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

EN1190 - Engineering Design Project

Team Strawhats
Portable Bluetooth Audio Splitter

Group Members

Index Number	Name
230145E	Dilhan W.A.
230256U	Ilankoon I.M.M.K.B.
230258D	Imaduwage O.N.H.
230544C	Rathnayake M.A.G.K.N.

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1 Problem Description

1.1 Problem

Entertainment is typically a shared experience — whether it's listening to music or watching a movie, it's always better experienced together than alone. Typically, this is achieved using a device's built-in audio output system (such as a phone, TV, or tablet) with the help of a speaker.

Most devices we typically use in day to day life come with built-in speaker systems to allow us to share entertainment with ease. However, this approach has its limitations.

The usage of speakers is not feasible in most public spaces, and their use comes with the loss of privacy and a general distrubance to people in the vicinity. In such situations, using earphones is a conventional solution - with the world largely shifting to adopt the large scale use of Wireless Earbuds.

Unfortunately, there is no existing cheap and accessible technology allowing the connection of multiple Wireless earbuds together.

1.2 Expectations

We aim to create a solution that seamlessly pairs Bluetooth audio from a digital device to several Wireless earbud pairs, while supporting a wide of Bluetooth devices.

1.3 Our Solution

Our device functions as a wireless Bluetooth splitter, connecting multiple devices simultaneously. The user first pairs their mobile phone (or any other appropriate Bluetooth output device), and then pairs up to 4 Bluetooth earbuds - allowing them to hear seamless audio streams at once.

1.4 Justification and Alternatives

Newer Bluetooth technologies in the form of "AuraCast" now support multiple Bluetooth audio streams simultaneously. While the usage of such chips in modern phones greatly increases efficiency and ease, the cutting edge technology lacks support for a wide range of devices, outside of flagship models. This presents an evident issue, since the problem of Bluetooth broadcasting requires solutions that support all devices.

MercAp, our wireless Bluetooth splitter, relies on standard Bluetooth chips - therefore allowing for support of all types of Bluetooth audio output devices.

MercAp currently supports up to 4 Bluetooth earbuds. This number of devices was validated through our market evaluation, confirming both the need for this device and the lack of an effective alternative on the market.

2 Product Feasibility

We have successfully built a feasible product, meeting the requirements to provide a solution to the problem considered.

We used KCX-BT v1.4 Bluetooth Audio transceiver modules to provide the audio input and outputs for our device. We opted for analog audio noise filtering, due to the lower cost and ease of building a compact device. We used two 3.7V rechargeable Li-Ion batteries, with a center tapped configuration to power our chips as necessary. We also utilised LED lights as indicators for connectivity.

3 Functionality

The designed operation of the MercAp device relies on connection of one Bluetooth audio output device (i.e. a mobile phone or laptop) and four Bluetooth earbuds. Furthermore, the device features switches to allow the user to limit the number of Bluetooth earbuds being connected as required.

4 Device Specifications

- Weight: 200g
- Dimensions: 12.8 x 12.8 x 4 cm
- Bluetooth Capability: Version 5.2 with backwards compatibility
- Range: 20m
- Audio Dynamic Range: 80dB

