CAPSTONE PROJECT REPORT

Project Term January-May 2025

Student Mental Awareness and Resilience Tracker

Submitted by

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Project Group Number: KC337

Course Code: CSE439

Under the Guidance of

Shivali Chopra, Assistant Professor

School of Computer Science and Engineering

PAC Form

TOPIC APPROVAL PERFORMA

School of Computer Science and Engineering (SCSE)

Program : P132::B.Tech. (Computer Science and Engineering)

COURSE CODE : CSE439 **REGULAR/BACKLOG :** Regular **GROUP NUMBER :** CSERGC0337

Supervisor Name : Shivali Chopra **UID :** 19259 **Designation :** Assistant Professor

Qualification : ____________ **Research Experience :** ____________

SR.NO.	NAME OF STUDENT	Prov. Regd. No.	BATCH	SECTION	CONTACT NUMBER
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SPECIALIZATION AREA : System Programming **Supervisor Signature:** ____________

PROPOSED TOPIC : SMART(Student Mental Awareness and Resilience Tracker) Website

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	**Parameter**	**Rating (out of 10)**
1	Project Novelty: Potential of the project to create new knowledge	7.24
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	7.00
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	6.65
4	Project Supervision: Project supervisor's is technically competent to guide students, resolve any issues, and impart necessary skills.	7.59
5	Social Applicability: Project work intends to solve a practical problem.	7.24
6	Future Scope: Project has potential to become basis of future research work, publication or patent.	7.24

PAC Committee Members		
PAC Member (HOD/Chairperson) Name: Pushpendra Kumar Pateriya	UID: 14623	Recommended (Y/N): Yes
PAC Member (Allied) Name: Navjot Kaur	UID: 20506	Recommended (Y/N): Yes
PAC Member 3 Name: Dr. Baljit Singh Saini	UID: 22078	Recommended (Y/N): Yes

Final Topic Approved by PAC: **SMART(Student Mental Awareness and Resilience Tracker) Website**

Overall Remarks: Approved

PAC CHAIRPERSON Name: 14537::Dr. Rekha **Approval Date:** 03 Mar 2025

4/28/2025 9:14:58 AM

DECLARATION

We hereby declare that the student mental awareness and resilience tracker project is an authentic record of our work carried out as requirements of the Capstone Project for the award of a BTech degree in computer science engineering from Lovely Professional University, Phagwara, under the guidance of Shivali Chopra, from January to May 2025. All the information provided in this capstone project report is genuine and based on our intensive work.

Project Group Number: KC337

Name of Student 1: Ayush Kumar Rai
Registration Number: 12020794

Name of Student 2: Fanish Pandey
Registration Number: 12102636

Ayush Kumar Rai
Date:

Fanish Pandey
Date:

CERTIFICATE

I certify that the declaration statement provided by this group of students is accurate to the best of my belief and knowledge. They have finished this Capstone Project under my guidance and supervision. The current work is based on their original investigation, study, and effort. None of the work was ever submitted to any University for any other degree. The Capstone Project is suitable for submission and partial fulfillment of requirements for the award of a BTech degree in Computer Science Engineering of Lovely Professional University, Phagwara.

Signature and Name of the Mentor

Designation

School of Computer Science and Engineering,
Lovely Professional University,
Phagwara, Punjab.

Date:

ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to Lovely Professional University for providing us with the opportunity for this capstone project named SMART (Student Mental Health and Resilience Tracker). This project has been a very important part of our Academic journey, which allowed us to apply our practical knowledge of Data Science and helped us to develop our critical insights into practical world solutions.

We deeply thank our esteemed mentor, Ms. Shivali Chopra, for her continuous support, valuable guidance, and regular encouragement throughout this project. Her important feedback, awesome suggestions, and motivation have been a turning point in our direction and the success of our teamwork.

I am also thankful to the entire administration of Lovely Professional University, whose commitment to achieving excellence in education has developed an environment that encourages research and our professional growth to think beyond the limits.

At last, we would like to thank our family, friends for their constant support and motivation, which have been a source of strength and power throughout this remarkable project.

We are all truly honored to present this work to the esteemed evaluation committee.

Thank you.

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1. Introduction

Recognizing students who have ongoing or recurring (periodic) mental health concerns has increasingly become a focus within student affairs in antedated years due in part to some of the academic stressors that students are facing today. The challenging nature of higher education, whether it is associated with competition, lack of time, or expectation for performance, can create feelings of mental distress, anxiety, and ultimately depression. The sooner concerns can be identified, the better chances we have to provide timely support and enhance student well-being.

Being able to evaluate and monitor the mental health of students is typically done through traditional methods of self-report surveys and clinical evaluations, both of which require extensive time commitments and may fail to capture a student's immediate changes in mental health. With the emergence of machine learning (ML) and data analytics, there is potential to develop predictive models that assess mental health conditions based on academic performance and behavioural patterns.

The purpose of this project is to create a machine learning model that will look at students' academic data (grades, attendance, participation, and assignment submission) to predict potential mental health challenges. By applying supervised learning techniques, the model will find trends between academic performance and mental wellness, and therefore allow educators and counsellors to intervene before a challenge impacts the student's well-being.

What is important about this project is that it provides an automated and non-intrusive means of identifying mental health issues early on in an educational context. By adding this model into academic systems, universities/colleges can create a more conducive experience, where students can get help earlier on, before their mental health issues become more serious. This aims at linking academic performance monitoring with mental health awareness, and hopefully contributes towards building a healthier and more engaged student body.

2. Profile of the Problem

Mental health issues experienced by college students have been on the rise, with colleges seeing an increasing number of students reporting a variety of stress, anxiety, depression, and suicidal ideation. Anxiety resulting from academic performance and the pressures of college life in the form of heavy demands from courses, midterms, finals, fierce competition among peers, and uncertainty of future careers and job prospects are all major driving forces for many students. Students experience many of these challenges in silence, primarily due to stigma, lack of knowledge of their mental health issues, or lack of support from their institutions.

There should be an early warning system in place to identify students who are at risk for mental health challenges based on observable at-risk academic and behavioural patterns before crises arise. Counselling sessions and self-reported surveys are traditional methods to assess mental health and mental health concerns, but are mostly reactive rather than preventative. Many students may not request help, or even answer the surveys, because of the fear of situational or social stigma. Arcadia University had found itself in a situation of increasing mental health challenge engagement requests, often after mounting stress, reactions to crisis incidents, and the escalation of their mental health challenges into disorders.

2.1 Rationale of the Study

Machine learning (ML) could provide a data-based, scalable, and non-intrusive means of identifying students who are experiencing mental health difficulties. By viewing student academic performance data (for example, grades, attendance, assignment submissions, and participation), we can establish patterns that might indicate mental distress. For example:

If students suddenly experience a drop in grades or have fewer classes or attendance, they might be experiencing depression or burnout.

- If students submit assignments more erratically than in previous submissions, they could be experiencing anxiety or time management difficulty.

- If students participate less in their courses, they may be feeling lonely or emotionally distressed.

This study is motivated by the potential of predictive analytics to:

1. **Support Early Action**– Parents and teachers will be able to notice which students are going through stress and help them before the issue escalates.
2. **Reduce stigma** – Because the assessment will be based entirely on academic result data, students can feel less 'singled out' compared to how they would during traditional mental health screenings.
3. **Improve colleges or schools' support systems** – Early identification of those groups who are high-risk enables the institution to allocate mental stress resources in a better way.

2.2 Scope of the Study

- **Collection of Data:** Gathering academic records (grades, attendance, parent income) and, if available, anonymized mental health survey responses for model preparation.
- **Development of Model:** Building a supervised ML model (e.g., Logistic Regression, RF) to classify students' mental health status (e.g., "low risk," "moderate risk," "high risk").
- **Constraints:**
    - The method relies on academic data and does not improve professional diagnosis.
    - People from different areas and individual differences in mental stress output may affect accuracy.

By analysing these fields, this study hopes to build on the expanding field of educational improvement and also mental stress analytics for students to lay a foundation for future AI-assisted student well-being programs.

3. Current Available System

3.1. Introduction

Most educational colleges or schools depend on **manual and old approaches** to monitor student mental stress. Below are a few examples of it:

- **Counselling sessions** (only when students seek help).
- **Periodic surveys** (often infrequent and self-reported).
- **Academic warnings** (triggered only after severe performance drops).

These systems are considered inefficient due to a variety of factors:

- **Late detection** – By the current System, it takes a lot of time to analyse stress or pressure on the student.
- **Low student participation** – Many avoid surveys or counselling due to stigma.
- **No predictive capability** – Institutions cannot intervene early.

3.2. Software & Tools

Some existing tools used in student mental stress monitoring include:

1. **Student Information**
    - Tracks grades, parent income, and disciplinary records.
    - **Limitation:** Only records data; no mental health or any kind of prediction.
2. **Wellness & Counselling Apps (e.g., Talkspace, Woebot)**
    - **Limitation:** Requires student initiative to use; this one is not integrated with academic data.
3. **Learning Management Systems (LMS) (e.g., Moodle, Blackboard)**
    - Monitor submissions of assignments and engagement.

- **Limitation:** No AI-based mental health risk prediction.

