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**SFEA (STRESS-FREE EXAMINATION APPLICATION)**

"Real-Time Stress Monitoring and Management for Students Using Heart Rate and Temperature Data to Optimize Exam Performance"

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**CHAPTER 02: LITREATURE REVIEW OF SFEA**

"Real-Time Exam Stress Monitoring and Management for Students Using Heart Rate and Temperature Data to Optimize Exam Performance"

In recent years, the idea of a **"stress-free examination Application (SFEA)"** has drawn a lot of attention, particularly in academic settings where stress can have a big impact on students' performance. Early research in this area, including groundbreaking works by **Shokr (2015)** and **Tharion et al. (2009)**, established the groundwork by emphasizing the physiological impacts of Exam stress, specifically through **heart rate variability (HRV), body temperature**, can provide insights. A definite pattern of decreased HRV during stressful exam conditions was seen in these investigations, indicating an overactive sympathetic nervous system and a lack of parasympathetic modulation. **Studies by Patil et al. (2015), Saab et al. (2019), and Castaldo et al. (2019)** demonstrate how research has progressed over time to investigate not only the physiological indicators of stress but also strategies for real-time monitoring with wearable devices. The advent of AI and machine learning algorithms has increased the application of HRV for Exam stress detection by improving the accuracy and customisation of stress prediction **(Haque et al., 2023**). According to research by **Sun et al. (2021) and Benchekroun et al. (2023)**, the incorporation of wearable technology into Exam stress management strategies has led to the development of real-time, non-invasive monitoring devices intended to lessen exam-related stress. These developments suggest a bright future in which students might maintain peak performance on important academic tests by using tailored therapies like feedback and mindfulness exercises. In order to create a stress-free examination atmosphere, the field has progressed from simple stress detection to complex, real-time stress management systems.

## RELATED WORK

In 2019 the research conducted by Saab et al. [1] explores the physiological effects of acute stress, focusing on changes in heart rate variability (HRV) during high-pressure academic settings. Conducted with 90 Lebanese university students, the study used wearable devices to monitor HRV before, during, and after a two-hour final examination. The results showed a significant reduction in HRV during exams, indicating heightened stress levels and increased sympathetic nervous system activity, often linked to the "fight-or-flight" response. After the exams, HRV returned to baseline levels, reflecting stress recovery.The study also revealed gender-based differences, with female participants showing lower HRV and higher heart rates than their male counterparts, suggesting more pronounced physiological stress responses in women. Individual differences in HRV responses were influenced by factors like stress-coping mechanisms, preparedness, and personality traits. The authors advocate for the use of wearable technology for real-time stress monitoring and stress management in educational environments. However, the study notes several limitations, including uneven gender and academic representation, lack of control over lifestyle factors (e.g., caffeine intake or physical activity), and the use of single-channel monitoring devices, which may affect data accuracy. The authors recommend further research with more diverse participants and improved monitoring techniques.

Kumar et al. [2] At 2022 in their study explored how acute academic stress impacts heart rate variability (HRV) in medical students. The research included 16 first-year medical students and monitored their HRV using electrocardiogram (ECG) recordings during three periods: a control period during a college cultural week, a moderate stress period during a second-term viva exam, and a high-stress period during a professional viva exam. The findings revealed a significant reduction in HRV during the examination periods, indicating a shift toward sympathetic nervous system dominance, which is characteristic of the "fight-or-flight" response. This reduction was particularly pronounced during the high-stress professional viva exam, suggesting a more intense physiological stress response. The decreased HRV reflected autonomic dysregulation, where parasympathetic (rest-and-digest) activity was impaired, thus highlighting the negative impact of exam stress on the autonomic nervous system. The authors conclude that HRV can be a valuable non-invasive tool for monitoring stress in academic settings and emphasize the need for interventions such as mindfulness or physical activity to help students manage stress and improve HRV. However, the study's small sample size and lack of exploration into individual variations in stress responses were noted as limitations, and future research should address these aspects to better understand how personal factors influence stress levels and recovery. This study sheds light on the physiological effects of academic stress and reinforces the importance of managing stress to maintain optimal health and performance in students.

