TEAM 66099A: THE ROBO-OLYMPIANS
SAN JOSE, CALIFORNIA
Reverse Engineering Online Challenge 2022
Sponsored by Texas Instrument

REVERSE ENGINEERING VTECH "MY LAPTOP" VT1424

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FINAL SUMMARY REPORT

Ever since I went on a school fieldtrip to the NASA Space Station. I was fascinated about how computers were a critical component of a rocket. A few weeks ago, while cleaning my room, I stumbled upon my old toy computer. It reminded me of my trip to NASA and my curiosity of how a rocket's computer worked. I took this opportunity to convince my team to dismantle the toy computer and find out how it works. Doing so, we were hoping to figure out how computers, with a maze of wires and large vacuum tubes, evolved into ones that we have today.

To dismantle, we had to use the right equipment. Different sizes of screw drivers, tweezers and wire cutters were things we needed to successfully take apart the computer and learn about how it worked. Having the mentor standing next with a fire extinguisher in the event of exploding capacitors was an overkill for us, but precaution is required, and safety goggle is a must. At least it saved one of the team member's eye from the flying springs while they were dismantling the mouse. Using our table, we carefully took apart the device.

As we dismantled the computer, we found countless wires, each connected to a key. We also took apart the mouse, which included a miniature PCB with contact plates and an interesting spring system. We looked further into the keyboard and discovered a flexible PCB that was connected to many printed wires. The key matrix, which is a grid of circuits, had a series of inputs and outputs, as it was latched onto many parts of the controller. As we took apart the screen/case of the computer, we revealed a horde of diodes but nicely tucked on a PCB.

Finally, with all devices dismantled and spread out, we were able to see how pressing a key then closes the circuit via the intricate network of printed wires on the PCB to display what is pressed! It was our moment of realization of how far we have come from the jungle of vacuum tubes circuit boards to small but complex printed circuit boards! The most challenging part was identifying those miniscule components on the PCB, where we had to resort to a microscope and the internet. We were able to make sense of the connecting capacitor, resistor and transistor on how the current is smoothed, controlled and switched between circuits to send signals between devices.

As we finished cleaning up, we realized there are millions of parts which are all critical for a computer, such as microchips and a key matrix. However, a rocket has many parts to it, yet it has a computer to add more components to the mix. Although a rocket may have billions of objects and items, it cannot be compared to a toy computer. We had lots of fun dismantling the toy computer and we wish we could investigate the topic closer with a computer from today!

Word Count: 496

INTRODUCTION: VTECH “MY LAPTOP”

Figure 1: Keyboard, Display and Mouse

Figure 2: Model Number

Figure 3: Legal Note

Figure 4: Battery Label

Figure 5: Bottom View

Figure 6: Top View

DECONSTRUCTION PROCESS

Step 1: Safety is essential! Make sure to have safety goggles to protect your eyes from any loose pieces flying out or any exploding capacitors!

Step 2: Have the appropriate tools for taking apart the device, otherwise you can get hurt, damage the components, or tools.

Step 3: The first step that you must do is remove the power source, otherwise you could get an electric shock!

Step 4: Remove external covers

Step 5: Open the case

Step 6: Disconnect battery wires

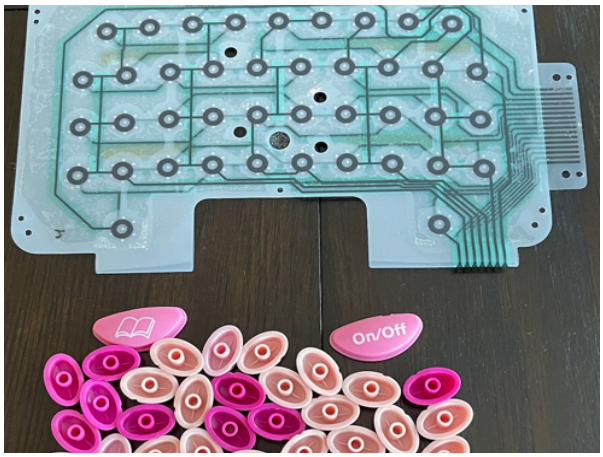
Step 7: Disconnect mouse wire

Step 8: Dismantle the mouse.

