Engineering project design

BM 1190

WEARABLE MIGRAINE THERAPUETIC DEVICE

PRODUCT PROPOSAL

Group Members

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❖ Problem:

Migraine is a global health issue without a solution. According to the results of the surveys done, one out of ten people in the world are suffering from migraine. This is a complex neurological disease mainly that results in,

- Intense headache on one side of the head.
- Moderate or sever throbbing sensation getting worse when move.

Although there is no permanent medical treatment for migraine, there are some ways to minimize the pain.

Most people who are usually suffering from migraine use to massage their forehead as an external treatment and to take pain killers as a medical treatment. But when the pain occurs, patients have to stop their all-other works to do massaging. It is time consuming and cause big issues to students and busy people. On the other hand, taking pain killers very often can cause side effects such as gastritis, ulcers and kidney or liver damages etc.

Therefore, there is a huge need of an effective solution for migraines.

❖ Our Solution:

To address this problem, we hope to design a user-friendly wearable migraine therapeutic device. We hope to use a Nerve Stimulation Method for this design. Through our device, we stimulate a nerve that cause migraine and reduce the pain. Therefore, whenever the migraine pain comes patients can wear the device and engage in their work without any disturbances.

❖ Constraints:

- Light weight
- Comfortable
- Safety
- Low power consumption

❖ **Technical Feasibility:**

For the proper functionality of our device, we need to generate a square pulse wave form with gradually varying amplitude. To meet our goal, we can follow the following procedure.

Step1:

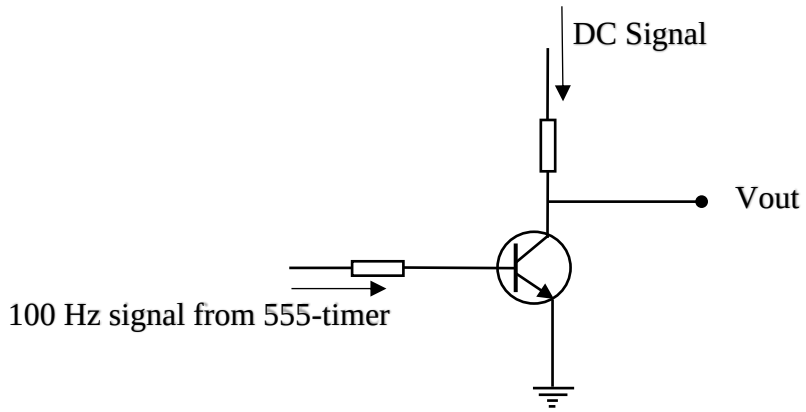
- Program a PWM signal of which duty cycle varies with the time by using an ATmega micro-controller.

Step2:

- Send the generated signal through a digital to analog converter and get the DC output.

Step3:

- Another signal of frequency 100 Hz is generated by 555- timer IC and sample the above signal by sending the two signals via a transistor. Signal generated by 555-timer is set to the base to switch on and off the transistor in a frequency of 100Hz.



Step 4:

- Send the output of the transistor through a voltage to current convertor and the desired current wave form is generated.

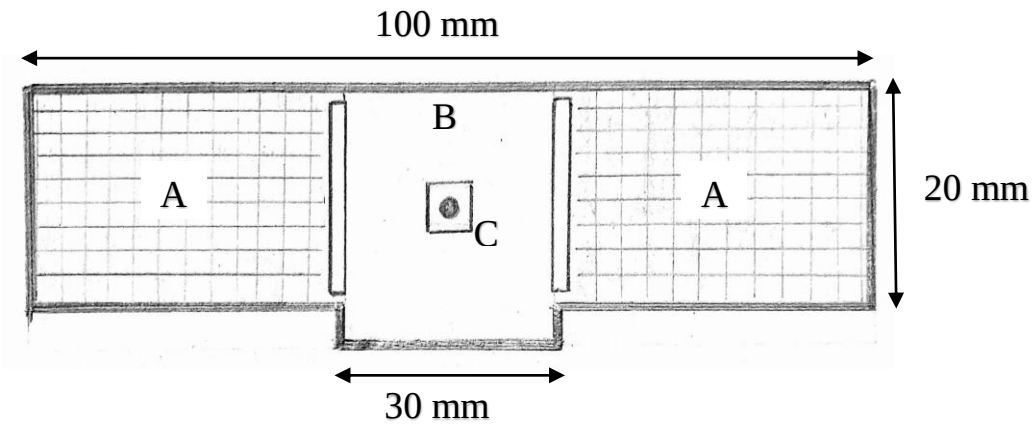
All the components needed for our design can be found easily and therefore, our design is technically feasible.

