Department of Electronics and Telecommunication Engineering
University of Moratuwa

BM1190 – Engineering Design Project

Project Final Report

Dream Guard

by

The I-V Leaguers

Submitted by

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Content

1. Introduction

The aim of this project is to design and develop a biomedical sleep inducer to improve the sleep quality of individuals. The project is undertaken by a team of four Engineering undergraduates from the University of Moratuwa. The following report provides details of the progress made towards achieving the project objectives.

1.1 Problem Description

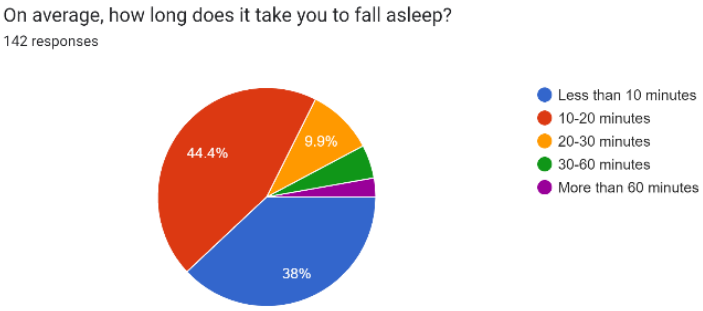
This disorder is mainly characterized by the dissatisfaction of the sleep duration or quality and difficulties going into sleep or maintaining sleep. The lack of sleep creates greater distress and difficulties during daytime functioning. Fatigue, erratic moods, lack of focus, poor work performance, and several other issues can be results of insomnia. Even though the disorder is very common, it can be difficult to understand due to the lack of knowledge of the disease. That lack of understanding, and the problems with the standard treatment methods have resulted in a significant number of patients living their lives suffering from the disease without trying a solution.

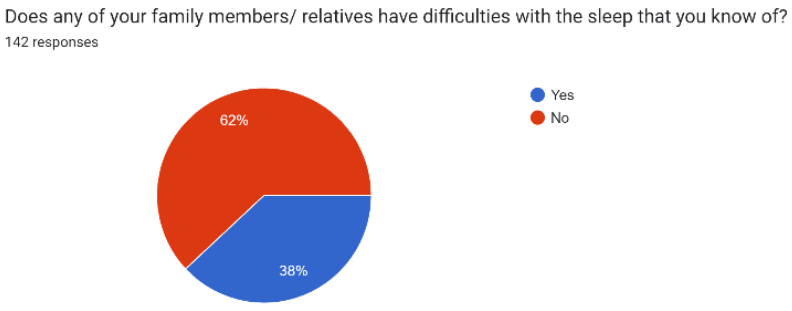
1.2 Motivation

Recently, insomnia was recognized as a disorder that needs to be treated directly than treating the symptoms, doctors now recognize insomnia as a separate disorder. This has led to new treatments that are more specific to sleep problems. Instead of using generic treatments like medicine or talk therapy, doctors are using treatments that focus on helping people with insomnia specifically. Due to the ineffectiveness of psychological therapies and harmful side effects of chemical drugs, a long-time solution needed to be addressed.

1.3 Justification for selection

A biomedical sleep inducer could be an effective and long-term solution to treat insomnia. It would use a non-invasive technique, using magnetic fields to alter brain activity and promote sleep. As this approach doesn’t use drugs, the side effects to the patients will be minimum and future health issues won’t be raised due to the drugs. Also, a portable sleep inducer can be taken anywhere, and it is a cost effective which is practically usable than spending a lot of money and going to meet therapists or taking medicinal drugs.





The survey results show that a significant portion of participants take up to 30 minutes to fall asleep, and a high percentage of respondents have at least one person in their household who struggles with sleeping.