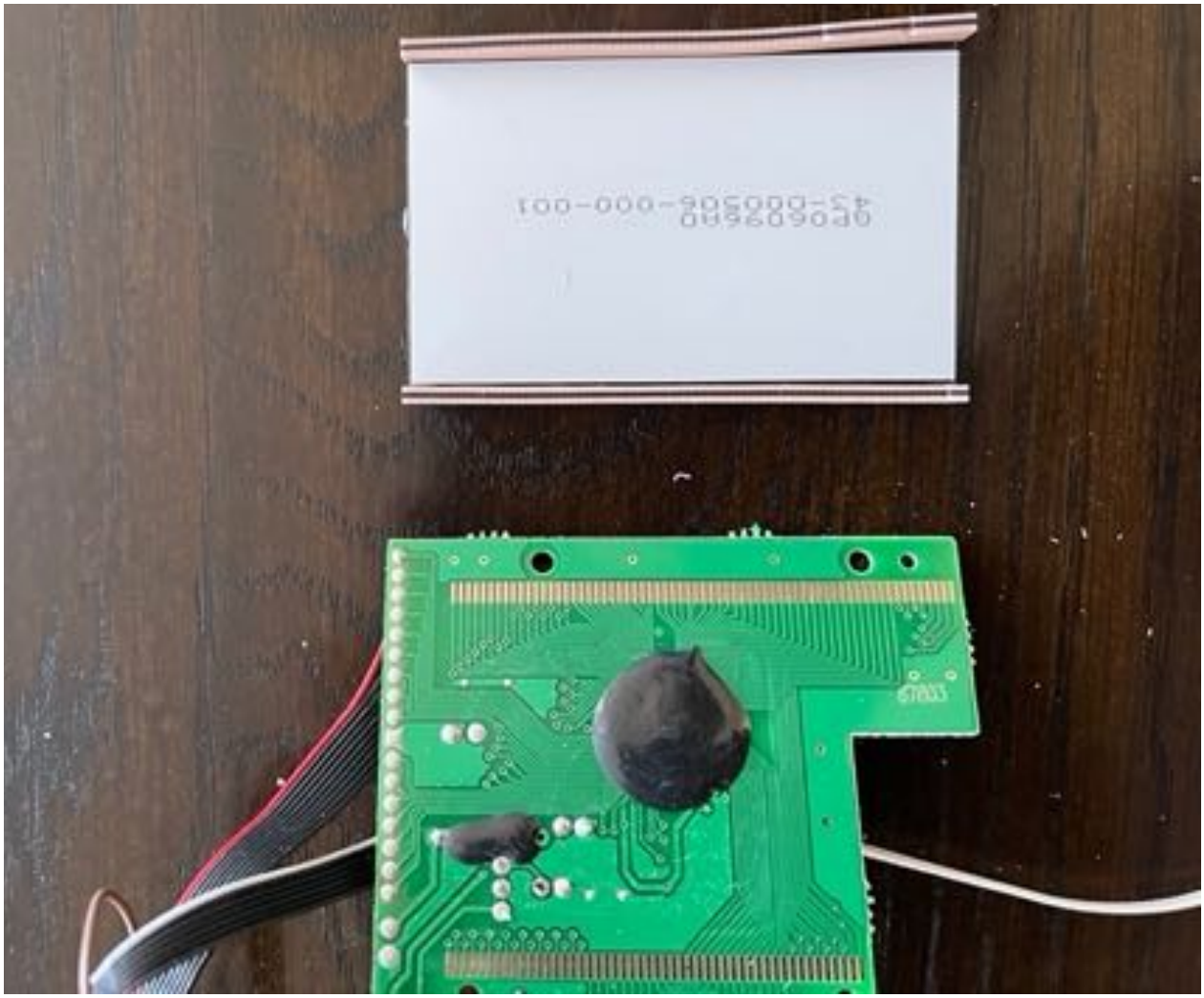
Step 9: Dismantle mouse contraption

Step 9: Remove the speaker and button

Step 10: Remove touch pad and keys

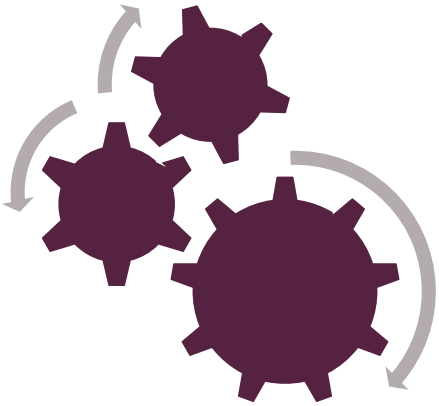


Step 11: Remove display unit and central printed circuit board

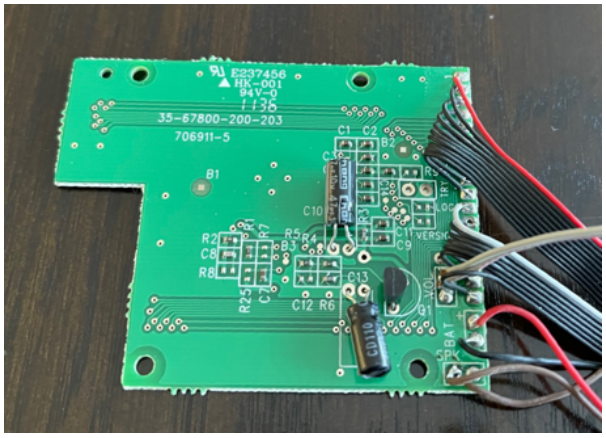


RESEARCH PROCESS

Step 1: Examining the connectivity of components with the help of tweezers to map out the circuit board.



