University of Moratuwa
Faculty of Engineering
Department of Electronic & Telecommunication Engineering

EN1190 Engineering Design Project

AUTOMATIC SOUND REGULATOR

by

Skynet Tronics

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1. Problem Description

1.1 Problem

Effective communication is crucial when addressing an audience, ensuring that every individual can clearly hear and understand the speaker. However, practical challenges arise due to variations in speaking styles, voice levels, and acoustics. In situations where multiple people speak, the ideal approach is to adjust the audio system for each speaker individually. However, this typically requires a skilled audio technician, which may not always be practical or cost effective. While hiring such a professional might be justified for large-scale events, common scenarios like lectures, meetings, or small gatherings often rely on a single, fixed audio setting. This can lead to uneven audibility. Some speakers may be too loud, while others may be difficult to hear, resulting in communication gaps and reduced

1.2 Expected Goal

Our goal is to introduce a new device which regulates the output sound of an audio system without damaging or reducing the quality of audio signal in an affordable price range. It enables individuals and organizations to control their audio needs effortlessly.

1.3 Solution

To address the issue of fluctuating audio levels that impact communication clarity, we propose the development of an external volume adjustment device. This system intelligently monitors and adjusts the audio output from an existing amplifier without needing to replace or heavily modify the current setup.

1.4 Justification of Selection

Although there are many amplifiers in the current market, there are many real-world issues. such as being unaffordable, needing a dedicated person for controlling the device, lack of expertise in sound system handling, etc. To validate the problem, we conducted a survey among audio engineers, sound controllers, students and institutions that manage large audiences. The feedback confirmed that fluctuating audio levels are a common issue. Also, we introduced our solution, an automatic sound regulator. As positive feedback, our stakeholders emphasized the need for a dynamic adjustment solution. Through the validation of the stakeholders, we, Skynet Tronics, identified clear market demand for a dynamic audio controller.

2. Product Feasibility

2.1 Technical Feasibility

We have successfully demonstrated the technical feasibility of our project by completing the necessary design, development, and testing phases. Key components were selected based on performance, compatibility, and availability. A central processing unit was used to handle core functionalities, including signal processing and system control. The device is powered by a stable power source, with voltage regulation implemented to ensure reliable operation. A custom PCB was designed to integrate all essential modules, improving both efficiency and compactness. The external casing was developed using 3D printing to securely house internal components and provide a professional finish. The final assembly and testing were carried out in the digital lab. These steps confirm that all technical requirements were met, validating the practical implementation of the proposed system.

2.2 Hardware Feasibility

The hardware components we used are

- Atmega328p microcontroller
- LM386N Op Amp
- 1.1’ OLED Display
- 3.5mm and 6.5mm input/ output ports
- 230V ac to 5V dc converter
- 3.5mm to 3.5mm connector
- 3.5mm to 6.35mm connector

2.3 Software Feasibility

Software	Purpose
Altium Designer	PCB designing
Arduino	Programming atmega328p microcontroller
SolidWorks	Enclosure designing

3. Product Applications

The automatic sound regulator is designed to improve the clarity and consistency of audio in various real-world applications. Especially, multiple speakers are involved in speaking, or the same speaker is speaking for a long time. It is particularly useful in environments that lack a dedicated audio technician. Moreover, continuous manual adjustment of volume is not possible. Likewise, we identify several practical applications of our design.

- **Lecture halls and classrooms:** Different lecturers or students may speak at different voice levels.
- **Business meetings and conferences:** To ensure all participants are clearly heard without m less knowledge in sound handling, etc.anual intervention.
- **Community events/ Religious gatherings:** Multiple speakers or performers participate.
- **Workshops and training sessions:** Clear communication is essential for learning. Also speaking for a long time causes the volume of the speaker to reduce by the time.

Using an automatic sound regulator as an intermediate device in addition to the existing sound systems offers an affordable, plug and play solution to maintain optimal audio levels. Its ability to continuously monitor and adjust volume in real time helps reduce listener tiredness, prevents communication breakdowns, and enhances the overall audience experience.

4. Product Architecture

The underlying architecture of our automatic sound controller is a very simple, easy to understand. The main part of our product is amplification (amplification module). In addition to this, we can identify controlling modules, power modules, input/ output modules basically.

The amplification module consists of an LM386N operational amplifier and a voltage divider circuit. The op amp has a constant gain but varying input voltage. A servo motor which is controlled according to the input sound signal has been used to operate a potentiometer and generate the varying input of the op amp. That means a similar signal to input sound signal is generated using the amplification module which is amplified or attenuated.

