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Software Development Group Project

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CS -40

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Problem

Introduction to Problem

Sleep is a fundamental pillar of health and well-being; however, university students often face challenges in achieving consistent and high-quality rest. These difficulties typically arise from academic pressures, irregular schedules, poor habits, and time management issues. As a result, sleep deprivation or compromised sleep quality can occur, adversely impacting academic performance, leading to lower grades, as well as affecting both mental and physical health and cognitive functioning. Importantly, sleep deprivation is not merely an individual issue but a systemic one, as it affects a significant portion of the student population.

Problem Background and Stats

As for the demanding life of a University Student, work keeps piling up with These pressures most definitely leads to several challenges in maintaining healthy sleep patterns -:

1. Bad Habits

- Irregular Sleep Schedule:

➔ Students often struggle with varying schedules and juggling classes, finishing homework & assignments and, more importantly attending social activities and part-time jobs. These activities lead to inconsistent sleep times, which can disrupt the body's

natural circadian rhythm, making it harder for students to get restful sleep.

➔ Irregular sleep patterns can also interfere with sleep quality, leaving students tired even after a seemingly long night of rest.

- Caffeine Dependence:

➔ Many students rely on caffeinated beverages such as coffee, energy drinks and soda to stay awake, especially during late-night study sessions.
➔ As excessive caffeine consumption can disrupt a person's sleep cycle by prolonging sleep latency (time it takes for an individual to fall asleep) and reducing sleep duration. This results in poorer sleep quality and increased daytime sleepiness.

- Lack of Physical Activity:

➔ A sedentary lifestyle, common among students due to long hours spent studying and attending classes, can lead to poor sleep quality.

➔ Regular physical activity is essential for maintaining healthy sleep patterns as it helps to reduce stress, improve mood and promote better overall sleep quality.

- Excessive Screen Time:

➔ Prolonged use of electronic devices for studying and entertainment purposes can delay sleep due to the blue light emitted by these screens.

➔ Additionally, engaging in stimulating activities on screens before bedtime can make it difficult for students to unwind and relax, further interfering with sleep quality.

2. Poor Time Management

- Heavy Academic Work Load:

➔ University courseworks with their deadlines can cause significant stress on students, making it difficult for them to unwind and fall asleep.

➔ The constant pressure to perform well in academics often leads to late-night studying sessions, which can later interfere with their regular sleep schedule.

- Procrastination (delaying or postponing):

➔ Delaying or postponing assignments and studying until the last minute leads to late-night study sessions that disrupt regular sleep patterns.

➔ Both stress and anxiety associated with procrastination can also impact sleep quality.

As sleep issues continue to widespread among university students, a study that MIT conducted (References added) on their students shows that students who consistently sleep at regular times and get a minimum of 7 hours achieve better grades than those with irregular sleep patterns, showing up to a 50% drop in grades for students averaging 6 ½ hours of sleep.

Example in The Problem

Attempted Solution of the Competitors

The proposed app stands out by its laser focus on addressing the unique sleep-related challenges faced by university students. Leveraging advanced Machine learning techniques, it can provide more accurate and personalized sleep quality predictions compared to the traditional machine learning approaches used by other apps. Additionally, the app's plan to collect data anonymously can encourage more honest self-reporting from users. Integrating feedback from sleep experts and providing a comprehensive suite of lifestyle management tools further strengthen the app's ability to deliver evidence-based, holistic solutions to improve sleep quality and academic performance among the target university student audience.

Sleep Cycle- https://www.sleepcycle.com/

Shut Eye- https://shuteye.ai/

Better Sleep- https://www.bettersleep.com/

Feature	Our Idea	Sleep Cycle	Shut Eye	Better Sleep
University Student Focused	Tailored to student needs	General users	General users	General users
Deep Learning-based Prediction	Advanced, personalized (using ML-linear)	Traditional ML	Traditional ML	Traditional ML
Anonymized Data Collection	Respects user privacy	Linked to accounts	Linked to accounts	Linked to accounts
Professional Feedback Incorporation	Clinically-validated	No medical input	No medical input	No medical input
Comprehensive Lifestyle Management	Sleep Quality Prediction, Lifestyle Management, Goal Setting	Sleep Tracking and Analysis	Sleep Tracking and Analysis	Sleep Tracking and Analysis

