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Somnific Smart Pillow An App Integrated Device For Insomnia Patients

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ABSTRACT

The one of most essential needs for human survival are sleep. Without proper sleep, life becomes extremely difficult and unhealthy. Some factors like stress, anxiety, shift work often lead to sleep disorders such as insomnia, sleep apnea, parasomnia, and narcolepsy. These disorders significantly affect a person's quality of life by reducing their efficiency, concentration, and overall well-being.our aims to help individuals suffering from sleep disorders by making the surroundings more conducive to perceiving and responding to electromagnetic fields, thereby improving sleep quality without the use of drugs.

Keywords: *Insomnia, parasomnia, narcolepsy, geomagnetic field, conductive.*

1. INTRODUCTION

In today's fast-paced world, people are under constant pressure due to stress, increased workloads, and the need to adapt to economic challenges such as inflation. The widespread use of electronic devices and exposure to artificial lighting further disrupts the body’s natural circadian rhythm and reduces the ability to perceive. Recent advancements in wearable technology offer new possibilities for real-time sleep monitoring. existing solutions often lack integration with therapeutic feedback mechanisms. This study addresses that gap by designing a mobile-controlled smart pillow system for insomnia patients.

2. OBJECTIVE

Recent advances in smart technology and biofeedback systems have enabled the development of innovative tools for monitoring and improving sleep quality. Smart pillows, in particular, have emerged as a promising approach to track sleep patterns and deliver therapeutic interventions. While several commercial devices offer sleep tracking capabilities, few incorporate active therapeutic feedback mechanisms to aid in inducing and maintaining sleep. This paper presents the development of a mobile-controlled smart pillow system designed specifically for individuals suffering from insomnia. The system integrates a mobile application with circuit that controls an electromagnetic coil. The electromagnetic field is intended to create a calming effect, potentially enhancing sleep onset and quality.

3. LITERATURE SURVEY

1.Cove: Cove’s patented vibration technology stimulates specialized skin receptors, which interpret the vibration signal as affective touch; in doing so, the device activates the affective touch response in the brain, promoting activity in the insula.

2.Muse S headband: Muse gives you audio feedback based on your brain activity, teaching you how to master your mind and gain more control over your focus. Incase headbands are tight then it may cause traction alopecia, hair breakage, and scalp strain, especially around the hairline.

3.Dodow: It projects a calming blue light, which works as a guide for your breathing, and helps you to fall asleep naturally, and on average 2.5 times faster than on your own." "At the end of the 8 or 20minute cycle, the sleep aid shuts off automatically, leaving you in the perfect place to fall asleep.

4.CES: Cranial Electrotherapy Stimulation, the current influences electrical activity in the brain, particularly in areas involved in mood regulation and sleep (like the limbic system and hypothalamus). It may help increase alpha brainwaves, which are associated with calm, relaxed states.

4. METHODOLOGY

The magnetic field associated with the Earth is called the geomagnetic field. It is essentially dipolar—having two poles: the North Pole and the South Pole. Near the Earth's surface, the magnetic field is stronger, but as we move away from the surface, the field becomes distorted.

According to Faraday's Law of Induction, when electricity passes through a coil, it generates an electromagnetic field. This principle is the basis for the sleep inducer's methodology. Through this we create an artificial electromagnetic field as natural geomagnetic field which doesn't produce any side effects.