2. Technical Feasibility

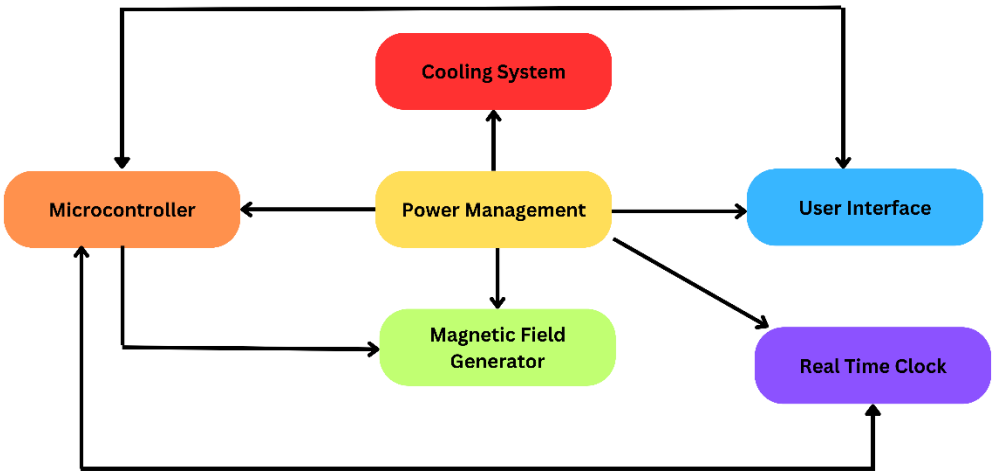
The technical feasibility of the proposed biomedical sleep inducer project is supported by the availability of the required resources and the demonstrated ability to achieve the project's performance targets. Firstly, the required resources such as the magnetic field generator, microcontroller (ATMega328P), control circuitry, power management components, cooling system, and user interface components are all widely available on the market. These components have been used in various biomedical and consumer electronic devices and have proven to be reliable and effective. We have used three 3.7V Li-ion rechargeable batteries to power up the device. For our device components such as the OLED Screen, RTC, and Atmega 328P, we want a stable 5V voltage. LM7805 Voltage Regulator has been used here to regulate the voltage to 5V efficiently.

Secondly, the performance targets involve generating a magnetic field to stimulate brain activity. Additionally, the timer system has been included to switch off the device at the time that the timer is set. Using the RTC module, code the ATmega328P chip using Arduino and use it for the device. We also use an OLED display 128×64 and buttons to interact with the users.

Finally, the use of a rechargeable battery, 12V adapter, and a Li-ion 18650 3s 20A BMS PCM Battery Protection Board for power management ensures that the device is portable and easy to use. The development of the user interface is also a well-established technology, and the microcontroller and control circuitry can be programmed to achieve the desired functionality. In summary, the technical

feasibility of the proposed biomedical sleep inducer project is supported by the availability of required resources, proven performance of the components, and demonstrated ability to achieve the project's performance targets.

3. Product Architecture



3.1 Power Management

The power management of Dream Guard uses three 3.7V rechargeable batteries and BMS to utilize the power for portability and protect these batteries from overcharging. As the main device component OLED is used to display time and RTC is used to measure the passage of time. LM7805 voltage regulator regulates the voltage to 5V efficiently. Atmega328p is the brain of this device which controls all the activities of this device. As the key component, a coil is used to generate the electromagnetic field with required frequency.

3.2 Magnetic Field Generator

Generate an electromagnetic field of 9.6Hz.

3.3 Cooling System

We incorporate a cooling system in the form of a fan to avoid the occurrence of overheating.

3.4 Microcontroller

To enable the inducer to be turned off automatically after a user-specified duration, a timer will be incorporated into the design.

3.5 Real Time Clock

It is used to give time for the display and timer.

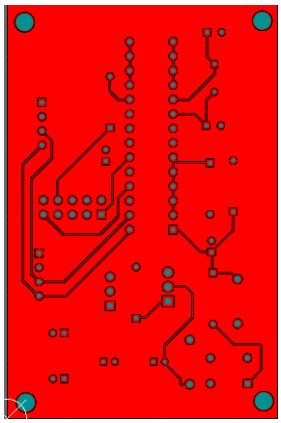
3.6 User Interface

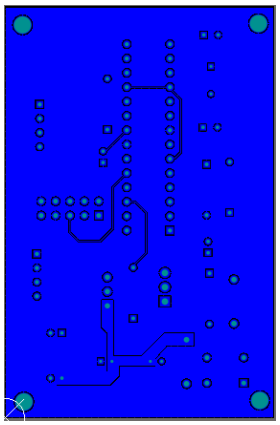
We have incorporated a OLED display with six digits that enables users to set the timer based on their preferences. Along with the display, we have added a power switch, an ON switch, and two switches that allow users to adjust the time. To ensure that users can easily determine whether the device is turned on or off, we have included indicators that show its status.

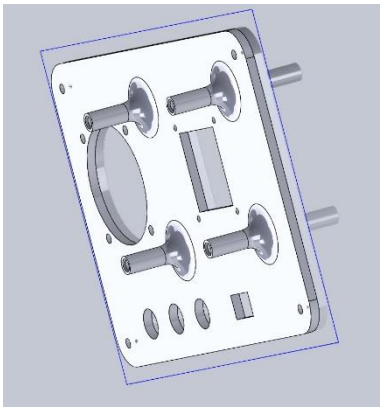
4. Device Design

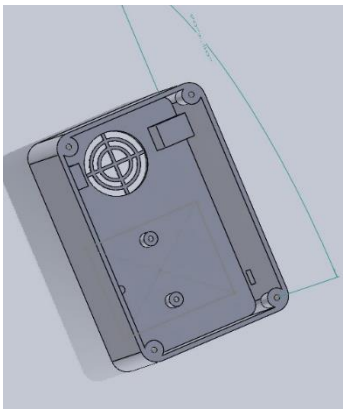
As more features were needed, like the fan and vent, we changed the design accordingly.

