

A Machine Learning-Driven Online Mobile Application for Personalized Student Stress Management Detailed Project Plan

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1. Project Background

In Hong Kong, a total of 31 suspected student suicides were recorded in the year 2023, marking it the highest figure recorded in a decade [1]. These figures are further corroborated by the findings of the Department of Health where at least 2 out of every 100 surveyed students had contemplated suicide during the 2022/23 school year [2]. Another mental health survey conducted in 2021 by the KELY Support Group have revealed that academic pressure is ranked first place among causes for stress [3]. These figures have highlighted the concerning state of Hong Kong students' mental health and served as a signal for intervention and action.

In response, the Mental Health Support Hotline has been set up by the government as an official 24-hour immediate mental health support and referral service. Additionally, the government introduced the Three-Tier School-based Emergency Mechanism to identify and provide professional help to high-risk student [2].

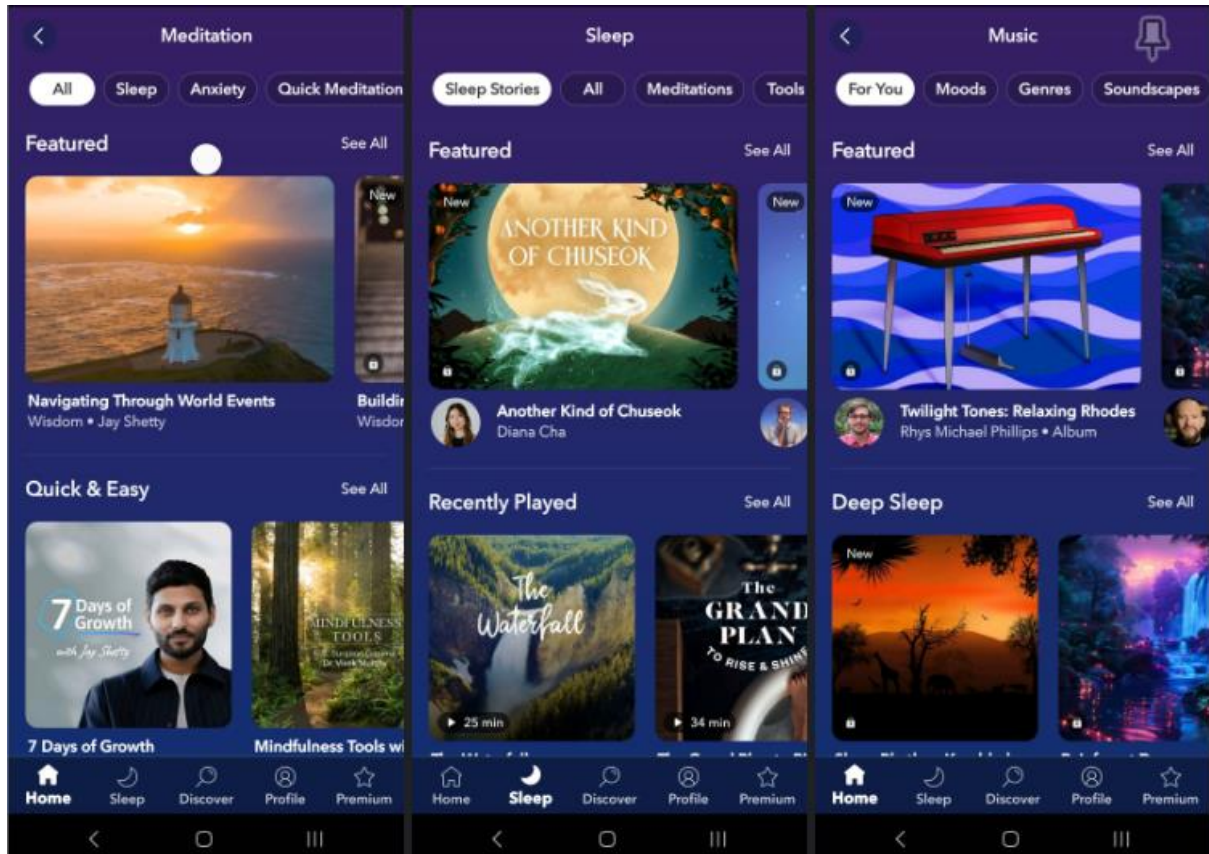
However, the students' accessibility to these services raises concerns. In general, a student may be reluctant to seek help actively due to the fear of ostracism and judgment. In 2022, the KELY Support Group highlighted that over 60% of surveyed adolescents refrained from seeking mental health support despite experiencing difficulties [3]. As a result, when the afflicted student does not actively seek help, the burden falls on educational institutions and families to recognize and assist the distressed student. Although the first tier of the said mechanism and hotline both aims to identify students with mental health issues [2] [4], the shortage in manpower could potentially lead to students not receiving the necessary assistance. The KELY Support Group have pointed out the insufficient number of professional service providers in Hong Kong where the number of stationed psychiatrists falls below half of the World Health Organization standard for the population size [3]. Therefore, the current system could be limited in capacity to provide sufficient mental health support.

