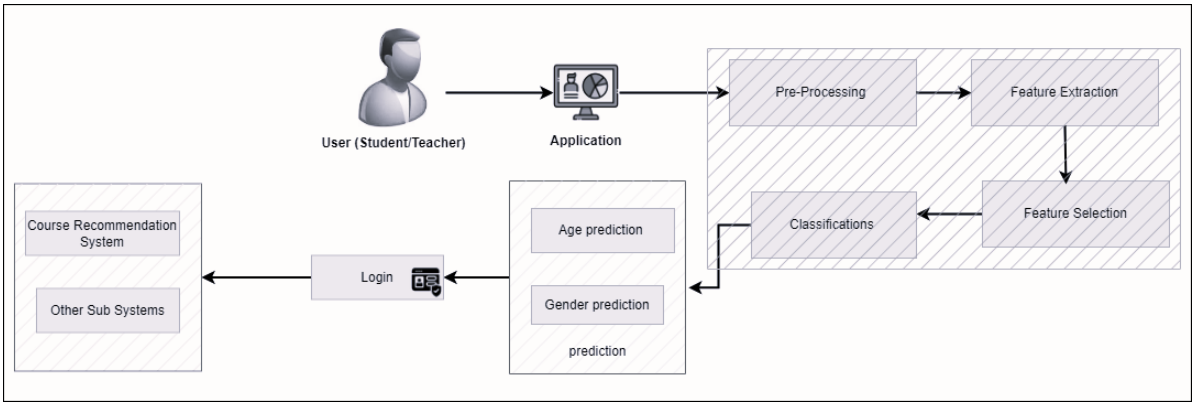

Figure 9: System diagram for Easy Authentication

Component 3: AI-Driven Mental Health Support

This component addresses the crucial issue of mental health within the educational community by introducing an AI-driven mental health therapist chatbot. The chatbot is designed to provide timely, confidential support and guidance to users experiencing emotional distress, ultimately promoting holistic well-being. Figure 10 illustrates the system overview of this component.

Methodology:

- ✓ Chatbot Development: Develop an AI-powered chatbot using natural language processing (NLP) and machine learning techniques.
- ✓ Emotion Recognition: Incorporate emotion recognition capabilities into the chatbot to identify user emotional states.
- ✓ Confidentiality Assurance: Implement secure and confidential communication channels to ensure user trust.
- ✓ Continuous Learning: Train the chatbot to improve its responses over time by learning from user interactions.
- ✓ Resource Referrals: Provide users with helpful resources and recommendations for further support when necessary.

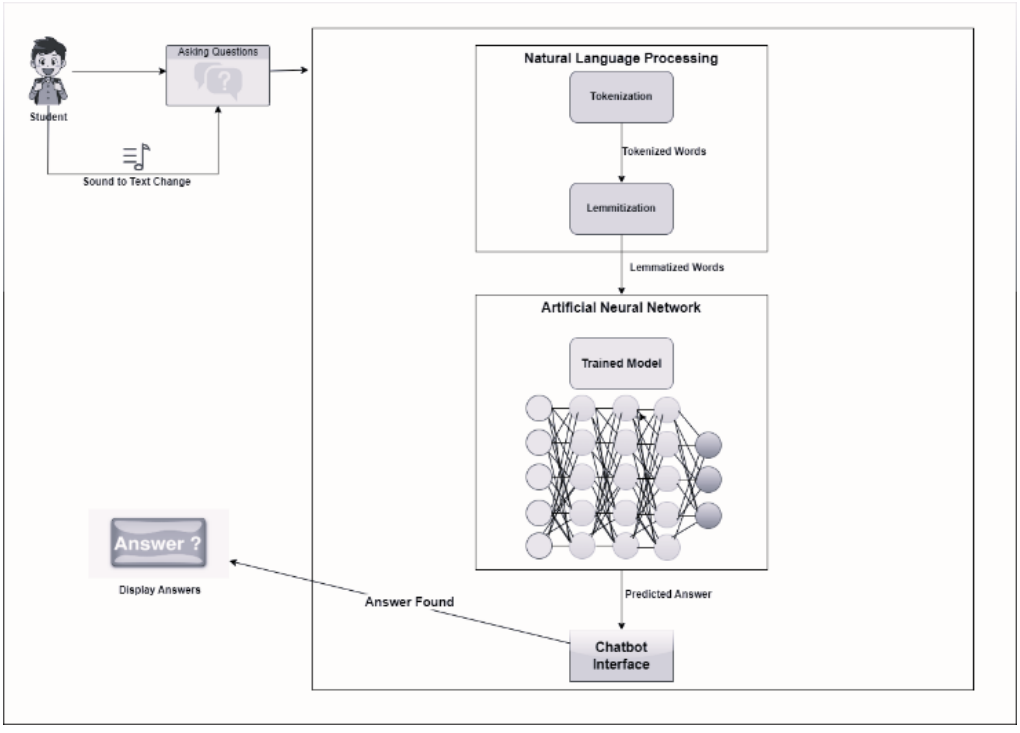

Figure 10: System diagram for AI Chatbot

Component 4: Document Reconstruction for Accessibility

This component focuses on enhancing content accessibility and comprehensibility within the Sparkle Edu platform. It employs advanced text analysis and reconstruction techniques to predict and restore missing words and letters in educational materials, making them more accessible to all users. Figure 11 shows the system overview diagram of this component.

