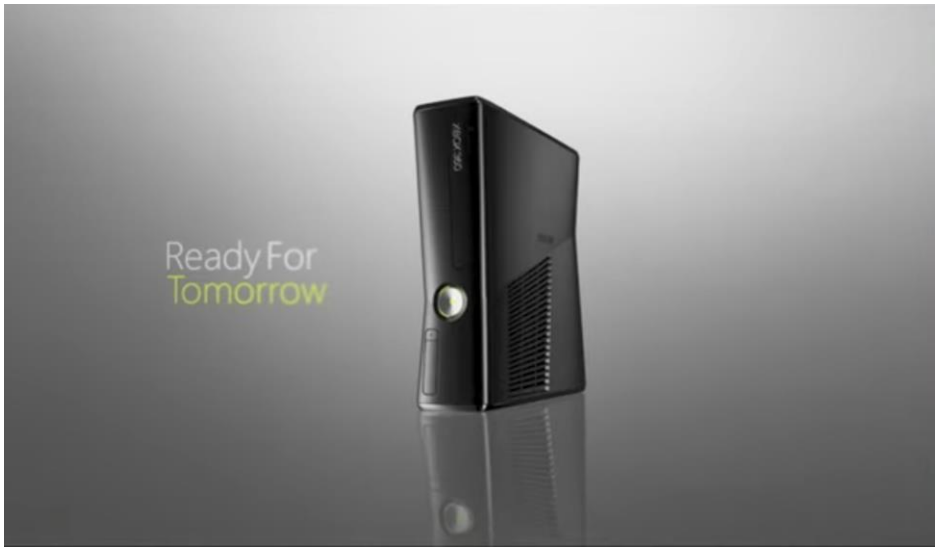
VEX VRC – 2023 / 2024

Reverse Engineering Online Challenge



Team Number - 6008D

Richwood, Ohio

North Union High School

Carter Hartings, Eulaela Colwell, Felix Plouck, Philip Ardrey, Taylor Reeb

Word Count: 494 (not including title page, image captions, or tables/graphs)

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Introduction

Our team has been in robotics since 2017 (5 years ago) and has been dedicated to the competition since we first joined. Before we decided to join robotics, there were many things that influenced our interest in the sport, one of which being video games. The similarities of a remote control, heated competition, and the ability to play with friends made the connection between video games and VEX robotics very apparent, guiding our fascination to sign up. Now that we are old enough to fully understand the mechanics of a robot that we build now, our team wants to understand the build and function of a video game console. We concluded that the best way to comprehend this information is by disassembling a console and recording the process. Our team chose to take apart an Xbox 360 Slim because it was what we grew up playing on and because of our access to the machine (previously owned).

Figure 1 – 6008D with an Xbox 360 Slim

Process

We needed to create a plan for our disassembly procedure, which we did by taking the engineering design process and adding steps specific to the task that we are completing. This process is shown in *figure 2* below.

