

VEX VRC 2023-2024

Reverse Engineering Challenge

Disassembly and Summary Report of a Meta Quest 2 Virtual Reality Headset



Gael Force Robotics

Team 5327Swag

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Introduction

In the technological landscape, virtual reality emerges as a beacon of limitless potential for the future of the industry. Within VEX Robotics, VR transforms the game, offering a fresh perspective on Over Under 2023-2024. Team 5327S employs the engineering-design process, iteratively refining our robot designs for peak performance. Now at a stage in our process where victory hinges on inches, we look to VR as a strategic ally, leveraging its CAD and simulation capabilities with applications like CreateVR, to optimize performance with unprecedented precision. Due to its use of infrared cameras and IMU's being similar to our robot's use of VEX sensors, we feel that understanding how a VR headset works offers us greater insight into our robot's functionality. To unveil its inner workings, we decided to delve into the exploration of the complex systems within the Meta Quest 2, unlocking valuable insight into engineering innovation.

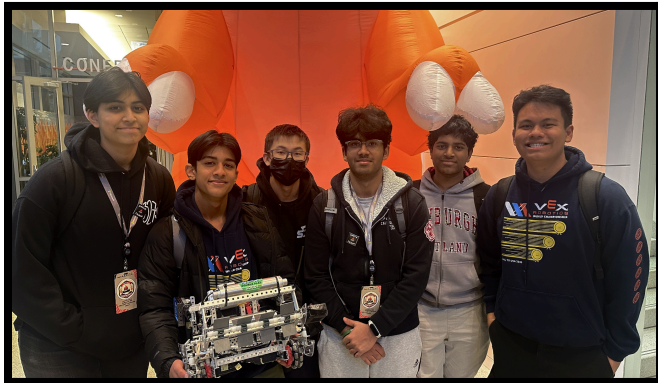


Figure 1.1 and 1.2 - Team 5327S.

Preliminary Planning and Research

Action Plan

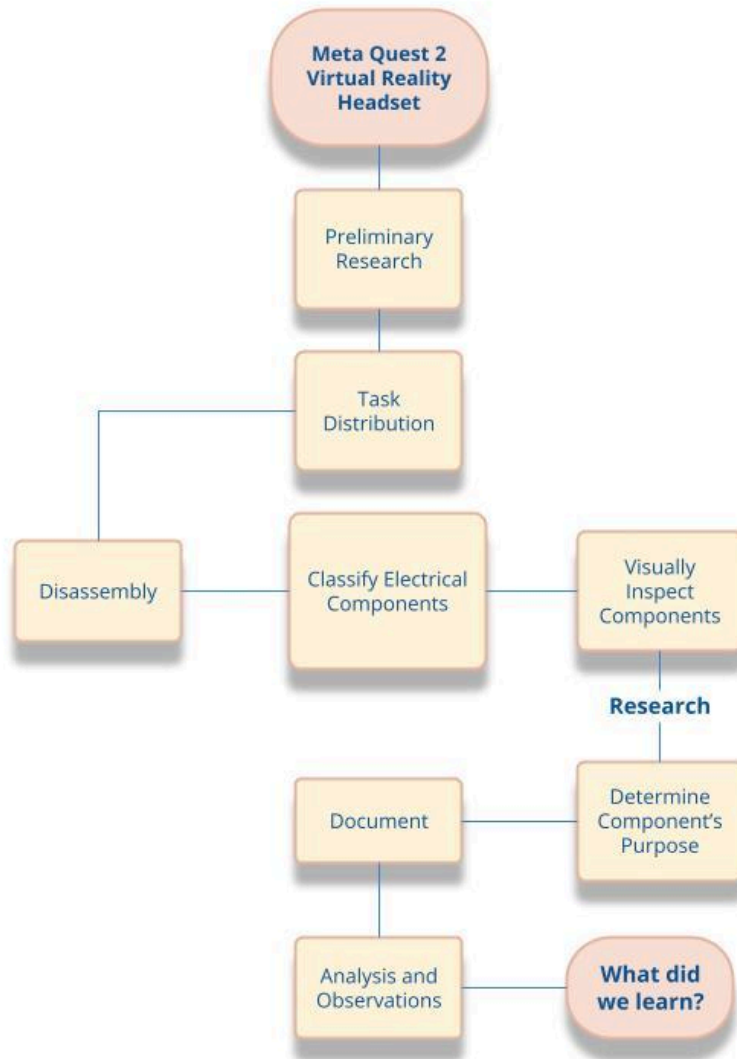


Figure 2 - 5327S flowchart plan to disassemble and analyze the Meta Quest 2.

Headset Components

After completing preliminary research, we disassembled the headset and analyzed its internal components.