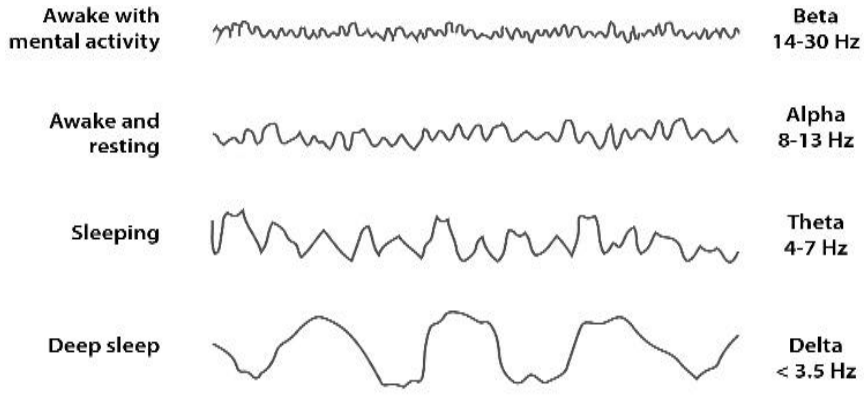


Fig-1

5. BLOCK DIAGRAM

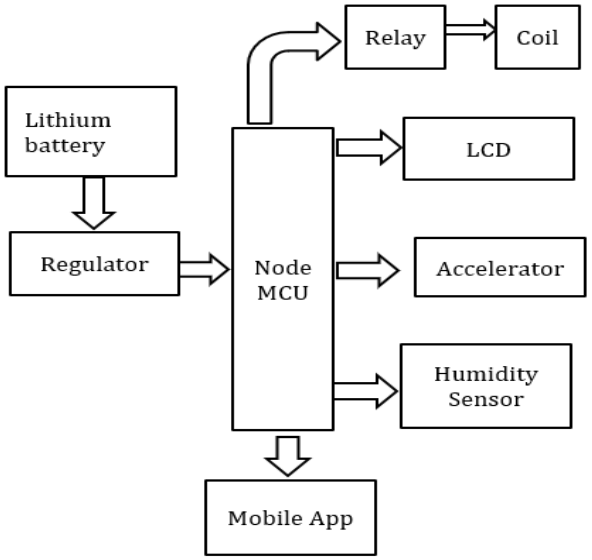


Fig-2

6. HARDWARE COMPONENTS

A. Node MCU (ESP8266)

Node MCU (ESP8266) serves as the central processing unit of the system. Node MCU is responsible for acquiring sensor data, processing the information, and controlling the heating element based on predefined thresholds. It also facilitates communication with a mobile application via Wi-Fi, providing users with real-time data access and control.

B. DHT11 Temperature and Humidity Sensor

The DHT11 sensor is employed to monitor the environmental temperature and humidity levels around the user. It is a digital sensor that combines a capacitive humidity sensor and a thermistor for temperature measurement.

Specifications:

1.Temperature range: 0–50°C with ±2°C accuracy.

2.Humidity range: 20–90% RH with ±5% accuracy.

It communicates with the Node MCU (ESP8266) via a single-wire digital interface, ensuring simple integration and low power consumption.

C. Accelerometer (ADXL345)

The smart pillow system employs the ADXL345, a compact and low-power 3-axis digital accelerometer, to detect head movements, sleep posture, and body orientation during rest. This sensor plays a critical role in analyzing sleep patterns, identifying restlessness, and detecting abnormal motion behaviors that may indicate discomfort or underlying health issues. The sensor communicates with the Node MCU (ESP8266) via the I2C or SPI protocol, enabling fast and efficient data transfer with minimal wiring complexity. In this application, the accelerometer is embedded within the pillow and calibrated to:

1.Detect slight shifts in head position,

2.Monitor body orientation or postural changes during sleep,

D. LCD Display Unit

To provide immediate and user-friendly access to real-time system data, the smart pillow integrates a Liquid Crystal Display (LCD) module. Specifically, a 16x2 alphanumeric LCD is employed, capable of displaying two lines of 16 characters each, which is sufficient for showing critical information such as temperature, humidity, and system status.

It is connected to the Node MCU (ESP8266) via a parallel data interface, often using an I2C adapter to reduce pin usage and simplify wiring.

E. Relay Module

The smart pillow system incorporates a relay module to enable the controlled operation of the heating coil, based on the environmental temperature measured by the DHT11 sensor. A relay acts as an electromechanical switch, allowing the low-power Node MCU (ESP8266) to safely control a high-power load, such as the heating element. The relay used in this system is a single-channel 5V electromagnetic relay, which can be triggered by the microcontroller's digital output. It serves as an interface between the logic-level signals of the Node MCU and the higher-voltage circuit powering the heating coil.

F. Coil Module and its Functional Role in the Smart Pillow System

In the proposed smart pillow system, the coil plays a pivotal role in enhancing user comfort and potentially aiding sleep through the generation of a controlled electromagnetic field. As depicted in the block diagram (Fig 1), the coil is interfaced with a relay, which is in turn managed by the Node MCU (Microcontroller Unit). This arrangement allows the system to selectively energize the coil based on real-time physiological and environmental data. The coil module is actuated via a relay switch, enabling the microcontroller to regulate the coil's activity without direct electrical loading. This ensures safety and energy efficiency, especially in portable, battery-operated systems. The electromagnetic field produced by the coil is hypothesized to stimulate relaxation responses in the human body, based on principles of low-frequency electromagnetic therapy. The activation of the coil is conditionally triggered based on sensor data collected from the accelerometer (for body posture/movement) and humidity sensor (to assess sleeping conditions).

Thus, the integration of the coil within the smart pillow not only introduces a novel mechanism for non-invasive sleep modulation but also aligns with the broader objective of real-time, user-responsive health monitoring facilitated by the Internet of Things (IoT).