Methodology:

- ✓ Text Analysis: Employ natural language processing techniques to analyse educational content and identify missing elements.
- ✓ Predictive Algorithms: Develop predictive algorithms to suggest missing words and letters based on context and language patterns.
- ✓ Reconstruction Process: Implement a reconstruction process that inserts the predicted missing elements into the content seamlessly.
- ✓ User-Friendly Interface: Design an intuitive user interface that allows users to access reconstructed content.
- ✓ Assessment of Impact: Evaluate the impact of document reconstruction on content accessibility and comprehensibility through user feedback and metrics.

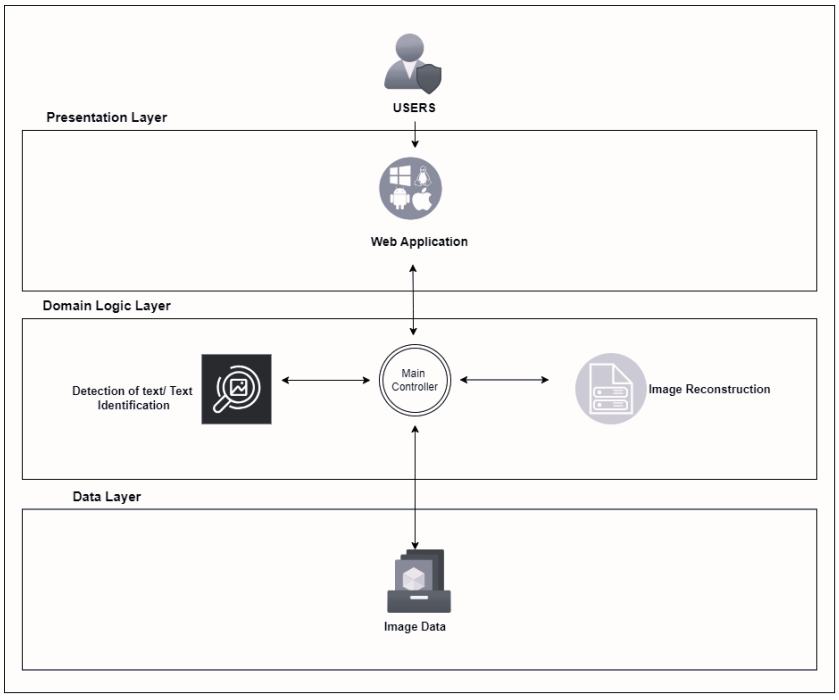

Figure 11: System Diagram for Document reconstruction

2.3. Development Process

Agile is an iterative and incremental approach to software development that emphasizes collaboration, adaptability, and customer feedback throughout the development process. It is well-suited for projects like Sparkle Edu, where requirements may evolve, and where rapid responses to changing circumstances are essential. Here's an overview of how the Agile development process was applied to the creation of Sparkle Edu:

1. Project Initiation:
    - The project began with a clear understanding of the objectives: to create an easy and healthy learning platform.
    - The team identified the core components and outlined initial high-level requirements based on research problems.
2. Product Backlog Creation:
    - A product backlog was established, comprising a prioritized list of features, functionalities, and user stories for each component.
    - These backlog items were continuously refined and updated based on feedback from stakeholders, including potential users and educators.
3. Sprint Planning:
    - The project was divided into a series of time-boxed development cycles called "sprints."
    - Before each sprint, the team conducted sprint planning meetings to select backlog items to work on during that iteration.
    - Sprint goals and objectives were defined, and the team estimated the effort required for each selected item.
4. Daily Standup Meetings:
    - Each day during a sprint, the development team held short daily standup meetings to discuss progress, challenges, and plans for the day.
    - This ensured that team members were aligned and could address any issues promptly.

5. Development and Testing:
    - Development work began on the selected backlog items, with developers writing code and testers conducting continuous testing.
    - Continuous integration and automated testing were employed to catch and resolve issues early in the development process.
6. Collaboration and Feedback:
    - Collaboration among team members, including developers, testers, designers, and domain experts, was encouraged throughout the development process.
    - Frequent demonstrations and feedback sessions with stakeholders, such as potential users and educators, were held to gather input and refine the product.
7. Review and Adaptation:
    - At the end of each sprint, a sprint review meeting was conducted to demonstrate the completed work to stakeholders.
    - Feedback from the sprint review was used to adapt and reprioritize the product backlog.
    - The team conducted a sprint retrospective to reflect on what went well and identify areas for improvement in the next sprint.
8. Continuous Integration and Deployment:
    - Continuous integration and deployment pipelines were established to automate the build, testing, and deployment processes.
    - This allowed for rapid delivery of new features and updates to users.
9. Scaling and Release:
    - As the development process progressed, the Sparkle Edu platform expanded its user base and incorporated feedback from a growing community of users.
    - Regular releases and updates ensured that the platform remained aligned with evolving user needs and educational trends.
10. Ongoing Improvement:
    - The Agile approach fosters a culture of continuous improvement, with the team regularly assessing and adapting its processes to enhance productivity and product quality.

