WAKE-BAND: WEARABLE ANTI-MICROSLEEP DETECTOR

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ABSTRACT

Wake-Band is a wearable anti-microsleep detector that helps to prevent brief, involuntary sleep episodes during periods of exhaustion, particularly while driving or performing attention-demanding jobs. The system uses a Mini ESP32 microcontroller, a MAX30102 heart rate sensor, an MPU6050 motion sensor, and a GPS module to track heart rate, movement, location, and speed in real time. Wake-Band detects early indicators of microsleep using a unique algorithm, which includes lowering heart rate, less movement, head drooping, and risky driving behaviour (for example, rapid speed dips or unsafe places). When the device detects both physiological and movement circumstances, it sends a vibration alarm to wake the user. Wake-Band, which is rechargeable, wearable, and affordable, provides a practical, student-driven solution for enhancing safety and attentiveness.

KEYWORDS: Wake-Band, Microsleep detection, vibration alert system.

PROBLEM AND OBJECTIVE

Wake-Band's main problem is the increasing risk of microsleep related accidents, particularly among individuals who perform tasks that require prolonged attention such as driving. Microsleep refers to a short, involuntary episode of sleep that usually occurs when a person is extremely tired or sleep-deprived. Although it lasts only a few seconds, it can cause a person to temporarily lose awareness of their surroundings, which may lead to dangerous situations such as road accidents. In Malaysia, fatigue and drowsy driving are significant contributing factors to traffic accidents, especially among long-distance drivers, delivery riders, and night-shift workers who often experience insufficient rest. The primary goal is to develop a dependable and reasonably priced wearable gadget that can identify early indicators of microsleep in real time, preventing mishaps and improving user safety. By utilizing a heart rate sensor, motion sensor, and GPS module to analyze indicators like decreasing heart rate, decreased movement, head drooping, and risky driving habits, this research specifically seeks to merge physiological monitoring with behavioral tracking. Providing an instant vibration alarm system that can successfully bring the user back to consciousness prior to a microsleep episode is another goal.

Furthermore, Wake-Band aims to provide a useful and user-friendly solution that is rechargeable, pleasant for extended usage, and available to high-risk groups like drivers, delivery riders, and students. Overall, the project aims to deliver an innovative, student-driven technology that reduces fatigue-related risks and contributes to safer road environments in Malaysia.

DESIGN DESCRIPTION

Microsleep is a brief, involuntary sleep episode that can occur during long journeys or times of exhaustion, contributing to a high rate of traffic accidents in Malaysia. Long-distance truckers, night shift workers, and motorcyclists face the greatest risk. Current awareness campaigns are insufficient because users lack a real-time technology capable of detecting early indicators of microsleep and dangerous driving behaviour. To address this issue, our team created Wake-Band, a wearable anti-microsleep detector that includes a motion sensor, heart rate sensor, and GPS module. The device tracks movement, heart rate, location, and speed to detect signs of drowsiness or risky driving. When Wake-Band detects microsleep, it activates a vibration alarm to restore user awareness. Wake-Band, which is rechargeable, easy to wear, and affordable, is aimed at drivers, delivery riders, and students, offering a practical and innovative solution to eliminate microsleep-related dangers. As we delve into the specifics of Wake-Band's features, objectives, novelty, and commercial potential, a careful analysis is necessary to assess its effectiveness, practicality, and societal impact.

VISUALS

The Wake-Band is extremely practical and beneficial since it provides a simple, accessible, and affordable solution to microsleep detection, as opposed to many existing solutions, which are complex, expensive, and primarily aimed at professional or large-scale consumers. Its wearable and portable design makes it suitable for usage by anyone, including drivers, students, night shift workers, and machine operators, without the need for installation, calibration, or technical knowledge. By offering real-time notifications via vibrations or sound, the device helps to prevent accidents and loss of focus, making it useful for both safety and productivity. Beyond instant notifications, the Wake-Band can track fatigue patterns and sleep-related data, providing users with valuable insights into how to enhance their daily habits and general well-being. The Wake-Band's simplicity, mobility, and continual utility make it a practical and broadly relevant innovation for everyday living.



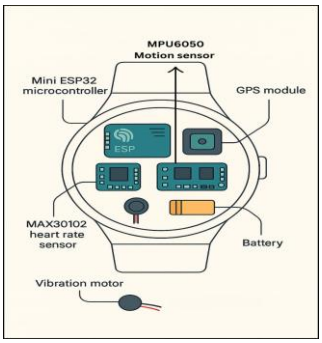


Figure 1: Front View

Figure 2: Component View

NOVELTY AND UNIQUENESS

Combining motion sensing, heart rate monitoring, and GPS tracking in one wearable device introduces something new and unusual to microsleep prevention. Wake Band uses this integrated approach to observe both the user's physical condition and driving behaviour at the same time, and therefore it can detect early signs of drowsiness with greater accuracy. Furthermore, Wake Band provides an immediate vibration alert when risky behaviour appears, and this direct response makes it different from awareness campaigns or ordinary fitness trackers that cannot react in real time.

Designed specifically for high risk groups, Wake Band also offers an unusual level of practicality because it is light, rechargeable, and comfortable for long hours of use. These features make it more accessible than many specialised safety tools that are often expensive or inconvenient. Moreover, Wake Band focuses on both physical and behavioural changes together, and this gives it a clear advantage over general wearables that are not created for accident prevention. As a result, Wake Band stands out as a new and impactful innovation that can reduce microsleep incidents and improve community safety.

BENEFITS TO MANKIND

Wake-Band helps reduce the risk of accidents caused by microsleep by detecting early signs of drowsiness and alerting the user in real time. This improves safety for drivers, workers, and students who often experience fatigue during long hours of activity. By providing an affordable and wearable solution, the device makes fatigue monitoring accessible to a wider population. Wake-Band also improves quality of life by increasing awareness of personal health and alertness, allowing users to take preventive actions and maintain safer and more responsible behaviour during daily activities.

COMMERCIAL POTENTIAL

Wake-Band shows strong commercialization potential as an affordable solution to reduce microsleep-related risks among drivers in Malaysia. Between 2011 and 2021, 1,305 road accidents were linked to driver fatigue (Abu Hanifah, 2024). Most existing fatigue detection systems are only available in expensive vehicles, making them inaccessible to many users. Wake-Band offers a lightweight, wearable device that detects early signs of fatigue and provides real-time alerts. Its compact design and low power consumption make it practical for daily use, especially for drivers and p-hailing workers who often experience long working hours.

CONCLUSION

Wake-Band offers a practical and innovative solution to the increasing problem of microsleep-related accidents in Malaysia. By integrating motion sensing, heart rate monitoring, and GPS tracking into a single wearable device, it can detect early signs of drowsiness and alert users through a real-time vibration system. Its affordability, portability, and ease of use make it

an accessible safety tool for drivers, workers, and students who often experience fatigue. The project has strong potential to improve user awareness and safety while contributing to reduced accident rates. With its novelty, practicality, and commercialization potential, Wake-Band can significantly enhance road safety and community well-being.

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