Step 2: Using the magnifying lens, as well as the microscope, to examine and record the circuit board components.



Step 3: Researching components online by using overviews, forums, wiki, and datasheets.

DEVICE COMPONENT ANALYSIS

Device Overview

Device Diagram

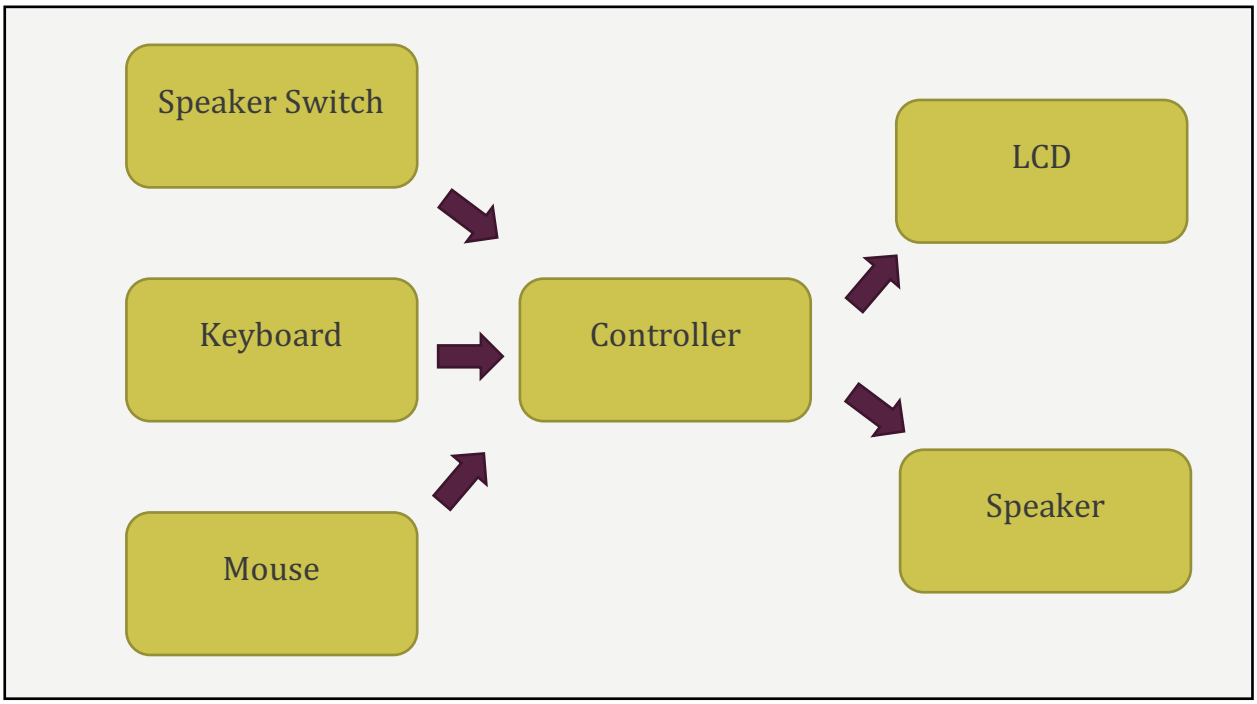


Figure 7: Interaction between the key components of the My Laptop device.