To address the limitations in official methods, this project proposes an online mobile application that empowers students in managing stress effectively, fosters their emotional resilience through peer interaction. This project also utilizes a machine learning approach to identify high-stressed students, which can significantly alleviate the workload on educational institutions, thereby addressing the issue manpower shortage issue.

1.1 Analysis of available applications

Given the current saturation of stress relief mobile applications in the market, it is crucial for this project to analyze existing mobile applications to discern favored user features and potential areas of improvement. The Calm mobile application will serve as the subject of analysis on its app features and delineate how this project diverges from conventional approaches to stress relief mobile applications.

The Calm application offers a diverse array of user features, including daily offerings, guided meditation, music tracks [5]. From figure 1, the interface has a user-friendly layout with intuitive controls, enhancing the overall user experience. These distinctive features and design attributes serve as a good basis for the UI/UX design on the proposed stress management-oriented mobile application.



(Figure 1: User interface of the Calm app. captured from the Calm app)

However, Calm currently lacks a social interaction feature, a weak point this project aims to address with the inclusion of an online peer forum. This forum facilitates the sharing of relatable experiences and foster community building among students. Recent studies have also demonstrated that a secure and engaging online peer support forum establishes environment that encourages conversations and motivates users to participate in reciprocal social support interactions, resulting in diminished feelings of isolation and an enhanced sense of connection [6]. Ergo, this feature offers significant mental health benefits.

2. Project Objective

The objective of this project is not to replace the existing official services but rather to complement them through the proposed mobile application. As such, this project will closely align with the 4Rs Mental Health Charter outlined by the Education Bureau and will adopt the recommended preventive approach to address student mental health [7].

2.1 Promoting stress-reduction methods to students

The mobile application will incorporate a range of user-oriented functionalities like sleeping music geared towards encouraging healthy sleep patterns, a meditation feature promoting physical well-being through relaxation, and daily tips to assist students in navigating obstacles encountered in their daily lives. This strategic approach is in alignment with the 3 principles of 'Rest, Relaxation, and Resilience' articulated within the suggested charter [7]. Through these features, the mobile application aims to successfully promote stress-reduction strategies to students.

2.2 Strengthening students' social connections

The mobile application will have an online peer forum where students can interact with their peers, thereby enriching their social life. This objective aligns with the 'Relationship' principle from the charter [7], allowing students to have opportunity to interact with classmates outside of school hours, fostering a sense of community and support. According to Marshall [6], a feedback loop is created where existing users enjoy sufficient positive forum experiences revisit the forum more, prolonging and enlarging the online community which increases positive interactions. With the forum, the online forum aims to strengthen students' social connections.

2.3 Identifying high-stressed students

The mobile application will use a machine learning-driven warning system that can identify students experiencing high stress levels, adopting the suggested prevention strategy. With existing studies [8] that showed that machine learning can analyse the emotional state of an individual, the integration of this warning system within the mobile application is feasible. Furthermore, students can actively monitor each other's well-being and identify signs of heightened stress levels, allowing for timely identification and reporting of high-risk students at an early stage. With these features, the online forum aims to identify high-stressed students to allow for early intervention from other parties.

3. Project Methodology

3.1 Production Platform

The application will be published to both the Apple App Store and Google Play Store to maximize user reach and accessibility. Backend services will be hosted on Firebase, providing a scalable and secure solution for user authentication, database management (Firestore), and cloud functions.

3.2 Development Environment

The application will be developed using React Native with Expo. This combination allows for efficient cross-platform development, enabling the app to run on both iOS and Android devices with a single codebase. Developers will mainly use Visual Studio Code as the IDE, benefiting from its robust ecosystem of extensions and support for React Native development.

3.3 System Architecture

Presentation Layer

The UI will be built using React Native components, ensuring a native look and feel on both mobile platforms.