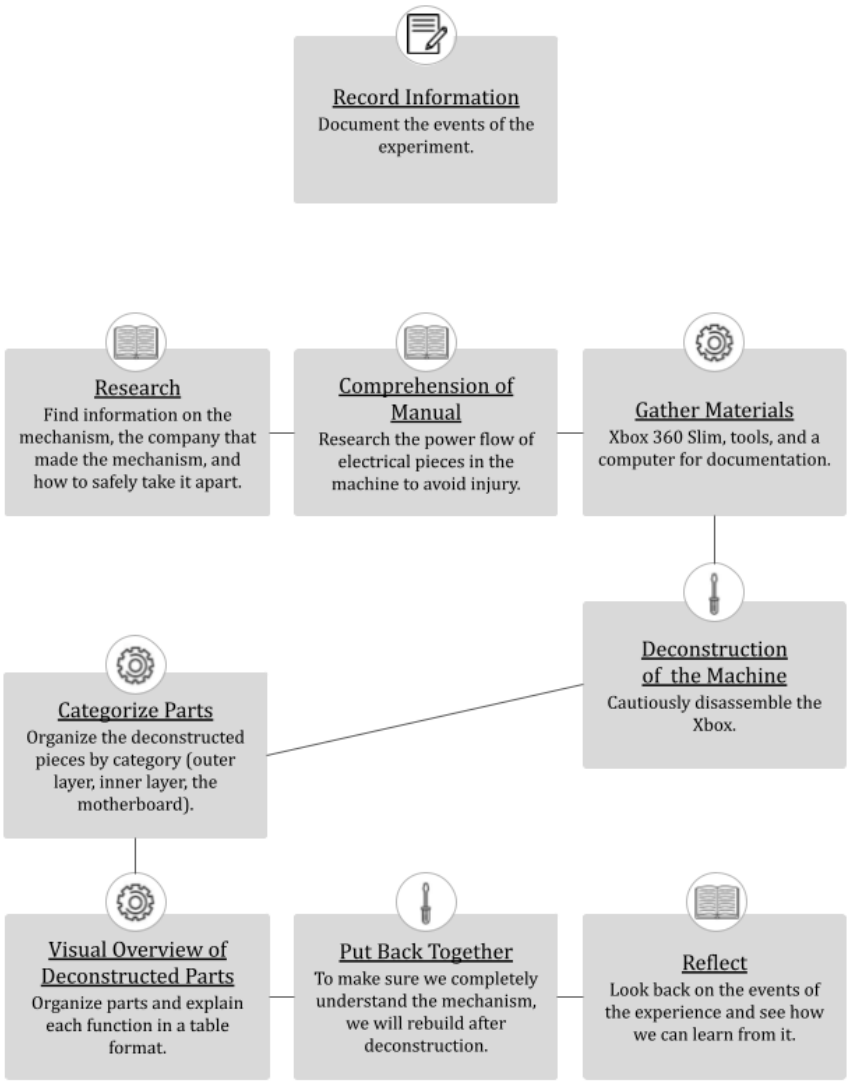


Figure 2 – Reverse Engineering Design Process

Disassembly

When starting the disassembly process, we made sure to stay organized, document the entire process with images and notes, and ensured that we did not damage any part of the mechanism to make reconstruction possible.

Tools Used:

- Torx T8 Screwdrivers
- Torx T10 Screwdrivers
- Torx T6 Screwdrivers

Manual Resources Used:

- Exploded View of Xbox 360 (fig 3)