An atmega328P microcontroller as the central controller of the device. It continuously monitors the input sound signal. First, it samples the input signal and calculates the average voltage of the input sound signal. If the average voltage value exceeds the user-defined range, it changes the overall gain by operating the servo motor.

As the power source, the device is powered by 5V dc source. Therefore, we use a 230V ac to 5V dc converter.

To give input signal and bring output signal, there are two types of port in the input/ output interface (3.5mm, 6.35mm). That increases the versatility of the regulator and customer satisfaction. 1.1’ OLED display is used as the main external output to give a attractive user experience. Additionally, there is a power on/off indicator.

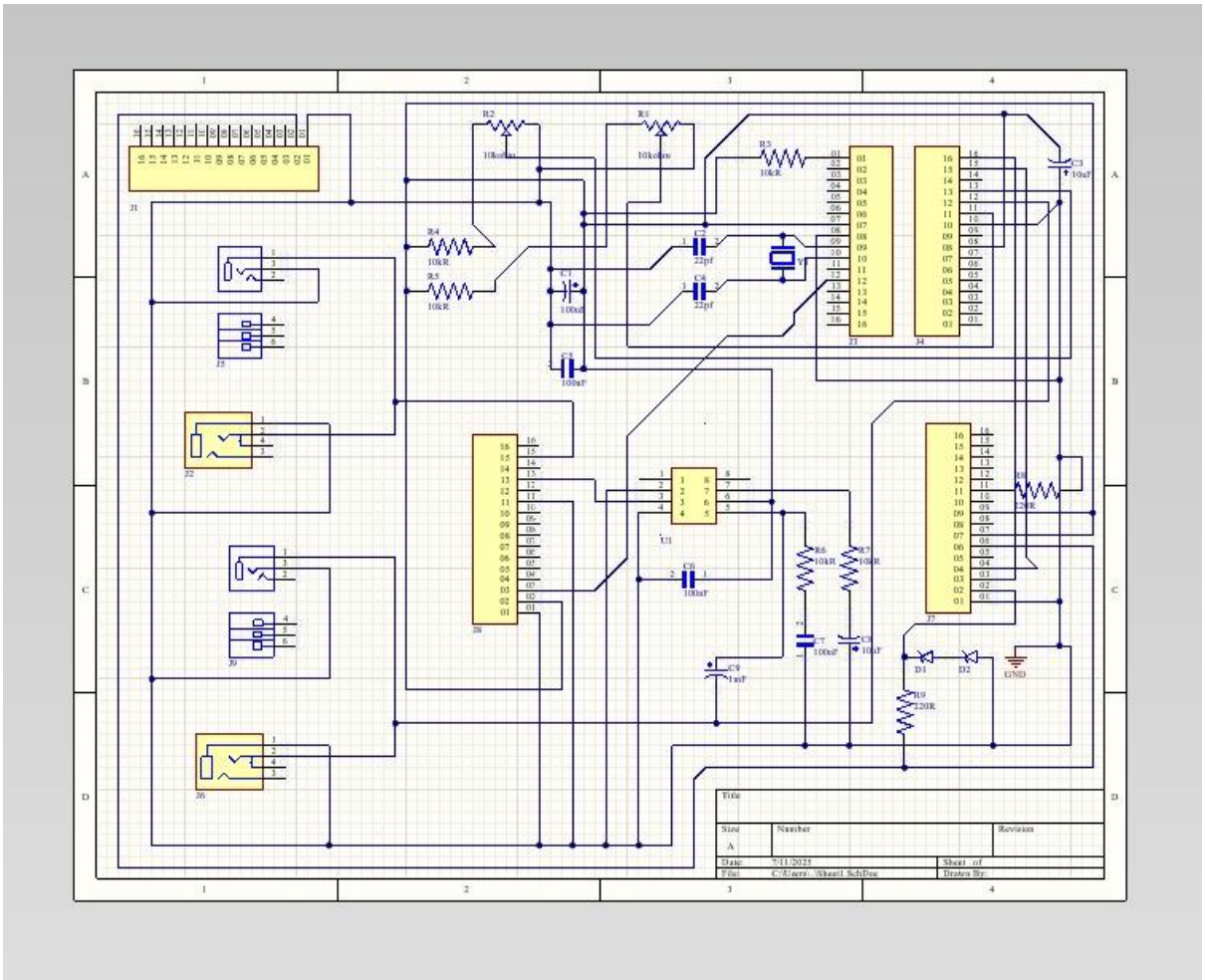
5. Product Specifications

Specification	Description
Type	Automatic sound regulator
Dimensions	20cm x 15cm x 5cm
Weight	300 g
Power Supply	230V to 5V converter included
Power Input	5V, 85mA
Supported Port Types	3.5mm, 6.35mm
Connectors	3.5mm connecting wires included
Display	1.1” OLED Display
Indictors	ON/ OFF indicator
Features	Automatic gain adjustment Enhanced sound control efficiency User-friendly display Low power usage Support for multiple port types Durable controlling switches, ports, knobs Small and light weight design Easy to use (Plug & Play)

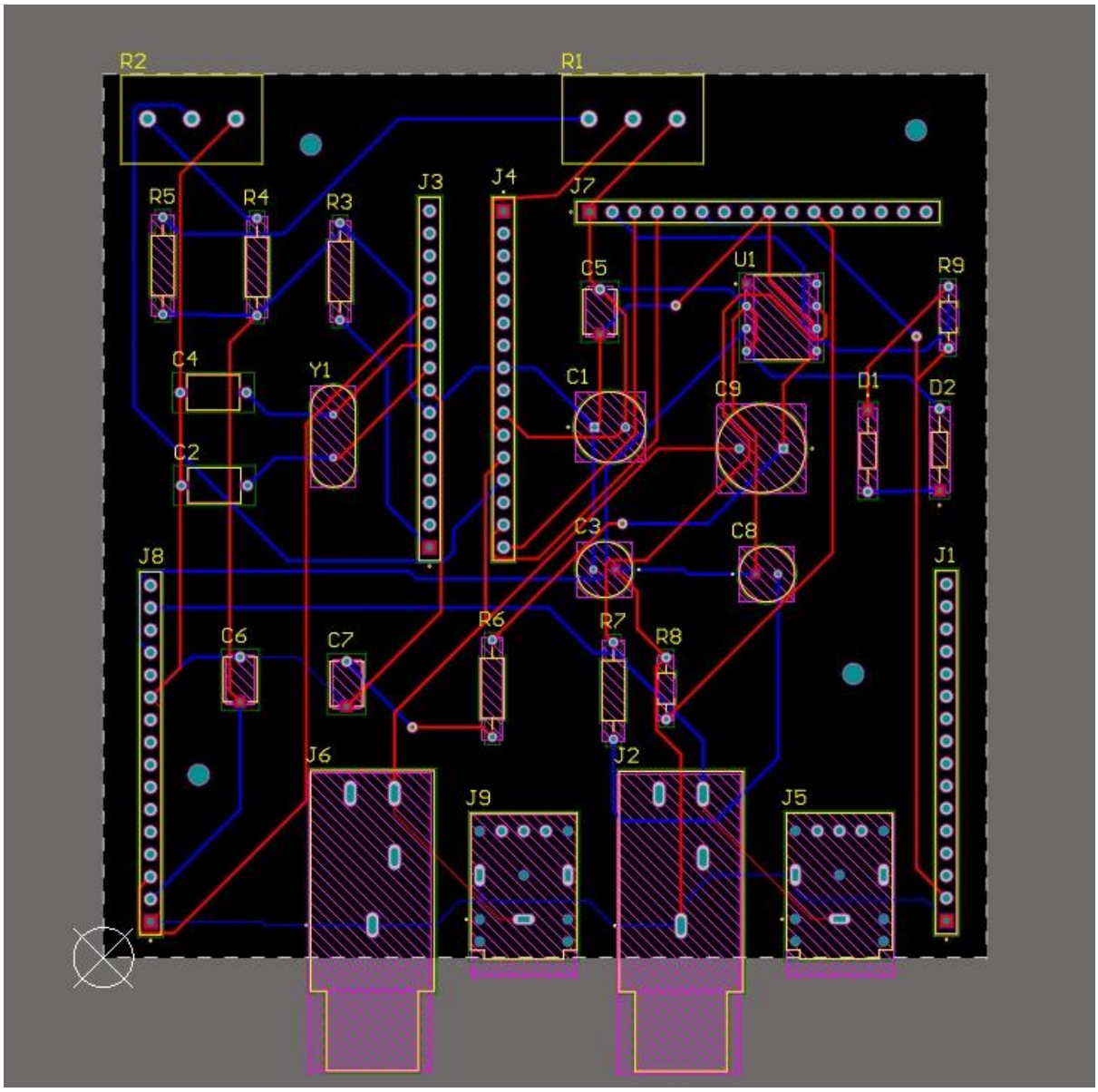
6. PCB Design

Altium PCB designs of 2-layer printed circuit board.