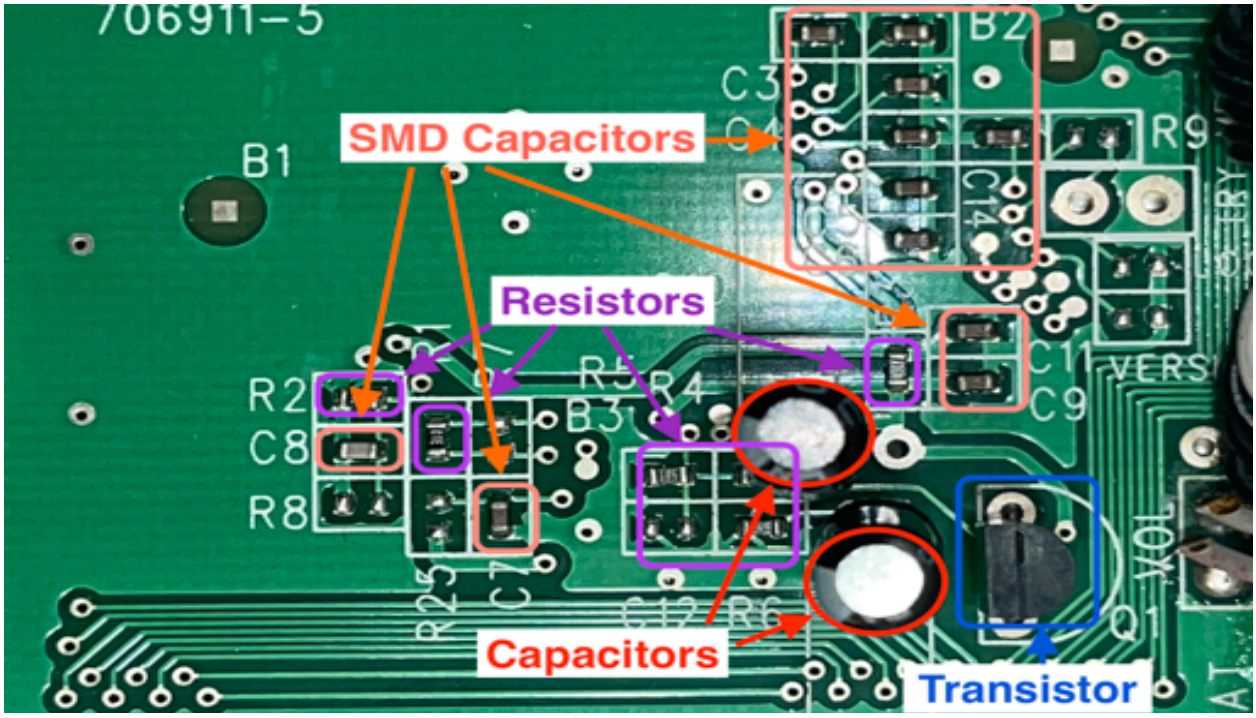


Figure 8: Printed Circuit Board for the Controller

Components Summary

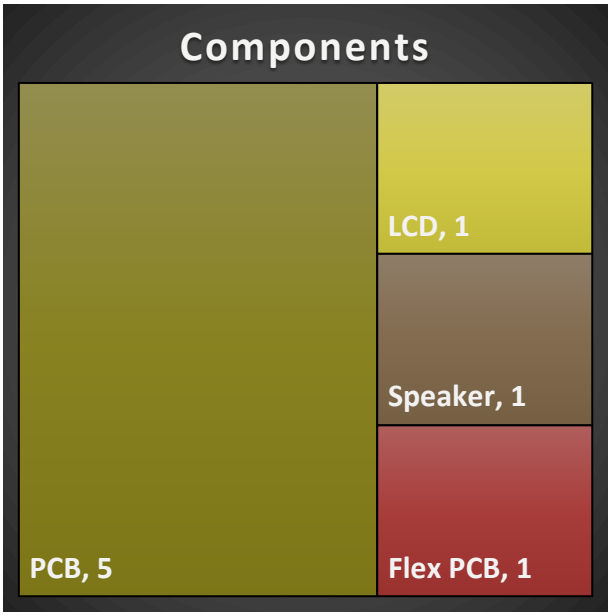


Figure 9: Electric and Electronic Components inside the My Laptop

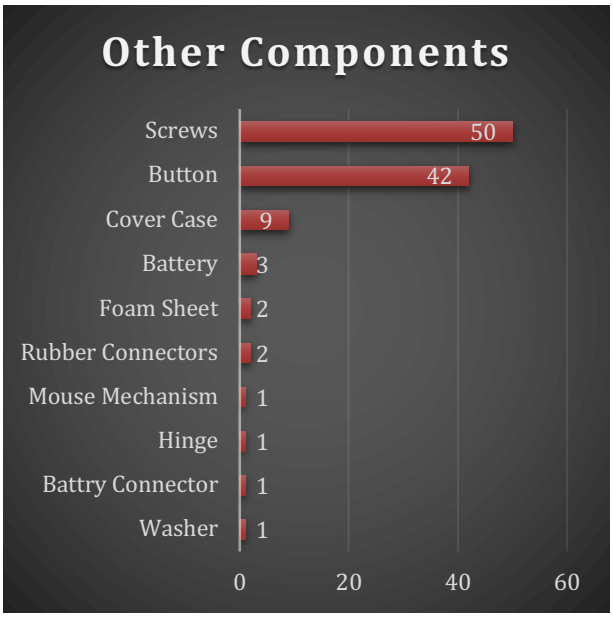


Figure 10: Other components inside the My Laptop

Printed Circuit Board Components Summary

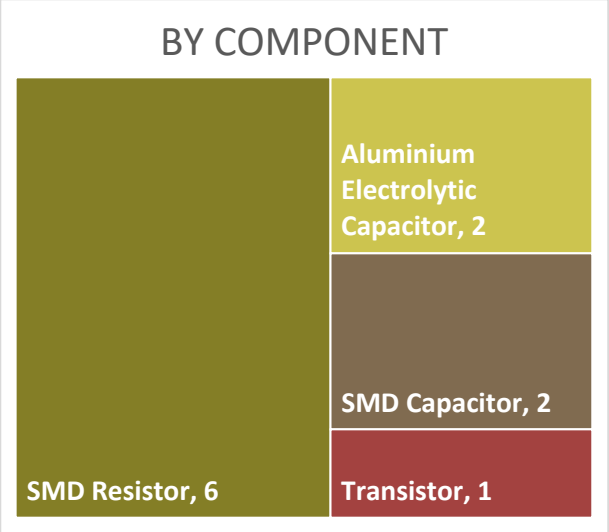


Figure 11: Components found in the Printed Circuit Board