Application Layer

The application logic will be implemented using JavaScript and TypeScript, organized into modular components. This modularity facilitates easy testing and maintenance, promoting code reusability.

Machine learning algorithms will be developed on Python using Django as the framework. It allows robust backend processing. The application will communicate with the Django service via RESTful APIs to access machine learning functionalities.

Data Layer

Data will be stored in Firebase Firestore, a NoSQL database that supports real-time data synchronization.

User authentication will be managed through Firebase Authentication, providing a secure and user-friendly solution for sign-up and login processes.

The application will communicate with Firebase for database retrieval and authentication tasks, ensuring efficient data handling and security.

3.4 Technical Implementation Details

Feature 1: Initial Stress Review

User will take an initial quiz (design according to Health Central [9]) to determine their stress level. This initial data will help tailor personalized content within the app.

Feature 2: Personalised Tips of the Day and other Miscellaneous features

The app will offer daily personalized tips and relaxation techniques based on user preferences and feedback. Users can rate the usefulness of each tip, allowing the system to learn and improve recommendations over time.

The recommendation system will utilize collaborative filtering to suggest personalized tips and adapts by analysing user interactions and preferences.

The application will include sleeping and meditation sound features, users can select their desired relaxation sounds and ambient settings for a personalized relaxation environment.

Feature 3: Stress Log and Tracking

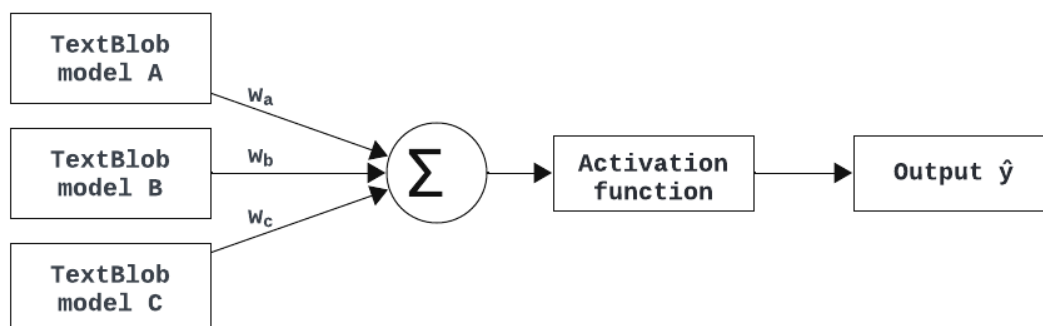
Users are prompted to log their stress levels daily upon login, providing a continuous record of their emotional state. This visualizing stress trends over time, helping users identify patterns and triggers.

Feature 4: Thought Sharing Platform

The app will incorporate an online peer forum, enabling users to share their stress management strategies, initiate discussions about their challenges and receive peer inputs.

Feature 5: Stress Warning System

A machine learning-based early warning system will be used to identify students experiencing severe stress or suicidal ideation. By analysing various data points like stress assessment results, the stress log and model output, the application can proactively flag and notify relevant parties to intervene and provide necessary support.



The figure outlines the model flow, user forum messages is the input, these models conduct sentiment analysis which each produce a numerical sentiment score. Subsequently, the weighted sum of pre-trained TextBlob models A, B, and C outputs undergo an activation function then yield an estimated output. The 3 inner models are trained on distinct sourced social media sentiment analysis datasets, the training will be done through built-in TextBlob module support. The outer voting model is trained with a dataset designed for predicting stress levels in social media articles, iteratively updating the weight vector based on the calculated errors from misclassifications. The final predicted output is a binary class label indicating whether the user is overstressed or not.

The project will involve initial research into stress management tools and user preferences to inform the development process. Following this, the team will focus on designing and implementing the user interface, basic backend functionality. Continuous user testing and feedback loops will guide the refinement of the application to ensure usability and effectiveness.

4. Project Schedule and Milestones

Period	Work Description	Progress
Sep~early Oct	-Research -Architectural specifications	Ongoing
Oct	-Augment and filter test data -Build and train initial models -Construct initial mobile application (Front end)	Not Started
Nov~early Dec	-Construct mobile application server (Back end) -Tune the hyperparameters of the models	Not Started
Dec	-Prepare interim report and presentation	Not Started
Jan~Mar	-Debug and improve mobile app based on feedback -Fine tune the models -User testing	Not Started
Apr	-Prepare for final report and presentation -Source code clean up -App deployment	Not Started

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