In 2015 a study conducted on the use of heart rate variability (HRV) as a non-invasive method for detecting stress levels in individuals by Patil et al. [3]. The primary objective of their research was to explore how variations in HRV can reflect different levels of stress, particularly in response to stress-inducing tasks like public speaking and mental arithmetic. To achieve this, the participants' HRV was monitored using electrocardiogram (ECG) recordings to capture real-time heart rate data. The researchers focused on analyzing several HRV parameters, including mean RR intervals, standard deviation of RR intervals (SDNN), and the low-frequency/high-frequency ratio (LF/HF), which provides insights into the balance between the sympathetic and parasympathetic nervous systems. Based on existing literature, the researchers anticipated finding a reduction in HRV during stressful tasks, indicative of heightened sympathetic nervous system activity associated with the "fight-or-flight" response. They also expected HRV to return to baseline levels once the stressor was removed, reflecting recovery. The study concluded that HRV could be a reliable tool for real-time stress detection, with applications in biofeedback techniques and wearable devices aimed at helping individuals manage stress in daily life. However, the study also had some limitations, such as a potentially small sample size, lack of exploration into individual differences in stress responses, and the limited scope of stressors used in the experiments. Despite these limitations, the research highlights HRV as a valuable physiological marker for monitoring stress, which could be particularly useful in mental health interventions and stress management practices.

Yoo et al. [4] in 2020 conducted a study exploring the relationship between heart rate variability (HRV)-measured stress and academic achievement in medical students in 2020. The primary aim of the study was to understand how HRV, a physiological marker of autonomic nervous system activity, correlates with academic performance in high-pressure environments like medical schools. The researchers hypothesized that low HRV, which signals increased stress, would be linked to poorer academic outcomes, while higher HRV, reflecting a more balanced autonomic nervous system and lower stress, would correlate with better academic performance. The study involved tracking HRV in medical students at various times, such as before exams or during intense academic workloads, using wearable ECG devices. The students' academic performance, likely measured by exam scores or GPA, was then compared to HRV data, particularly focusing on metrics like the standard deviation of RR intervals (SDNN). The study also accounted for other factors influencing academic performance, such as study habits, sleep patterns, and socio-economic background. Based on existing literature, the study anticipated a negative correlation between HRV and academic performance, with lower HRV indicating higher stress and potentially poorer outcomes. The findings of this research emphasize the need for incorporating stress management strategies into medical education, as HRV could serve as an objective, real-time indicator for stress, enabling timely interventions.These strategies might include mindfulness, physical activity, and biofeedback to help students reduce stress and improve both their academic achievements and overall well-being. However, the study may have limitations, such as a small sample size, and it might not have fully considered individual coping mechanisms or external factors like teaching quality and mental health, which could also impact both stress levels and academic outcomes. The research highlights the importance of personalized stress management interventions in academic settings to enhance student performance and well-being.

Sun et al. [5] investigated the use of wearable devices for detecting mental stress through heart rate variability (HRV) monitoring, highlighting the potential of these devices for real-time, non-invasive stress detection in 2021. The study focused on how HRV, an indicator of autonomic nervous system activity, can serve as a physiological marker for stress. The researchers conducted the study with 60 healthy volunteers who were exposed to stress-inducing tasks such as mental arithmetic and the Stroop color-word test. Wearable devices continuously monitored the participants' heart rate and ECG signals during the tasks. Key HRV features, including standard deviation of RR intervals (SDNN), low-frequency (LF) power, high-frequency (HF) power, and the LF/HF ratio, were analyzed. The results showed significant HRV changes during the stress-inducing tasks, such as a decrease in SDNN and an increase in LF power, reflecting stress-induced sympathetic nervous system dominance. These HRV changes were found to correlate with the participants' self-reported stress levels, validating HRV as a reliable stress marker. The study concluded that wearable devices are promising tools for real-time, continuous mental stress monitoring, with the potential for early detection and personalized intervention. The study also suggested the integration of machine learning algorithms to improve the accuracy of stress detection systems. Despite a few limitations, such as the controlled nature of the stress-inducing tasks and the relatively small sample size, the research contributes to the growing body of evidence supporting the use of wearable devices for stress detection and mental health management in various environments, including workplaces and schools.