5. Altium and SolidWorks Designs



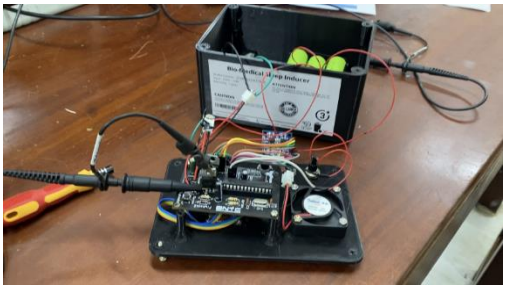


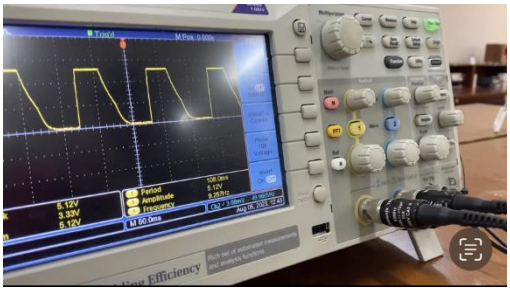




6. How the Device Works

Over device is a biomedical sleep inducer with the timer. After switching on the device, the user can switch on the inducer. Then the device asks the time when the inducer needs to stop. The user can change the time using the “Minute” and “Hour” buttons after setting the timer the device automatically goes to displaying the time in the screen while creating a low power Magnetic field with a frequency of 9.27Hz Magnetic Field as it soothes the mind and make it easy to sleep. The fan cools down the coil preventing overheating of it.





7. Marketing, Sales, and After-Sale Service considerations

The marketing aspect of our project is crucial for its success. Our goal is to design a comfortable and attractive product that can be easily purchased from government-approved pharmacies. We will also advertise our sleep inducers in medical clinics, with the support of doctors who see the benefits of our product as an alternative to sleeping pills for insomnia. With the growing demand for natural and non-invasive solutions, we are confident that our sleep inducers will have a high demand in the global market. To ensure customer satisfaction and trust in our product, we offer a 1 Year warranty for our sleep inducers. In case of any issues, users can simply get a new coil for free within the warranty period, and later for a small fee from authorized dealers only. We also offer trade-ins for our new product, as well as redeemable rewards for loyal customers. Also, we will add an instruction manual for the users on how to use it effectively. We also created a maintenance manual for maintaining it.

8. Project Budget with BOQ

Item	Quantity	Price
PCB Printing	1	2280
Enclosure 3D Design	1	3100
Enclosure Push Buttons	4	240
Rocker Switch	2	60
Mini Cooling Fan	1	295
5V Zenor Diodes	1	6
12V Zenor	1	6
RTC	1	245
Battery	3	1770
BMS	1	500
10uF Capacitor	4	24
Crystal Oscillator	1	35
22pF Capacitor	2	3
Resistors	All	50
Printing and Stationary	All	250
Wires/Headers/JST	All	100
Battery Case	1	120
Nuts and Bolts	All	150
Mosfet	1	120
AtMega 328P	1	800
Coil	1	500
OLED	1	700
Total		11354

Expected Price for Mass Production	9000
No of Units Expected to produce	150
Expected Selling Price	10000
Expected Profit	150000

9. Task allocation among the group members

- Jayamadu, as the team leader, was responsible for overseeing the overall progress of the project and ensuring that the team met the deadlines. He was also responsible for managing the team's budget and resources. He was also responsible for the coding part.
- Rebecca was responsible for researching and analyzing the technical feasibility of the project. She was also responsible for designing and testing the product's performance targets to ensure that they are achievable. She was also responsible for designing the PCB using Altium Designer.
- Tashin was responsible for designing the product architecture, including the block diagram view of the product and the selection of components for each block. He was also responsible for designing the product enclosure with Solid Works.
- Charles is responsible for marketing, sales, and after-sale service considerations. He was responsible for identifying potential markets for the product and developing marketing strategies to reach those markets. Charles was also responsible for developing plans for after-sale service and support. Also, he is responsible for the designing of the circuit analyzing it and soldering.