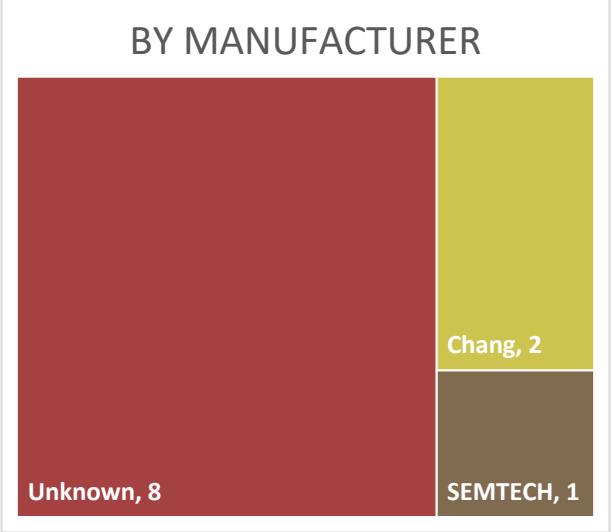
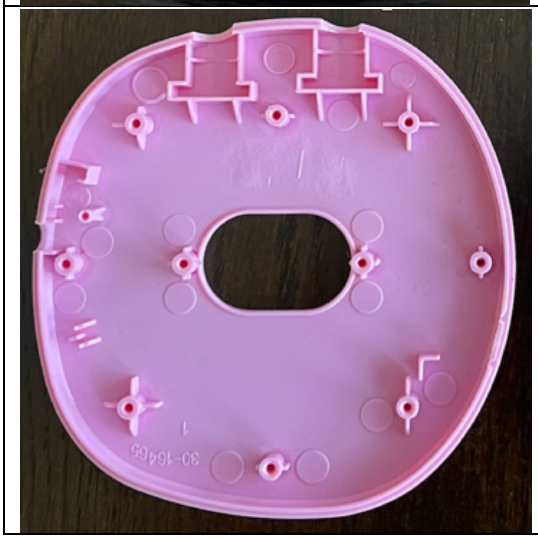


Figure 12: Manufacturer of those components found in the Printed Circuit Board

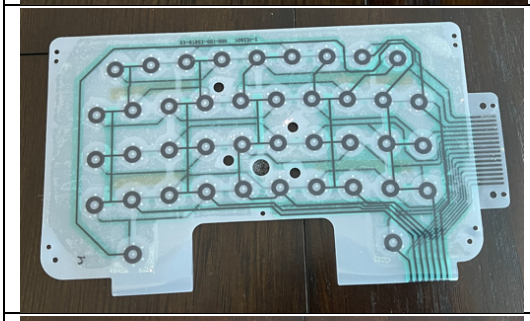
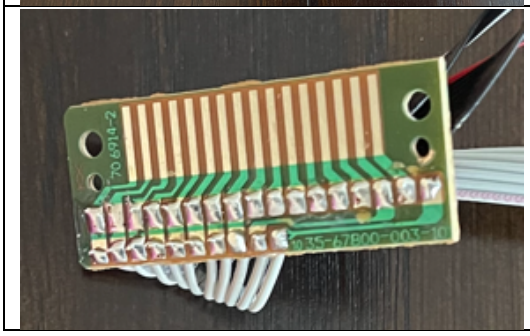
External Components

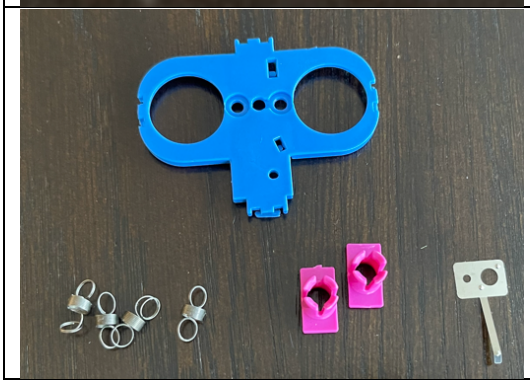
Name	Part Type /Quantity	Description	Function /Comment
	Casing X 1	Keyboard Bottom Cover	Protects the internal components of the keyboard and speaker.
	Casing X 1	Keyboard Top Cover	Holds the keyboard buttons in place.
	Casing X 1	Display Unit Back Cover	Protects and covers the display and the controller board.

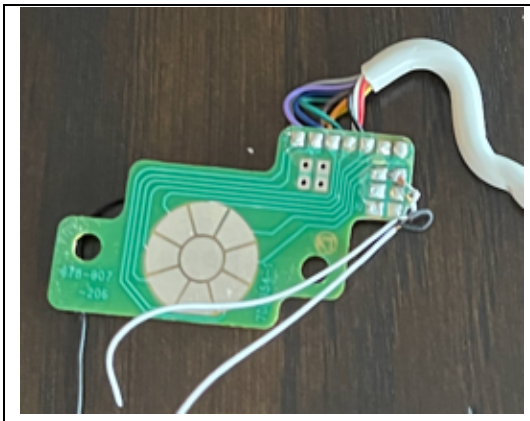
	Casing X 1	Display Unit Front Cover	Hold display unit in place.
	Casing X 1	Mouse Cover	Covers the mouse contraption and also has a button.
	Casing X 1	Mouse Holder Top Cover	This holds the mouse platform and the springs that control the mouse's movement.