Tools

- Phillips #00 Screwdriver
- T2 Torx Screwdriver
- Forceps
- Swiss Army Pocket Knife

Safety Precautions

- Gloves
- Protective Goggles
- Tarp/Trash Bag
- Mask

Disassembly Process

Step 1:

Acquire all safety equipment including gloves, goggles, a tarp, and masks, as well as the tools.



Figure 3.1 - Tools used to deconstruct headset.

Step 2:

Remove the rear cover of the headset to gain access to the front cover screws.

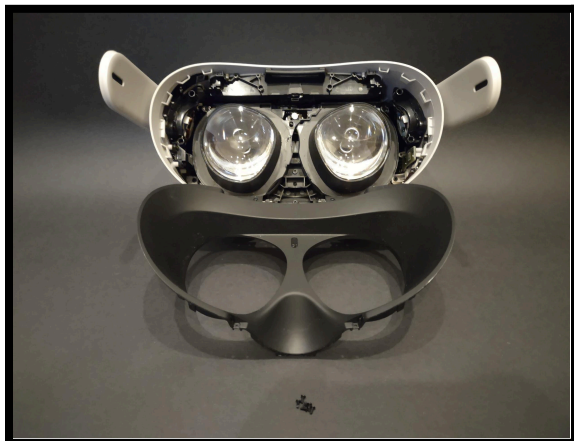


Figure 3.2 - Removal of the eyepiece trim.

Step 3:

Remove the front cover to reveal the internal components and circuitry.

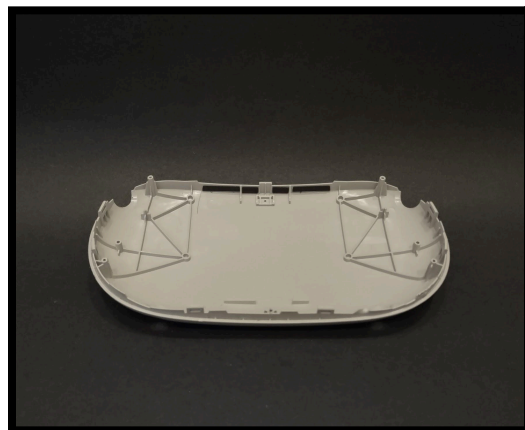


Figure 3.3 - Removal of the front cover.

Step 4:

Remove the bluetooth antenna and cooling fan.

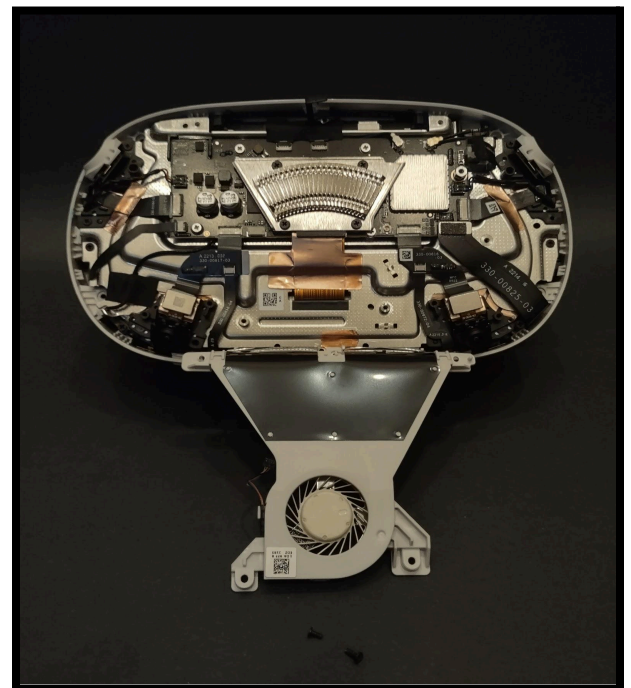
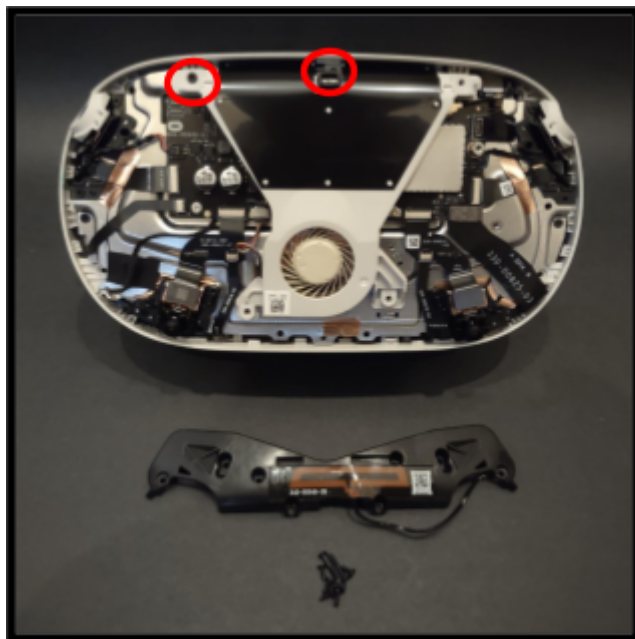
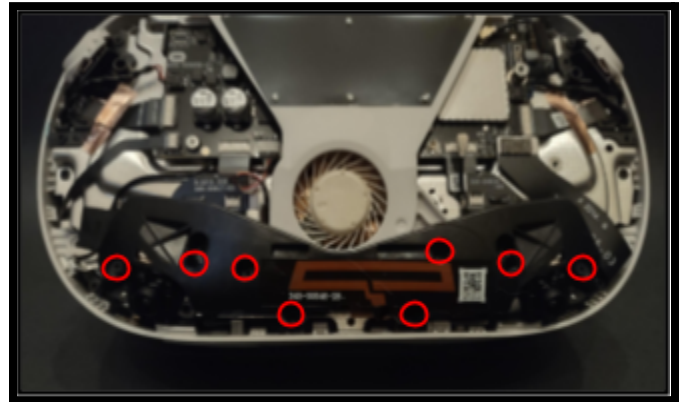
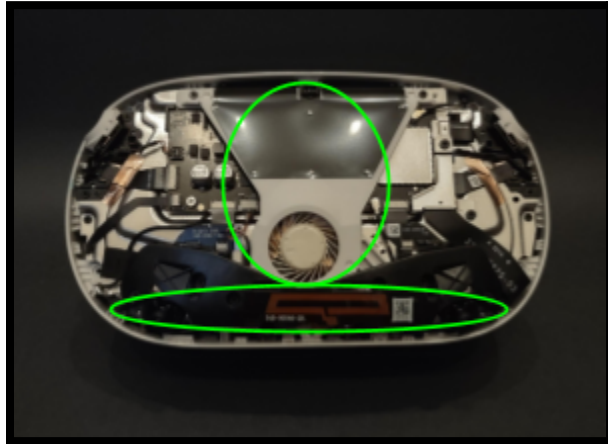