In 2019 Castaldo et al. [6] explored the potential of ultra-short term heart rate variability (HRV) features as surrogates for longer-term HRV measures in detecting mental stress in real-life scenarios. The research, published in BMC Medical Informatics and Decision Making, focused on analyzing HRV data from brief, less than one-minute periods to determine if these ultra-short segments could effectively identify stress. The study involved a single participant who wore a heart rate monitoring device for a week to capture data during daily activities, with specific periods marked as "stressful" or "non-stressful" based on self-reported stress levels. Key HRV features, including SDNN (standard deviation of RR intervals), LF (low-frequency power), and HF (high-frequency power), were extracted from the heart rate data to analyze the autonomic nervous system’s response to stress. The researchers hypothesized that ultra-short HRV features would show distinct variations during stress, indicative of sympathetic dominance. The study’s findings suggested that even short windows of HRV data could be sensitive enough to detect stress, supporting the feasibility of real-time, continuous stress monitoring through wearable devices. While the study had limitations, such as relying on a single participant and self-reported stress, the research paves the way for future developments in wearable technology aimed at real-time, continuous mental stress monitoring in everyday settings. This could lead to more efficient, battery-friendly wearable devices that offer real-time feedback for stress management.

Benchekroun et al. [7] conducted a study in 2023 published in Sensors to evaluate the generalizability of HRV-based stress detection models across different datasets. The primary aim was to assess whether HRV models trained on one dataset could effectively be applied to others, an important step toward creating robust, universally applicable models for stress detection. The study used two distinct datasets: the Multi-modal Dataset for Real-time, Continuous Stress Detection, which includes physiological signals such as heart rate from participants undergoing various stress-inducing tasks, and the University of Waterloo Stress Dataset, which also contains heart rate and ECG data recorded during stress-inducing tasks. The researchers trained models on the Multi-modal dataset and tested their performance on the University of Waterloo dataset to determine how well these models generalized to new data. The expected findings were that certain HRV features, such as the standard deviation of RR intervals and the LF/HF ratio, combined with machine learning techniques like support vector machines or random forests, would perform consistently across datasets, offering reliable stress detection. The significance of the study lies in its potential to develop more adaptable and scalable stress monitoring systems, which could be applied in various real-world settings, from healthcare to workplace environments. However, the study acknowledged limitations such as dataset characteristics and individual differences in stress responses, which could influence the generalizability of the results. This research contributes to the ongoing efforts to improve HRV-based stress detection systems by ensuring they can perform across diverse populations and stress contexts.

Haque et al. [8] explore the advancements and challenges of using artificial intelligence (AI) in predicting stress levels based on heart rate variability (HRV) data in their research published in Sensors. In 2023 The study focuses on examining state-of-the-art AI techniques for stress prediction, with HRV being a well-established physiological marker of stress. The paper reviews various AI algorithms, including machine learning models such as support vector machines and random forests, deep learning models like neural networks, and hybrid approaches that combine multiple models for better accuracy. It also discusses HRV features commonly used in stress prediction, such as standard deviation of RR intervals (SDNN), low-frequency (LF) and high-frequency (HF) power, and the LF/HF ratio. The findings highlight that deep learning models, due to their ability to handle complex data, tend to outperform traditional machine learning models in predicting stress, although they may come with higher computational complexity. This research emphasizes the potential of AI in advancing stress prediction tools, particularly for personalized, real-time stress management systems integrated into wearable devices. However, the review is limited by its reliance on existing literature, and its generalizability may be affected by the limitations of the reviewed studies. The research provides valuable insights into enhancing stress detection systems, aiming to improve mental health interventions.