- This iterative cycle of development, feedback, and adaptation continued throughout the project's lifecycle.

By following the Agile development process, the Sparkle Edu team was able to create a flexible and responsive platform that effectively addressed research problems and user needs in the dynamic field of e-learning.

Figure 12 shows the Agile based development life cycle.

Figure 12: Agile based Development Lifecycle

Project Management

Project management and version control are critical aspects of the development process for Sparkle Edu. These tools and practices help ensure effective collaboration, efficient task management, and the preservation of code integrity. Here's an overview of how Microsoft Planner and GitLab were employed in these capacities:

1. Task Planning and Organization:
    - Microsoft Planner served as the central hub for task management, allowing the team to create, assign, and organize tasks related to the development of Sparkle Edu.
    - Tasks were categorized into sprints and assigned to team members based on their expertise and capacity.
2. Priority Setting:
    - The platform provided the ability to set task priorities, ensuring that high-priority items were addressed promptly, aligning with Agile principles.
3. Task Dependencies:
    - Dependencies between tasks were clearly defined, enabling the team to manage the sequence of work efficiently. For instance, the completion of a user interface design task might precede the coding task.
4. Deadline Tracking:
    - Planner allowed the team to establish deadlines for tasks, ensuring that sprint goals were met and that the project stayed on schedule.
5. Progress Monitoring:
    - Team members could update the status of their tasks, facilitating real-time progress monitoring during daily standup meetings.
6. Collaboration and Communication:
    - The collaboration features within Microsoft Planner enabled team members to comment on tasks, ask questions, and provide updates, fostering effective communication within the team.

2.3.2 Requirement Gathering

After further investigation of how to impact machine learning to develop a solution and what kinds of systems are going to be implemented that produce better results with higher accuracy, there are many research articles devoted to the e-learning sector. Appropriate models have been built as a result of analysis and a deeper knowledge of the solutions that are very suitable for this application. When putting the e-learning paradigm into practice, the following needs are taken into account.

Non-functional Requirements:

- Reliability
- Availability
- Performance

2.5.1 Development Methodology

a. Stress Detection using facial expression and drowsiness detection.

1. Data Collection and Preprocessing:

In order to develop an effective stress and drowsiness detection system, a diverse data set is collected. This dataset comprises facial images of individuals along with corresponding emotion labels. It is important to ensure that the dataset captures a wide range of emotion levels and variations in facial expressions. This can be achieved by recruiting participants from different demographics and inducing stress through various methods such as psychological stressors or real-life scenarios. The data collection process involves capturing facial images using a webcam. Additionally, eye regions are detected and extracted to assess eye state, which is a crucial component for drowsiness detection.

2. Model Training:

The methodology for training the emotion recognition model involves crucial steps to ensure effective development. Firstly, emotion labels and corresponding folder names are defined, establishing the mapping between emotions and data folders. Feature extraction captures relevant information, using grayscale conversion and resizing to (48x48) pixels via the function. Data normalization ensures features range from 0 to 1, optimizing data processing. CNN model architecture is defined using Keras' Sequential API, with three convolutional layers using ReLU activation, followed by max-pooling. Flattening and dense layers with softmax activation output probability distributions for seven emotions.

3. Emotion and Eye State Recognition Models:

Two deep learning models are employed for emotion recognition and eye state classification, respectively. The emotion recognition model is trained using preprocessed facial images and corresponding emotion labels. It is capable of recognizing seven emotions, namely Angry, Disgust, Fear, Happy, Neutral, Sad, and Surprise. The eye state classification model is trained using preprocessed eye regions and labeled data, distinguishing between "Open" and "Closed" eye states.

4. Stress Calculation:

Stress frames are calculated by monitoring the recognized emotions and identifying frames with emotions related to stress, such as Anger, Disgust, Fear, and sadness. The stress frames are then compared to the total frames to determine the stress percentage.

5. Real-Time Processing:

The system performs real-time processing of facial images and eye regions captured from the webcam. For each frame, the models predict the emotion, and eye state, and recognize student faces using the trained models. The system also tracks the duration of eye closure to detect drowsiness.

6. Alerting Mechanism:

When the eye state indicates prolonged closure for more than 10 seconds, an audio alert is triggered to indicate drowsiness. Additionally, if the calculated stress percentage exceeds 50%, a separate audio alert is activated, indicating a high stress level.

7. Data Logging:

The system logs the student data, including the date, student ID, student name, and stress percentage, into a CSV file. This data can be used for further analysis and monitoring of students' stress levels over time.