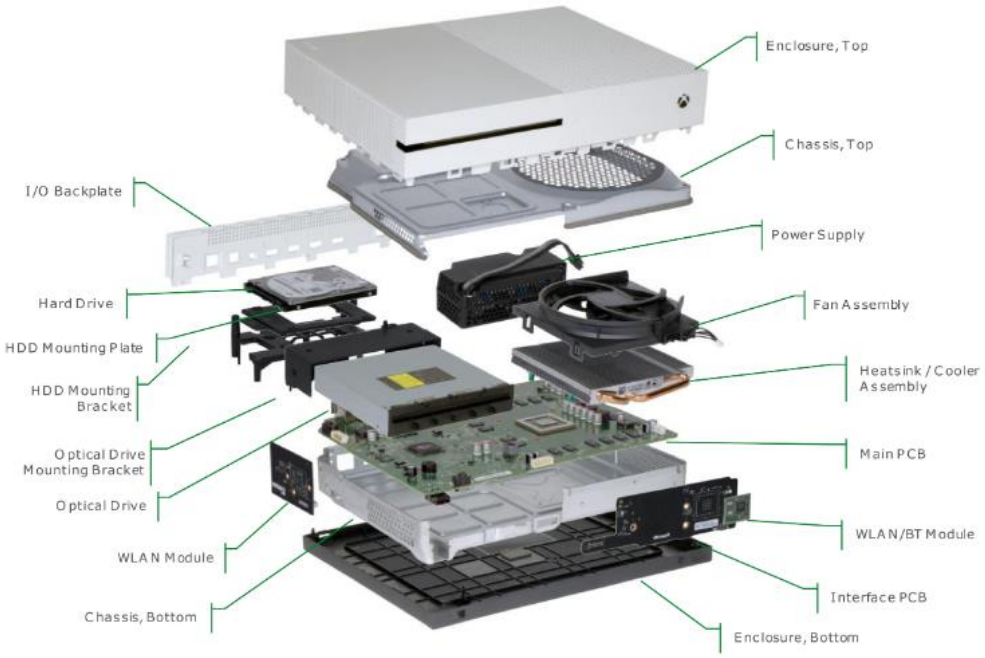


Figure 3 – Exploded View of Xbox 360

Figure 4 – Removing The Outer Layer

Figure 5 – Removing the Optical Drive

Figure 6 – Deconstructing The Inner Layer

Start Time: 12:44 PM

End Time: 1:36 PM

Total Disassembly Time: 52 minutes

Discovery Review

We learned many things from taking apart the Xbox. Studying the schematics for the motherboard has helped us to be able to identify a power flow through electrical components of the machine and study how many volts each piece uses. We were also able to identify each component and study their functions, similarly to how we would in our Engineering Notebook during robotics.

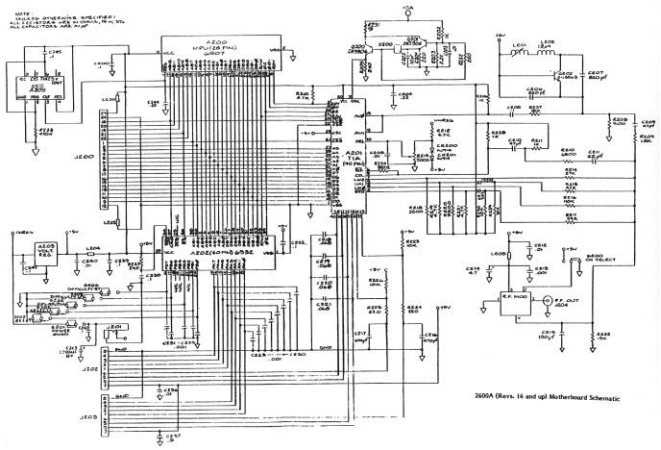


Figure 7 - Trinity Motherboard Schematic

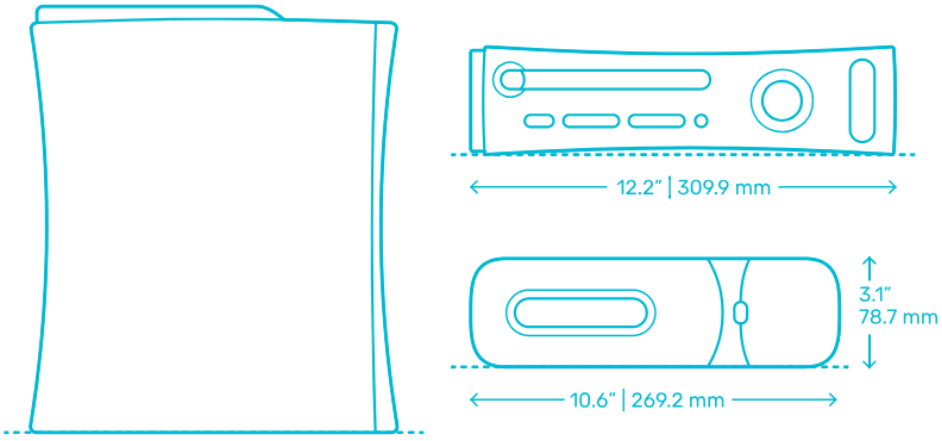


Figure 8 – Sketch of an Xbox 360 Slim

Component Summary

After taking apart the Xbox, we organized all the parts to get a better understanding of their individual functions, helping our team comprehend the collaborative functions of the parts.

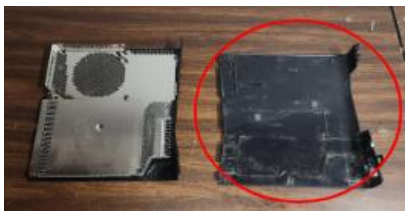
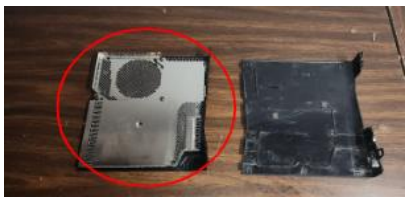
Outer Layer		
Part	Part Description	Photo
Enclosure (Top)	Protects the inside of the Xbox from dust, debris, and being impaired by any kind of damage.	
Enclosure (Bottom)	Protects the inside of the Xbox from dust, debris, and being impaired by any kind of damage.	
Backplate	Connects the two enclosures.	