6.1 Schematic design

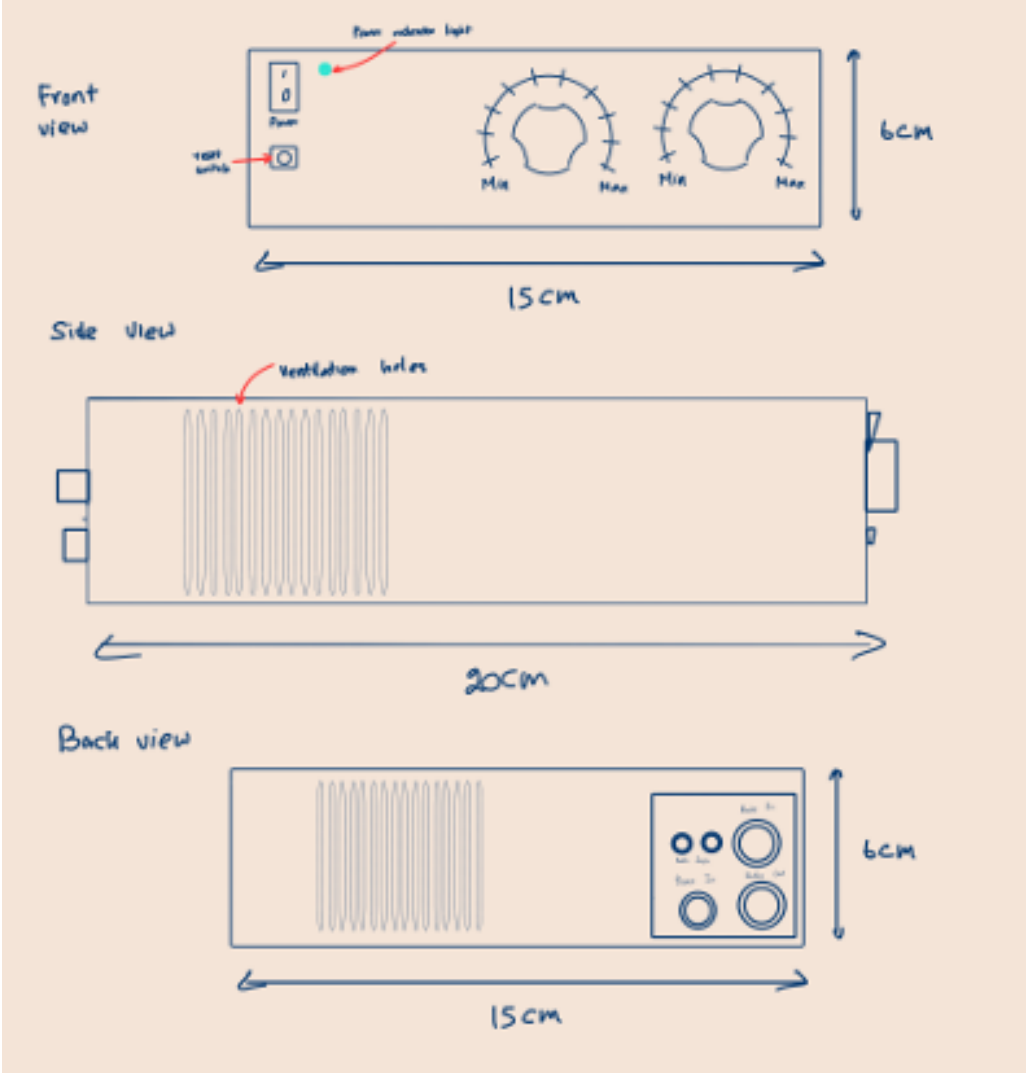


6.2 PCB layout



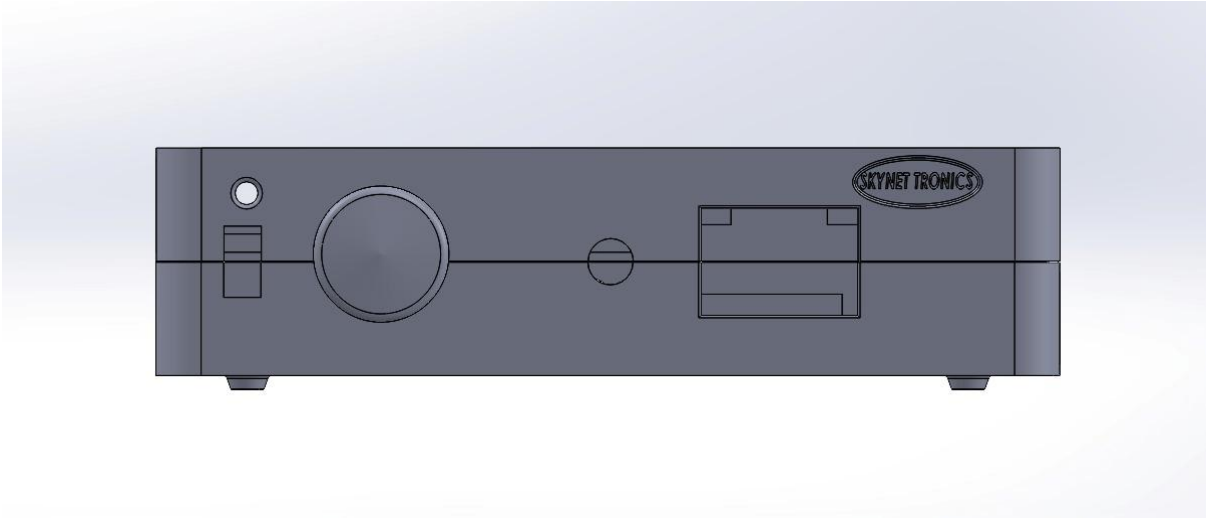
7. Product Enclosure

7.1 Rough Sketches



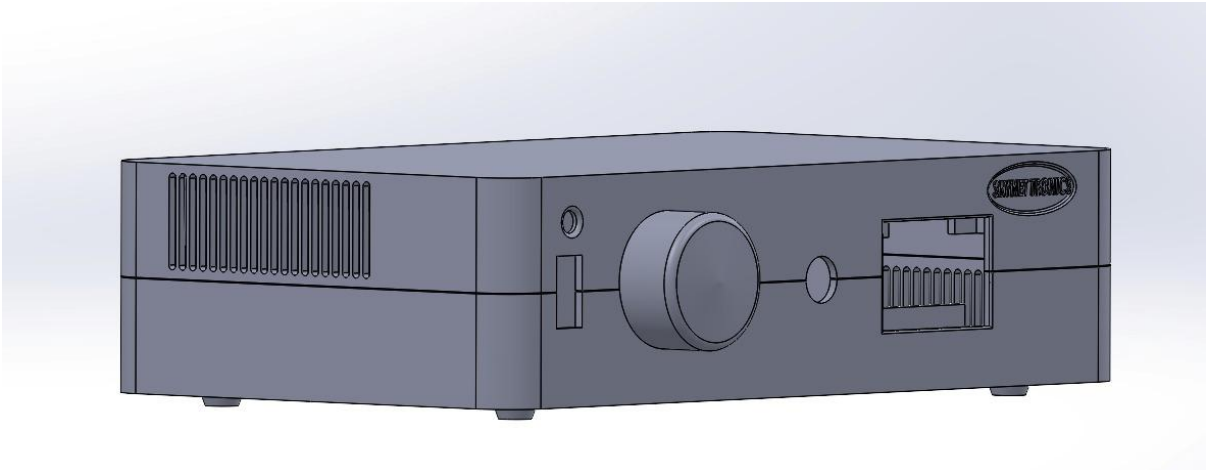
7.2 SolidWorks Designs

Front view

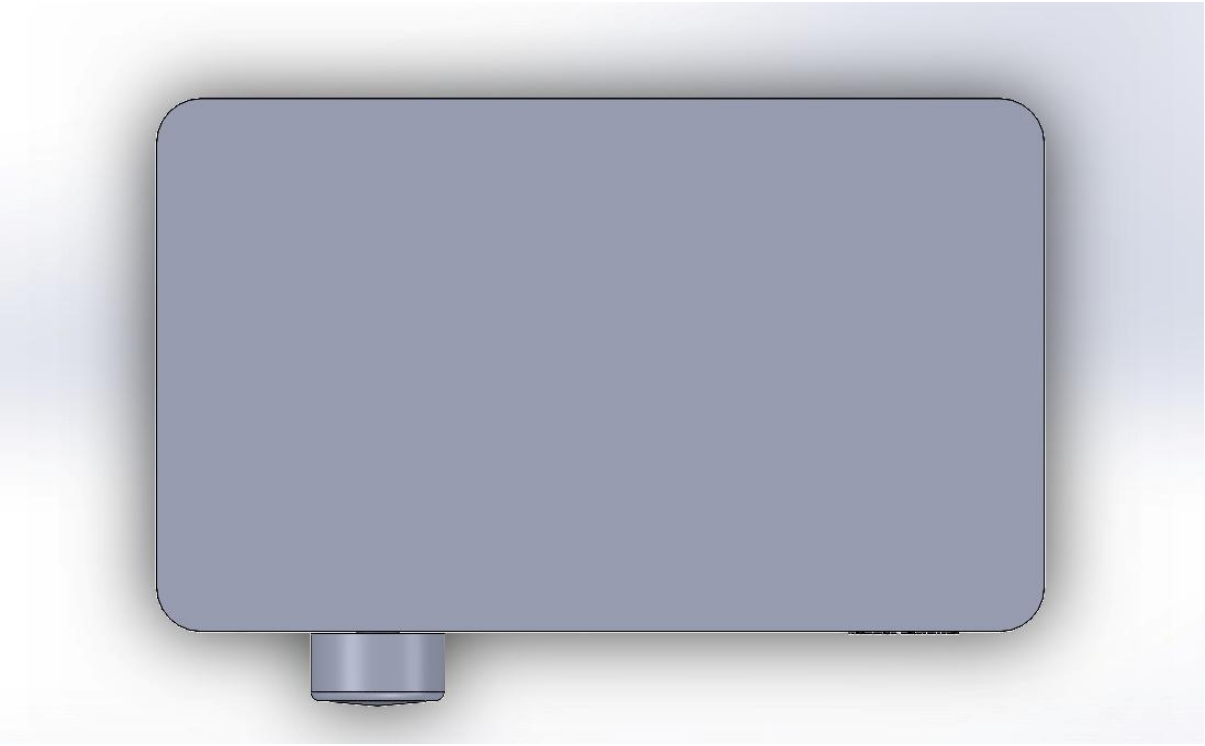


Back view

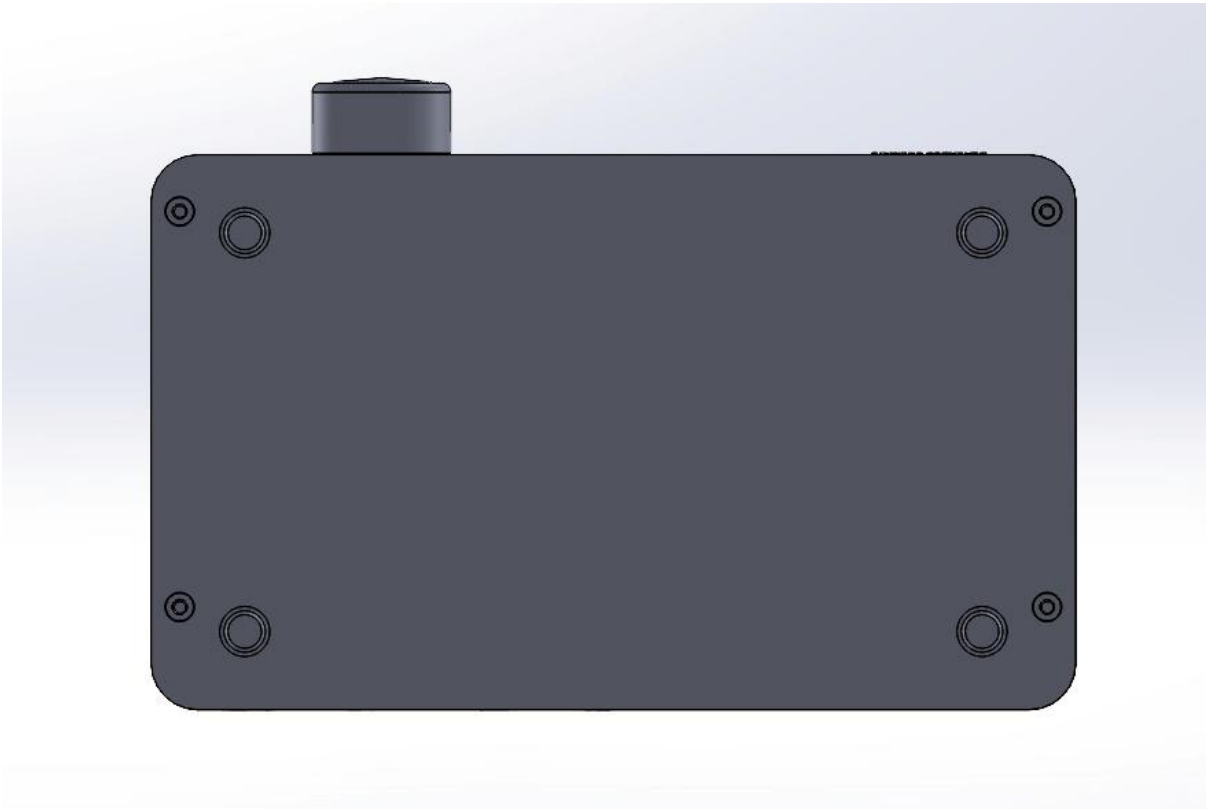
Side view



Top view



Bottom view



8. Final Product

9. Market Analysis

Our sound regulator is in the category of electronic amplification device which holds huge capacity for the market in sound engineering. In the market there are several types of amplifiers such as power amplifiers, pre-amplifiers, etc. We are different from those common amplification devices. Because our intention is to design an intermediate device to sound controlling in pre-defined range.

Our stakeholders are sound engineers, audio controllers, academic institutions, students, speakers, government authorities, event organizers, etc. According to our analysis, our target market is growing day by day.