The proposed methodology presents a non-intrusive and real-time approach to identifying stress and drowsiness, making it suitable for applications in educational institutions, healthcare facilities, and workplace environments. The use of deep learning models allows for accurate and efficient recognition of emotions and eye states, contributing to a robust stress and drowsiness detection system.

b. Facial Authentication with Course Recommendation System

The methodology employed in this research focuses on developing a model for age and gender prediction using Convolutional Neural Networks (CNNs). To begin, a diverse dataset of images

with age and gender labels is collected from various sources, ensuring the representation of different demographics. The collected dataset undergoes pre-processing to enhance image quality and usefulness. This involves resizing the images to a standard size, such as 128x128 pixels, and normalizing the pixel values between 0 and 1.

Data augmentation techniques, including random cropping, flipping, and rotation, are applied to augment the dataset, thereby improving the model's performance and generalization.

For model construction, a sequential CNN architecture is utilized, leveraging the TensorFlow Keras library. The model comprises multiple layers, such as Conv2D, LeakyReLU, Batch Normalization, MaxPooling2D, Dropout, Flatten, and Dense layers. These layers enable the extraction of features from the input images, allowing the identification of patterns and information relevant for predicting age and gender. Batch Normalization stabilizes the learning process, while the LeakyReLU activation function introduces non-linearity. Dropout layers are incorporated to prevent overfitting by randomly disabling neurons during training. The final dense layer with a sigmoid activation function produces the age and gender predictions.

The model is trained using a categorical loss function and the Adam optimizer. The dataset is split into training and validation sets (80:20 ratio) to prevent overfitting. Hyperparameters, like learning rate and batch size, are fine-tuned. Evaluation is done on a separate test dataset using metrics such as accuracy, precision, recall, and F1 score. Potential biases are analyzed. Overall, this systematic CNN-based approach aims to achieve accurate age and gender predictions, contributing to the field of age and gender categorization from photographs.

c. AI Mental Health Therapist

Analysing related research publications found online was done to obtain requirements for the study. Identification of existing or new systems that are similar, and research of the methodology

utilized are the main goals of this study. Reading research articles mostly focused on key topics including artificial intelligence, Conversational Chat box, Natural Language Processing, and Convolutional Neural Networks are the major methods used for past research analysis. The main emphasis was placed on the description of the research's methodology, tools, experiments, and overall findings with regard to the development of building a mental therapist chat box. Most existing systems were found by referring to academic articles and a range of web sources. An important emphasis was placed on identifying the features they already provided as well as any potential flaws in the technology and methods employed.

1. Feasibility Study:

The research study placed significant emphasis on technical feasibility during the requirements analysis phase, particularly in configuring the necessary tools for resiliency evaluation. Prospective system requirements, development technologies, and tools for Chatbot were carefully identified. The viability of the schedule was also a crucial consideration. The requirement analysis phase proved vital, as it helped identify essential criteria and potential challenges for practical implementation. Data gathered from various sources during the requirement-gathering phase facilitated the quick identification of critical elements, potential difficulties, and insights into the process. This stage enabled a clear understanding of how to utilize various tools and technologies effectively. The feasibility of the project and precise parameters were determined, ensuring a comprehensive understanding of the planned research. By prioritizing technical feasibility, the study laid a solid foundation for the development and successful implementation of the resilient assessment Chatbot.

2. System Analysis:

Utilizing tools such as NLP and CNN to allow the data to communicate and answer questions.

d. Document Re-construction

1. Requirement Gathering:

Conduct in-depth surveys for the user requirements of the system. Such as Assembling the specifications needed to create a precise document reconstruction system, finding out what other experts or technical users think of the system's fundamental concept, Describe the software specifications for text reconstruction and prediction.

2. Development Methodology:

To manage a project effectively, time, scope, and cost should be considered. This project should be able to retain requirements changes while also accepting adjustments during the project. Agile methodology was chosen after careful consideration of all the variables so that the prototype could be developed, could be corrected after receiving regular feedback from the mentor, and there would be enough time for all the feedback to be taken and developed in brief sprints, resulting in a product that would be to the highest satisfaction of the author and the mentor. Presenting a functional prototype makes it simple for the mentor to provide input.

3. OCR:

Digital camera and mobile document image acquisition are emerging trends in Optical Character Recognition (OCR) and text detection. However, these processes may introduce distortions and result in poorly scanned text, impacting OCR accuracy. To enable automated storage, indexing, and information retrieval with full access to content, OCR techniques are essential for extracting and recognizing words with high accuracy from scanned documents.

2.5 Commercialization aspects of the product

Our commercialization plan for Sparkle Edu centers on a subscription-based model for each of its four core components, leveraging the platform's innovative features to cater to the diverse needs of users and institutions.

1. **Component-Based Subscription Model**:

Sparkle Edu will offer users the flexibility to subscribe to individual components, allowing them to tailor their experience to their specific requirements. This component-based pricing strategy ensures that users only pay for the functionalities they need, enhancing cost-effectiveness and value proposition.