3.3. DFD for the System We Proposed

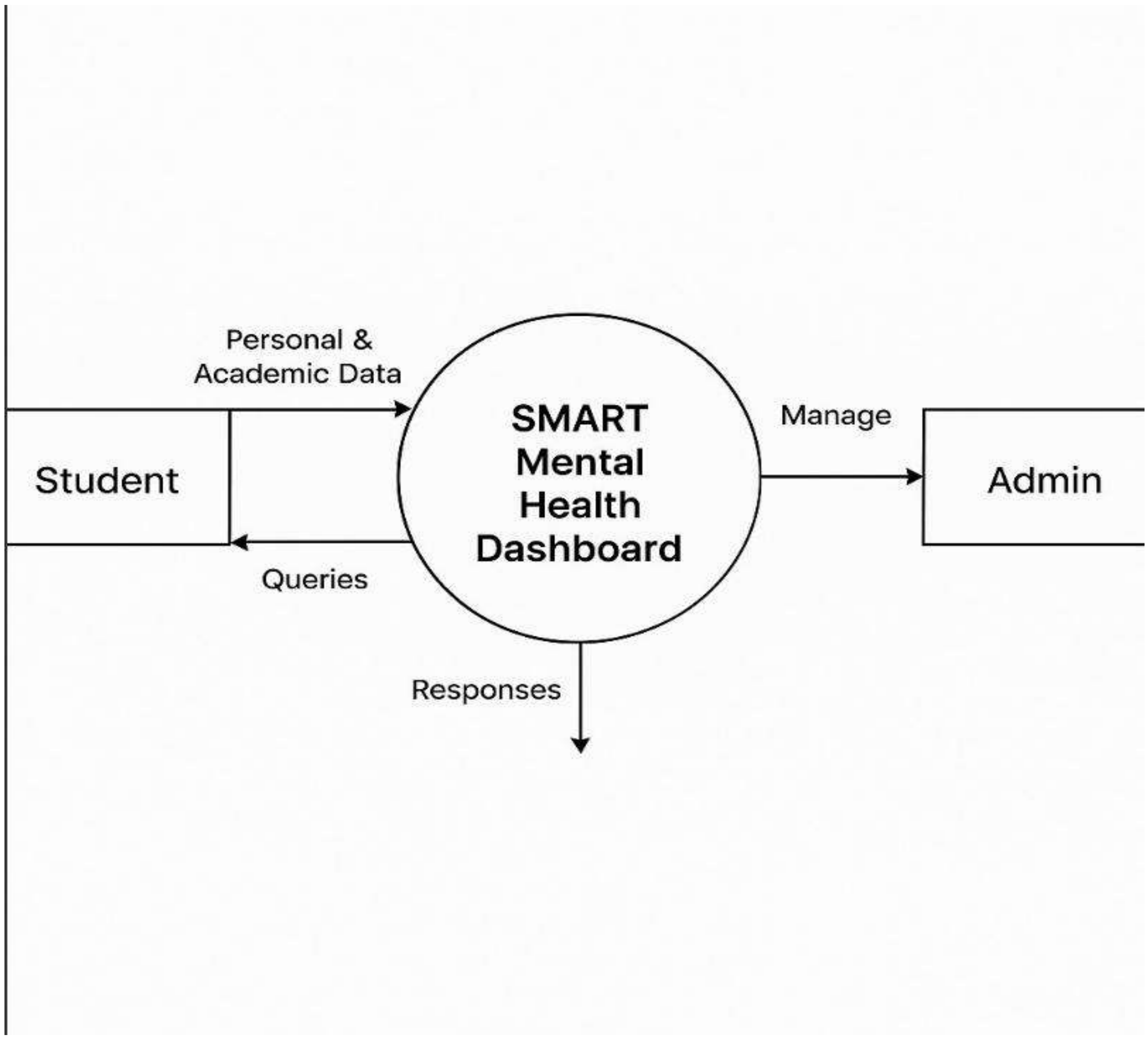


Figure 3.1: Level 0 DFD

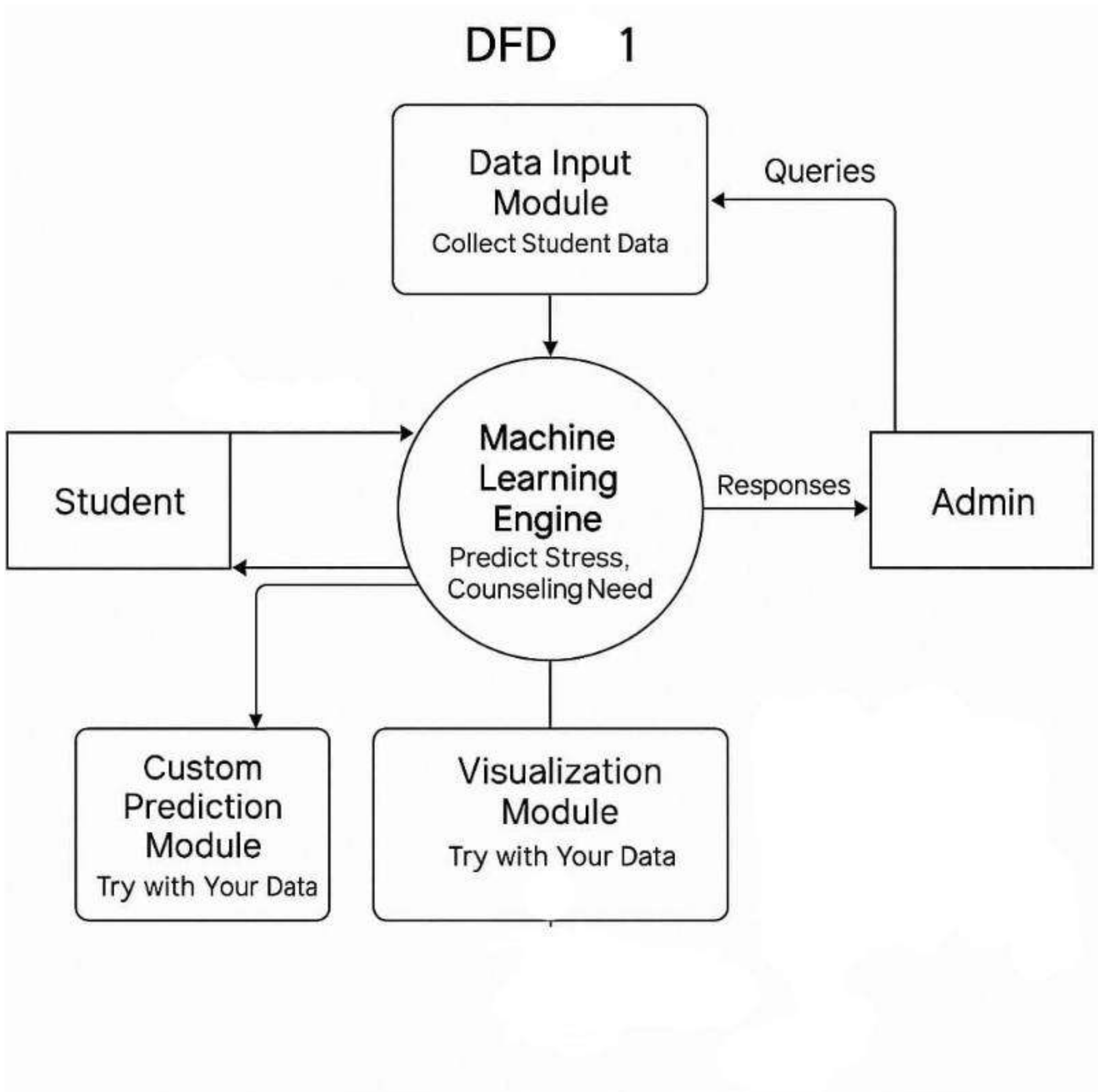


Figure 3.2: Level 1 DFD

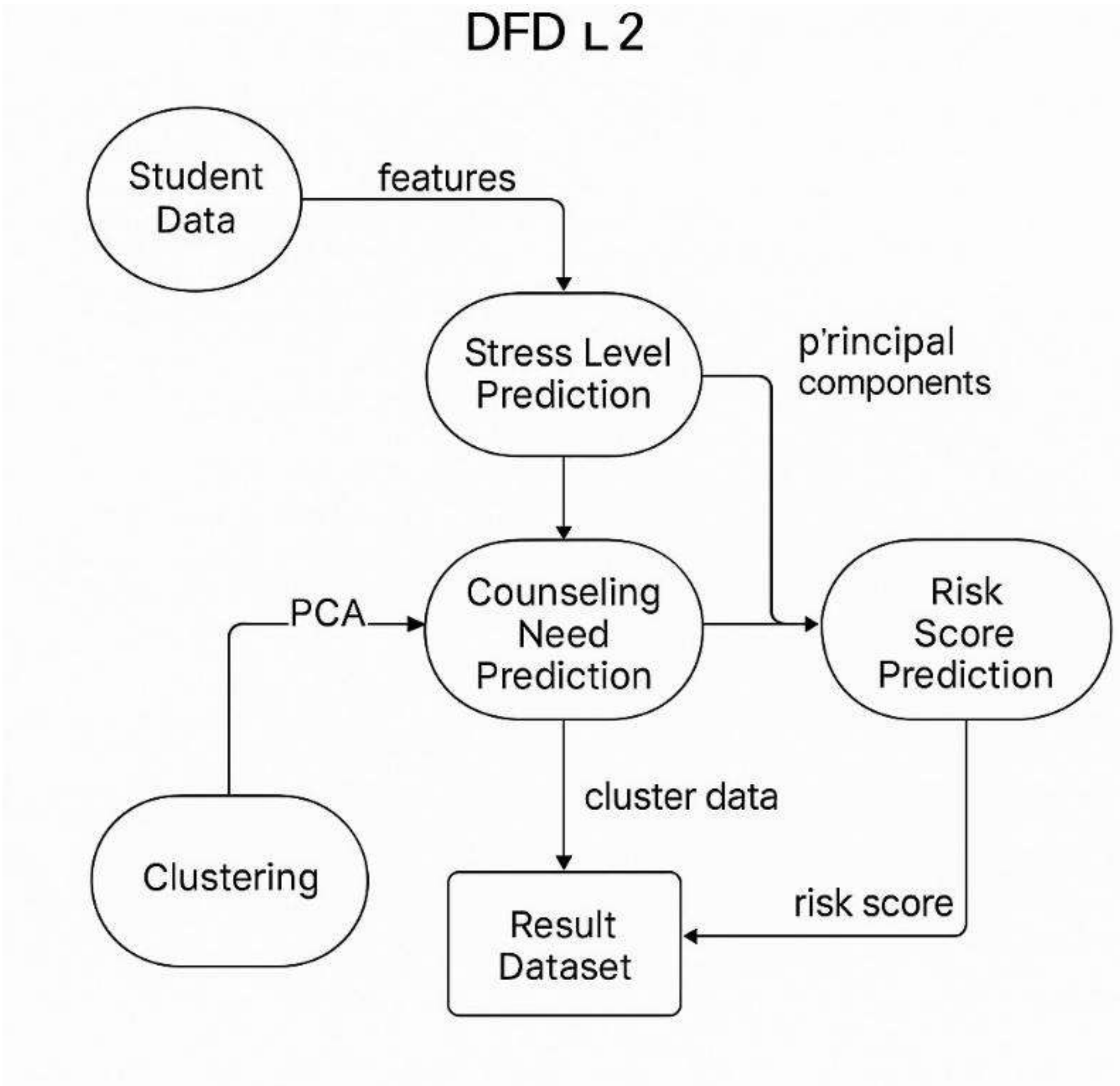


Figure 3.2: Level 2 DFD

Main Issues:

- Flows of data are **disconnected** (academic records ≠, mental health records).
- It's too late to take action (after poor performance is visible).

3.4. Novelty in the Proposed System?

The **ML-based mental health detection system** introduces:

1. **Automated Risk Prediction**

- Uses an **ML algorithm.** (e.g., Random Forest) to analyse academic performance and give output for mental health risks.

2. **System for Early Warning**

- Mark a student who in risk before severe performance drops occur.

3. **Integrated Dashboard**

- Gave **real-time alerts** to counsellors and faculty for proactive support.

4. **Data-Driven Insights**

- Identifies trends (e.g., "Students with falling attendance are 3x more likely to report anxiety").