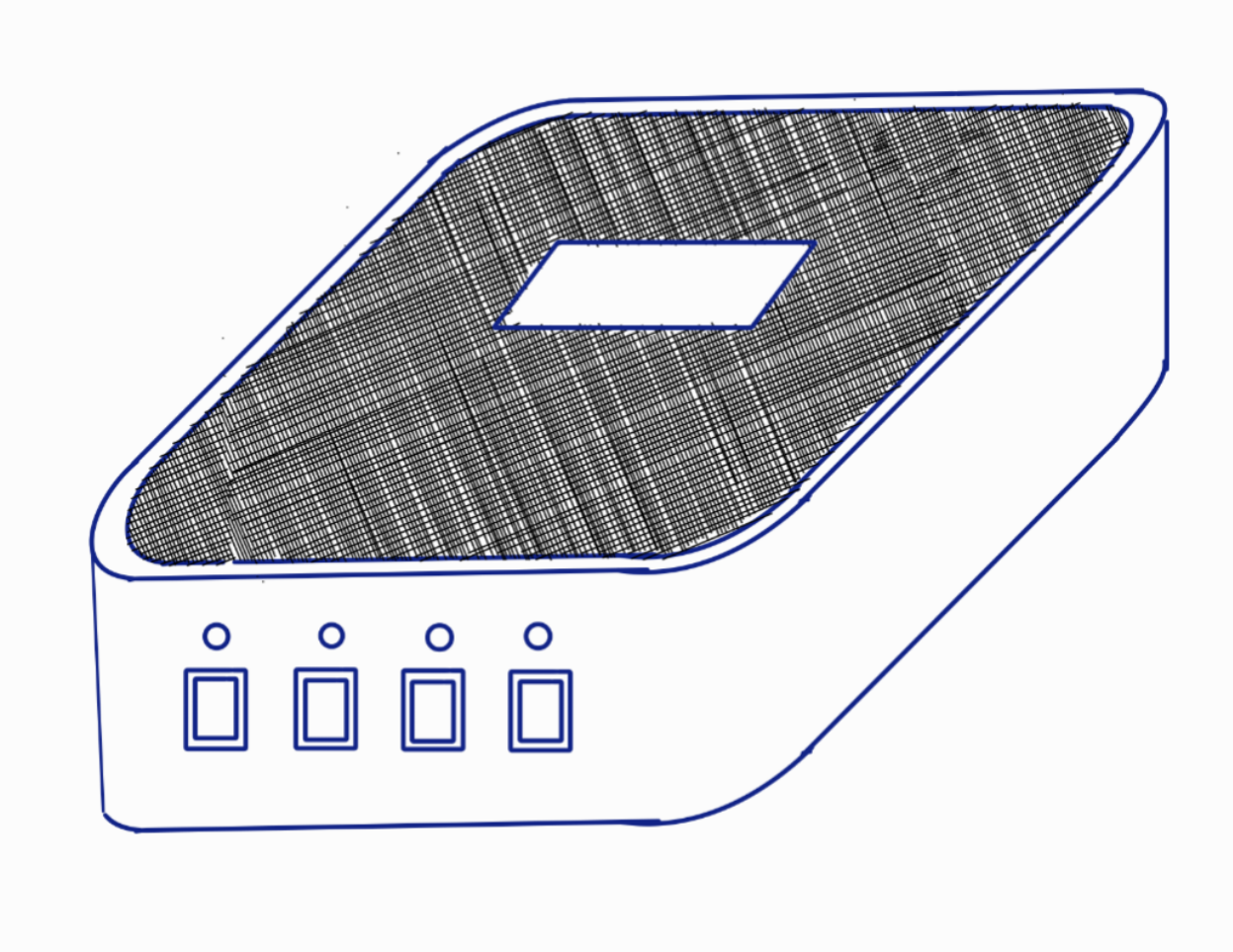
5 Product Architecture

KCX-BT Emitter Module - This is a wireless Bluetooth audio transceiver module that integrates stereo audio transmission and reception

NE5532 Operational Amplifier - This is used to buffer and split the analog audio streams without losing the fidelity

Power Supply - This provides 7.4V, split into two power rails at +3.7V and -3.7V with a common ground; using two 3.7V 3200mAh Li-Ion batteries.