2. **Tiered Pricing:**

To cater to a wider audience, Sparkle Edu will implement tiered pricing for each component. Users can choose from different subscription tiers, offering varying levels of access and features. For instance, a basic tier may provide essential functionalities, while a premium tier could include advanced features and premium support options.

3. **Education Marketplace Integration:**

We will explore partnerships with educational marketplaces and learning management systems (LMS) to integrate Sparkle Edu as a complementary service. By positioning Sparkle Edu as an add-on within established educational ecosystems, we aim to expand our user base and reach a broader audience.

4. **Student and Teacher Discounts:**

To support individual students and educators, Sparkle Edu will offer special pricing and discounts. These incentives will encourage educators to adopt the platform for their teaching needs, fostering its integration into educational settings.

5. Marketing and Promotion:

Our marketing efforts will encompass online channels, social media, content marketing, and strategic partnerships. We will create targeted campaigns to highlight Sparkle Edu's unique features and benefits, driving user acquisition and retention.

By implementing this comprehensive commercialization plan, Sparkle Edu aims to establish itself as a leading solution in the e-learning market, offering tailored experiences that enhance education and well-being for students and educators worldwide.

2.6 TESTING & IMPLEMENTATION

2.6.1 Testing

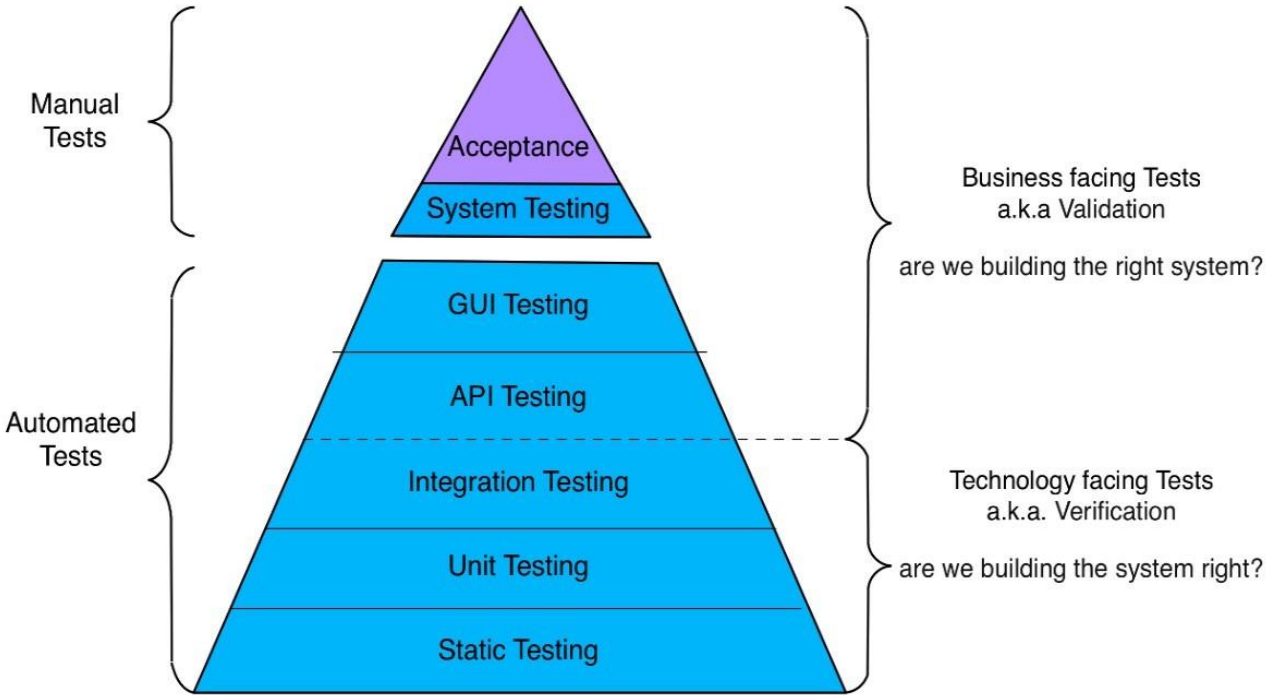

Figure 13: Test Triangle

The figure 13 demonstrates a clear method for testing software before release at each stage of development, as well as for testing applications and fixing defects. Applications generally improved in quality and were the best deliverable item as a result of testing. Software testing is often really fundamental in the development life cycle to identify flaws and errors that have been established quietly throughout the stages of development. Additionally, it is crucial to confirm the item's quality. Contrary to common opinion, it is necessary for a product or computer software application to function properly. Every level of the SDLC that we follow must have the following subtle testing categories.

1. **Unit Testing**

In this stage, each of the individual units are tested and make sure each work is working accurately with bug-free. As a result of this component essentially pass effectively that's noted as an error-free component and it'll become ready for the part to integrate with the main component. This testing part generally comes beneath white box testing, contrary to popular belief.

