

An IoT-Based Sleep Inducer Using Geomagnetic Field

E. Udhayakrishna¹

Dept. of Biomedical Engineering
Sri Venkateshwaraa College of Engineering and Technology
Ariyur, Puducherry.
udhayakrishna155@gmail.com

S. Kalaiventhn²

Dept. of Biomedical Engineering
Sri Venkateshwaraa College of Engineering and Technology
Ariyur, Puducherry.
kalaiventhn@gmail.com

R. Kaleem³

Dept. of Biomedical Engineering
Sri Venkateshwaraa College of Engineering and Technology
Ariyur, Puducherry.
kaleemrasool10@gmail.com

S. Thulasiraman⁴

Dept. of Biomedical Engineering
Sri Venkateshwaraa College of Engineering and Technology
Ariyur, Puducherry.
thulasiraman@gmail.com

A. Rajalakshmi⁵

Assistant Professor
Dept. of Biomedical Engineering
Sri Venkateshwaraa College of Engineering and Technology Ariyur, Puducherry.
rajaianush@gmail.com

Abstract — A state of sleeplessness at night, premature awakening in the morning, and frequent wake-ups throughout the nocturnal hours are what makeup insomnia- a condition that could impede one's daily affairs. Insomnia can cause daytime drowsiness, and poor concentration, and leave individuals feeling unrested. Induceable insomnia, often experienced by people worldwide, can stem from stress as a result of external and internal stimuli. Examples may include overwhelming workloads or challenging relationship dynamics leading to persistent anxiety. The interplay of a planet's magnetic flux and its geomagnetic fields is intimately linked, given the former always inevitably assumes a dipolar form on the surface. People tend to experience better sleep under natural environmental conditions, likely due to their ability to unconsciously perceive the earth's natural magnetic fields. This project aims to design a circuit that emits an electromagnetic field of low frequency through a radiator coil to help create an ideal sleep environment. The developed model provides an inexpensive and accessible system to help individuals overcome insomnia.

Keywords— insomnia, magnetic flux, stress, electromagnetic field.

1. INTRODUCTION

Insomnia is a sleep disorder that causes difficulty falling asleep or staying asleep. It can be a short-term or long-term problem and may come and go. Acute insomnia lasts for up to several weeks, while chronic insomnia occurs at least three nights a week for three months or more. Insomnia can result in daytime sleepiness, low energy, irritability, and depression, which can lead to an increased risk of accidents and difficulties with focus and learning. Insomnia can be caused by various factors such as stress, chronic pain, heart failure, hyperthyroidism, heartburn, restless legs syndrome, menopause, certain medications, and drugs like caffeine, nicotine, and alcohol. Other risk factors include working night shifts and sleep apnea. Diagnosis is based on sleep patterns and an examination to look for underlying causes. Screening for insomnia can be done with two questions.

Sleep hygiene and lifestyle changes are typically the first lines of treatment for insomnia, and cognitive-behavioral therapy can be added. While sleeping pills can help, they are associated with injuries, dementia, and addiction and are not recommended for long-term use. The effectiveness and safety of alternative medicine are unclear. Between 10% and 30% of adults experience insomnia at any given time, and up to half of people experience insomnia in a year. Insomnia is more common in people over the age of 65 and women than men. Insomnia has been described since ancient Greece.

Sleep-related breathing disorders (SRBD) describe a group of disorders that involve difficulty breathing during sleep, including obstructive sleep apnea (OSA). These are common symptoms are seen. OSA occurs when the airway is obstructed during sleep, leading to hypoxemia and hypercarbia. Obesity and abnormal facial contours are primary risk factors for OSA. SRBD can range from frequent loud snoring to OSA and can affect up to 57% of men and 40% of women who are obese or snore repeatedly during sleep. Polysomnography (PSG) or sleep study is the gold standard for diagnosing sleep-related disorders. However, PSG has limitations such as expense, long wait times, limited availability, and inconvenience. To overcome these limitations, new techniques use a geomagnetic field to induce sleep for insomnia

patients. Since it is an IoT device that sends a message of the patient's heartbeat whether the patient is active or resting by using a heartbeat sensor.

