SLEEP MONITORING SYSTEM

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| *Sachin Singh*  *Department of Computer Engineering*  *(Software Engineering)*  *FET, Jain (Deemed-to-be University)*  *Bangalore-562112*  [*sachinsingh2156@gmail.com*](mailto:sachinsingh2156@gmail.com) | *Manish Yadav*  *Department of Computer Engineering*  *(Software Engineering)*  *FET, Jain (Deemed-to-be University)*  *Bangalore-562112*  [*ymanish0428@gmail.com*](mailto:ymanish0428@gmail.com) | *Aayushma Thapa*  *Department of Computer Engineering*  *(Software Engineering)*  *FET, Jain (Deemed-to-be University)*  *Bangalore-562112*  [*aayushmathapa392@gmail.com*](mailto:aayushmathapa392@gmail.com) |

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| *Samyak Maharjan*  *Department of Computer Engineering*  *(Software Engineering)*  *FET, Jain (Deemed-to-be University)*  *Bangalore-562112*  [*samayakmaharjan3@gmail.com*](mailto:samayakmaharjan3@gmail.com) | *Karthikeyan S*  *Department of Computer Engineering*  *(Software Engineering)*  *FET, Jain (Deemed-to-be University)*  *Bangalore-562112*  [*link2karthikcse@gmail.com*](mailto:link2karthikcse@gmail.com) |

*Abstract*—In the realm of personal health and medical diagnostics, sleep monitoring systems have emerged as pivotal tools. This review provides a comprehensive examination of contemporary sleep monitoring technologies, delineating their evolution, functionalities, and applications. It commences with a brief overview of the importance of sleep monitoring in healthcare and personal wellness, followed by a detailed analysis of various types of sleep monitoring systems, including wearable devices, non-wearable technologies, and mobile applications. The report delves into the comparative effectiveness and accuracy of these systems, highlighting technological advancements and user experiences. A critical evaluation of the strengths, limitations, and user feedback of current systems reveals significant insights into their practicality and reliability. Additionally, the review explores the burgeoning developments in this field, particularly the integration of artificial intelligence and machine learning, which promises enhanced precision and user engagement. This report not only serves as a valuable resource for understanding current trends and challenges in sleep monitoring but also provides a vision for future research directions. It aims to assist healthcare professionals, researchers, and technology developers in comprehending the potential and limitations of existing systems, thereby fostering innovation in the development of more sophisticated and user-friendly sleep monitoring solutions.

Keywords— Collaboration, Digital Transformation, E-Learning, Innovation, Online Education, Payment Processing, Personalized Learning, Platforms, Security, Virtual Classroom

# **Introduction**

In recent years, the importance of sleep in maintaining overall health and well-being has gained substantial recognition, prompting a surge in the development and utilization of sleep monitoring systems. Sleep, a vital physiological process, plays a critical role in cognitive function, emotional regulation, and physical health. Disruptions in sleep patterns have been linked to a wide array of health issues, ranging from chronic diseases to impaired cognitive functions. Consequently, the accurate monitoring of sleep patterns has become a critical component in both clinical settings and personal health management.

The advent of sleep monitoring systems signifies a remarkable evolution in healthcare technology, offering individuals and healthcare professionals unprecedented insights into sleep patterns and quality. These systems, varying from sophisticated wearable devices to non-invasive home-based setups, leverage an array of sensors and algorithms to track various sleep parameters such as duration, stages, and quality of sleep. With the escalating prevalence of sleep disorders and growing public interest in health and wellness, these systems have become more than mere gadgets; they are now essential tools in preventive healthcare and personalized medicine.

This review report aims to provide an in-depth analysis of the current landscape of sleep monitoring systems. It encompasses a detailed examination of the technologies employed, their effectiveness, user experiences, and their applications in both clinical and personal contexts. By scrutinizing the latest advancements and identifying existing gaps in technology and application, the report seeks to offer a comprehensive perspective on the state of sleep monitoring technologies. It also aims to shed light on the future potential of these systems, considering the ongoing technological innovations and the increasing awareness of the importance of sleep health.

In navigating through the realms of technology, health, and personal wellness, this review stands as a testament to the intricate relationship between technological advancement and healthcare, and its profound impact on improving the quality of life.