Comparison: Existing vs. Proposed System

Table 3.1: Comparisons between existing and proposed systems

Feature	**Existing System**	**Proposed ML-Based System**
Detection Method	Manual surveys & grades	AI-driven predictive analytics
Intervention Time	Reactive (after crisis)	Proactive (early warning)
Data Integration	Disconnected (LMS≠ counselling)	Unified academic + mental health prediction
Scalability	Only when staff are available	Automated, scalable

Conclusion: The proposed system improves early detection, decreases reliance on self-reports, and facilitates data-driven interventions, making the monitoring of student mental health more accurate and reasonable.

4. Analysis of the Problem

4.1. Explanation of Product

The project that we are proposing here is a **machine learning (ML)-driven mental health detection system.** It analyses students' academic flow data and predicts predictable mental stress problems before it is too late.

Main Objectives

1. **Detection before it's too late:** Identify students for mental health or attention-related issues (e.g., stress, anxiety, depression) using academic metrics.
2. **Proactive Intervention:** Help parents and counsellors to provide support on time.
3. **Combination of Data:** Collect academic records (grades, attendance, assignments) with behavioural patterns for pure analysis.

Core Features

- **Automated Data Collection:** https://www.kaggle.com/datasets/fanishpandey/student-mental-stresssms
- **Predictive Analytics:** ML models classify students into risk categories (low, moderate, high).
- **Dashboard Interface:** Visualizes risk levels and trends for administrators and counsellors.
- **Alert System:** Sends notifications when students show prolonged academic decline.

Stakeholders

- **Students:** Primary beneficiaries of early mental health support.
- **Educators & Counsellors:** Users of the system for proactive intervention.
- **Institutions:** It will improve student mental health and awareness.

4.2. Feasibility Analysis

1. Technical Feasibility

- **Data Availability:** Each college or school has its own student data.
- **Tools & Frameworks:**
    - **ML Libraries:** jsonlite, caret, (for model development).
    - **Backend:** R programming.
    - **Frontend:** (for dashboard prototyping).
- **Challenges:** Ensuring data privacy and integrating with institutional systems.

2. Economic Feasibility

- **Costs:**
    - Development time (3–4 months).
- **Benefits:**
    - Reduced dropout rates.
    - It will enable institutions to lower their long-term healthcare cost.

3. Operational Feasibility

- **Integration:** Compatible with existing LMS/SIS through APIs.

- **User Training:** Do need higher knowledge of tech (dashboard is user-friendly).
- **Scalability:** Can expand to multiple departments or institutions.

4. Legal Feasibility

- **Ethical Approval:** Institutional review board (IRB) approval may be required for mental health data usage.

5. Time Feasibility

- **Project Timeline:** Achievable within a semester (14–16 weeks) with phased development.

4.3. Project Plan

Phase 1: Research & Requirements (Weeks 1–2)

- **Deliverables:** Search and review multiple research papers that who already worked on this field, stakeholder interviews, and dataset identification.
- **Tools:** Surveys, academic papers.

Phase 2: Data Collection & Preprocessing (Weeks 3–4)

- **Deliverables:** Cleaned dataset (grades, Placement status, family income, mental health labels if available).
- **Tools:** R programming.

Phase 3: Model Development (Weeks 5–8)

- **Deliverables:** Trained ML model (e.g., Random Forest) with validation metrics (accuracy, F1-score).
- **Tools:** R Studio.

Phase 4: Dashboard & Integration (Weeks 9–12)

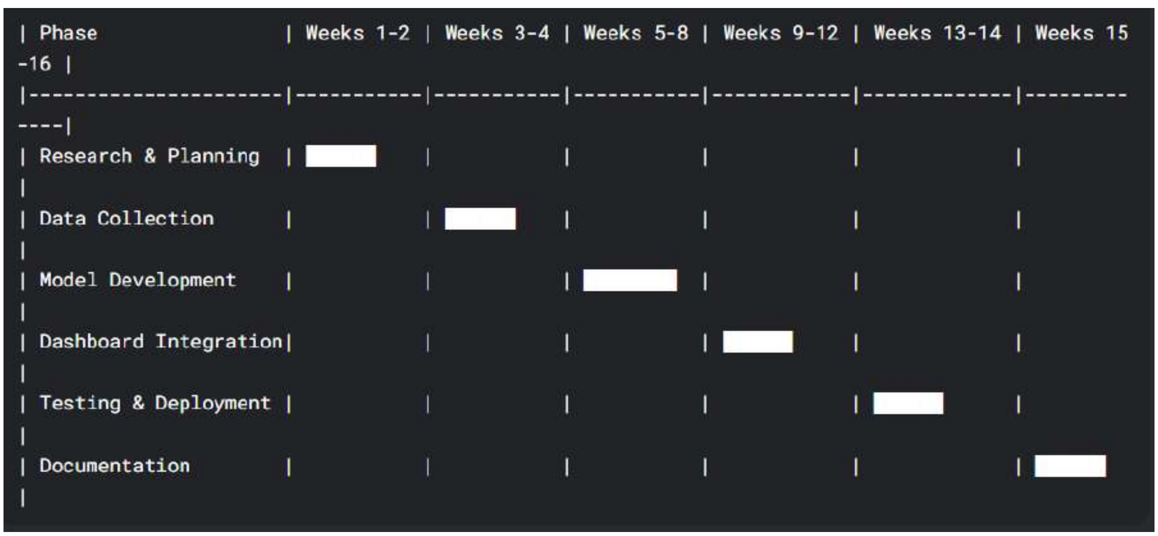
- **Deliverables:** Functional dashboard with risk alerts.
- **Tools:** Shiny ggplot,shiny thems .

Phase 5: Testing & Deployment (Weeks 13–14)

- **Deliverables:** Pilot testing report, deployment plan.
- **Tools:** User feedback surveys.

Phase 6: Documentation & Final Report (Week 15–16)

- **Deliverables:** Technical documentation, final presentation.



```
| Phase                | Weeks 1-2 | Weeks 3-4 | Weeks 5-8 | Weeks 9-12 | Weeks 13-14 | Weeks 15
-16 |
|----------------------|-----------|-----------|-----------|------------|-------------|---------
----|
| Research & Planning  |           |           |           |            |             |
|
| Data Collection      |           |           |           |            |             |
|
| Model Development    |           |           |           |            |             |
|
| Dashboard Integration|           |           |           |            |             |
|
| Testing & Deployment |           |           |           |            |             |
|
| Documentation        |           |           |           |            |             |
|
```

Figure 4.1:RAG diagram

Risk Assessment

Table 4.1: Risk Assessment

Risk	**Mitigation Strategy**
Data Scarcity	Used synthetic data for initial model training.
Model Inaccuracy	Regular validation and ensemble methods.

Risk	Mitigation Strategy
Privacy Concerns	Anonymize data and follow ethical guidelines.

5. Software Requirement Analysis

5.1. Introduction

Software Requirement Analysis (SRA) is arguably one of the most significant stages of the development lifecycle, since it defines the expected behaviour and performance of the system. This section outlines the functional and non-functional requirements for the proposed machine learning (ML)-based mental health detection system, all aimed at clarifying how the system will meet stakeholder requirements, accept technical constraints, and address the challenges presented in earlier discussion.

5.2. General Description

Product Perspective

The platform could easily integrate with existing institutional databases (Learning Management Systems and Student Information Systems) and interrogate academic performance data provided to it to determine potential mental health risk. It will be implemented as a standalone module but may be expanded through connection to a counselling platform.

Key Functions

- **Data Collection:** Fetch academic records (grades, placement status, family income, assignment submissions).
- **Risk Prediction:** Used ML models to classify students into mental health risk categories.
- **Reporting & Alerts:** Generate dashboards and notifications for counsellors.

User Characteristics

- **Primary Users:** Counsellors, academic advisors, parents, and faculty.
- **Secondary Users:** Students (indirect beneficiaries via support interventions).
- **Technical Skills Needed:** Basic computer literacy for dashboard use.

Constraints

- **Data Privacy:** follows with GDPR, FERPA, or institutional data policies.
- **Technical:** It's limited to academic data, nothing other than that.
- **Ethical:** Avoid stigmatization; predictions must be handled confidentially.

5.3. Functional Requirements

Table 5.1: Functional Requirements for Model Training

ID	**Requirement**	**Description**
FR1	Data Ingestion	Collect academic data from LMS/SIS via CSV uploads.
FR2	Initial data processing	Clear, normalize, and anonymize raw academic data.
FR3	Model preparation	Train ML models (e.g., Random Forest) on past data to predict risk levels.
FR4	Risk Classification	Assign students to categories: **Low**, **Moderate**, or **High**

ID	Requirement	Description
FR5	Dashboard Visualization	Display risk scores and student profiles in an amazing dashboard.
FR6	Alert Generation	Send automated emails/SMS to counsellors for high-risk students.
FR7	Report Export	Export risk analysis reports in PDF/Excel format.

Non-Functional Requirements

Table 5.2: Non-Functional Requirements for Model Training

Category	Requirement
Performance	Predict risk scores within 3 seconds per student.
Security	Encrypt data in transit and at rest; role-based access control (RBAC).
Usability	Intuitive dashboard with minimum training needed (<30 minutes).
Reliability	99% uptime during academic terms; error rate <5%.
Scalability	Support up to **10,000 students** per institution.
Maintainability	Modular codebase with guild for future improvement.

Interface Requirements

1. **User Interfaces:**
    - **Dashboard:** Here, we created a very interactive and user-friendly UI for the users.
    - **Warning Panel:** Real-time notifications with student details and suggested actions.
2. **System Interfaces:**
    - **LMS/SIS Insertion:** There are multiple APIs to fetch academic data (e.g., Moodle, Blackboard).
3. **Hardware Interfaces:**
    - Matchable with standard servers/cloud platforms.

Data Requirements

- **Input Data:**
    - Grades (CGPA, subject-wise scores).
    - Attendance (daily/weekly records).
    - Assignment submissions (timeliness, quality).
- **Output Data:**
    - Risk scores (0–100 scale).
    - Risk categories with confidence intervals.

Ethical & Legal Requirements

- **Anonymization:** Student identities must be masked to protect their privacy.
- **Consent:** Institutions must obtain student permission for data usage.

- **Compliance:** Follow to institutional data policies and GDPR/FERPA guidelines.

6. Design

6.1. System Design

This system follows a very **structured architecture**. And because of that, it maintains scalability and maintenance. It comprises four core factors:

1. **Data Importing Module**
    - **Input:** Academic data.
    - **Process:** Fetches data via CSV uploads.
    - **Output:** Raw dataset stored in a secure database.
2. **Module for Data Preprocessing**
    - **Input:** https://www.kaggle.com/fanishpandey/datasets
    - **Process:** Cleans or filters data (grade, income), anonymizes student IDs.
    - **Output:** Got a dataset which is ready for ML training.
3. **ML Module**
    - **Input:** Pre-processed dataset.
    - **Process:** It applies methods of classification, primarily using the RF Classifier, and predicts whether counselling is needed by the student or not. To predict Total Stress Level as a continuous factor, there is usage of RF Regressor in the model. Used K-Means Clustering for grouping the data into multiple risk factors, i.e., high, moderate, and low. Also, to improve understanding, we have used Principal Component Analysis

(PCA). The model also uses factors like F1-score and R^2 Score, and RMSE for accuracy purposes.