G. Regulator

The voltage regulator serves as a critical intermediary between the lithium-ion battery and the system's electronic components. To address this mismatch, a voltage regulator is used to convert and stabilize the input voltage, ensuring

consistent and safe operation across all hardware modules. The use of a voltage regulator also contributes to energy efficiency, minimizing unnecessary power dissipation and thereby extending battery life

Overall, the voltage regulator ensures power reliability and system integrity, acting as a safeguard for the sensitive electronics used in continuous health monitoring applications.

H. Lithium Battery

In this system, the lithium battery supplies a nominal voltage (typically 3.7V), which is regulated to a stable 5V using a voltage regulator circuit to power the Node MCU and associated sensors. This ensures safe and consistent operation of all electronic components without voltage fluctuation or damage. The use of a battery-driven power supply eliminates the need for continuous wired power, enhancing user mobility and ensuring comfort during sleep.

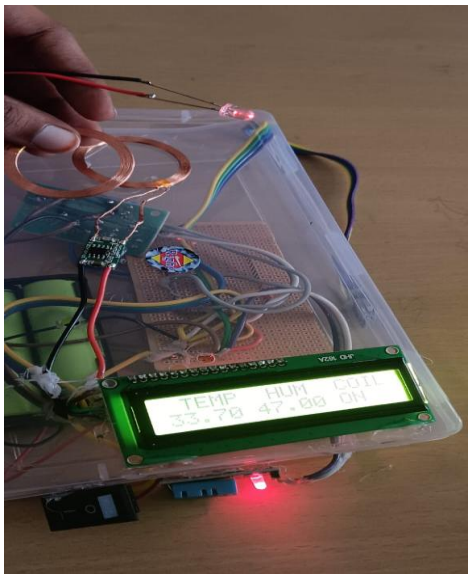
The lithium battery can be recharged via USB or a dedicated charging circuit, making the system energy-efficient and sustainable for long-term usage. Battery management techniques, such as overcharge protection and discharge monitoring, can be integrated to further enhance reliability and safety.

I. Mobile Application Interface

To enhance user accessibility and promote remote health monitoring, a mobile application is integrated as the system's primary user interface. The application receives real-time data from the smart pillow system via the Wi-Fi-enabled Node MCU (ESP8266) and presents key physiological and environmental parameters in a structured and user-friendly format. The wireless communication ensures that on - off purpose for induces the electromagnetic coil to function.

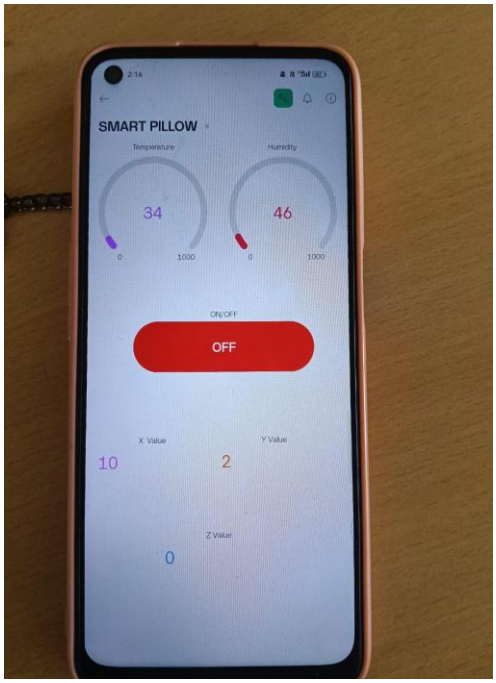
7. IMPLEMENTATION

The sleep inducer system is implemented by embedding low-frequency electromagnetic wave emitters within a memory foam pillow. These emitters are controlled via a wifi enabled microcontroller, which connects to a mobile app. The app allows users to customize stimulation settings, track sleep patterns, and schedule automatic shut-off.



8. RESULT

The App-Integrated Sleep-Inducing Smart Pillow was evaluated based on its ability to enhance sleep quality through the controlled use of low-frequency electromagnetic waves. The results are categorized into three key areas: waveform generation accuracy, app functionality, and user sleep experience.



9. CONCLUSION

The development of a sleep-inducing smart pillow that utilizes electromagnetic wave stimulation such as low-frequency pulsed electromagnetic fields (PEMF) or Cranial Electrotherapy Stimulation (CES) offers a promising, non-invasive solution to address sleep disorders and improve overall sleep quality. By integrating this technology with a mobile application, users gain personalized control, real-time monitoring, and tailored sleep programs based on individual sleep patterns and preferences.

This innovative combination not only enhances user comfort and convenience but also aligns with modern trends in digital health and wellness. With further validation through clinical testing and user feedback, the smart pillow has the potential to become a valuable tool for those seeking safe, tech-assisted sleep support—bridging the gap between neuroscience, smart devices, and holistic well-being.

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