2. **Module Testing**

It is defined as another sort of program testing, which was done to check the subroutine, a subprogram, and class.

3. **Integration Testing**

In this testing, all the individual components or units are combined and tested as a group. This testing aims to be assessing the compliance of each component or framework which contains the functional prerequisites.

4. **System Testing**

When the whole system was integrated, it is conducted. All the functional requirements of the system are assessed in this testing. Evaluating the end-toned specifications is the purpose of this type of testing. Once the bug was identified at this testing stage, then the bug will be debugged by the team members.

5. **User Acceptance Testing**

The client or the end-user performs this testing. It will be done at the end of the testing phase. The feedback and user experience are given by target users. The main goal of this testing is to find whether the target customer's requirements are satisfied or not.

Maintenance

The maintenance phase is the last phase of this SDLC model. Here, maintaining the software updates, repairs, and fixes of the application are considered as some of the functionalities conducted in this phase.

The developed component has been passed through all the testing phases with errorfree. The entire system should be divided when performing the testing phase which will be a realistic way of testing.

3 RESULTS & DISCUSSION

a. Stress Detection using facial expression and drowsiness detection.

The research successfully integrated facial expression analysis and drowsiness detection to detect stress levels in users. The system accurately identified stress-indicative facial expressions and monitored drowsiness patterns. This comprehensive approach offers valuable insights into users' emotional states and alertness levels, providing a robust stress detection solution. Once the prediction is done, the CSV report will be generated. Figure 14 shows the output clearly.

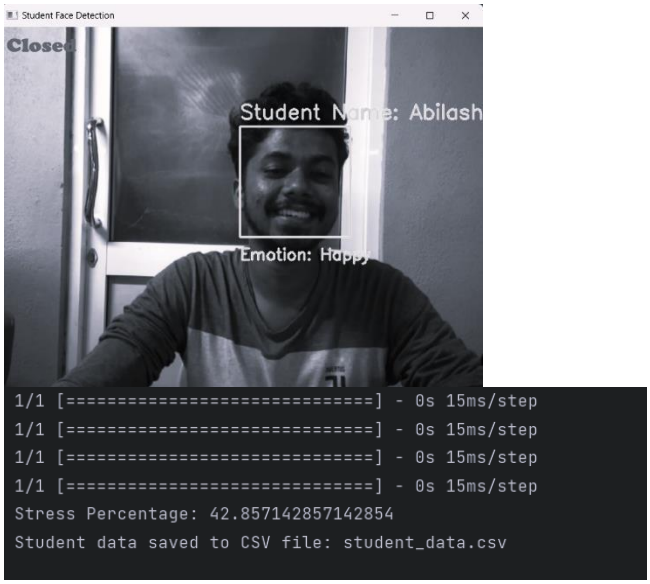

Figure 14: : Stress Identification with Drowsiness Detection Output

b. Facial Authentication with Course Recommendation System

The facial authentication system achieved high accuracy in age, and gender identification. By analysing facial features, the system accurately classified users' age and gender, enabling personalized course recommendations based on gender-specific preferences and learning styles. This approach enhances user experience and promotes inclusivity in course selection. Figure 15 illustrates the system output for an input image.

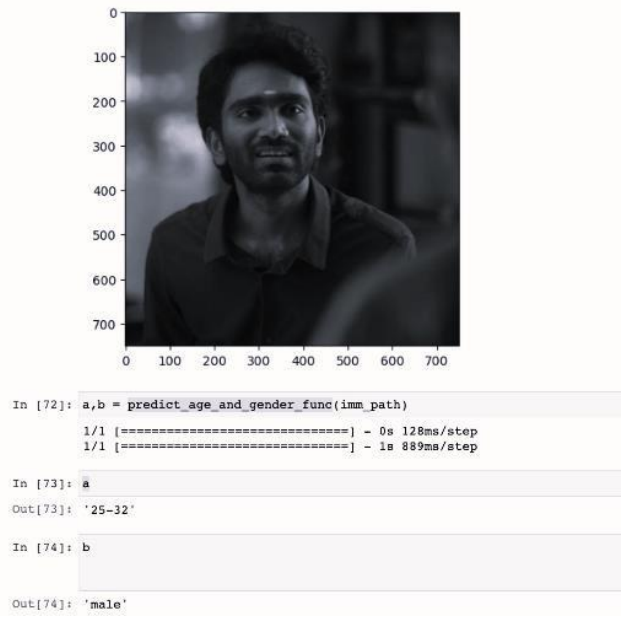

Figure 15: Age, Gender Detection

c. AI Mental Health Therapist

The AI Mental Health Therapist chatbot demonstrated promising outcomes in providing mental health support. User feedback indicated a high level of satisfaction with the chatbot's responsiveness and empathy. The system's ability to offer timely advice and resources showcases its potential as a scalable and accessible mental health support tool. Figure 16 shows the system output for an input image.

