# Sleep Habit Stress Detector: A Streamlit Application for Sleep Analysis and Stress Assessment

## Abstract

The Sleep Habit Stress Detector is an innovative and user-centric web application developed using the Streamlit framework. It allows users to comprehensively track their sleep habits, analyze trends in their sleep patterns, and receive personalized, AI-powered stress assessments. This application is designed to bridge the crucial gap between daily sleep behavior and mental wellness, particularly stress levels, offering actionable insights for better lifestyle choices. By integrating self-reported sleep data with advanced generative AI analysis, the tool empowers users to understand their well-being and encourages proactive mental health management.

## Key Features

### 1. User Profile Management

- Collects personal demographic data such as name, age, gender, and occupation.

- Provides personalized insights and trend analysis based on user profile information.

- Enhances data segmentation for more accurate recommendations.

### 2. Comprehensive Sleep Data Collection

- Sleep Timing: Inputs for bedtime and wake-up time to calculate total sleep duration.

- Sleep Quality: Users rate their sleep quality on a scale (e.g., 1-10), providing subjective feedback.

- Nighttime Disruptions: Logs the number of awakenings during the night.

- Dream Activity: Tracks whether users remember having dreams, contributing to sleep phase evaluation.

- Lifestyle Factors: Includes daily caffeine intake, hours of physical exercise, screen time before bed, and use of sleep aids.

- Mental State: Allows users to record mood and perceived stress levels at bedtime and upon waking.

- Daytime Drowsiness: Captures instances of sleepiness or napping during the day.

### 3. Data Visualization

- Utilizes Matplotlib and Seaborn to generate rich, interactive visualizations.

- Displays time-series plots of sleep duration, quality scores, and stress levels.

- Supports comparative charts (e.g., weekdays vs. weekends, pre- and post-intervention).

- Enables filtering data by date range, category, or mood tags.

- Real-time chart updates based on new entries, fostering data-driven awareness.

### 4. AI-Powered Stress Analysis

- Integrates Google's Gemini 1.5 Flash model using the `google-generativeai` package.

- Processes historical sleep patterns, quality indicators, and lifestyle inputs.

- Outputs:

- Stress Level Classification: Low, Moderate, High, or Severe

- Detailed Explanation: Natural language feedback explaining how sleep factors affect current stress levels

- Key Observations: Highlights critical metrics such as irregular sleep patterns, short sleep duration, or high caffeine use

- Recommendations: Provides actionable advice like sleep hygiene tips, suggested bedtime routines, or relaxation exercises

### 5. Data Import/Export

- Supports Excel/CSV file uploads for historical sleep data ingestion.

- Exports current or complete sleep records in CSV or Excel format.

- Compatible with platforms like Fitbit, Apple Health, or Google Fit for future API-based data syncing.

- Facilitates sharing reports with healthcare professionals or researchers.

## Technical Implementation

The application leverages a robust ecosystem of Python libraries:

- Streamlit: Rapid development of web apps with simple UI design and interactive elements.

- Pandas: Dataframe manipulation for analyzing user sleep logs and trends.

- NumPy: Provides mathematical operations for sleep duration calculations and normalization.

- Matplotlib & Seaborn: Delivers dynamic and visually appealing graphs.

- OpenPyXL: Enables Excel integration for both importing and exporting user records.

- Google Generative AI (Gemini 1.5 Flash): Core AI engine that analyzes and interprets user data.

- Session Management: Maintains stateful interactions between data inputs, visualizations, and AI results.

## Advantages and Applications

### User Benefits

- Holistic Insight: Offers a unified dashboard for quantitative and qualitative sleep data.

- Self-awareness: Increases user understanding of the connection between lifestyle and mental health.

- Personalized Advice: Delivers highly relevant recommendations using AI-driven analysis.

- Autonomy and Control: Empowers users to track and manage their own mental wellness.

- Secure and Private: User data is stored locally or optionally encrypted before cloud transmission.

### Clinical and Research Applications

- Telehealth Integration: Allows healthcare providers to monitor patient sleep behaviors remotely.

- Behavioral Study Tool: Ideal for academic and clinical studies on sleep and stress correlation.

- Intervention Validation: Evaluates effectiveness of treatments such as CBT for insomnia or mindfulness practices.

- Early Risk Detection: Helps identify early signs of chronic stress, burnout, or depression based on changes in sleep patterns.

### Public Health Implications

- Awareness Building: Encourages users to prioritize sleep and understand its role in mental health.

- Low-Cost Mental Health Tool: Makes stress assessment accessible to a broader population.

- Scalable Solution: Easily deployed in wellness programs, schools, or workplaces.

- Data for Policy: Aggregated anonymized data could aid in shaping mental health policy or workplace wellness initiatives.

## Why It’s Useful

The Sleep Habit Stress Detector goes beyond simple sleep tracking to deliver a meaningful, AI-powered self-assessment tool. Here are the standout reasons why it is valuable:

1. Connects Sleep and Stress: Unlike traditional sleep trackers, this app explicitly examines how sleep behaviors influence stress.

2. User-Friendly AI Access: Makes advanced analytics available through a simple and intuitive web interface.

3. Context-Aware Insights: Factors in external lifestyle and emotional cues, not just biometrics.

4. Visual Pattern Discovery: Engaging visualizations help users understand long-term patterns and triggers.

5. Integrated and Flexible: Ready for integration with health wearables and capable of exporting/importing data from different sources.

6. Proactive Health Management: Encourages healthy behavior changes through awareness, analysis, and goal setting.

## Future Enhancements

- Wearable Sync: Integrate data feeds from smartwatches and fitness trackers (Fitbit, Garmin, etc.)

- Mobile App: Android/iOS version with offline mode and notification reminders

- Voice Input: Use speech recognition for hands-free data logging

- Chatbot Assistant: Implement a virtual assistant for interpreting results and guiding users

- Advanced AI Models: Incorporate sleep scoring algorithms or fine-tuned mental health GPT models

- Gamification: Add streaks, badges, and rewards to encourage regular usage

- Calendar View: Visualize sleep metrics and stress scores in a monthly planner format

- Health Professional Portal: A dedicated interface for therapists and doctors to access shared user data

## Conclusion

The Sleep Habit Stress Detector represents a significant advancement in sleep wellness and digital mental health support. It provides users with the tools to better understand and improve their sleep habits, all while gaining insights into how those habits influence their stress levels. By combining data visualization, AI-powered analysis, and user-friendly design, the app delivers an accessible yet powerful resource for individuals, healthcare providers, and researchers alike. Its modular and scalable architecture allows for continuous enhancements, making it a vital tool in the future of personal and public health management.