❖ **Technical specifications:**

- Standards
  - Pulse frequency :100 Hz
  - Pulse duration :500 μs
  - Pulse width :250 μs
  - Step-up intensity :30 μs
  - Maximum intensity :1 mA

- Dimensions

Electrode pad



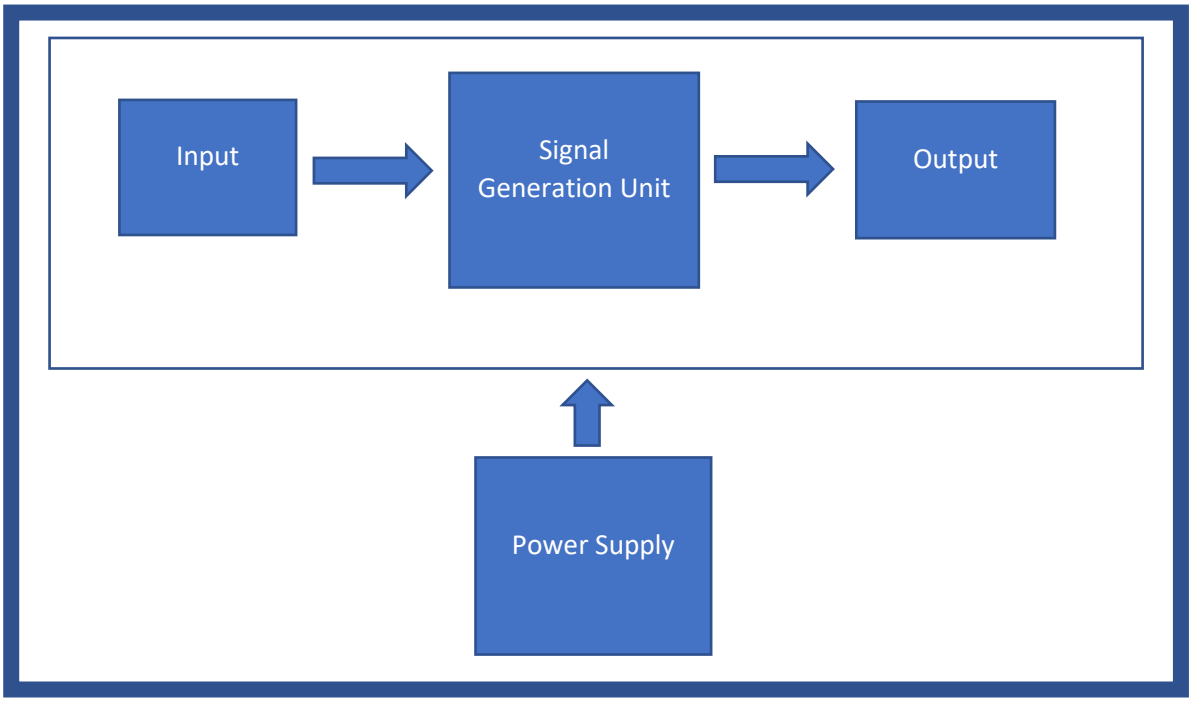
A-Self-adhesive pad
B-Insulated area
C-Hook (To hold the electrode pad with the circuit above tightly)