Figure 3.4 - Removal of the bluetooth antenna and cooling fan.

Step 5:

Remove the heatsink and mainboard.

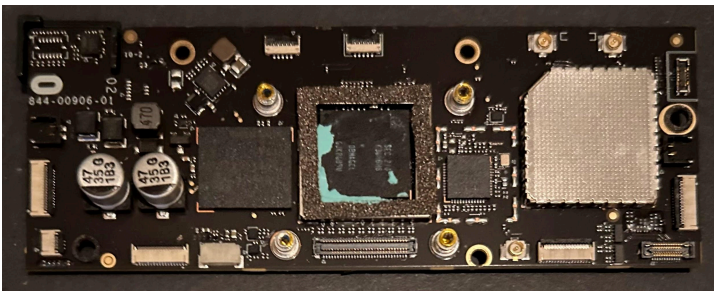
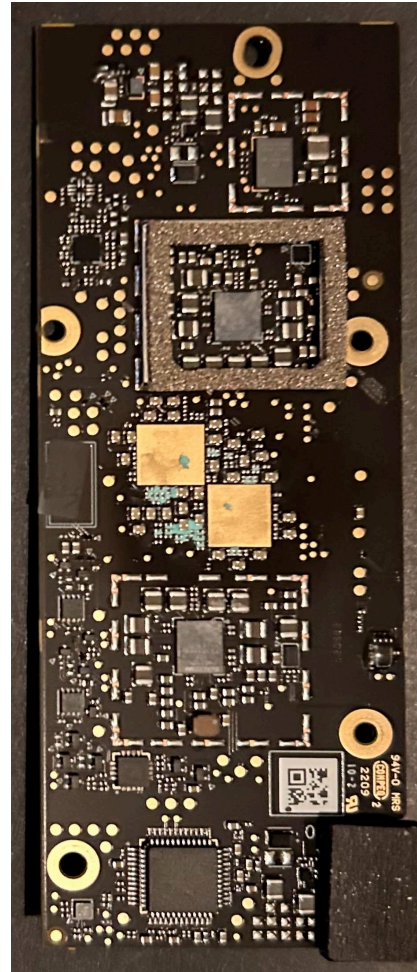
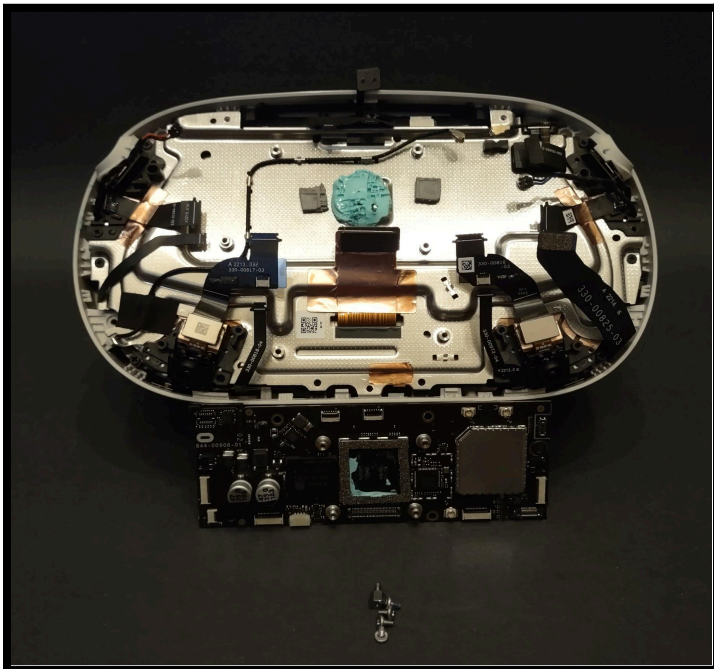
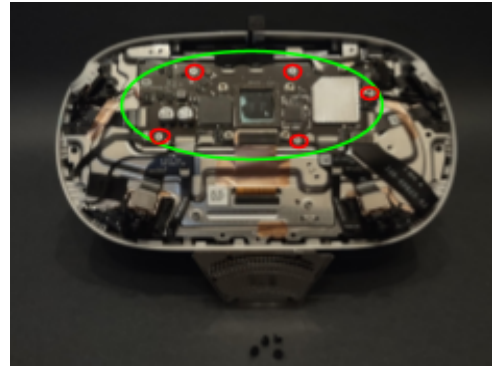
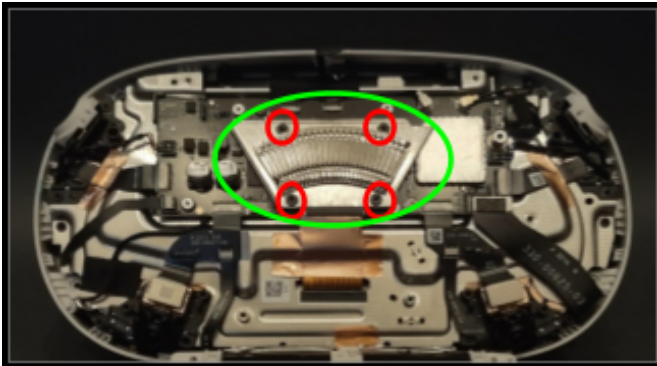