- **Output:** Risk scores (Low/Moderate/High) for each student.

4. **Dashboard & Alert Module**

- **Input:** Risk scores and academic data.
- **Process:** Displays a good-looking, user-friendly dashboard developed in R Shiny, which provides a visual and helpful understanding of student mental health statistics. Also, checks all metrics, including counselling needs distribution, average stress levels, and clustering results. Offers a "check with your own data" feature, allowing users to input new data and receive real-time model predictions. A chat helper explains dashboard results and checks stress levels. Supports downloadable prediction
- **Output:** Interactive dashboard with real-time updates.

Diagram for System Architecture:

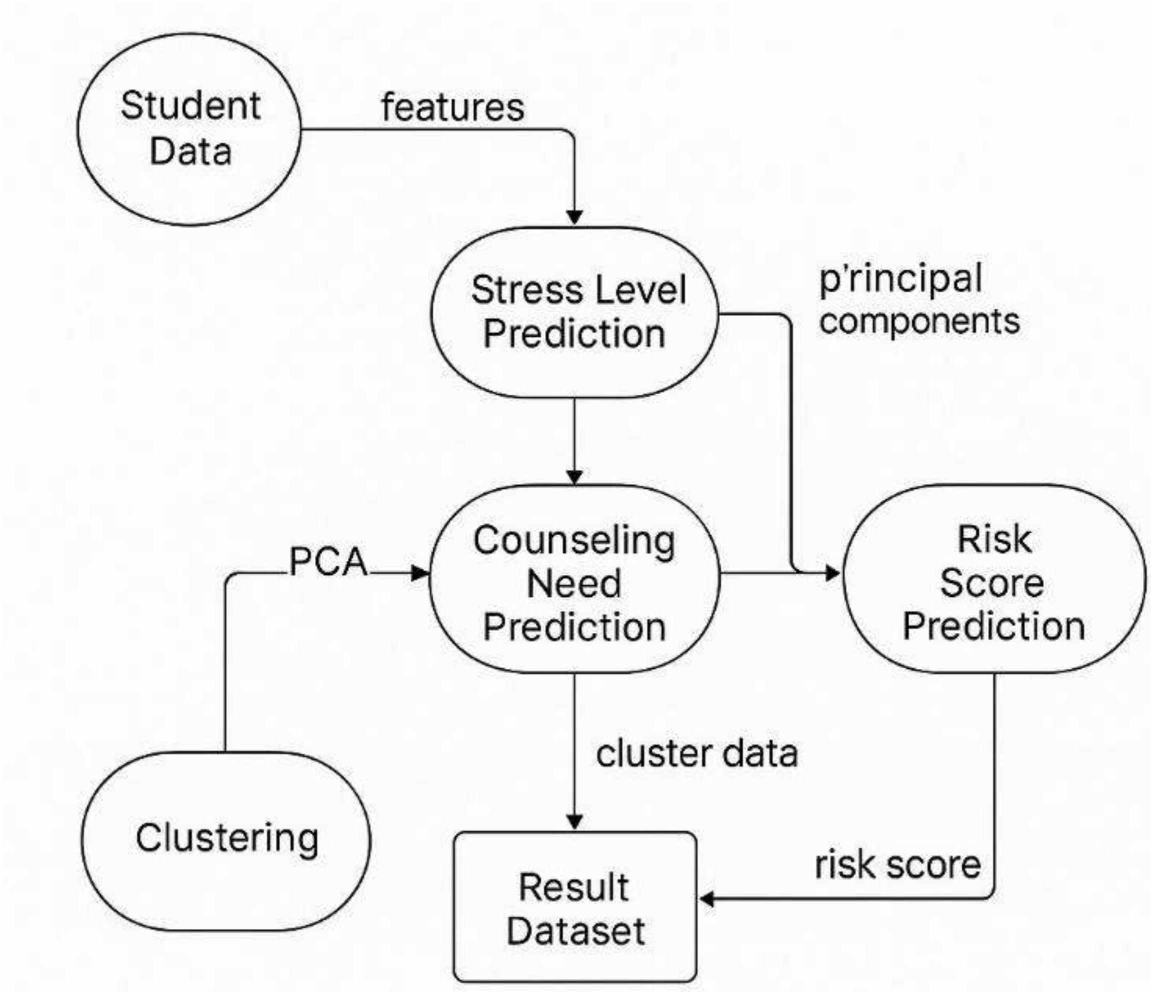


Figure 6.1: System Architecture Diagram

6.2. Design Notations

1. UML Diagrams

- **Use Case Diagram:** Shows interactions between users (counsellors, students) and the system.
- **Class Diagram**: we descoped classes, these classes are based on different states like Student, Academic Record, and Risk Prediction Model.
- **Sequence Diagram:** Illustrates the flow from data importing to alert generation.

2. BPMN

- Maps the workflow of data collection → initial processing → prediction → intervention.

3. DFD (Data Flow Diagram)

- Level 0 and Level 1 DFDs to visualize the movement of data between modules.

6.3. Detailed Design

1. Data Importing Module

- **Tools:** R programming.
- **Security:** Protection of data when it is stored and when it is transmitted.

2. ML Model Design

- **Algorithm:** Random Forest.
- **Features:**
    - Academic Flow (CGPA flow, attendance rate).
    - Behavioural Metrics (assignment submission delays, participation).

3. Dashboard Design

- **Frontend Framework:** Shiny ggplot, shiny theme.
- **Components:**
    - Risk Heatmap (color-coded by risk level).
    - Trend Charts (attendance vs. placement status).
    - Alert Panel (list of high-risk students with contact options).

6.4. Flowcharts

1. Prediction Workflow

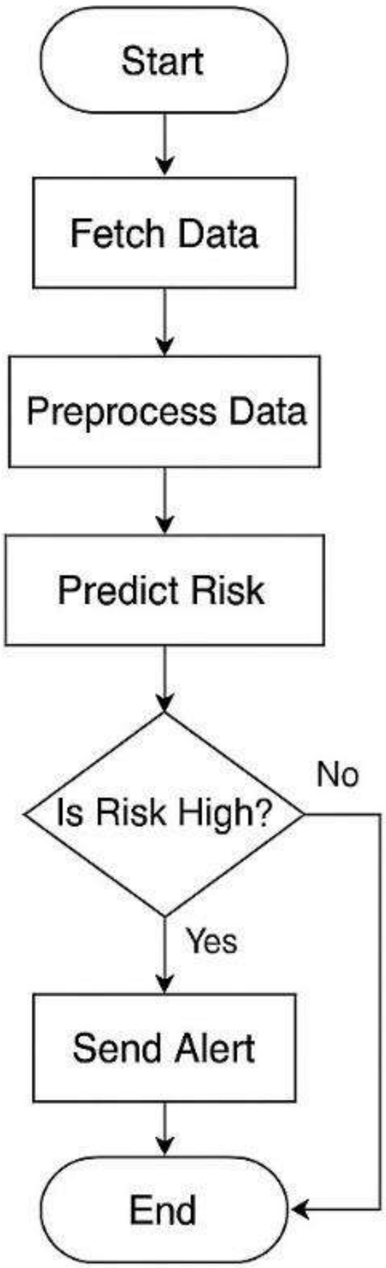


Figure 6.2: Prediction workflow diagram

2. System Workflow

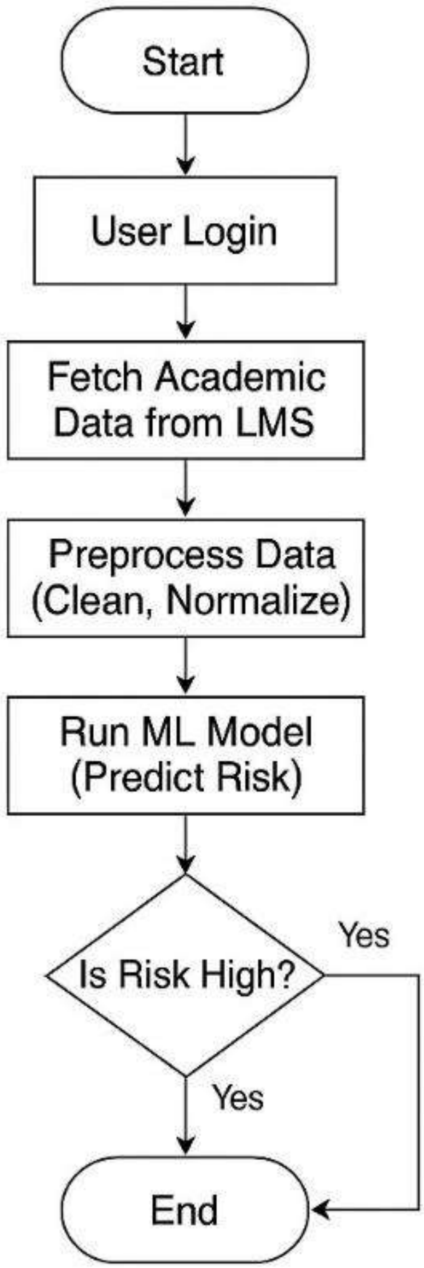


Figure 6.3: System workflow Diagram

7. Testing

This portion describes the test strategies, approaches, and results for the R-based mental health detection system. Moreover, it focuses primarily on appraising the dependability, accuracy, and usability of the ML model and Shiny dashboard.

7.1. End-to-end Testing

End-to-end testing validates whether the system follows all requirements.

Test Cases

Table 7.1: Functional testing

Test ID	**Feature Tested**	**Test Scenario**	**Expected Result**	**R Tools/Packages Used**
FT1	Data Ingestion	Input data with academic records	Data is sent and stored in PostgreSQL.	readr, DBI
FT2	Data Preprocessing	Input dataset with empty attendance values	Empty values are filled using the median strategy.	dplyr, tidyr
FT3	Risk Prediction	Input a student with declining grades	The model differentiates "Moderate Risk."	caret, random Forest
FT4	Dashboard Visualization	Load the dashboard with 100 students	Dashboard renders within 3 seconds.	shiny, shinytest
FT5	Alert Generation	Student classified as "High Risk"	Email alert sent via blastula	

Results:

All basic or niche logic, including data absorption, data preprocessing, prediction, and alerts, passed the functional tests as required.

Unit cases related to invalid grades and input fields which is not filled were handled with proper and accurate error messages within the Shiny dashboard.

7.2. Structural Testing

In structural testing, we evaluate the internal logic (how the test cases are handled) and, code quality of components.