Shokr et al. [9] investigate the effect of exam stress on heart rate variability (HRV) parameters in healthy medical students. The study aimed to understand the physiological impact of stress during exams, using HRV as a tool to measure stress levels. In 2015 The research involved 49 medical students, with HRV measurements taken during three conditions: a relaxed period, terminal examination, and professional examination. The findings suggested that HRV was reduced during the terminal and professional exams compared to the relaxed period, indicating a shift towards sympathetic nervous system dominance. Notably, female students exhibited a greater reduction in HRV than male students, highlighting potential gender differences in stress responses. The study concluded that HRV analysis can serve as a non-invasive tool for stress detection, making it useful in academic settings for monitoring and managing student stress. However, the small sample size and uncontrolled external factors, such as lifestyle choices, limit the generalizability of the findings. This research emphasizes HRV's potential as a diagnostic tool for stress and suggests that stress management techniques could help improve HRV and academic performance.

PhysioNet et al. [10] provide a valuable resource through the Wearable Exam Stress Dataset, which captures physiological responses to stress in real-world settings, specifically during exams. In 2021 The dataset includes data from wearable devices that monitor skin conductance (electrodermal activity) and skin temperature—both of which are significant indicators of stress and emotional arousal. Skin conductance reflects the activity of sweat glands, often elevated under stress, indicating sympathetic nervous system activation. Skin temperature, influenced by blood flow, can decrease during stress due to vasoconstriction. Data was collected during actual exam conditions, offering high ecological validity and real-world relevance. The dataset presents several potential applications, such as real-time stress detection and prediction of cognitive performance during exams by analyzing these physiological parameters. While the dataset offers insights into stress responses in academic settings, limitations include a small sample size, potential confounding factors such as physical activity or ambient temperature, and the absence of additional physiological signals like heart rate variability. Despite these limitations, the dataset provides a strong foundation for developing real-time stress monitoring systems using wearable devices.

Tharion et al. [11] conducted a study to examine the effects of exam stress on heart rate variability (HRV) in healthy students. The research aimed to determine if there were significant changes in HRV during exam periods compared to a relaxed holiday period. Eighteen students participated in the study, with HRV measured using electrocardiogram (ECG) recordings taken during a 5-minute supine rest under two conditions: during a holiday period and an examination period. The study focused on several HRV parameters, including the mean RR interval, standard deviation of RR intervals (SDNN), total spectral power, and the low frequency (LF) and high frequency (HF) normalized units (nu), as well as the LF/HF ratio. The findings indicated a significant decrease in mean RR interval and total spectral power during exams, suggesting a reduction in HRV and a shift towards sympathetic nervous system dominance, which is associated with stress. However, no significant changes were observed in the LF nu, HF nu, or the LF/HF ratio, indicating a more complex stress response that was not fully captured by these parameters. The study concluded that HRV could be a useful tool for assessing stress in academic settings, although the small sample size and short-term HRV measurements limited the comprehensiveness of the findings. This research supports the conclusions of Elsayed Shokr , which also noted a decrease in HRV during exams, but it highlights that the specific HRV parameters that change may vary across studies in 2009.

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## APPLICATION REVIEW

## ****Exam Stress****

The focus of the stress app is on students who suffer from anxiety brought on by examinations. The app provides a diversified set of stress management techniques including but not limited to guided breathing and motivational quote calming the agitated mind during difficult times. The app has a simple interface in which the main emphasis is placed on the application of relaxation methods in order to reduce the level of anxiety and enhance general mental health before and/or in the course of an exam. It’s a free resource that can also cater to students who do not wish to spend too much time looking for ways to help them concentrate again on studies.

## ****7 Cups Therapy & Support****

You can use the 7 Cups Therapy & Support app for free. It enables you to communicate with listeners who are trained to keep their identities secret. Students who are anxious and stressed out about tests benefit from this. You may discuss more than just your emotions with the app. It also teaches you how to manage stress by teaching you how to take care of yourself and become more conscious of your thoughts. This app can help students take care of their mental health. It provides them with a space where they can discuss their concerns without fear. They see things more clearly and develop mental health practices as a result. All of this aids pupils in managing their test anxiety in a well-rounded manner.

## ****SimpleMind Lite Mind Mapping****

Thanks to SimpleMind+, students can create mind maps and easily arrange their ideas visually. The application allows the users to break down complex study materials or preparation for an examination into clearer and simpler blocks. It is possible for the users to decompose and connect ideas with visuals – this lightens the burden, therefore making preparation easier. This is useful in alleviating pressure because it promotes understanding and assurance towards the academic task at hand. Although the standard version is available at no charge, a paid version Pro with extra features can be purchased for $6.99.