Figure 3.5 - Removal of the heatsink and mainboard, front and back view of mainboard.

Step 6:

Remove the midframe and battery, locate the speakers.

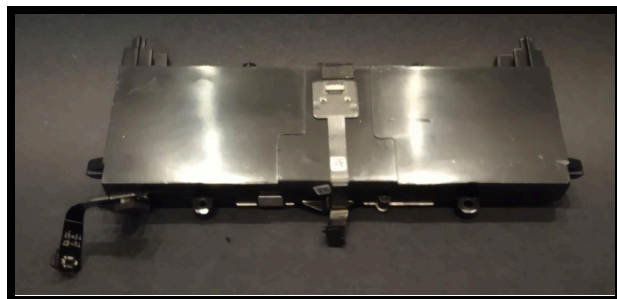
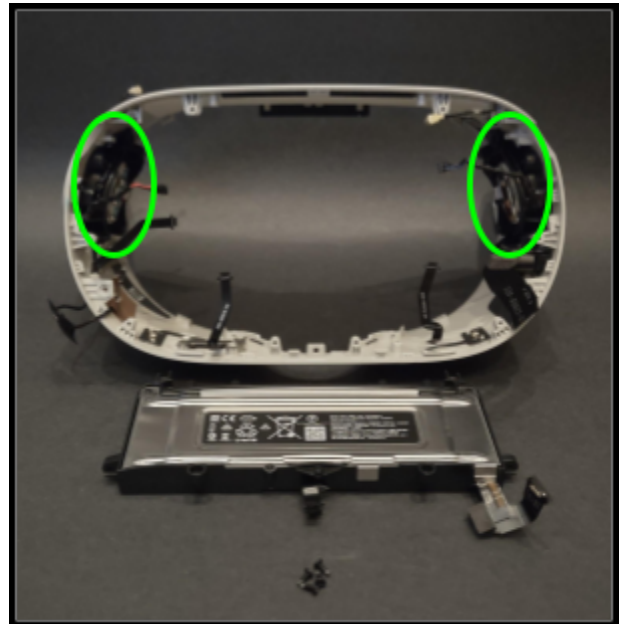
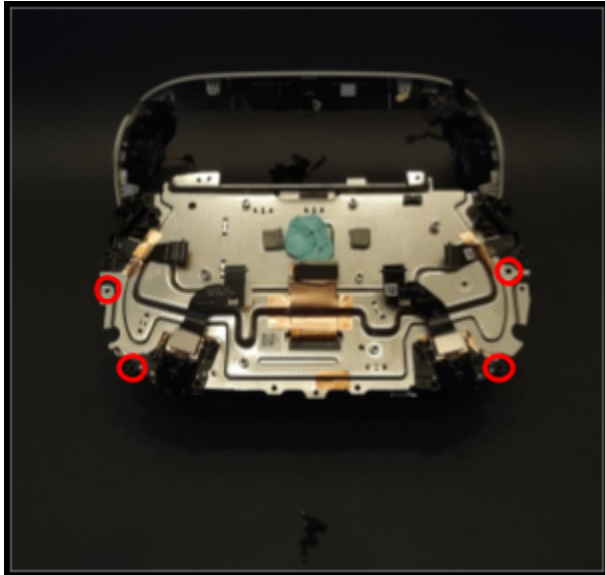