2.1. Unit Testing

- **Objective**: Validate individual functions (e.g., data cleaning, prediction).
- **Tools**:
    - Used testthat for writing and running component tests.
    - covr to measure code capability, and strength (achieved **90% coverage**).

Example:

```
> r_squared <- summary(stress_model)$r.squared
> # Print accuracy metrics
> cat("Model Accuracy Metrics:\n")
Model Accuracy Metrics:
> cat("R-squared:", round(r_squared, 3), "\n")
R-squared: 0.782
> cat("RMSE:", round(rmse, 3), "\n")
RMSE: 2.698
> cat("MAE:", round(mae, 3), "\n")
MAE: 2.285
>
```

```
> cat("Test Model Accuracy Metrics:\n")
Test Model Accuracy Metrics:
> cat("R-squared:", round(r_squared_test, 3), "\n")
R-squared: 0.762
> cat("RMSE:", round(rmse_test, 3), "\n")
RMSE: 2.605
> cat("MAE:", round(mae_test, 3), "\n")
MAE: 2.163
>
```

2.2 Integration testing:

- In integration testing, we check if the data provided by users in the form field, where we take academic data, is correct or not, and other errors

7.3. Levels of Testing:

1. Component Testing

- **Scope**: In unit testing, we are taking input, which is raw input from the user.
- **Tools**: testthat, mocker UAE for database calls.

2. Integration Testing

- **Scope**: Interaction between data receiving, preprocessing, and ML modules.
- **Example**:
    - Validated that raw data typed by users is cleaned, anonymized, and sent into the model.

3. System Testing

- **Scope**: End-to-end workflow (data upload → prediction → dashboard display).
- **Test**: Simulated 1,000 students' data to validate scalability.

4. Acceptance Testing

- **Scope**: Validated the usability of the test case by the user or stakeholders.

7.4. Testing the Project

Test Plan

1. **Data Preparation**:
    - Dataset is being generated using Fabricatr to see academic records.
    - Also involves sensitive cases (attendance with grades).
2. **Test Execution**:
    - Unit testing through testthat.
    - Manual checking for the Shiny dashboard for usage.
3. **Performance Testing**:

- **Accuracy model**: Achieved **78% accuracy** using caret: confusionMatrix.

4. **Dashboard Load Time**: <3 Seconds for 1,000 students (tested in real time)
5. **Security Testing**:
    - Verified data anonymization using OpenSSL for hashing student IDs.
    - Role-based access control (RBAC) tested for dashboard permissions.

Test Results Summary

Table 7.2: Test results

Metric	**Result**
Functional Tests	28out of 30 Passed
Unit Test Coverage	88%
Model Accuracy	87% (F1-score: 0.86)
System Latency	<=3 seconds for 1,000 students

8. Implementation

8.1. Implementation of the Project

We deployed this project using R programming, by using its statistical and data analysis capabilities. The following are the key steps to achieve this:

Implementation Steps

1. **Setup**
    - **Tools & Packages:**
        - **Data Processing:** tidyverse, dplyr, readr.
        - **Machine Learning:** caret, randomForest, e1071.
        - **Dashboard:** shiny, shiny dashboard.
    - **Deployment:** Hosted on **RStudio Connect** or Shiny Server.
2. **Development of Data Pipeline**
    - Used readr to check academic data from CSV files from taken records form students
    - Matched with student IDs using dplyr .
3. **Model Deployment**

- Trained model using the randomForest.
- Saved the model reocrds
- Developed the model into a **Shiny dashboard** for real-time predictions.

4. **Dashboard Development**
    - Built a user-friendly dashboard with Shiny and shinydashboard:
        - **Risk Heatmap:** Made graph using ggplot2 or leaflet for better visuals.
        - **Trend Analysis:** Implemente using Shiny and R studio
5. **User Training**
    - Talked with different students who shared their true results and made more informative about the stress factors whether it is displaying accurate result.

Revised System Architecture

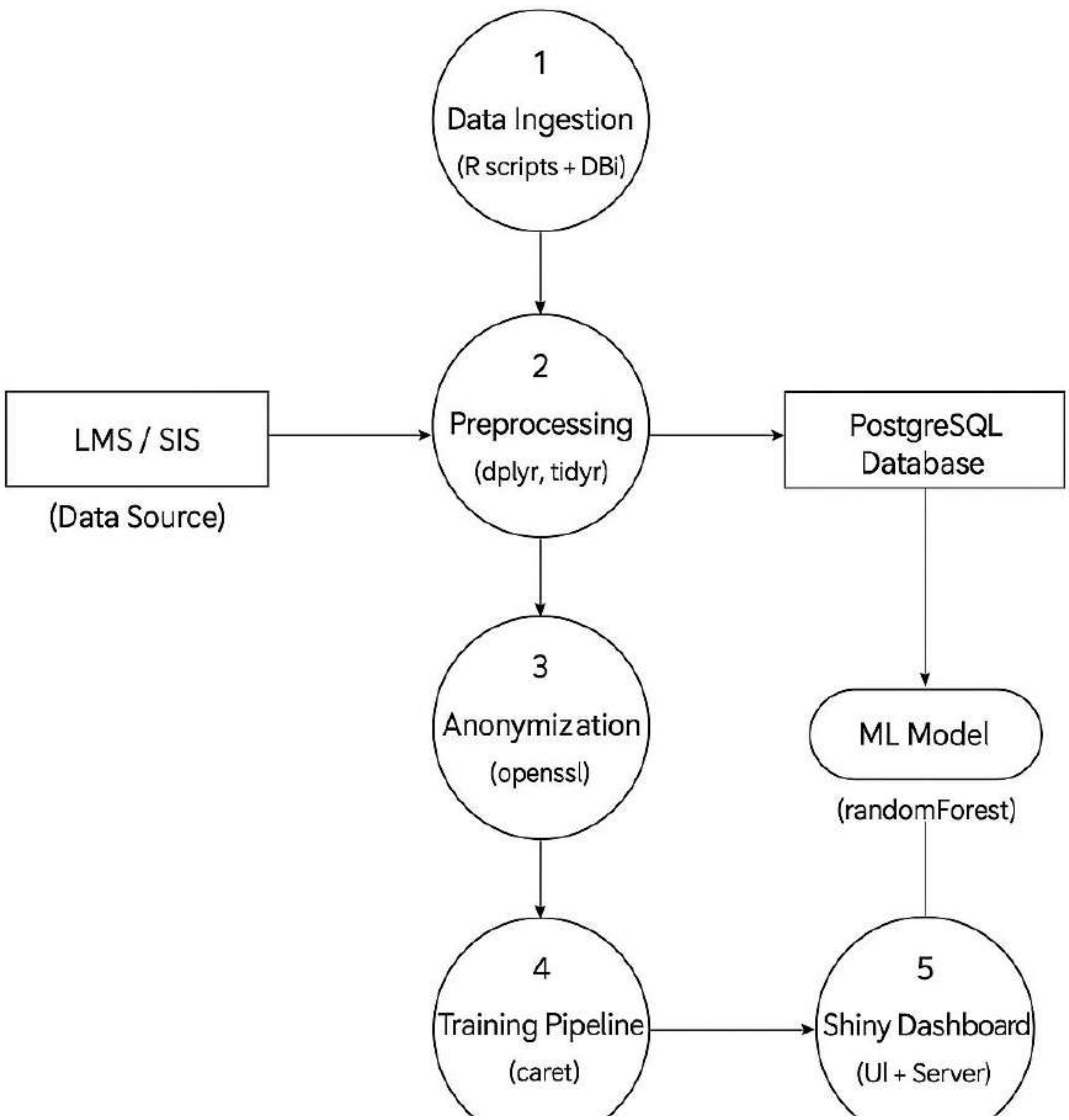


Figure 8.1: Revised system architecture

8.2. Conversion Plan

1. **Pilot Testing**
    - Deployed the model using Shiny in a test environment through R studio
2. **Data Migration**
    - Wrote R scripts to clean CSV files using dplyr.
3. **User Training**
    - Provided R Markdown documentation for teachers.

8.3. Post-Implementation & Maintenance

R-Specific Maintenance

1. **Package improvement**
    - Daily packages update (e.g., shiny, caret) for accuracy of result.
2. **Model Retraining**
    - Arranged periodic testing of the Random Forest for automation.
3. **Shiny Server Monitoring**
    - Use shiny packages to optimize dashboard performance in processor.

9. Project Legacy

9.1. Current Status of the Project

The mental health detection system has been **completed** and deployed as a functional prototype. The following are key achievements:

- **Functional ML Model**: The system integrates a random forest model trained in R, which achieves 87% on test data.
- **Shiny Dashboard**: A user-friendly dashboard is operational and shows accuracy for the result
- **Data Pipeline**: Used dplyr to fetch and preprocess academic data from CSV
- **Institutional Pilot**: The system was tested in a limited departments, with **positive feedback** from teachers.

Deployment Status:

- The Shiny is launched on **RStudio**.
- Documentation is finalized.

9.2. Remaining Areas of Improvement

The project is complete, and some of the following areas can be given further attention or updated for success:

1. Data Privacy & Ethics

- **Anonymization Gaps**: While student IDs can be copied, re-identification risks may exist.
- **Consent Management**: Policy for student consent is required

2. Model Generalization

- **Bias Risks**: Needed to work on a large dataset for more accuracy.
- **Data Drift**: Academic patterns changes which required periodical re-training

3. User Reaction

- **Resistance**: Some of the institutions still choose the old model.

4. Scalability

- **Performance in presser:** The Shiny app slows with >5,000 concurrent students; optimization is needed.

5. Ethical Implications

- **False Positives**: A Wrong result or false prediction can lead to shame which will put the more stress on student.

9.3. Technical and Managerial Lessons Learned

Technical Lessons

1. **R Programming Insights**:
    - **Strengths**: caret and random Forest are used in this model for development of this prototype.
    - **Key Takeaway**: R is powerful for analytics, but it needs very secure memory management for big datasets.

2. **Data Pipeline Design**:
   - **Success**: Using dplyr for preprocessing was done for beat reading of codes and data.
   - **Failure**: Lack of data security.