- Weight

  about 50g

❖ **Architecture:**

Product architecture



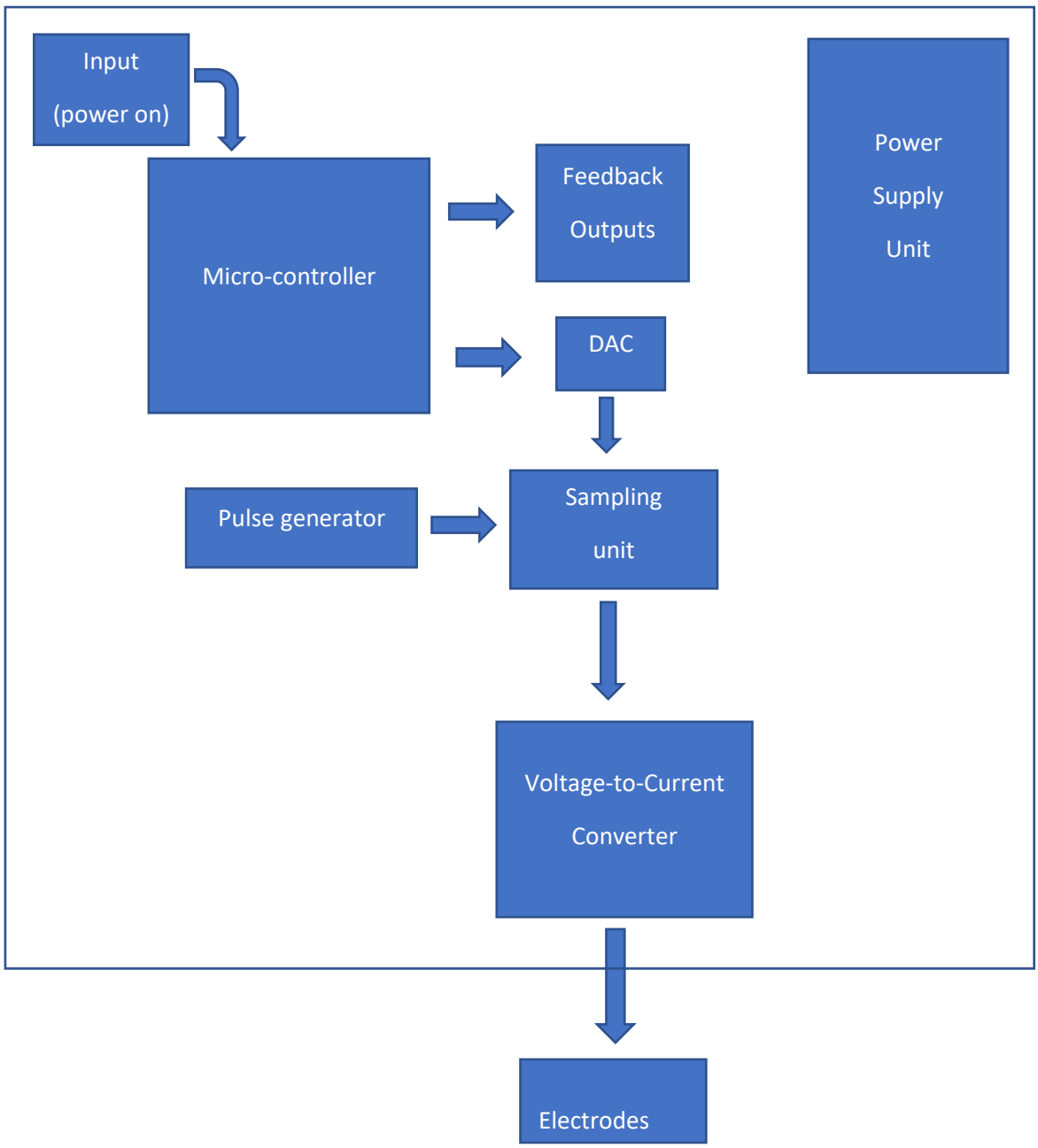
Input : power on device(button press), power for recharging

Output : current to electrode, feedback sounds and lights

Signal generation : generate desired signal

Power Supply : supply power to each unit ,recharging battery

Circuit architecture



1)Input :

- power on/off
- push button

2)Micro-controller :

- Run main program and generate basic signal (PWM)
- Atmega328p (& standalone circuit)

3)Power Supply Unit :

- Supply power to each unit
- Batteries, voltage regulator, recharging unit

4)Feedback outputs :

- give feedbacks
- LEDs, buzzer

5)DAC :

- converts PWM signal to an analog signal
- lowpass filter (OpAmp, 3 resistors, 2 capacitors)

6)Pulse generator :

- generate a pulse signal (which is used for sampling)
- 555timer IC, 2 capacitor, 3 resistors

7)Sampling unit :