B.Types of Insomnia:

1. Primary Insomnia: It is a type of insomnia that is not caused by another medical condition, medication, or substance. It is often related to psychological factors such as stress or anxiety. Treatment for primary insomnia may involve lifestyle changes and/or cognitive behavioral therapy.

2. Secondary Insomnia: It is a type of sleep disorder that is caused by an underlying medical or psychiatric condition. It can also be caused by substance use or medication. Treatment of the underlying cause is essential to improve sleep quality.

2.PROPOSED SYSTEM

The act of sleeping is a crucial uncontrived phenomenon that holds significant meaning for our overall physical and psychological health. The state of being unable to fall asleep or remain sleeping, known as insomnia, is a difficult and intricate condition that poses significant treatment challenges. Some people turn to harmful medications to cope with insomnia. Nevertheless, diverse means of addressing this sickness exist. One such method employs a device that discharges an electromagnetic field possessing low frequency to produce a conducive atmosphere for slumber. In our proposed module, we aim to help insomniacs achieve a peaceful night's sleep by using a sleep inducer that sends waves to the brain at a specific frequency. In this project, we can produce low-frequency magnetic up to 15Hz and additionally, we added a heartbeat sensor to sense insomnia patient heart rate level in addition to that we induce alpha, beta, and theta waves also.

A. Brain Wave Pattern.

1. Beta (14-30Hz) –It is a type of neural oscillation that reflect the fast electrical activity of the brain when it is actively engaged in cognitive tasks, such as problem-solving, decision-making, and focusing attention.

2. Alpha (8-13.9Hz) –It is a type of neural oscillation that occurs in the human brain when a person is

awake but relaxed and is associated with a state of calmness, relaxation, and meditation.

3. Theta (4-7.9Hz) – It is a low-frequency brain wave that is linked to various mental and emotional states, including deep relaxation, meditation, visualization, and dreaming.

4. Delta (1-3.9Hz) - They are the slowest brain waves and are important for the restorative functions of the body during sleep.

B. Reasons for Insomnia.

There is a multitude of reasons why insomnia may occur, consisting of stress-related factors, anxiety-associated issues, depression-triggered causes as well as medical conditions which could lead to sleep deprivation. Furthermore, medications that one might be taking and substance abuse could contribute to the development of insomnia too. Poor habits when it comes to sleeping patterns also tend to harm our sleep quality while shift work can disrupt restful nights. Finally yet importantly aging itself tends to take away from healthy slumber for some individuals. To successfully tackle insomnia, it is imperative to pinpoint and resolve the root cause(s) via modifications in one's lifestyle, counseling sessions, treatment with pharmaceuticals, or an amalgamation of different strategies. It is within the realm of possibility to enhance one's quality of sleep by means such as bolstering their nocturnal behavior, regulating psychological states related to stress and unease, tending to any medical predicaments that may be contributing factors, altering prescribed pharmaceuticals in conjunction with professional supervision or employing sleep-inducing substances upon the advice of a healthcare specialist.

C. HARDWARE USED

Components used are

1. Arduino - Simplifying electronics prototyping to use hardware and software.
2. LCD Display -It is a type of flat panel display technology that uses liquid crystals to produce images.
3. PWM TRIGGRING DRIVE -It is a technique for varying the width of pulses in a periodic signal to control the amount of power delivered to a load

4. Heart beat sensor – It is a device that measures a person's heartbeat and provides real-time data about their heart rate and pulse

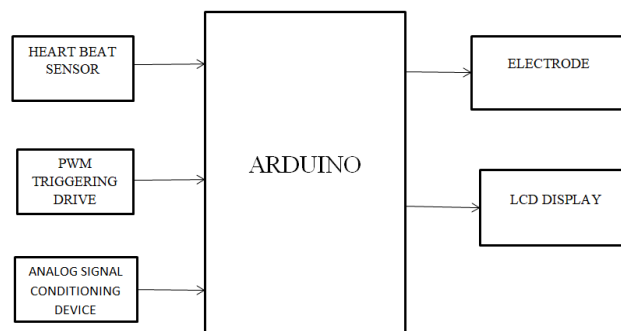


Fig. 1. Block diagram of Proposed System.