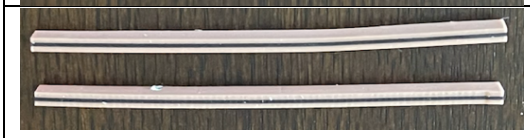
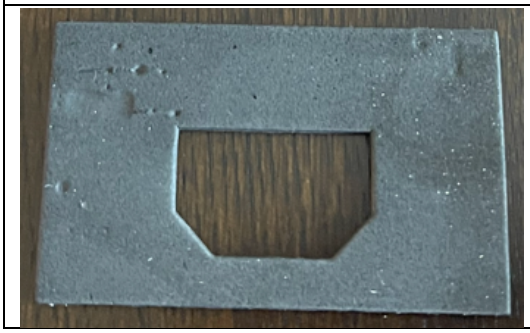
	Casing X 1	Mouse Holder Bottom Cover	The bottom cover to protect the mouse contraption.
	Casing X 1	Battery Case Cover	Prevents the batteries from falling out of the computer and also allows the user to take out the batteries easily.
	Screw X 8	Screws for External Case	This hold all of the cases on the computer firmly in place.
	Hinges X 1	Holder and Clip for the Display Unit Case	These hinges allow the display screen to open and close.

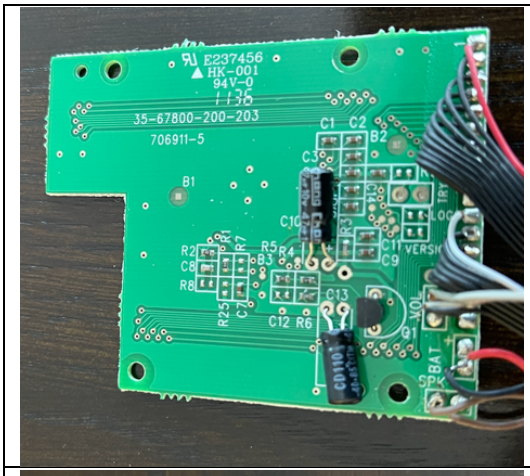
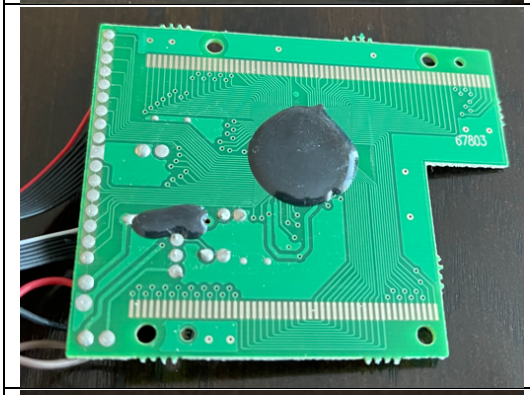
Internal Components

Name	Part Type /Quantity	Description	Function /Comment
	Buttons X 41	Keyboard Buttons	When a key is pressed it touches the touch pad and closes the electric circuit.
	Flex Printed Circuit Board X 1	Keyboard Matrix Circuit	When an electric circuit is closed by pressing the key, the touch pad sends the signal to the controller board.
	Foam Sheet X 1	Foam Sheet for Touch Pad	The cushion on the bottom of the touch pad helps to spring the keys back up.
	Printed Circuit Board X 1	Circuit Board to connect the Keyboard to the Controller Board	When the touch pad is pressed, it sends a signal to the LCD.