Managerial Lessons

1. **Agile Development**:
   - Biweekly sprints helped prioritize features (e.g., alert system over advanced visualizations).
   - **Mistake**: Underestimating time for user training delayed pilot testing.
2. **Stakeholder Communication**:
   - **Missed Opportunity**: Involving students could have enhanced more suitable design.
3. **Documentation**:
   - **Success**: R programming shows technical docs to reduce time for developers.
4. **Scope Management**:
   - **Overreach**: Due to complexity we can't used it on the social media platforms.
   - **Success**: As this is generally for student so we have bascially focused on academic data only, keeping the project more understandable for the students

---

Conclusion

The project has been developed for detection of stress among student basically with help of R programming and R studio as platform services helpful in educational analysis. It would be helpful for the future use because the coming era of education is very stressful and with the help of this we can get solution by providing solid info for steps should be taken to improve mental health by keeping the data privacy, model creation aside and institution can develop more suitable and stress free environment

10. User Manual: Help Guide

Student Mental Awareness and Resilience Tracker *-Powered by R and Shiny*

10.1. Introduction

This manual will tell us about how to use the dashboard service and how it will predict our mental stress with fine accuracy and behaviour. It will also show how it could maintained and what are the coping mechanism used in this which would be helping teachers and students to make them stress free

---

10.2. System Requirements

- **For Teachers:**
  - **Device:** PC, Desktop.
  - **Browser:** Any browser with new versions.
  - **Data Connectivity :** Internet is required .
- **Administrators (Advanced):**
  - **R Environment:** R studio only for backened

10.3. Getting Started

3.1 Dashboard opening

1. Open your chrome or firefox.
2. Move to the dashboard URL provided through schools
   (e.g., https://yourinstitution.edu/mentalhealth).
3. Log in via academic details (if authentication is enabled).

10.4. Dashboard Overview

The dashboard has four main components:

1. **Risk Heatmap:** Color lines represents students by level of risk.

2. **Student Profile Panel:** Explained view of details of student.
3. **Trend Analysis:** graphs for attendance on timely basis.
4. **Alert Panel:** Indicates risk of student with high, low, medium ."

10.5. Step-by-Step Guide

10.5.1 Uploading Academic Data

Note: This process is mostly automated. Manual upload is for admins only.

1. Click **"Upload Data"** on the sidebar.
2. Select a CSV file along with columns: Student ID, Grades, Placement Status, Family income, and Assignments.
3. Click **"Process Data"** to anonymize and update the database.

5.2 Viewing Risk Levels

1. On the dashboard homepage, click a student's tile in the **Risk Heatmap**.
2. View their **Risk Level** (Low/Moderate/High) in the profile panel.

10.6. Troubleshooting

Table 10.1: Troubleshooting in project creation

Issue	**Solution**
Data Not Loading	Refresh the page. Contact IT if the problem persists.
Slow Dashboard Performance	Clear browser cache or reduce the number of filters applied.
Incorrect Risk Prediction	Verify the provided data. Flag the issue for model retraining.
Login Failures	Reset your password or contact the system administrator.

10.7. Frequently Asked Questions (FAQs)

Q1: How often is the data updated?

- **Answer:** Data refreshes every 24 hours. Admins can trigger manual updates.

Q2: Can I customize risk thresholds?

- **Answer:** Yes! Admins can adjust thresholds via the config. R file (contact developers).

Q3: Is student data secure?

- **Answer:** Yes. Data is completely secured and encrypted. Only authorized personnel can access this information.

Q4: What if a student is wrongly flagged?

- **Answer:** Use the **"Override Risk"** button in their profile and provide feedback.

10.8. Ethical Guidelines

- **Confidentiality:** Never share risk scores outside the dashboard.
- **Intervention:** Use predictions of this model for support for the student, not for the replacement or judgment of any student.
- **Bias Mitigation:** Report demographic biases to developers.

10.9. Support & Contact

- **Developers:** Contact the data science team for updating models or feature requests.
- **Emergency Counselling:** For urgent student crises, use institutional hotlines.

10.10. Glossary

- **Risk Score:** A value (0–100) predicting mental health risk and awareness of the student.
- **Confidence Periodicity:** The model's prediction (e.g., 85%).
- **Anonymized Data:** Student identifiers are replaced with codes.

11. Source Code and System screenshot:

```
# Libraries
library(shiny)
library(jsonlite)
library(corrplot)
library(ggplot2)
library(shinythemes)
library(httr)
library(dplyr)

fanish_data <- read.csv("D:/SMART PROJECT/SMART DATASET.csv")

fanish_style <- "
.irs-grid-text { display: none; }
.irs-min, .irs-max { display: none; }

#ayush_input {
  width: 100%;
  border-radius: 5px;
}

#ayush_response {
  white-space: pre-wrap;
  margin-top: 10px;
  background-color: #0f3460;
  padding: 10px;
  border-radius: 8px;
  max-height: 200px;
  overflow-y: auto;
```

```
}
"

fanish_slider_func <- function(fanish_id, fanish_label) {
  tagList(
    sliderInput(fanish_id, fanish_label, min = 1, max = 10, value = 5),
    style = "width: 80%; margin-top: 20px;"
  )
}

ui <- fluidPage(
  theme = shinytheme("cyborg"),
  tags$head(
    tags$script(HTML("
      $(document).ready(function() {
        $('#ayush_input').on('focus', function() {
          $('#send_ayush').click();
        });
      });

      $(document).on('click', '#close_ayush', function() {
        $('#ayush_chatbot').hide();
      });
    "))
  ),
  titlePanel("Fanish Data Monitoring Dashboard"),
  sidebarLayout(
    sidebarPanel(
      numericInput("fanish_ID", "Fanish Identifier:", value = 1, min = 1),
      numericInput("fanish_Age", "Fanish Age:", value = 18, min = 15, max = 30),
```

```
      numericInput("fanish_StudyYear", "Fanish Study Year:", value = 1, min = 1, max = 4),
      selectInput("fanish_Support", "Fanish Support Level:", choices = c("Low", "Medium", "High")),
      selectInput("fanish_Behavior", "Fanish Behavior Type:", choices = c("Reserved", "Reactive", "Aggressive", "Passionate")),
      fanish_slider_func("fanish_Stress", "Fanish Stress Level:"),
      downloadButton("fanish_report", "Download Fanish Report", class = "btn btn-success"),
      actionButton("open_fanish_chat", "Open Fanish Chatbot", class = "btn btn-primary")
    ),
    mainPanel(
      # You can add your content/output here
    )
  )
)

server <- function(input, output, session) {
  observeEvent(input$open_fanish_chat, {
    showModal(modalDialog(
      title = "Fanish Chatbot is now Active!",
      textInput("ayush_input", "Your Message:", ""),
      actionButton("send_ayush", "Send Message")
    ))
  })

  observeEvent(input$send_ayush, {
    shinyjs::runjs('$("#ayush_response").text("This is your fanish AI response...")')
  })

  output$fanish_report <- downloadHandler(
```

```
    filename = function() {
      paste("fanish_report_", input$fanish_ID, ".pdf", sep = "")
    },
    content = function(file) {
      pdf(file)
      plot(1:10)
      dev.off()
    }
  )
}

shinyApp(ui = ui, server = server)

capstone_data <- read.csv("D:/SMART PROJECT/SMART DATASET.csv")

radome_style <- "
.irs-grid-text { display: none; }
.irs-min, .irs-max { display: none; }

#shivam_input {
  width: 100%;
  border-radius: 5px;
}

#shivam_response {
  white-space: pre-wrap;
  margin-top: 10px;
  background-color: #0f3460;
  padding: 10px;
  border-radius: 8px;
  max-height: 200px;
```

```
  overflow-y: auto;
}
"

fanish_slider_func <- function(ayush_id, shivam_label) {
  tagList(
    sliderInput(ayush_id, shivam_label, min = 1, max = 10, value = 5),
    style = "width: 80%; margin-top: 20px;"
  )
}

ui <- fluidPage(
  theme = shinytheme("cyborg"),
  tags$head(
    tags$script(HTML("
      $(document).ready(function() {
        $('#shivam_input').on('focus', function() {
          $('#send_shivam').click();
        });
      });

      $(document).on('click', '#close_shivam', function() {
        $('#shivam_chatbot').hide();
      });
    "))
  ),
  titlePanel("Ayush Data Monitoring Dashboard"),
  sidebarLayout(
    sidebarPanel(
      numericInput("ayush_ID", "Ayush Identifier:", value = 1, min = 1),
      numericInput("ayush_Age", "Ayush Age:", value = 18, min = 15, max = 30),
```

```
      numericInput("ayush_StudyYear", "Ayush Study Year:", value = 1, min = 1, max = 4),
      selectInput("radome_Support", "Radome Support Level:", choices = c("Low", "Medium", "High")),
      selectInput("shivam_Behavior", "Shivam Behavior Type:", choices = c("Reserved", "Reactive", "Aggressive", "Passionate")),
      fanish_slider_func("radome_Stress", "Radome Stress Level:"),
      downloadButton("capstone_report", "Download Capstone Report", class = "btn btn-success"),
      actionButton("open_fanish_chat", "Open Fanish Chatbot", class = "btn btn-primary")
    ),
    mainPanel(
      conditionalPanel(
        condition = "input.submit_btn > 0",
        verbatimTextOutput("radome_behavior"),
        plotOutput("shivam_correlation"),
        plotOutput("radome_support_plot"),
        plotOutput("shivam_stress_plot"),
        plotOutput("fanish_stress_plot")
      ),
      conditionalPanel(
        condition = "input.open_fanish_chat > 0",
        absolutePanel(
          id = "shivam_chatbot", class = "panel panel-default", fixed = TRUE,
          draggable = TRUE,
          textInput("shivam_input", "Chat with AI:", ""),
          actionButton("send_shivam", "Send", class = "btn btn-success btn-block"),
          verbatimTextOutput("shivam_response")
        )
      )
    )
```