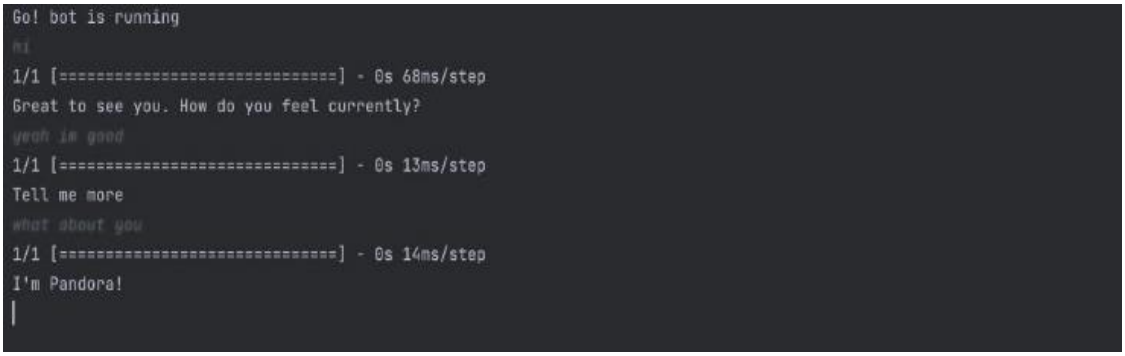

Figure 16: Chatbot output

d. Document Re-construction

The text prediction and document reconstruction system showed remarkable performance in generating accurate and contextually relevant text predictions. User testing revealed a significant reduction in typing effort and improved document completion. The system's efficiency and accuracy highlight its value in enhancing productivity and writing workflows. Figure 17 shows the system outputfor an input image.

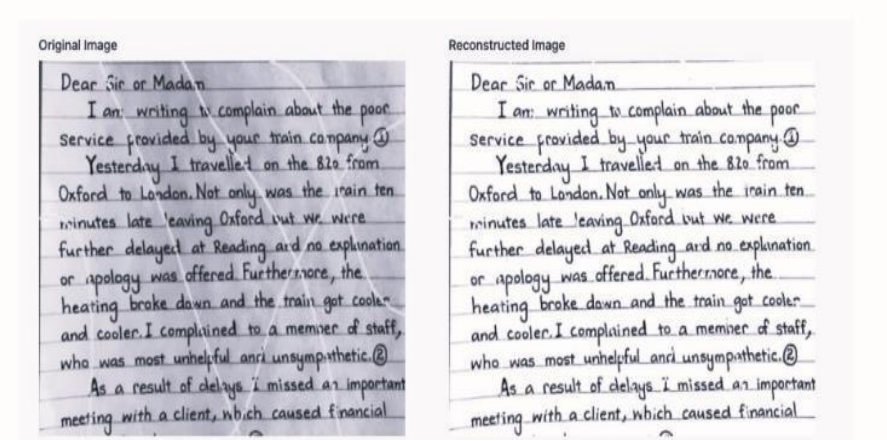

Figure 17; Document Reconstruction Output

4 SUMMARIES OF EACH STUDENT'S CONTRIBUTION

IT Number	Name	Component	Role
IT20132682	Abilash.L	Stress Detection using facial expressions, Drowsiness Detection & Attention Seeking	Business Analyst Developer Tester Project Manager
IT20051648	Danushan.R	Facial Authentication & Course recommendation	Business Analyst Developer Tester
IT20072742	Agash.V	AI Mental Health Therapist Chatbot	Business Analyst Developer Tester
IT20250874	T.Abinaya	Document Reconstruction	Business Analyst Developer Tester

Table 1: Summary Of Each Student's Contribution

5 CONCLUSION & FUTURE WORK

The integrated e-learning system, comprising emotion recognition, drowsiness detection, facial authentication, and document reconstruction, has shown promising results in improving the online learning experience. Emotion recognition and drowsiness detection enabled real-time monitoring of students' emotional engagement and alertness, providing timely interventions to optimize learning outcomes. The facial authentication feature enhanced security and personalization in course recommendations, catering to individual needs. The document reconstruction system effectively generated accurate text predictions, streamlining content creation and improving productivity. Overall, the system has demonstrated its potential to revolutionize online education by fostering a dynamic, empathetic, and efficient learning environment.

Despite the system's successes, several areas offer opportunities for further development and enhancement. In emotion recognition, exploring more advanced deep learning architectures and incorporating multimodal data sources (e.g., voice and gesture analysis) could improve emotion classification accuracy. For drowsiness detection, investigating additional physiological signals like EEG and heart rate variability can provide comprehensive insights into students' alertness.

In facial authentication, exploring facial expression-based authentication and anti-spoofing techniques can bolster system security. Additionally, incorporating user feedback to fine-tune course recommendations based on individual preferences and learning history can optimize personalization.

For document reconstruction, integrating natural language processing (NLP) models and context awareness can refine text prediction accuracy. Exploring collaborative editing features and cross-platform compatibility can further enhance document creation.