- using pulse and analog signal generate final voltage signal
- transistor, 2 resistors

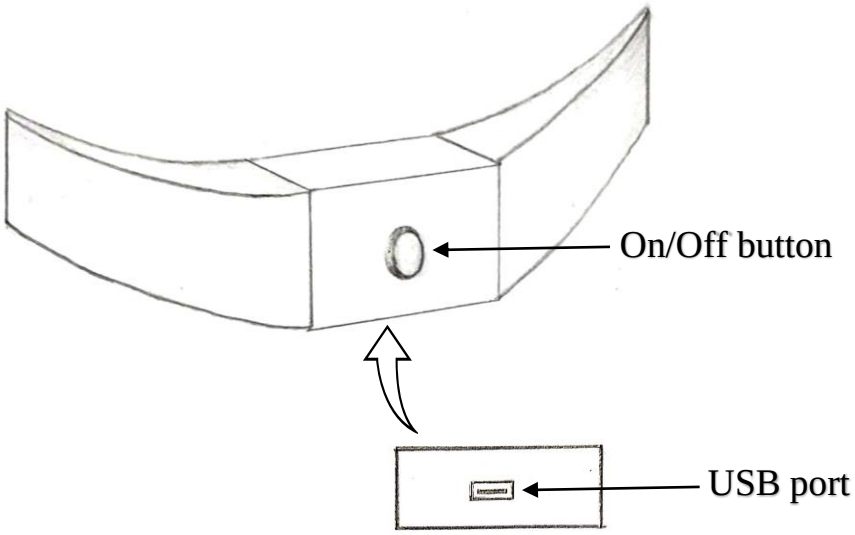
8)V-to-C converter :

- convert final voltage signal to a current signal (which is independent from output resistance)
- OpAmp, 5 resistors

❖ **Enclosure:**

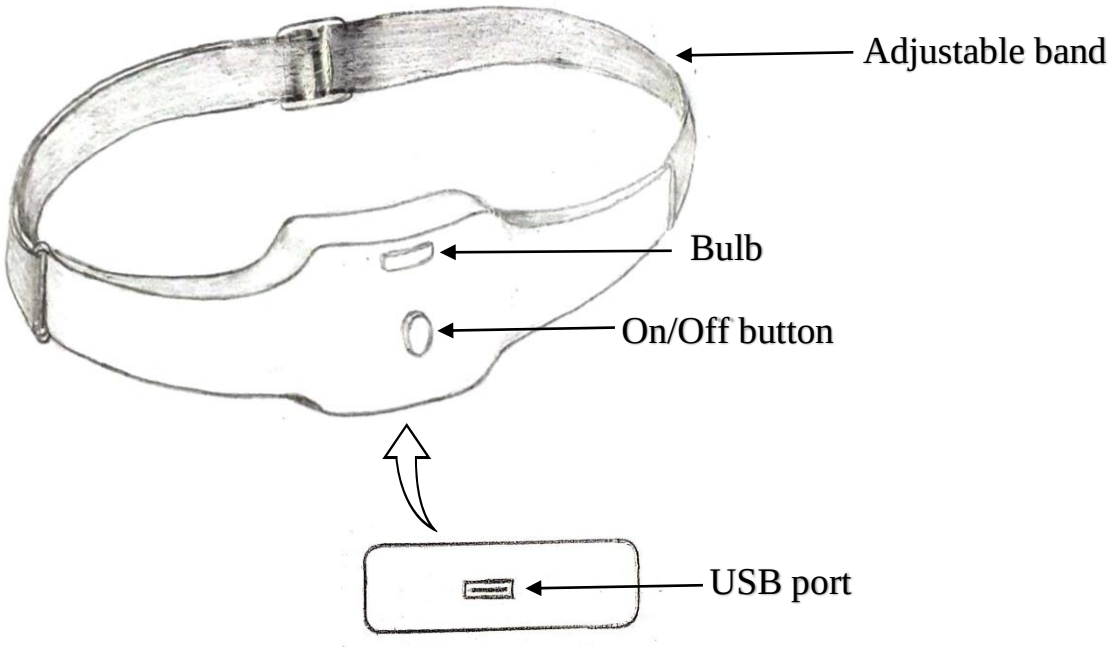
- On/Off button should be added to switch On or Off the device.
- We are planning make the device rechargeable so that it is more efficient and therefore a USB port was decided to add.
- So, the initial sketch was as follows.