There are many competitors in the market with a competitive selling price between LKR 20000 to LKR 100000. However, in our problem identification, we realized that it is difficult to afford such an amount of money for a simple sound regulator. Moreover, some imported devices are not compatible with local devices. For example, issues with connecting devices. Some devices have additional features which are not useful and not worth money.

As a solution, Skynet Tronics is introducing a real-time, affordable, simple sound regulator. To compete with the market, it has many features as well. Such features are good sound quality, high sensitivity, user friendly display.

10. Final Budget

A full review of our budget is presented below. We identified that the cost of designing a single unit is high, mainly due to shipping expenses and the inefficiency of 3D printing in terms of cost. Therefore, we provide the estimated unit cost for mass production. We expect to reduce costs by importing a large number of PCBs at once to minimize shipping expenses. Additionally, we plan to use molding instead of 3D printing during mass production.

Expenses	Cost in Product Designing (LKR)	Cost Per Unit in Mass Production (LKR)
PCB manufacturing and shipping	3000	500
Enclosure designing	7500	2000
Components/ Assembling	4500	2750
Warehouse and Transportation	1000	100
Marketing	-	50
Additional costs	-	600
Total cost	16000	6000

The total cost of a unit is LKR 6,000. With an 80% profit margin, we plan to price our product at LKR 10,800.

Total Cost	Profit Margin	Final Price
LKR 6000	**80%**	**LKR 10800**

11. Future Developments

We, Skynet Tronics are planning to develop our product to improve and give a high-quality outcome to the user. Initially, we are focusing on increasing the sound quality of the Automatic Sound Regulator. As a part of this, we come up with some ideas to reduce the noise effect. Such as separate the power supply module and the amplification module, using high quality components, clean and clear soldering, etc.

In addition to that there is an intention to apply AI/ ML advanced technologies to recognize the patterns in input signal, so that they improve regulating operation. For example, self-threshold defining. Currently our device cannot handle sudden spikes of sound since we are relying on an average value of input voltages. Therefore, our goal is to optimize our device to handle sudden spikes of sound by identifying such conditions and reducing the response timing.

12. Task Allocation

Skynet Tronics is a group of four undergraduates from the University of Moratuwa. First, we identified several problems with the intention of developing a solution. Then we selected one problem worth solving and validated it through discussions with stakeholders. Meanwhile, we developed and presented our solution to stakeholders and validated it. After that, we started building the device by allocating parts of the product development process among us.

Name	Task
A. H. T. M. Weerakoon	Circuit designing, Soldering
W. M. H. Wanigasundara	Circuit analysis, Programming
H. D. J. D. Samaranayaka	PCB designing, Assembling
H. A. P. Aroshana	Enclosure designing, Market review

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