Figure 3.6 - Removal of the midframe and battery, front view of stereo speakers.

Step 7:

Remove the IR cameras, separate the lenses from the LCD Display.

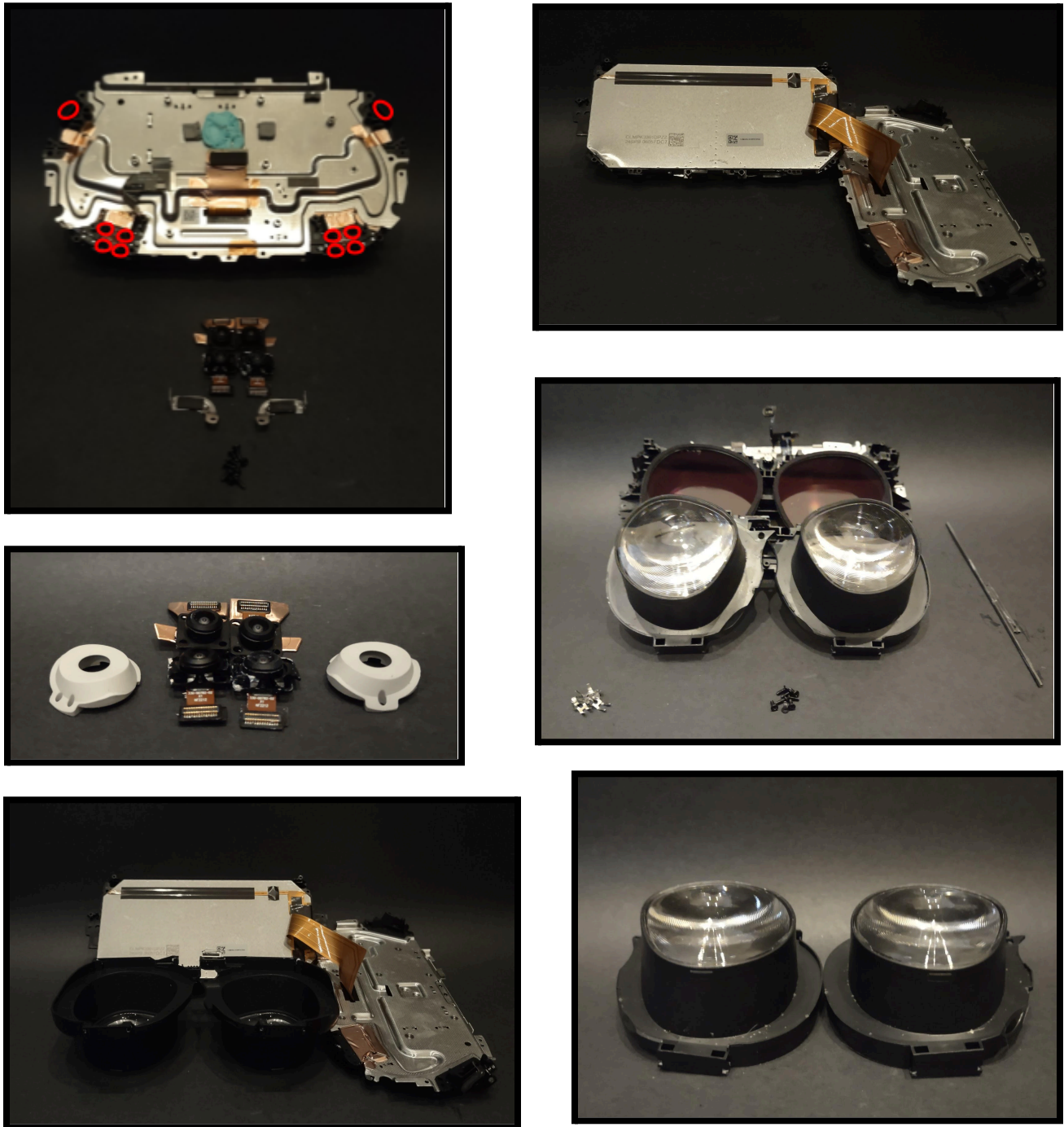


Figure 3.7 - Removal of Infrared Cameras, Fresnel Lenses, and LCD Display.