Initial sketches



- Our device is a wearable device. So, there should be a mechanism to set the device on the forehead. Therefore, we decided to add an adjustable band to hold the device properly on the forehead.
- We further planned to add a bulb to indicate the user whether the device is On or Off.
- So, we did some renovations to the initial sketch and the finalized sketches are as follows.

Finalized sketches



❖ UI Design:

- On/ Off button at the front of the device to switch On or Off.
- Small LED bulb just above the On/Off button, to indicate whether the device is On or Off. If the device is in On state, the LED lights up.
- A USB port is there at the bottom of the device to recharge whenever the battery is dead.
- The intensity of the bulb at the front is also an indication about the state of the battery. If the intensity is very low the device should be recharged.
- There is also a beep speaker as feedback to the user to indicate the device is switched on and to indicate the operation is completed.

  when switched on - 1 beep sound
  when operation is completed - 2 beep sounds

❖ Marketing:

- About 26 million in US alone suffer from migraine. Therefore, there is a huge market for a migraine therapeutic device in the world.
- Because of the adjustable band any person can use the device despite the size of head.
- Also, since the device is rechargeable, it can be used again and again and therefore more efficient.
- Our device is designed in such a way that it relieves the pain gradually while operating.
- Any person with any kind of headache can use our device and experience the maximum results.
- Because of the user-friendly design, patient does not need any specific prior knowledge about the device to use.
- Since it is light weight and can properly set to the forehead, the patient does not get any unnecessary stress about holding the device on the head
- The materials used to design the enclosure in contact with the skin are smooth and are guaranteed to have no side effects on the skin such as rashes, itching, reddish skins etc. and therefore, patients find it comfortable to wear.

Marketing will be done mainly via social media like Facebook, Instagram and YouTube. We also can expand our customer base by reaching out to the doctors and informing about the device and its functionality. We further use an official webpage to facilitate our customers to reach us and to aware them about the device.

❖ Sales

When we are designing the product in large scale, we hope to use more effective components while maintaining the device at an affordable price. Also, when producing in large scale, enclosure production can be done in a mold so that it will be cost effective. Our goal is to provide our service to the customers in a cost-effective manner.

❖ Maintenance and repair

We provide our service for customers in case of any failure of the device. In addition, we plan to provide user manual for the users to inform them about how the device should be used and maintained.

❖ Packaging

- The device is packed as a single unit.
- Packaging consists of a cardboard box and the device which is wrapped by a foam sheet is placed securely in the box.
- A user manual will be made available with the product.
- Product name, price, company logo, contact information, weight of the device will be printed on the box.

❖ Disposal

The packaging is made up of eco-friendly disposable materials. We also plan to use an eco-friendly fabric material for the headband. Enclosure and other electronic parts will be recycled. The user manual also includes details about the disposal of the device.

❖ Budget:

Components	*Quantity*	*Unit price (Rs)*	*Total price (Rs)*
ATmega 328p	1	2000	2000
NJU77000AF (OpAmps-working with 5V supply)	2	50	100
555 timer	1	30	30
Resistors	14	10	140
2N2222 transistor	1	10	10
Capacitors	5	10	50
7805 voltage regulator	1	70	70
Battery	2	550	1100
LED	2	5	10
Button switch	2	50	100
Beep speaker	1	70	70
electrodes	2	1000	2000
Enclosure (3D print)	1	5000	5000
Enclosure (buttons)	1	500	500
headband	1	2000	2000
Total			13180
Approximate Cost			15000

❖ Task allocation among group members:

Task	*Name*			
	Hansa Marasinghe 200381U	*Maheesha Morawaka 200400F*	*Ravindu Pushpakumara 200488E*	*Sithmini Ranasingha 200507N*
Product designing(overall)	25%	25%	25%	25%
PCB designing	30%	20%	30%	20%
Enclosure designing	10%	25%	25%	40%
Safety and Medical concerns	30%	40%	15%	15%
Documentation	20%	20%	20%	40%
Budget and financial management	35%	20%	35%	10%
Testing	25%	25%	25%	25%

Works Cited

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