## ****Study Bunny****

Whereas previously it was seen as a boring activity, people today consider Study Bunny as a game where individuals can pit themselves against one another and have fun in the process. For example, participants can log hours spent on books, and be rewarded with in-app currency for keeping a certain level of noise, or studding, over a period of time. Also, there are other devices like custom timers and flash cards which also assist learners in keeping the focus on learning most of the time. The software is very fascinating because it is interactive, strikingly using graphics like the bunny or the carrot, which rather helps to make the grueling process of preparing for exams bearable.

## ****Self-Help for Anxiety Management (SAM)****

The SAM application is designed for users who are experiencing stress or anxiety and offers a clinically proven cognitive behavioral therapy (CBT) module, which has a stress measurement and management mechanisms and an agent directed breathing exercises. Exam stress is the primary issue to which the app is targeted, and it has additional helpful aspects such as thoughts and activities management, and easy stress relief activities. This is a good inclusion as these aspects are focused on self-regulating healthy behaviors – in this case Management of stress as opposed to avoidance of stress – which is beneficial to the learners. On the other hand, it is free and accessible in the sense that it actively seeks to resolve stress problems rather than to avoid stressors only for a limited time.

## ****Exam Countdown****

Exam Countdown is a simple and effective application for students in organizing and managing their time by keeping track of the approaching exam dates. It sends timely alerts to students in order to prepare them well ahead of time. With clear deadlines set by the app, the stress of falling behind on studies and cramming at the last minute is eliminated. Its basic features appeal to most students who seek a dependable tool for tracking their academic calendar.

## BeCalm

The particular app under heuristics application affords its attention towards flexibility and medsp as the students tend to stress because of preparing for their exams. It offers the users, guided lessons for meditating, provides audio clips to relieve stress and also teaches breath control exercises in order to promote the mental well being of individuals and also alleviate the tension. This application is suitable for users especially learners who wish to incorporate relaxation exercises into their daily activities so as to help them remain calm and focused in the frustrating academic periods. Thus, all users are supplied with these stress management devices for free hence they are not costly.

## ****Peak****

**Peaks is an appliction designed to impact one’s cognitive abilities via a number of challenging games, such as– attention, memory and logical games. The design of the app is interactive and engaging which helps the students to make use of the app quite well when preparing for their exams. It helps in combating the stress that iray result from examination challenges as it develops ones mental flexibility and enhances concentration. The basic version of the app is freely available, however far more advanced mental training can be accessed with a premium subscription ($4.99 per month).**

## ****My Study Life****

My Study Life is one such planner application that is intended only for the students. It provides a mechanism to capture the various tasks, their timelines and the dates of examination in a simple navigable tool. As the application provides a single place to keep a track of impending deadlines and lists of things to be done, it helps in preventing the disorder associated with carrying out many tasks. This helped in organizing all the tasks at hand and also improved the efficiency of the user since there was a clear structure of how success was to be achieved. It is free of charge and is very appropriate for learners who want to manage their time effectively.

## ****Khan Academy****

Online education is something that Khan Academy excels at. Classes on cash, push and pull, and all those complex maths concepts are among the things you have. They have some amazing in-depth films and some awesome hands-on activities to play with if you want to dig into the tough stuff. Plus, they've got this sweet system that lets you see how smart you're getting and shows you the ropes on how to use that brainpower. They provide you with practice questions, a tool to monitor all of your cognitive progress, and direct assistance to save you time. This entire process helps you study more in less time and makes taking tests far less intimidating. Khan Academy is therefore excellent for boosting your self-esteem and mastering material when preparing for tests.