Meta Quest 2 Complete Deconstruction



Figure 3.8 - Deconstructed Meta Quest 2.

Major Electrical Components Overview

Within the Meta Quest 2, there is 1 main circuit board that handles every function of the headset. We inspected and analyzed this circuit board to understand its role in the overall system.

Meta Quest 2 Main Control Circuit Board

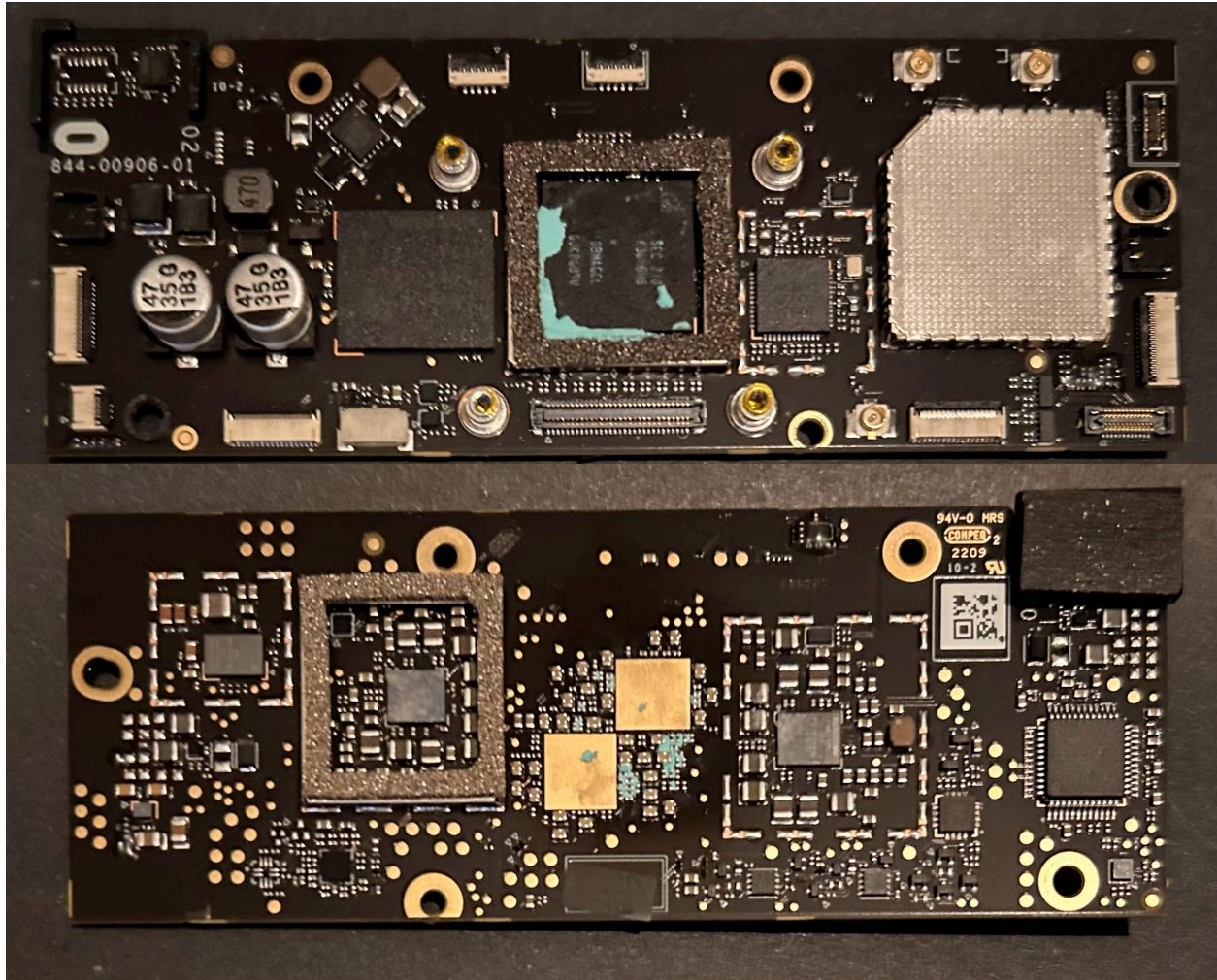


Figure 4.1 - Front and back images of Main Control Circuit Board.