Figure 9 – Outer Layer Parts List

Inner Layer		
Part	Part Description	Photo
Chassis (Top)	Extra protection for the electrical elements inside the chassis.	
Chassis (Bottom)	Extra protection for the electrical elements inside the chassis.	
Optical Drive Mounting Plate	Helps to hold the optical drive in place and provides a barrier between the wiring and the drive.	
Optical Drive	This allows Blu-ray discs and DVDs to be sold in the same region as the console.	

Internal Cooling Fan	Stops the machine from overheating when in use.	
Heatsink	Helps to alleviate heat from the device, improving performance and lifespan.	
WLAN Module	Allows internet connection to wireless internet connection networks under a wireless local area network (WLAN).	
WLAN/BT Module	Allows for wireless Bluetooth connection.	

Figure 10 – Inner Layer Parts List

The Motherboard (Trinity)		
Part	Part Description	Photo and Location on MB
CPU (45nm – combined chip)	Executes instructions from the hardware and software programs.	
PSU (135 Watts)	A power supply unit that changes mains AC to low-voltage DC power.	
GPU (45nm – combined chip)	Helps to process graphics, effects, and videos.	

Kinect Auxiliary Port	Used for additional audio input.	
HDD Port	Used to input hard drives.	
Power Port	Assists in the transfer of energy to the machine.	
Proprietary A/V Port	Allows TV speakers to access the audio.	
2 USB Ports	Connects peripheral devices to the Xbox and transfers digital data.	

Figure 11 - Motherboard Parts List

Attempt to Reassemble

To make sure that we had a complete understanding of how the Xbox functioned, we decided to attempt to rebuild it.

Figure 13 – Connecting the Fan

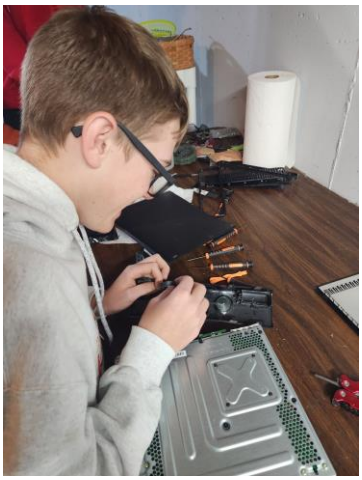


Figure 14 – Adding the Bottom Chassis

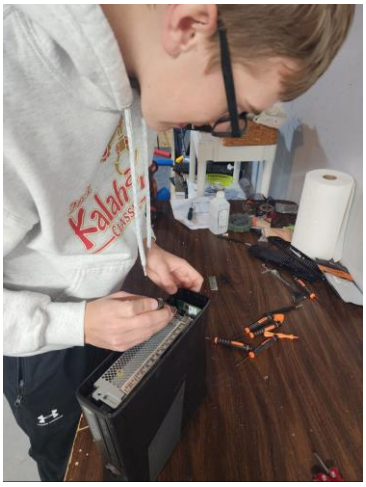


Figure 15 – Reconstructing The Outer Layer

Start Time: 2:00 PM
End Time: 2:29 PM
Total Reassembly Time: 29 minutes

Conclusion/Lessons Learned

This experience has taught our team the many important messages that will prove to be extremely useful throughout our lives. Taking apart the Xbox 360 Slim helped with our understanding of organized projects and using caution in each task we do. Understanding the components of the Xbox has helped to introduce us to the world of mechanical engineering. Overall, we are incredibly pleased with the results of this experiment and look forward to sharing this knowledge with others.

Lessons Learned:

- Circuit board components and their functions
- How a circuit board (specifically the Trinity model) works
- Developing a power supply diagram helps when studying a machine

Figure 16 – 6008D at the RiverBots Signature Event with the Design Award

References

Disassembly -

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Discovery Review -

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