Future work also involves addressing privacy concerns and data protection in each component. Ensuring robust data encryption, user consent, and compliance with data regulations will be critical to maintaining user trust. Continued research and development in these areas will enable the e-learning system to evolve into a comprehensive, user-centric platform, making online education more engaging, effective, and accessible to learners worldwide.

REFERENCE

[1] Danisman, T., Bilasco, I.M., Djeraba, C., Ihaddadene, N. (2014). Drowsy driver detection system using eye blink patterns. 2010 International Conference on Machine and Web Intelligence, Algiers, Algeria, pp. 230-233.

[2] S.V. Pavan Kumar, Gogula Mounika, Immadisetty Pavithra, Uppu Kalpana, Kanamarlapudi Alekya, Sagabala Parameswara, “tress Detection In IT Professional by Image Processing and Machine Learning” in Journal of Engineerning Science

[3] Hua Gao, Anil Yuce, Jean-Philippe Thiran, “DETECTING EMOTIONAL STRESS FROM FACIAL EXPRESSIONS FOR DRIVING SAFETY”, Signal Processing Laboratory (LTS5), Ecole Polytechnique F ´ ed´ erale de Lausanne, Switzerland

[4] Kaushal Puri, Devasheesh Tripathi , Yashvi Sudan , Prof. A.B Patil, “Feature Extraction Technique for Emotion Detection using Machine Learning” in SSRG International Journal of Electronics and Communication Engineering

[5] Z. S. N. M. A. a. M. M. Mardi, "EEG-based drowsiness detection for safe driving using chaotic features and statistical tests," Journal of Medical Signals And Sensors, vol. 1, no. 2, p. 130, 2011.

[6] S. M. R. a. M. M. Noori, "Driving drowsiness detection using fusion of electroencephalography, electrooculography, and driving quality signals.," J Med Signals Sens, vol. 6, no. 1, p. 39, 2016.

[7] J. D. S. U. T. D. E. a. M. G. Krajewski, "Steering wheel behavior based estimation of fatigue," in Driving Assessment Conference 2009, 2009.

[8] Gupta SK, Nain N. Review: Single attribute and multi attribute facial gender and age estimation. Multimed Tools Appl. 2023;82(1):1289-1311. doi: 10.1007/s11042-022-12678-6. Epub 2022 Jun 15. PMID: 35729932; PMCID: PMC9200214.

[9] Rothe, Rasmus & Timofte, Radu & Van Gool, Luc. (2018). Deep Expectation of Real and Apparent Age from a Single Image Without Facial Landmarks. International Journal of Computer Vision. 126. 10.1007/s11263-016-0940-3.

[10] Antipov, Grigory & Baccouche, Moez & Berrani, Sid Ahmed & Dugelay, Jean-Luc. (2017). Effective Training of Convolutional Neural Networks for Face-Based Gender and Age Prediction.

Pattern Recognition. 72. 10.1016/j.patcog.2017.06.031.

[11] Joy Buolamwini; Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification; Proceedings of Machine Learning Research 81:1–15, 2018 Conference on Fairness, Accountability, and Transparency

[12] Garain, Avishek & Ray, Biswarup & Singh, Pawan & Ahmadian, Ali & Senu, Norazak & Sarkar, Ram. (2021). GRANet: A Deep Learning Model for Classification of Age and Gender from Facial Images. IEEE Access. PP. 1-1.

10.1109/ACCESS.2021.3085971.

[13] M. METCALF, "The Best Mental Health Chatbots (& What They Can Do For You)," Fingerprint for success, 15 april 2023. [Online]. Available:

https://www.fingerprintforsuccess.com/blog/mental -health- chatbot. [Accessed 17 march 2023].

[14] A. A. Abd-alrazaq, "An overview of the features of chatbots in mental health: A scoping review," International Journal of Medical Informatics, vol. 132, no. 103978, 2019.

[15] K. Denecke, "Artificial Intelligence for Chatbots in Mental Health: Opportunities and Challenges," ResearchGate, 2019.

[16] A. N. Vaidyam, "Chatbots and conversational agents in mental health: a review of the psychiatric landscape."," The Canadian Journal of Psychiatry, vol. 64, no. 7, pp. 456-464, 2019.

[17] Markus Diem, Florian Kleber, and Robert Sablatnig. 2010. Document analysis applied to fragments: feature set for the reconstruction of torn documents. In Proceedings of the 9th IAPR International Workshop on Document Analysis Systems (DAS '10). Association for Computing Machinery, New York, NY, USA, 393– 400.

[18] Yue-Jiao Gong, Yong-Feng Ge, Jing-Jing Li, Jun Zhang, and

W.H. Ip. 2016. A splicing-driven memetic algorithm for reconstructing cross-cut shredded text documents. Appl. Soft Comput. 45, C (August 2016), 163–172.

[19] D.Kesarkar, Ms.Poonam and Ms.Mridula Rc. Prasad. “RECONSTRUCTION OF TORN PAGEUSING CORNER AND SEGMENTMATCHING.” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Energy 2 (2013): 2270-227

APPENDICES