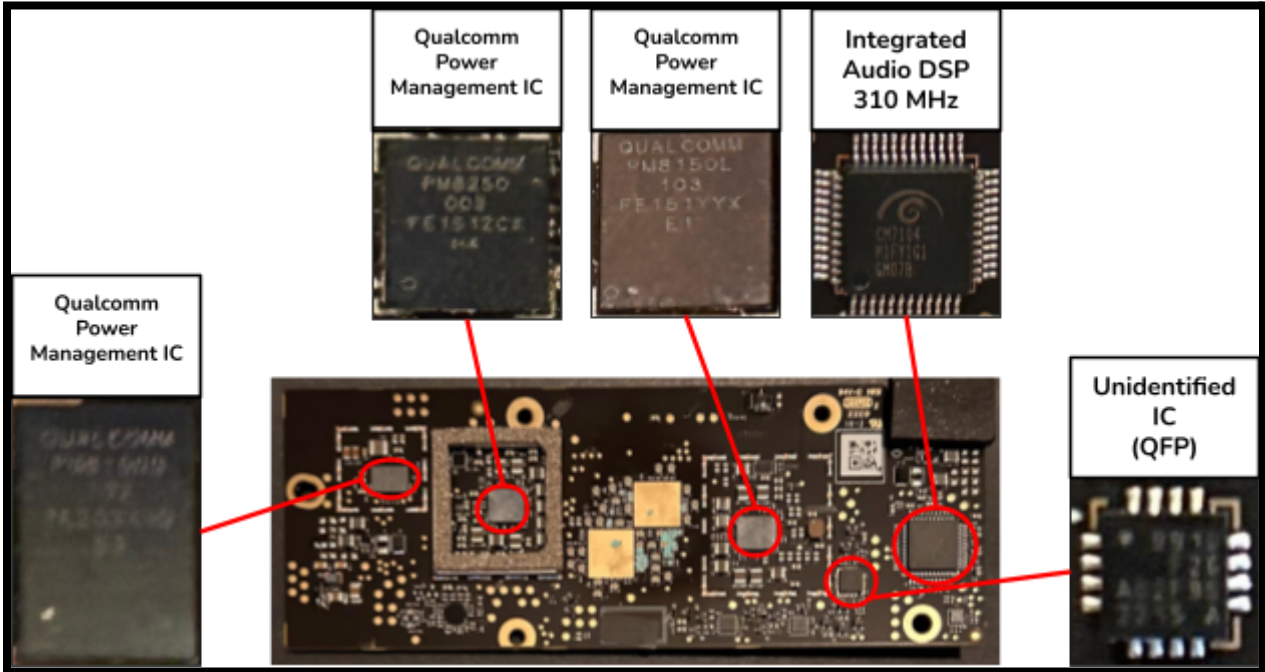
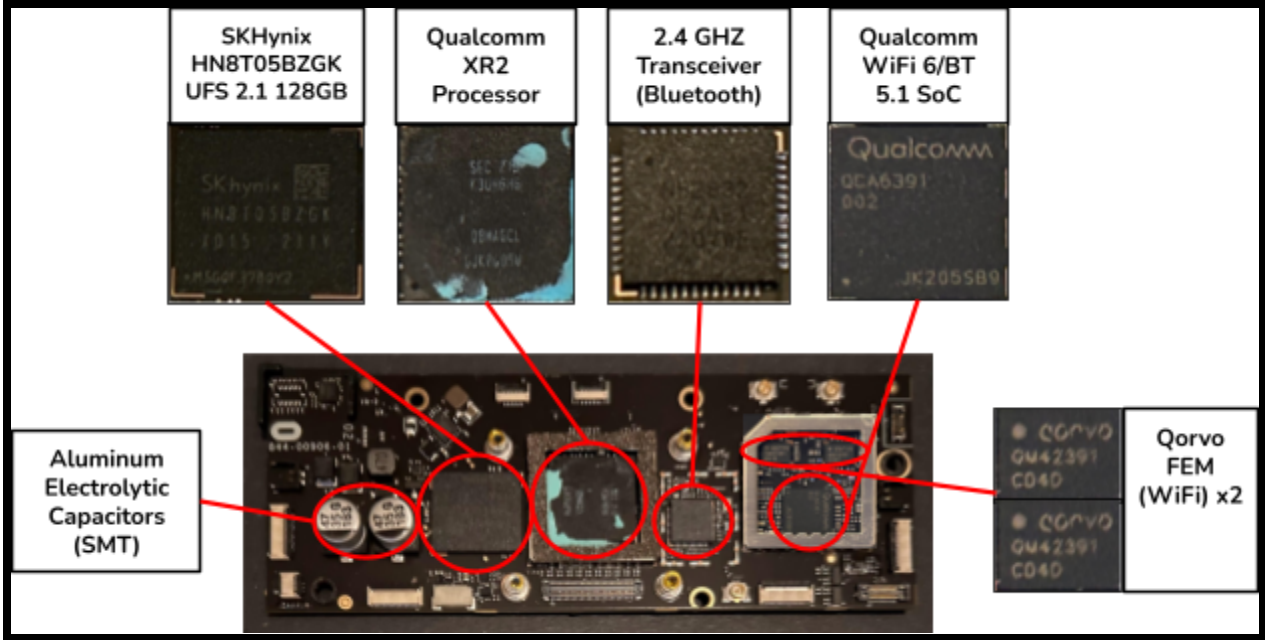


Figure 4.2 - Labeled front and back images of Main Control Circuit Board Integrated Circuits.