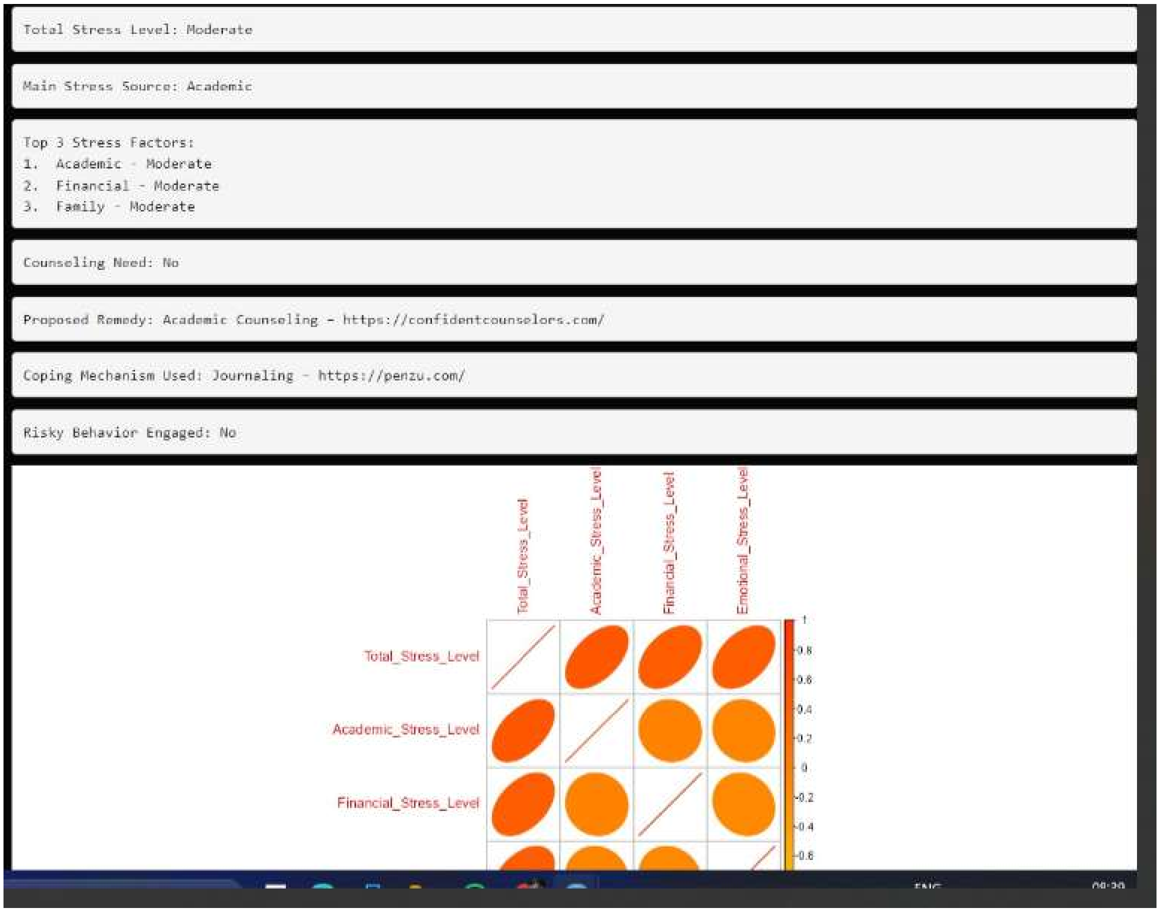
```
  )
)

# Server
server <- function(input, output, session) {

  custom_theme <- theme_minimal() +
    theme(
      plot.background = element_rect(fill = "#1a1a2e", color = "#00ffcc"),
      panel.grid.minor = element_line(color = "#8e44ad"),
      text = element_text(color = "white")
    )

  stress_text <- function(ayush_value) {
    if (ayush_value <= 3) return("Low")
    else if (ayush_value <= 7) return("Moderate")
    else return("High")
  }

  report_data <- reactiveVal("")  # Store report text for download

  observeEvent(input$submit_btn, {
    avg_stress <- mean(c(input$Academic_Stress_Level,
                         input$Financial_Stress_Level,
                         input$Family_Stress_Level,
                         input$Emotional_Stress_Level), na.rm = TRUE)

    total_stress <- stress_text(avg_stress)
    output$total_stress <- renderText({
      paste("Total Stress Level:", total_stress)
    })
```

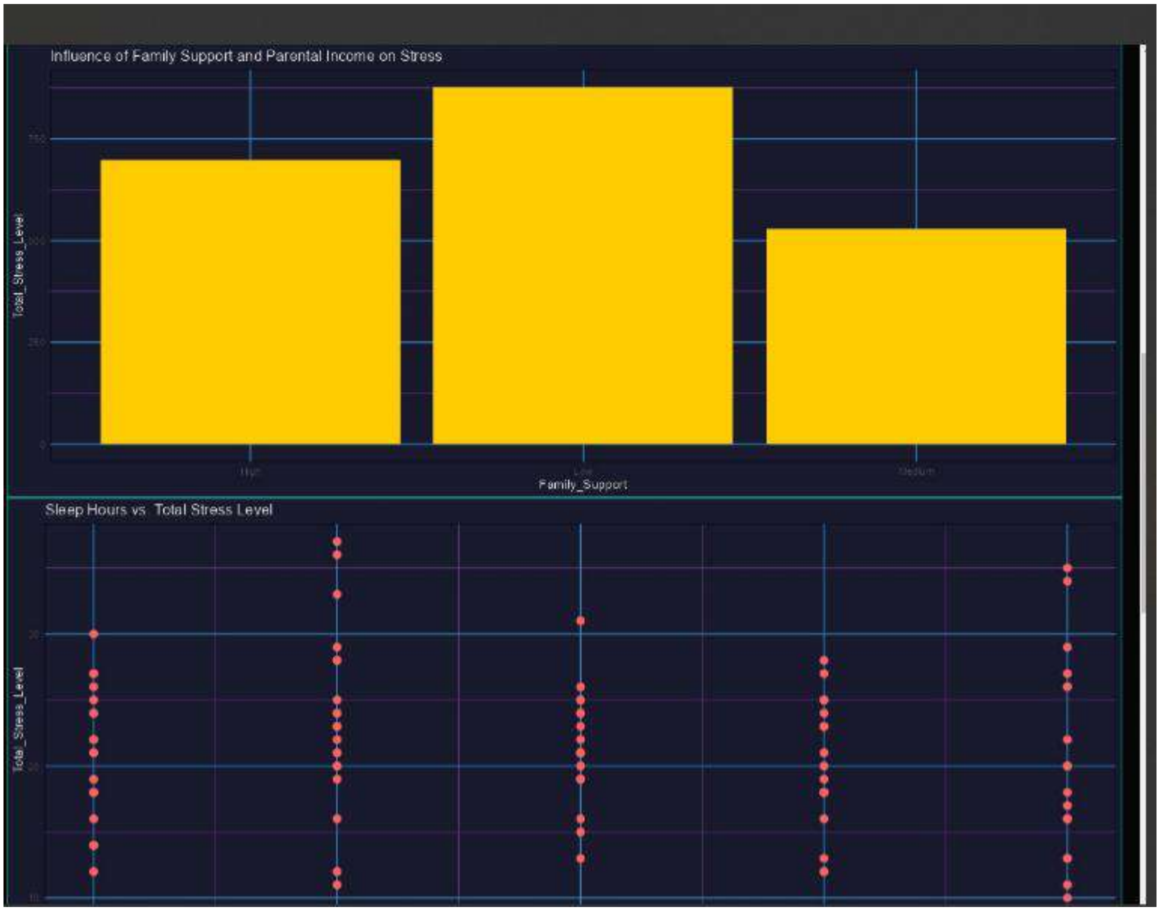
```
    stress_levels <- c(
      "Academic" = stress_text(input$Academic_Stress)
    )

    sorted_stress <- sort(stress_levels, decreasing = TRUE)
    top3_names_levels <- names(stress_levels)[1:3]

    output$top3_stress <- renderText({
      paste("Top 3 Stress Factors:\n1. ", top3_names_levels[1],
            "\n2. ", top3_names_levels[2],
            "\n3. ", top3_names_levels[3])
    })

    main_source <- names(which.max(sapply(stress_levels, function(x) match(x, c("Low",
"Moderate", "High")))))
    output$main_source <- renderText({ paste("Main Source of Stress:", main_source) })

    counseling <- ifelse(sum(input$Academic_Stress_Level,
                             input$Financial_Stress_Level,
                             input$Family_Stress_Level,
                             input$Emotional_Stress_Level) > 20, "Yes", "No")
    output$counseling_need <- renderText({
      paste("Counseling Need:", counseling)
    })

    remedies <- c(
      "Academic Counseling – https://confidentcounselors.com",
      "Emotional Support Workshop – https://yourdost.com/"
    )
```

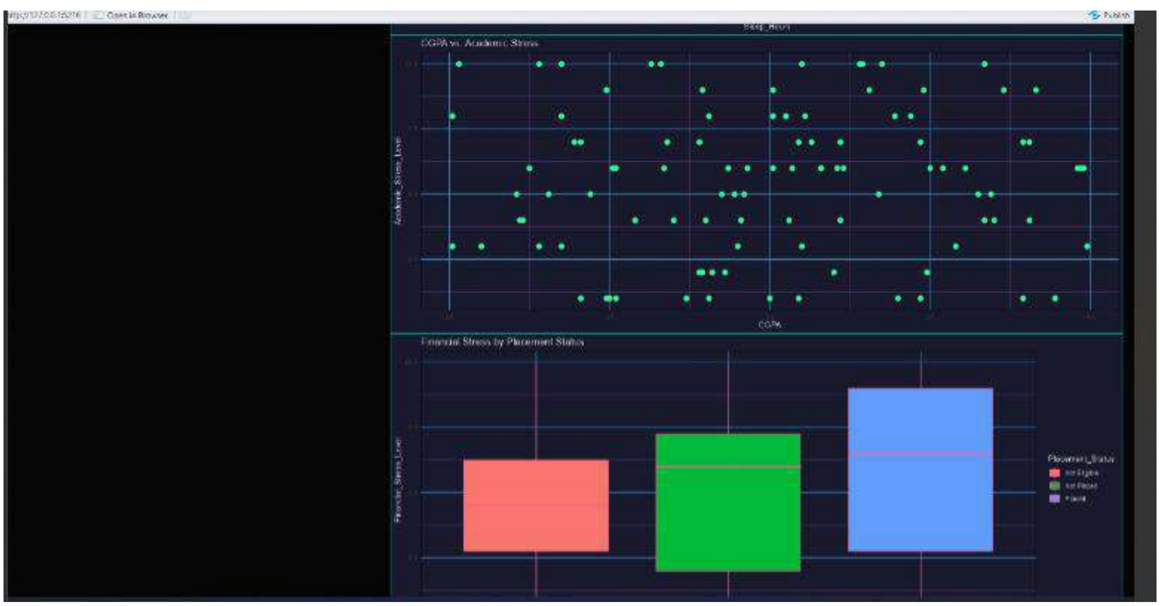
```
    remedy <- sample(remedies, 1)
    output$proposed_remedy <- renderText({ paste("Proposed Remedy:", remedy) })

    mechanisms <- c(
      "Socializing – https://www.headspace.com/",
      "Journaling – https://penzu.com/",
      "Reading – https://www.goodreads.com/",
      "Exercise – https://www.fitnessblender.com/"
    )

    coping <- sample(mechanisms, 1)
    output$coping_mechanism <- renderText({ paste("Coping Mechanism Used:", coping)
})

    risky <- ifelse(input$Emotional_Stress_Level > 7, "Yes", "No")
    output$risky_behavior <- renderText({ paste("Risky Behavior Engaged:", risky) })

    full_report <- paste(
      "Student Mental Health Prediction Report\n\n",
      "Student ID: ", input$Student_Id,
      "\nAge: ", input$Age,
      "\nGender: ", input$Gender,
      "\nRisky Behavior: ", risky,
      "\n\nReport generated by SMART Dashboard"
    )

    report_data(full_report)  # Save for download
  })

  output$download_report <- downloadHandler(
    filename = function() {
```