The contribution of this review paper is summarized as follows:

I. Summarize all the available technology in the sleep monitoring field.

II. To make aware of the limitations of the current available technologies.

III. To allow the future researchers for the further scope.

# **RELATED WORK**

There are four categories, in which we can classify modern sleep monitoring technologies, currently under study.

A diagram of sleep monitoring

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*Fig. 1. Categories of Modern Sleep Monitoring Technologies*

Modern sleep monitoring tools practice diverse sensing technologies. These sensors can also be used for sleep staging. We do not cover sleep stages in the proposed system. PSG (polysomnography) is a type of sleep observing technology, which measures physiological factors such as breathing, temperature, muscle fluctuation, and oxygen saturation (SPO2). With the help of this technology, researchers can classify sleep-onset and wake-up time. A device has been attached to the wrist of the patient during his sleep to analyze the physical parameters or changes. It is investigated that there is a solid relationship between wrist movement and the sleep status of the user. In another method, there is the use of audio-video recording together with a Passive Infrared (PIR) sensor to detect the patient’s sleep status.

The current study shows an ambient sleep observation method using sensors that are installed in homes. This study comprises of PIR sensors for motion detection, interaction sensors, which are connected to windows and doors, environment temperature monitors to measure the temperature of a room, and some other devices, which can detect heat and energy.

# **EXISTING WORK**

Several devices are also available which are currently used for sleep evaluation at home as shown in Table. Many of these are accessible in the market for purchase. The following table shows the comparison between various sleep monitoring devices where REM (rapid eye movement) and NREM (nonrapid eye movement) are sleep stages.

Table 1. Various Sleep Monitoring System Accuracy.

A table with a list of information

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The iBrain encompasses the headband, which registers solo front lead EEG signals. Zeo is another device that comprises the headband of plastic and cloth material placed on the forehead, which measures electroencephalogram (EEG), electromyography muscle electromyogram (EMG), and electrooculogram (EOG) signals, where these signals are transferred to mobile phone through Wi-Fi or bluetooth. The Heally system encloses embedded sensors within a shirt, which are used to calculate the respiratory and cardiac movement of the patient. The SleepTracker is another device fixed to a watch. This wristwatch captures human activity during sleep. WakeMate consists of a band, which is worn on the wrist of the patient. This band sends actigraphy information to a mobile phone. This information consists of total sleep duration, how many times the patient is awake during sleep and “sleep quality” information based on physical activity. Air cushion consists of an air-filled beanbag, which can calculate several ambient and physical parameters. Emfit Bed Sensor consists of Emfit foil electrodes, which locates under a mattress to calculate parameters like respiration, heart rate, and body movement.

Nowadays, mobile devices are commonly used in everyday routine, which also provides several apps to monitor the sleep of patients. A system called ubiquitous architecture uses heart rate signals, sound signals, and accelerometer data for sleep monitoring. This idea works combining with the monitoring system through a smartwatch or smartphone. It also suggests an innovative and intelligent algorithm for the signal organization.

Even though, the abovementioned methods and tools have their benefits for analyzing patient’s sleep. There are many drawbacks as well. Most of them are not grounded on the IoT and machine learning. The IoT model consists of many sensing devices, data transfer protocols, and cloud computing tools, which is trending and emerging nowadays. Data processing is performed on devices like mobile devices, which requires a lot of energy that is why such models can only be feasible for a little time.

# **IMPLEMENTATION**

**Web App components**

The components of the Academates app, as outlined in the provided materials, would likely include the following:

* User Authentication System: To handle user login and maintain secure access.
* User Profiles: For both students and teachers, with details like qualifications, subjects, availability for teachers, and learning preferences for students.
* Search and Matching Engine: Allowing students to search for teachers by topic and other criteria.
* Appointment Scheduling: For students to request and teachers to manage appointments.
* Virtual Classroom Environment: With video conferencing, interactive whiteboards, and screen sharing capabilities.
* Payment Gateway: To process payments from students to teachers.
* Rating and Feedback System: For students to rate teachers and vice versa, along with leaving feedback.
* Content Management System: For teachers to upload notes and resources.
* Data Storage and Security: To securely store user data, session records, and other pertinent information.

These components come together to create a robust virtual learning platform designed to facilitate and streamline the online educational experience for both students and teachers.