Proposed Solution

We offer a great solution that satisfies university students' need for a sleep quality management platform by giving good sleep quality. When we were researching how we make this platform we found a researched data set from the kaggle website.(Link for the data set :Student Sleep Patterns)

According to that data set, we are going to collect data from university students on things like age, gender, university year, sleep duration, study hours, screen time, caffeine intake, physical activity, and sleep quality. This data set is great for studying how sleep habits, grades, and lifestyle choices are related. It can be used for different analysis methods, like exploring data patterns, predicting outcomes, and sorting data into categories.

Reader can see how the user should enter the data for this platform.

Age: When a user entering the age it should be an integer and also age should be between 10 to 50.

Gender: User has to select the gender male, female or other.

University Year: Users should enter what year they are currently studying.

Sleep Duration: Total hours they sleep per night.

Study hours: Average hours they study per day.

Screen time: How many hours a user spent on screen without studying per day.

Caffeine intake: User has to enter average caffeinated beverages consumed per day.

Physical activity: Number of minutes user spend on the physical activities(integer)

Sleep quality: User has to rate their sleep quality on scale of 1 to 10(Like 1 being worst, 10 being best)

Research:

We are conducting research involving IIT university students from the first year to the final year, focusing on lifestyle factors that may impact their sleep quality. This study aims to gather valuable data on sleep duration, screen time, caffeine intake, physical activity, and study hours to analyze the influence of these habits on sleep patterns and well-being.

Data will be collected anonymously via a Google Form sent to all students through email, allowing us to reach a broad sample of the student body(like above 500 students).

Additionally, we will seek feedback from a sleep health professional to refine our approach, ensuring that our model offers accurate insights and recommendations based on expert guidance.

Target Audience

In today's academic environment, university students often face challenges in maintaining a healthy lifestyle. A significant issue they encounter is difficulty in sustaining healthy sleep patterns, which can adversely affect both their academic performance and overall well-being.

Approximately 45% of college students experience sleep deprivation, with factors such as irregular schedules, excessive screen time, high caffeine consumption, and a lack of physical activity contributing to this predicament. Our proposed web application specifically targets university students aged 18 to 25, providing personalized insights based on user-inputted data and predicting sleep quality on a scale from 1 to 10.

By implementing advanced deep learning techniques, our application aims to enhance both academic performance and sleep quality for university students through accurate predictions and valuable feedback.

Resource Requirements

- Hardware Requirements:

  Wearable devices: We planned to use this wearable device to track our sleeping time (like wrist band)

- Software Requirement

1. Frontend :
   - user-friendly, responsive web interface with accessible UI.
   - Input forms for personal metrics and sleep journal entries.
   - Interactive data visualization for sleep patterns and recommendations.
2. Backend :
   - Database management system for storing user data, sleep records, user's screen time, and analytics.
   - Authentication and user management system.
   - Using API to track the user's sleep duration (for wearable devices), track the screen time,

3. Machine Learning:
    - Sleep quality prediction model using machine learning concept.

4. Analytics and Reporting:
    - Data visualization for sleep patterns, trends, and peer comparisons.

5. Security and Privacy:
    - End-to-end encryption for user data
    - Compile with data privacy regulations(GSPR)

- Technology Stack

1. Frontend :

    - Framework: React or Angular for building a dynamic responsive UI.

    - Styling: using CSS (optionally, using Tailwind CSS or Bootstrap)

    - Data visualization: chat.js or ploty for charts and analytics dashboards .

2. Backend:

- Framework: Node.js with Express(JavaSript) or Spring Boot (Java).

- Database: PostgreSQL or MongoDB for storing user data and sleep logs.

- Authentication: Firebase Auth for authenticate the customer

- Notification: Web push Protocol (for browser notification)

- API:
    1. Wearable Devices: Fitbit API , Apple Healthkit API , Garmin Connect API
    2. Sleep Tracking App API: Sleep Cycle API
    3. Calender API : Google Calender API , Apple Calender API
    4. Third-Party Sleep Analysis API

3. Machine Learning:

    - Language: python for machine learning.