System Observations

After inspecting and determining the functions of each of the headset's electronic components in conjunction with the software, we were able to map out the startup process, as seen in the control flow chart below.

Control Flow Chart

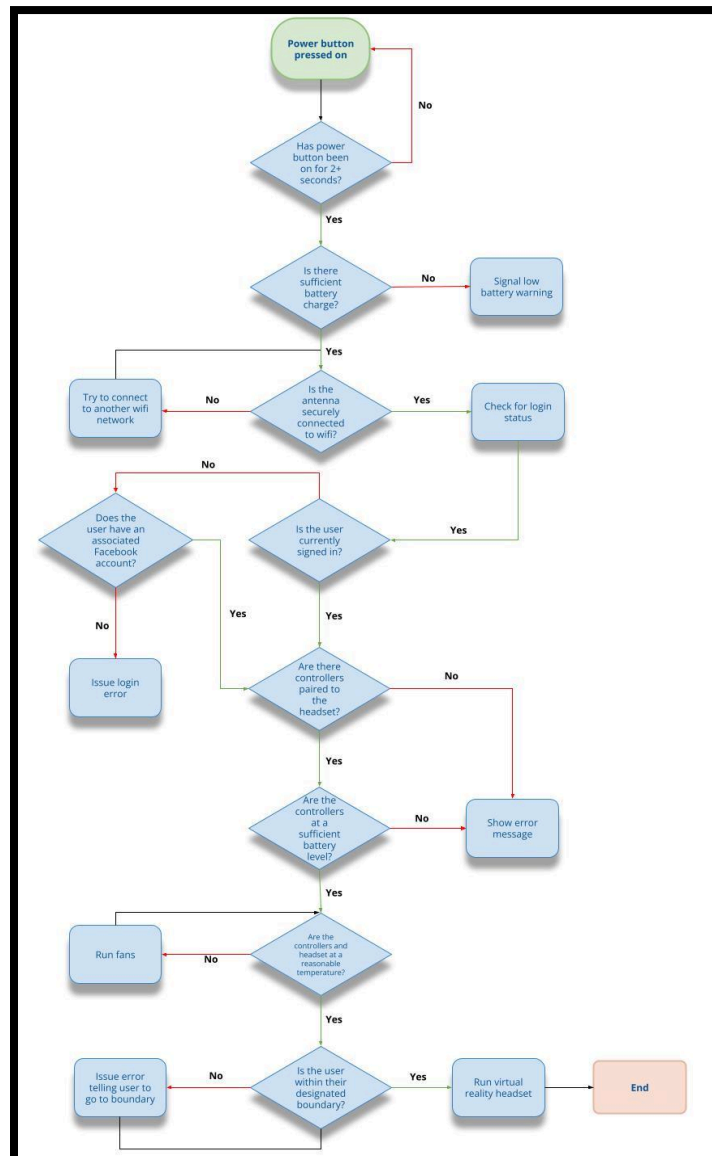


Figure 5 - Control flow chart of the startup process.

Conclusion – What did we learn?

In this challenge, we deconstructed a standalone VR headset mainly focusing on the electronic components. We identified several different types of ICs including the main processor, a transceiver, power management, storage, and integrated audio. Through each unique component, we were able to draw connections to our own robot and truly understand the interconnectedness of the systems within the headset, allowing us to incorporate complex systems between sensors and mechanisms on our own robot. We learned to commit to a plan of action, how to effectively research to find valuable resources online, and the intricacies of modern electronics.

Word Count - 498

Resources

- <https://www.ifixit.com/Guide/Oculus+Quest+2+Disassembly/139759>
- https://youtu.be/3wdLL3v_38I
- <https://embeddedcomputing.com/application/consumer/augmented-virtual-reality/tear-down-meta-quest-2-vr-headset>
- <https://www.educative.io/answers/what-are-the-basic-components-of-virtual-reality>
- <https://science.howstuffworks.com/question244.htm>
- https://xinreality.com/wiki/Fresnel_lens
- <https://robots.net/tech/how-does-the-room-scale-mode-of-virtual-reality-vr-work/>
- <https://youtu.be/AZ7ufYef-dM?si=gBGFMH8Pw7nVnNs4>
- <https://www.ifixit.com/Guide/Meta+Quest+2+Power+Button+and+LED+Board+Replacement/169156>