D. Brief about the components used:

1. Arduino - Among its merits is that it has been fashioned to allow easy access not just for seasoned professionals, but also hobbyists and scholars alike given the fact of being open-source in nature. The assemblage embodies a manipulable grid plate, an arena for software creation and modification operations, alongside a copious throng of users and developers predisposed to transferring their expertise along with projects. Within the circuit board domain, Arduino boards boast microcontrollers endowed with programmable capacities that enable them to execute diverse functions through a streamlined programming language and pre-existing codebases. This feature furnishes users with an effortless channel for translating their innovative ideas into tangible projects. Arduino's utility transcends a vast spectrum of domains, encompassing robotic engineering, process automation, the Internet of Things (IoT), as well as innovative expressions in creative arts. Its adaptability and cost-effectiveness have contributed to its widespread adoption for experimentation and inventive exploits within the electronics domain.

2. LCD Display - In the vast world of electronic devices, there is a particular type of flat-panel display technology that has established itself as an

eminent figure. It has gained widespread popularity and can be found in various gadgets including televisions, computer monitors, and digital clocks. In the composition of LCDs, we observe a conglomerate of layers that comprises two polarizing filters, an encompassing liquid crystal material, and a source for illumination at the rear. Liquid crystal material changes its optical properties in response to an applied electric field, allowing light to pass through or be blocked to create images and text. The technological displays that operate on liquid crystal are more advantageous over other types due to their minimal power usage, advanced picture quality, and compact framework.

3. PWM TRIGGRING DRIVE – It is a type of electronic circuit used to regulate the power delivered to a load. It works by rapidly turning the power on and off at a high frequency, with the width or duty cycle of the pulse being controlled by a modulating signal. The resulting waveform has a fixed frequency and variable pulse width, which can be used to control the average power delivered to a load such as an LED, motor, or heater. PWMs are widely used in a variety of applications, from motor speed control and audio amplification to power supply regulation and battery charging. They offer several advantages over traditional linear regulators, including high efficiency, low power dissipation, and precise control over the output voltage or current. The key to achieving optimal performance from a PWM circuit is selecting the appropriate components and tuning the control loop to ensure stability and reliability. PWMs have become an essential tool for electronics designers looking to create efficient and reliable circuits for a wide range of applications.

4. Heart Beat sensor - A technological apparatus denoted as a pulse-measuring gadget, or simply the heartbeat sensor is capable of quantifying the heart rate of an individual. The operation of the device is based on utilizing either an optic or electronic receptor to spot the palpitation of blood vessels in dermal tissue, which aligns with the rhythmic pumping motion generated by cardiac systole. The sensor then converts these signals into a digital output that can be read by a computer or mobile device. Heart rate sensors are commonly used in fitness tracking devices, sports watches, and medical monitoring equipment to track heart rate during exercise, rest, and recovery. These sensors can be worn on the wrist,

chest, or other parts of the body and can provide real-time heart rate data to help users track their fitness goals and monitor their cardiovascular health. Some advanced heart rate sensors also include additional features such as GPS tracking, sleep monitoring, and personalized workout recommendations. The accuracy of heart rate sensors can vary depending on the quality of the device and the location where it is worn, but with regular calibration and proper usage, they can be a valuable tool for individuals looking to improve their overall health and fitness.