    - Data Processing: Pandas and Numpy for data manipulation

    - Model Training: TensorFlow or PyTorch is used for model training.

4. Other Tools:

    - Version Control: Git with Github is used for version control and collaboration

    - Project Management: Trello for tracking the project milestones.

    - IDE: VSCode,Pycharm, and Intellije IDEA

    - Testing: Jest(for frontend), Pytest(backend), and Postman(API testing)

Features of The Solution

1. Sleep Quality Prediction

- Input personal metrics (age, gender, university year, etc.)
- Receive an instant sleep quality score (1-10 scale) and sleep quality assessments like,
    1. Sleep Efficency : Percentage of time Actually spend on Sleep (Calculated Bu Physical Devices on User Liker Smart Fitness Bands)
    2. Sleep Stages : Estimated Time Spend On light Sleep, Deep Sleep and Rem Sleep. Data By Wrist Bands
    3. Rating Heart Rate (From Wearable Devices)
    4. Heart Rate Variability(HRV) :Calculated Using Wearable Devices (Strong Indicator of Stress and Recovery)

- View a detailed breakdown of how each factor affects sleep quality Using Explanable AI (XAI) We planned to explane it Visually how Their Activities Contributes their Overoll Sleep Quality to Help User to Identify Why They Got This Score.
- When We Provide the feedback we Consider users Uni Year and their Typical Schedule .

2. Personalised Recomendation Engines

- Actionable Plannes :Insted of general Advices We give step by step planes for improvement using the knowledge of professional panel of doctors knowledge for example let us say Student have High Cafane intake than he Want We provides Simmiler Beverages has less cafane and provides schedule for intake the beverage and if users screen time is high we recommend app blocking and blue light filter reminders through our mobile application and other thing we can manage a sleep hygiene intake checklist and provide a reminder to them .
- Gamification: We introduse elements like badges , points or stickers to motivate the user to follow recommendation and improve their sleep.
- Community Features : We Allow User to Anonymously share their progress , challenges and tips with developers (US)

3. Sleep Jurnal and History

- Subjective Sleep Quality : Include A feature for User to sAY How they Feel Their Sleep Capturing qualitative data Alongside Objective Materials.
- Smart Integration**:** Integrate with wearable devices (Fitbit, Apple Watch) and sleep tracking apps to automatically import sleep data to our System Using their API s provided by the Manufactors of the Wearable Device Ans we can use services like google fit or apple healthkit to collect user data.
- Advanced Visualizing : provide more sophisticated visualizations like sleep cycle graphs , heatmaps showing sleep patterns overtime , and corelations between different Factors.

4.Goal Setting and Progress Tracking

- Adaptive Goal Setting : The Application will change the tasks and goles according to the users Daily Progress.
- Reminders and Notifications : Bedtime and Wakeup Alarms ,Pre Sleep routine Remeinder , Notification for Reaching Milestones .

5. Data Analytics Dashboard

- Peer Comparison: Allow Student to opt-in Anonymously compare their sleep data with others in their major and year
- Predective Analytics : Use Historic data and data we collect from students from google form mentioned earlier to predict potential sleep issus based on current trends.

6.Lifestyle Manegement Tools

- Study Schedule Optimization : Integrates with Calender Appes and Suggest Optimal Study Times based on sleep Patterns and Deadlines.
- Mindfulness and Relaxation Excercises : Include Guides Meditation , Breathing excercises and sleep Sounds to promote Bedtime .

7. Customization and Preferences

- Personalized Sleep Soundscapes : Allow users to Create Custom mixes of ambient sound or white noice
- Intergration with university resources : Provide linkes and details to university health Services , Councelling and acedemic support .

Conclusion

Reference

Competitors

Sleep Cycle- https://www.sleepcycle.com/

Shut Eye- https://shuteye.ai/

Better Sleep- https://www.bettersleep.com/

Problem Background and Stats -

Chandler, D.L. (2019). *Study: Better sleep habits lead to better college grades*. [online] MIT News | Massachusetts Institute of Technology. Available at: https://news.mit.edu/2019/better-sleep-better-grades-1001.