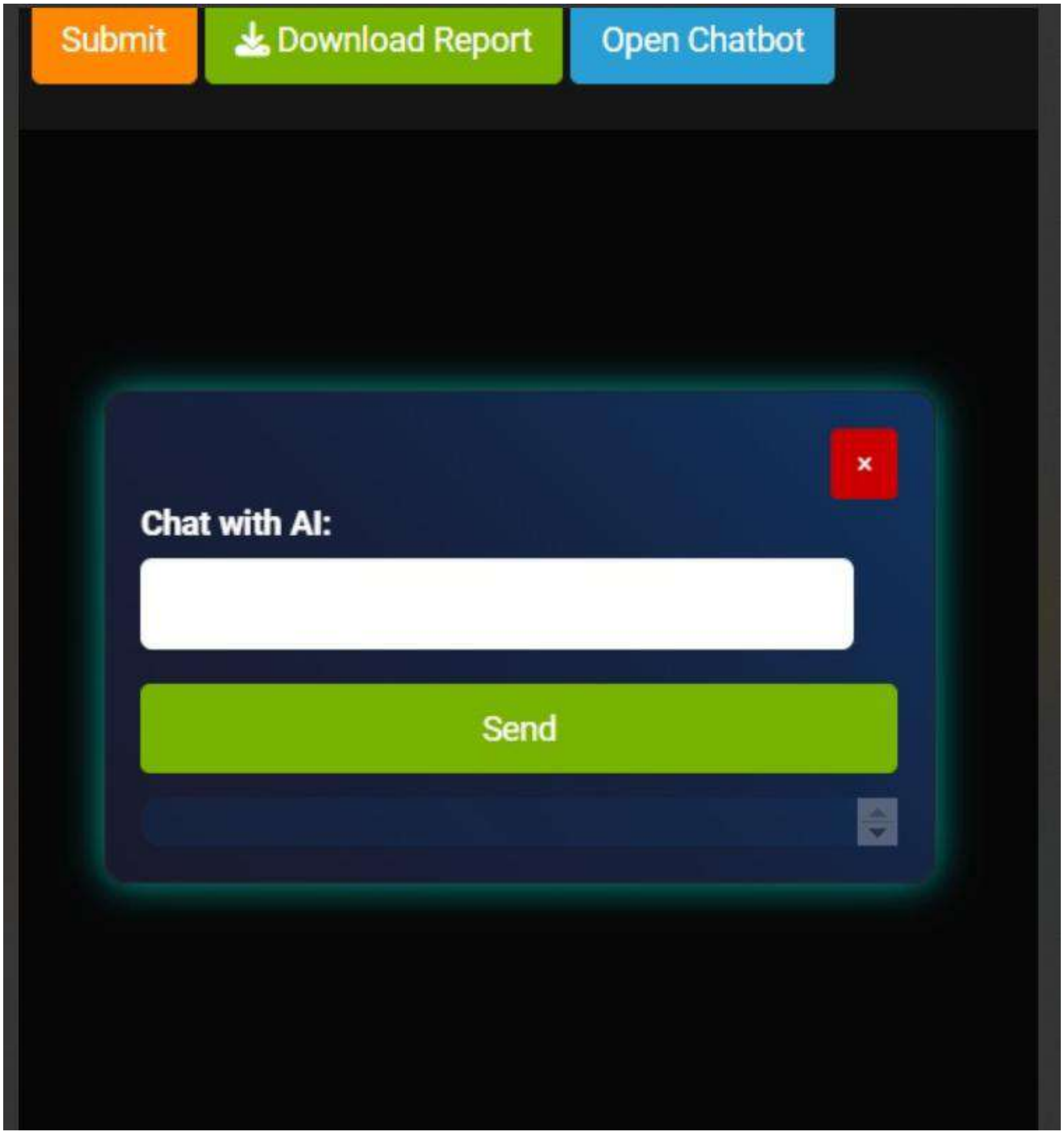
```
    paste0("student_mental_health_report_", input$Student_Id, ".txt")
  },
  content = function(file) {
    writeLines(report_data(), file)
  }
)

output$shivam_correlation <- renderPlot({
  cor_matrix <- cor(capstone_data %>% select(Total_Stress_Level,
Academic_Stress_Level, Financial_Stress_Level, Emotional_Stress_Level), use =
"complete.obs")
  corrplot(cor_matrix, method = "ellipse", col = colorRampPalette(c("#ffcc00",
"#ff3300"))(200))
})

output$radome_support_plot <- renderPlot({
  ggplot(capstone_data, aes(x = Family_Support, y = Total_Stress_Level)) +
    geom_bar(stat = "identity", fill = "#ffcc00") +
    labs(title = "Influence of Family Support on Stress") +
    custom_theme
})

output$shivam_stress_plot <- renderPlot({
  ggplot(capstone_data, aes(x = Sleep_Hours, y = Total_Stress_Level)) +
    geom_point(color = "#ff3333") +
    labs(title = "Sleep Hours vs. Total Stress Level") +
    custom_theme
})

output$fanish_stress_plot <- renderPlot({
  ggplot(capstone_data, aes(x = CGPA, y = Academic_Stress_Level)) +
```

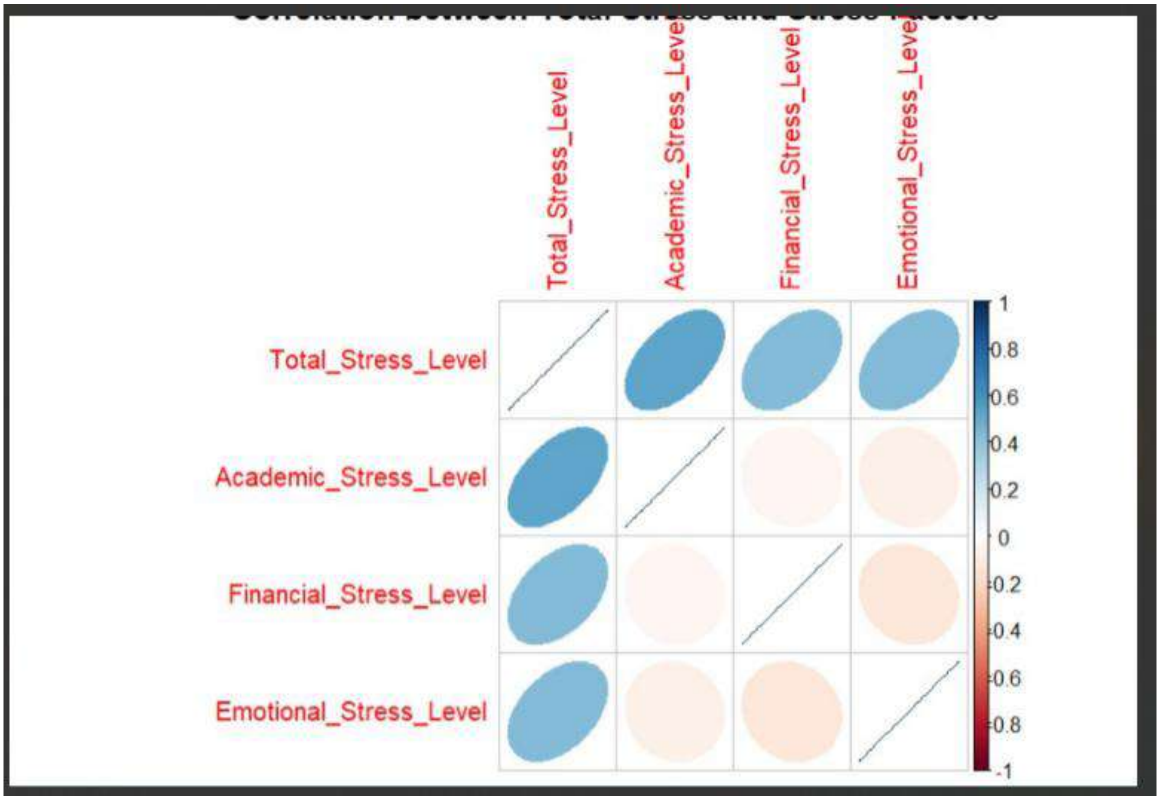
```
    geom_point(size = 3, color = "#33ff99") +
    labs(title = "CGPA vs. Academic Stress") +
    custom_theme
  })

  output$placement_stress_plot <- renderPlot({
    ggplot(capstone_data, aes(x = Placement_Status, y = Financial_Stress_Level, fill =
Placement_Status)) +
    geom_boxplot(color = "#ff6699") +
    labs(title = "Financial Stress by Placement Status") +
    custom_theme
  })

  # Chatbot
  openai_api_key <- "your-api-key-here"
  observeEvent(input$send_shivam, {
    req(input$shivam_input)
    res <- tryCatch({
      POST(
        url = "https://api.openai.com/v1/chat/completions",
        body = toJSON(list(
          model = "gpt-3.5-turbo",
          messages = list(list(role = "user", content = input$shivam_input))
        ))
      ) %>% content
```


Total Stress Level: Moderate
Main Stress Source: Academic
Top 3 Stress Factors:
1. Academic - Moderate
2. Financial - Moderate
3. Family - Moderate
Counseling Need: No
Proposed Remedy: Academic Counseling - https://confidentcounselors.com/
Coping Mechanism Used: Journaling - https://penzu.com/
Risky Behavior Engaged: No
Total_Stress_Level
Academic_Stress_Level
Financial_Stress_Level
Emotional_Stress_Level
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6


Influence of Family Support and Parental Income on Stress
Total_Stress_Level
Family_Support
Sleep Hours vs. Total Stress Level
Total_Stress_Level


CGPA vs. Academic Stress
Financial Stress by Placement Status


Submit
Download Report
Open Chatbot
×
Chat with AI:
Send



12. Bibliography

1. Doing exercise is makes stress free used for coping mechanisms from education minds in effective stress buster
2. Academic stress inventory , stress factor and academic stress factors taken from Havard institute of medical sciences.
3. American Psychological Association (APA). (1984) referenced from https://psycnet.apa.org/record/1984-26502-001
4. Centers for Disease Control and Prevention (CDC). (n.d.). Youth Risk Behavior Surveillance System (YRBSS). Retrieved from https://www.cdc.gov/healthyyouth/data/yrbs/index.htm
5. Glozah, F. N. (2014). Exploring the role of parental bonding in youth mental health. BMC Research Notes, 7(1), 1-7.
6. Shinn, M., & Toohey, S. M. (2001). The connection among Housing and Mental Health in the Urban Poor. American Journal of Public Health, 91(3), 532–535.

7. Price, C., & Joffe, H. (2012). Stress and coping among low-income parents. Psychology & Health, 27(10), 1–23.
8. Baker, S. E., & Henson, J. M. (2007). Coping with problems of financial: The Role of Coping Strategies in negative impact of Mental Health Outcomes. Journal of Health Psychology, 12(3), 447–460.
9. Schieman, S., & Bianchi, S. M. (2005). The Stress Process and Depression: A Test of the Emotional Work Model. Journal of Health and Social Behavior, 46(1), 42–55.
10. Gupta, R., & Srinivas, K. (2018). Academic and Financial Stress in Indian Students: A Cross-Sectional Study. Journal of Educational Psychology, 36(2), 150–159.