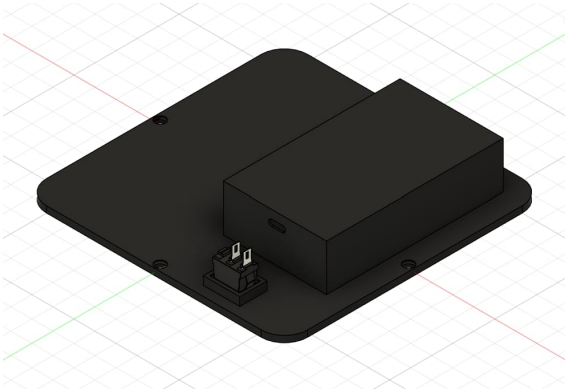
5.1 Initial Sketch



5.2 Final Enclosure

(a) External View

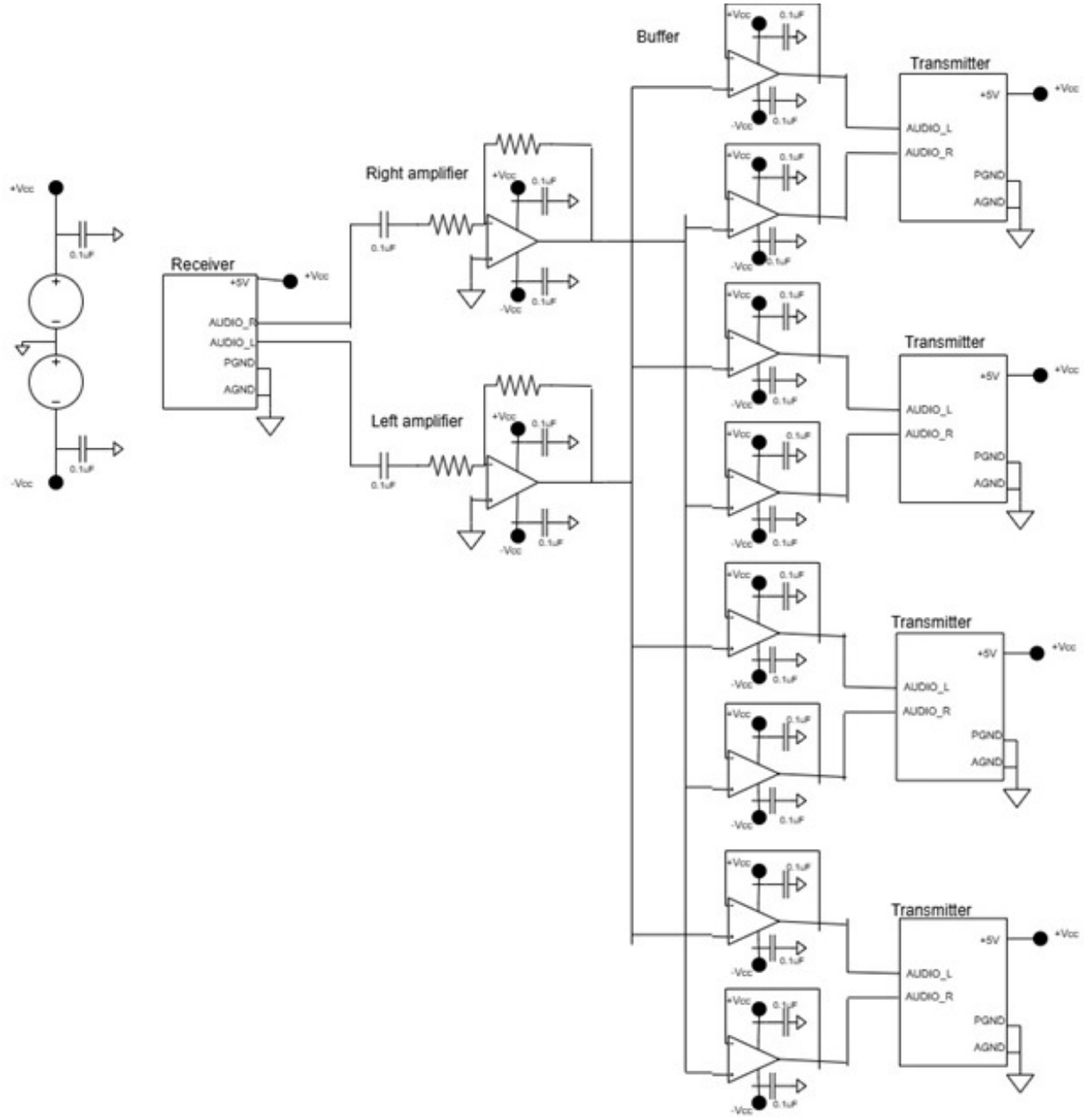
(b) External View



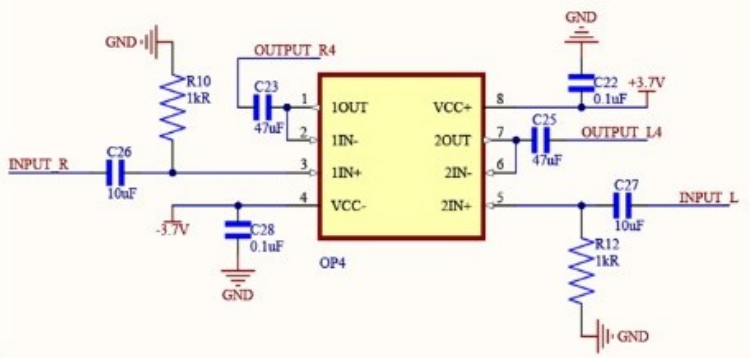
(c) Internal View

5.3 PCB Design

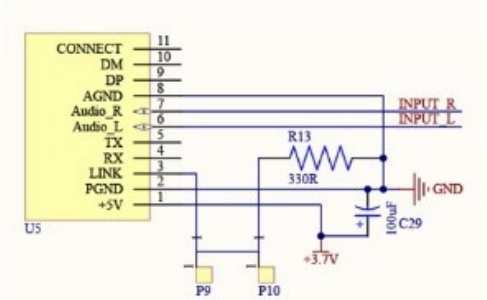
5.3.1 Circuit Diagram



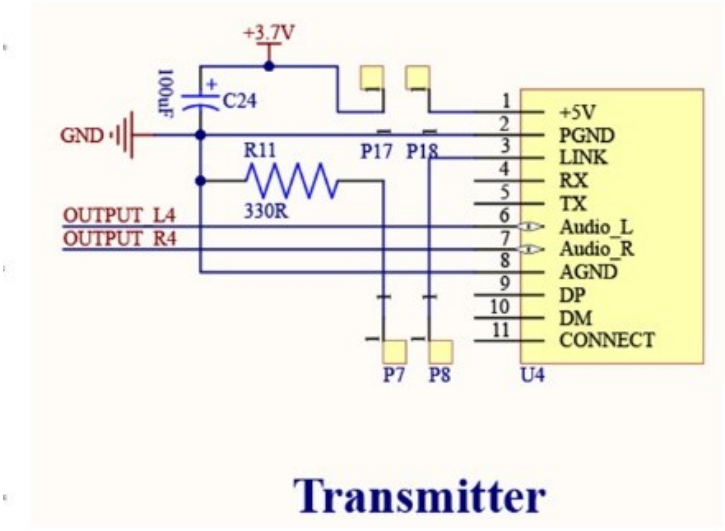
5.3.2 PCB Schematic



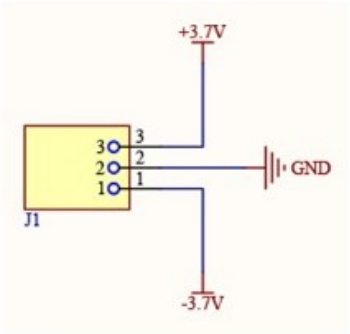
Operational Amplifier Buffer/Splitter



Bluetooth Reciever

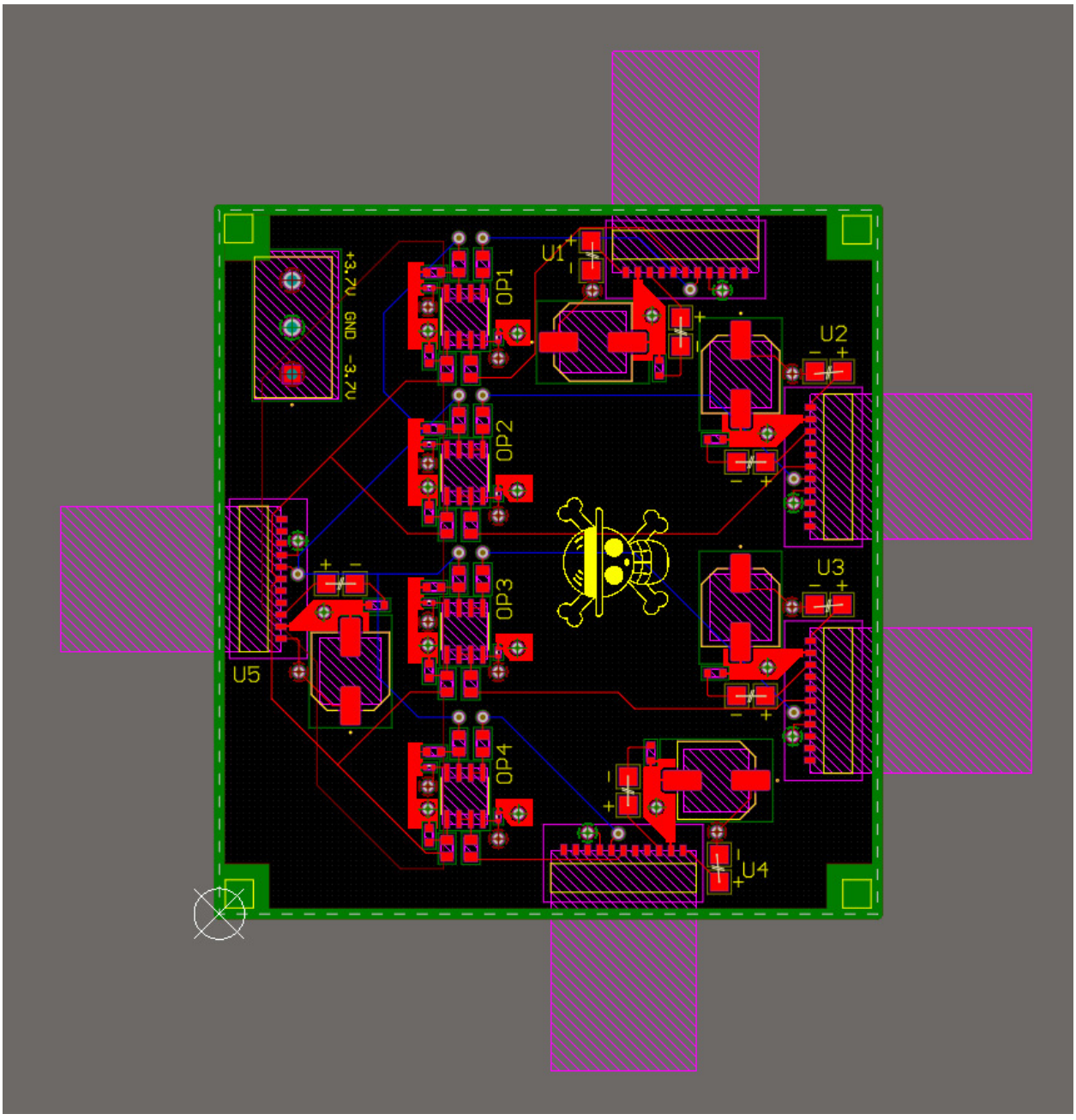


Transmitter



Split-Rail Power Supply

5.3.3 Final PCB Layout



5.4 Final Product

6 Market Analysis

Before designing the product, our team performed a market evaluation in order to determine following criteria:

1. Overall interest in the product
2. Age range of the people who are interested
3. Expected number of headphones to connect to the device simultaneously
4. Expected price range for the device

From this evaluation, it was determined that our primary shareholders were in the young adult demographic. The requested range of devices to be connected simultaneously was between 3 and 4. Regarding the expected price range, the responses received were inconclusive. We recieved a large variety of expected prices for our product. We attribute this to both the novelty of the device being proposed and the lack of an alternative product as a point of reference for price estimation. This clearly demonstrates the potential market for this device.

7 Task Allocation

Name	**Task**
Imaduwage O.N.H.	Circuit Design, PCB Design
Ilankoon I.M.M.K.B.	Circuit Analysis, Soldering
Rathnayake M.A.G.K.N.	Enclosure Design, 3D Printing
Dilhan W.A.	Product Design, Assembly

8 Final Budget

Component Name	**Unit Price (Rs.)**	**Quantity**	**Total Price (Rs.)**
KCX-BT-EMITTER	500	5	2500
NE5532 Operational Amplifier	45	5	225
Miscellaneous Components			1600
Enclosure 3D Printing			5000
PCB Printing	2100	1	2100
Total			11425