**Steps and Flowchart**

The steps for an online personalized learning system are as follows:

A diagram of a teacher

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*Figure 2: Flowchart of Academates*

**Teacher Side**

Step 1: Teacher Login

Step 2: The teacher opens his profile.

step 3: The teacher checks the lecture requests.

step 4: If the lecture request is there, the teacher accepts or declines the request.

step 5: After accepting, the teacher can come back at the accepted time and take the class.

step 6: Add feedback about the students.

step 7: Get the payment.

**Student Side**

Step 1: Student Login

Step 2: Search for the desired lecture from the available teachers

Step 3: Submit a lecture request to the teacher.

Step 4: Wait for the teacher to accept or decline the request.

Step 5: If the request is accepted, be present at the scheduled time for the class.

Step 6: Participate actively in the class and take notes.

Step 7: After the class, review the feedback provided by the teacher, if any, and provide feedback to the teacher for the overall studying experience.

Step 8: Make the payment for the attended class.

Step 9: Check your profile for the progress.

A screenshot of a login form

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*Figure 2.1: welcome and login page*

This login page in Figure 2.1 is the gateway to the Academates platform, featuring a clean and user-friendly design. On the right, existing users are greeted with a straightforward interface to enter their username and password, with options to stay logged in or recover a forgotten password. A prominent 'Login' button initiates access to the system. A 'Sign Up' link is available for new users to create an account. The left side of the page showcases an illustration that reflects the collaborative and interactive nature of the platform, emphasizing education and technology.

A screenshot of a computer

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*Figure 2.2: Teacher Profile Page*

The teacher profile page within Academates serves as a personalized dashboard, providing an overview of a teacher's activities and interactions. It features sections for upcoming classes and assignments, a schedule calendar, ongoing lessons, and student grades. The sidebar allows navigation through different functionalities such as class schedules, grading, and accessing teaching materials. There's also a space for the latest updates, like approved scholarships, ensuring teachers stay informed. This interface streamlines the teaching process by keeping all relevant information and teaching tools in one accessible location, optimizing the educator's experience on the platform.

A screenshot of a cell phone

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*Figure 2.3: Teacher Search Page*

This page (Figure 2.3) on Academates is a directory for students to search and overview teachers available on the platform. It displays profiles of teachers with their names, subject expertise, and contact information, allowing for easy navigation and connection. The top bar categorizes teachers by subjects and topics for a more refined search, and individual cards provide quick links to more details or direct communication options. This setup facilitates the student's ability to find and interact with the right educators to suit their academic needs within the Academates ecosystem.

A screenshot of a computer

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*Figure 2.4: Student overview profile page*

In Figure 2.4, the profile overview page for Academates displays a student's educational engagement, featuring key statistics like courses completed, hours taught, and skills acquired. It provides a snapshot of the student's achievements and progress, with badges like "Dedicated Educator" rewarding consistent effort. A bio section allows personalization and a sidebar for easy navigation between different sections is present. Teacher details and a friends list encourage a community feel, fostering connections within the platform. This interface helps students track their academic journey and build a network, enhancing the learning experience on Academates.

# **RESULT**

The Academates project has successfully developed a robust and comprehensive online educational platform. It has achieved its goal of creating an interactive, user-friendly environment where students can easily find and engage with qualified teachers across various subjects. With features like live class streaming, interactive tools, and a secure payment system, the platform has enhanced the learning and teaching experience. Feedback from users has been positive, indicating high satisfaction with the platform's ease of use and the quality of educational content. Overall, Academates stands as a testament to the effectiveness of blending technology with education to foster an engaging virtual learning community.

# **CONCLUSION**

In conclusion, Academates represents a transformative leap in the realm of online education, addressing the prevailing challenges and reshaping the dynamics of teacher-student interactions. By establishing a user-centric platform that emphasizes transparency, security, and innovation, Academates not only connects educators and learners seamlessly but also enriches their experience through advanced tools like video conferencing and collaborative whiteboards. The robust rating system fosters a culture of trust and accountability, while future-oriented features such as AI-driven matching and multi-language support underscore our commitment to staying at the forefront of educational technology. As we propel into the future, Academates envisions becoming a cornerstone in the digital education landscape, offering a dynamic, accessible, and personalized learning journey for students worldwide, and providing a platform for passionate educators to share their expertise with an eager audience.

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