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## COMPARATIVE STUDY TABLE OF RESEARCH WORK

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S. No** | **Name of Paper** | **Algorithm/Method Used** | **Results** | **Shortcomings** | **Year** |
| 1. | **Tharion et al.** [11] (Short-term HRV measures in students during examinations) | Short-term HRV analysis | Observed reduced HRV during exams but no significant change in LF/HF ratio, suggesting nuanced stress responses. | Small sample size; short-term HRV measures may miss long-term stress effects. | 2009 |
| 2. | **Patil et al.** [3] (Stress detection using heart rate variability) | HRV-based stress detection models using short-term data | HRV measures were effective in stress detection. | Focused on short-term HRV without considering long-term physiological variations. | 2015 |
| 3. | **Shokr et al.** [9] (Effect of exam stress on HRV parameters in healthy students) | HRV analysis across relaxed and stress states | Found reduced HRV during exams, highlighting the physiological impact of academic stress. | Limited focus on other stress indicators like skin conductance or temperature. | 2015 |
| 4. | **Saab et al.** [1] (Effects of acute stress on HRV during university final examinations) | HRV analysis with statistical methods | Significant reduction in HRV during final exams, indicating stress-induced autonomic imbalance. | Small sample size, limited generalizability, no long-term monitoring. | 2019 |
| 5. | **Castaldo et al. [6]**  (Ultra-short term HRV features for mental stress detection) | Ultra-short HRV analysis techniques | Showed that ultra-short HRV measures can serve as surrogates for short-term HRV in stress detection. | Limited generalizability; ultra-short measures may not be as accurate for all contexts. | 2019 |
| 6. | **Yoo et al.** [4] (HRV-measured stress and academic achievement in medical students) | HRV metrics correlated with academic achievement | Found a link between reduced HRV and lower academic performance, emphasizing the impact of stress on learning outcomes. | Small, specialized sample limited to medical students; external stressors were not accounted for. | 2020 |
| 7. | **PhysioNet** [10] (Wearable exam stress dataset) | Wearable device data, skin conductance, and skin temperature | Provided real-world stress data during exams, useful for machine learning and cognitive performance prediction. | Missing HRV data; external factors like movement or ambient temperature might confound results. | 2021 |
| 8. | **Sun et al.** [5] (Mental stress detection using wearable devices and HRV monitoring) | Wearable HRV monitoring combined with machine learning | Demonstrated the effectiveness of wearable devices in detecting real-world stress. | Dependency on device accuracy; missing other stress biomarkers for comprehensive analysis. | 2021 |
| 9. | **Kumar et al.** [2] (Heart rate variability during examination stress in medical students) | Time-domain and frequency-domain HRV analysis | Observed reduction in HRV during exams, reflecting stress. | Did not include additional factors influencing HRV like lifestyle or sleep patterns. | 2022 |
| 10. | **Benchekroun et al.** [7] (Cross-dataset analysis for HRV-based stress detection models) | Machine learning models evaluated across datasets | Found variability in model performance across datasets, emphasizing the need for generalizable stress detection algorithms. | Generalizability was challenging due to inter-dataset variability in features and recording settings. | 2023 |
| 11. | **Haque et al.** [8] (State-of-the-art stress prediction using HRV and AI) | Artificial intelligence for HRV-based stress prediction | AI-based models improved stress prediction accuracy, showing potential for real-time applications. | Models require large datasets for training; computational cost can be high. | 2023 |