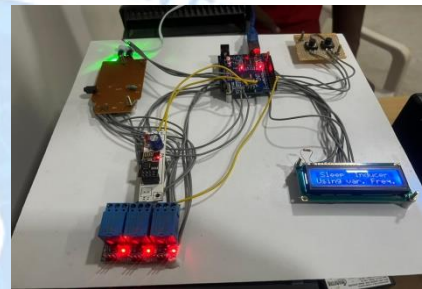


Fig. 2. Prototype of Biomedical sleep inducer.

E. Advantages of geomagnetic sleep inducer.

By this method, It can generate a frequency up to 15Hz Not only induce delta waves in addition it can create Alpha, Beta, and Theta waves. Promote good sleep without certain medications. This project sends a message to the guardian about the sleep condition of insomnia patients through a heartbeat sensor.

F. Limitations.

Still, we need more research about the brain wave patterns. Measurement of low-frequency magnetic is difficult in terms of accuracy.

IV. Result and Conclusion.

This project serves a dual purpose by offering assistance to individuals suffering from insomnia while also aiming to induce relaxation, improve attention, enhance focus, and facilitate learning. Notwithstanding, to augment our perception of the implications and processes at play here, supplementary data on brainwave

patterns correlated with these desired consequences is essential. Through a comprehensive exploration of the intricate formations of brainwave rhythms, we have an opportunity to procure priceless perceptions concerning the neural mechanisms that support this particular endeavour.

References

- [1] Y.Morita, K. Yamaguchi, K. Ashida, R.Ikeuraand K. Yokoyama, "Verification of sleep-inducing effect by excitation apparatus simulating mother's embrace and rocking motion," Robot Motion and Control (RoMoCo), 2013 9th Workshopon, Kuslin, 2013, pp.80-85.doi: \10.1109/RoMoCo.2013.6614588
- [2] Z. Zhang et al., "Automatic sleep onset detection using single EEG sensor," 2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Chicago, IL, 2014, pp. 2265-2268.
- [3] Z. Zhang et al., "Reduction in time-to-sleep through EEG-based brain state detection and audio stimulation," 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Milan, 2015, pp. 8050- 8053. doi:10.1109/EMBC.2015.7320261
- [4] MujawarUlfatjahan, Poornima, Prof. S.P. Tondare, Prof. S.P. Gaikwad Department of Electronics, Bharati Vidyapeeth College of Engineering, Pune, India Volume: 04 Issue: 04 Apr -2017eISSN: 2395 - 0056, p-ISSN: 2395-0072, Sleep Inducer
- [5] J D. Burman, "Sleep Disorders: Sleep-Related Breathing Disorders," FP Essentials, Vol. 460, pp. 11–21, Sep 2017.
- [6] Y.Morita, K. Yamaguchi, K. Ashida, R.Ikeuraand K. Yokoyama, "Verification of sleep-inducing effect by excitation apparatus simulating mother's embrace and rocking motion," Robot Motion and Control (RoMoCo), 2013 9th Workshopon, Kuslin, 2013, pp. 80-85.doi: \10.1109/RoMoCo.2013.6614588
- [7] MujawarUlfatjahan, Poornima, Prof. S.P. Tondare, Prof. S.P. Gaikwad Department of Electronics, Bharati Vidyapeeth College of Engineering, Pune, India Volume: 04 Issue: 04 Apr -2017eISSN: 2395 - 0056, p-ISSN: 2395-0072, Sleep Inducer
- [8] D. Burman, "Sleep Disorders: Sleep-Related Breathing Disorders," FP Essentials, Vol. 460, pp. 11–21, Sep 2017.
- [9] S. Lokavee, V. Tantrakul, W. Suwansathit, J. Pengjiam, and T. Kerdcharoen, "Detection of Sleep-Disordered Breathing and Sleep Efficiency with Wireless Pillow-Sheet Sensor Network," IEEE International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTICON), pp. 838-841, July 2019.
- [10] S. Lokavee, V. Tantrakul, W. Suwansathit, J. Pengjiam, and T. Kerdcharoen, "Efficacy of Positional Therapy Prototype for Patients with Positional Obstructive Sleep Apnea," 2020