## COMPARATIVE STUDY TABLE OF APPLICATIONS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Application Name** | **Rating on Android** | **Rating on**  **IOS** | **Pricing** | **Functionality** | **Purpose & Stress Management Approach** |
| 1 | **Exam Stress** | 4.5 | 4.7 | Free | Offers relaxation techniques, motivational quotes, and breathing exercises. | Focuses on managing stress with relaxation strategies tailored for exam anxiety. |
| 2 | **7 Cups Therapy & Support** | 4.2 | 4.7 | Free with in-app purchases | Anonymous chat with trained listeners for emotional support. | Provides emotional support, reduces stress by fostering connections, and teaches positive coping strategies. |
| 3 | **SimpleMind Lite - Mind Mapping** | 4.4 | 4.7 | Free with Pro ($6.99 one-time) | Helps organize study plans and thoughts visually using mind maps. | Reduces stress by visually structuring study material and breaking down tasks. |
| 4 | **Study Bunny** | 4.7 | 4.6 | Free with in-app purchases | Tracks study time and rewards students for focused work. | Makes studying enjoyable and stress-free with a gamified approach to focus. |
| 5 | **Self-Help for Anxiety Management (SAM)** | 4.3 | 4.4 | Free | Provides CBT-based tools, stress trackers, and breathing exercises. | Uses evidence-based techniques to alleviate anxiety and stress, offering self-reflection tools. |
| 6 | **Exam Countdown** | 4.2 | 4.5 | Free | Tracks exam dates and sends reminders for effective time management. | Helps reduce anxiety by allowing for early exam preparation with a clear timeline. |
| 7 | **BeCalm** | 4.5 | 4.6 | Free | Offers guided meditations, soundscapes, and breathing techniques. | Lowers stress with relaxation tools, ideal for calming the mind before exams. |
| 8 | **Peak** | 4.5 | 4.8 | Free with subscription ($4.99/month) | Features cognitive games to boost memory and focus. | Improves cognitive abilities, mental agility, and preparedness for exams, thus managing stress. |
| 9 | **My Study Life** | 4.4 | 4.5 | Free | Organizes tasks, schedules, and exam dates. | Reduces stress by providing structured planning and eliminating exam-related chaos. |
| 10 | **Khan Academy** | 4.7 | 4.8 | Free | Provides learning resources, practice exercises, and video tutorials. | Eases exam stress by improving knowledge and confidence through comprehensive preparation. |

**References:**

[1] Saab, N., El-Akawi, G., Saab, R. H., Arslanian, L. S., & Moussa, M. A. (2019). Effects of acute stress on heart rate variability during university final examinations. Frontiers in Physiology, 9, 1629. https://doi.org/10.3389/fphys.2018.01

[2] Kumar, D., Bhushan, S., Kumari, R., & Das, A. (2022). Heart rate variability during examination stress in medical students. International Journal of Physiology. Retrieved from <https://www.researchgate.net/publication/365052297_Heart_Rate_Variability_During_Examination_Stress_in_Medical_Students>

[3] Patil, D. H., Kumari, G., Daware, P., Shinde, V., & Raina, A. P. (2015). Stress detection using heart rate variability. International Journal of Emerging Technology and Advanced Engineering, 5(1), 197. <http://www.ijetae.com>

[4] Yoo, H. H., Yune, S. J., Im, S. J., Kam, B. S., & Lee, S. Y. (2020). Heart rate variability-measured stress and academic achievement in medical students. Psychiatry Investigation, 17(3), 257-263. <https://doi.org/10.30773/pi.2020.0121>

[5] Sun, Y., Liu, Q., Xu, F., & Zhang, Y. (2021). Mental stress detection using wearable devices and heart rate variability monitoring. Sensors, 21(8), 2873. <https://doi.org/10.3390/s21082873>

[6] Castaldo, R., Sanna, A., Lamberti, G., Di Tullio, M. S., & De Sio, S. (2019). Ultra-short term HRV features as surrogates of short term HRV: A case study on mental stress detection in real life. BMC Medical Informatics and Decision Making, 19, 242. <https://doi.org/10.1186/s12911-019-0742-y>

[7] Benchekroun, M., Elkind Velmovitsky, P., Istrate, D., Zalc, V., Morita, P. P., & Lenne, D. (2023). Cross dataset analysis for generalizability of HRV-based stress detection models. Sensors, 23(4), 100776. <https://doi.org/10.3390/s23041807>

[8] Haque, M., et al. (2023). State-of-the-art of stress prediction from heart rate variability using artificial intelligence. Sensors, 23(4), 100776. <https://doi.org/10.3390/s23041807>

[9] Shokr, E. (2015). Effect of exam stress on heart rate variability parameters in healthy students. <https://www.researchgate.net/publication/288436652_Effect_of_Exam_Stress_on_Heart_Rate_Variability_Parameters_in_Healthy_Students>

[10] PhysioNet. (2021). A wearable exam stress dataset for predicting cognitive performance in real-world settings (Version 1.0.0). <https://physionet.org/content/wearable-exam-stress/1.0.0/>

[11] Tharion, E., Parthasarathy, S., & Neelakantan, N. (2009). Short-term heart rate variability measures in students during examinations. The National Medical Journal of India, 22(2).