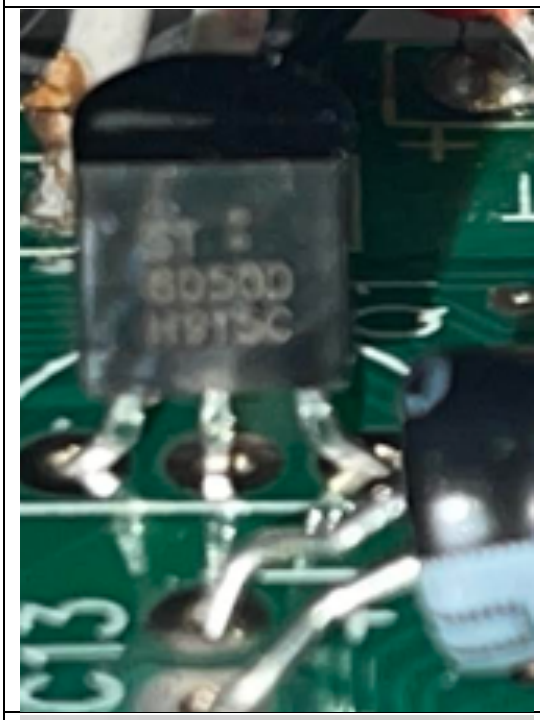
	Battery Connectors X 1	Wires to connect the Batteries	The springs holds the battery in place and the wires sends the current to the rest of the device.
	Cover X 1	Bottom Cover for the Battery Case	Secures the batteries in place.
	Power Source X 3	Battery	Powers the device.
	Mouse Contraption X 1	Four springs to hold the blue platform	The springs helps to move the mouse back into place after you let go of it.

	Printed Circuit Board X 1	Sensor to detect which direction the mouse is at.	When you move the mouse in a direction, a metal bar touches one of the eight plates on the PCB, which then let the controller know where the mouse at.
	Printed Circuit Board X 1	Connects the mouse to the controller board.	With this the controller board knows the position of the mouse.
	Speaker X 1	Impedance: 8 Ohms Power: 0.5W	When the button in the keyboard is pressed, the controller board then change the current to the speaker to play a specific tune.

	Button X 1 Printed Circuit Board X 1	Button and Sensor	When the button is pressed it touches the two lines and this completes the circuit.
	Liquid Cristal Display X 1	Model: GP06096A0 43-000506-000-001	This is a reflective LCD
	Connectors X 2	To conduct the current between the controller board and LCD.	Each printed stripe on the controller board send the single to the LCD through the conductors.
	Foam Sheet X 1	A sheet of soft foam.	It protects the LCD from cracking when it is pressed.

	Printed Circuit board X 1 (Top View)	The Controller Board	94V-0 Circuit board is defined as circuits inscribed on PCBs (Printed Circuit Boards) that have met the UL 94V-0 flammability test.
	Printed Circuit board (Bottom View)		This board receives signals from the touch pad and the mouse, then it sends signal to the LCD or the speaker.
	Screws X 4 Washers X 1	Screw with inbuilt washer and a leather washer.	This holds the touch pad and the speaker firmly.
	Screws X 20	Small Size Screw	Holds the various internal components firmly.
	Screws X 18	Medium Size Screw	Holds the various internal components firmly.

Integrated Circuit Board Components

Name	Part Type /Quantity	Description	Function /Comment
	Transistor X 1	Manufacturer: SEMTECH Model: 8050D Type: NPN Transistor Current: 1.5amp	This is used as a switch to send signals to the output sensors when the circuit is closed by the touch pad or the mouse.
	Capacitor X 2	Manufacturer: Chang Model: CD110 Capacitance: 100uF 47uF Voltage: 10v Operating Temperature -40 to +85°C	These two aluminum electrolytic capacitors smooth out the flow of the electrical current to the circuit board.

	Resistor X 1	SMD Resistor Resistance: 30 Ohm	Resistors control the amount of the current flowing through it. These are surface mount thin film resistors, which save space on the PCB. This helps to control the level of current going between each part of the circuit that are being closed by someone pressing the button or moving the mouse.
	Resistor X 1	SMD Resistor Resistance: 31 Ohm	Same as above.

	Resistor X 2	SMD Resistor Resistance: 95 Ohm	Same as above.
	Resistor X 1	SMD Resistor Resistance: 10 Ohm	Same as above.
	Resistor X 1	SMD Resistor Resistance: 6R8 Ohm Pd = 0,125 W Tol. = 5 % TK = 200 ppm/K	Same as above.
	Capacitor X 1	SMD Capacitor Class B X7R & X5R 1nano farad to 1micro farad	These smaller multi-layer ceramic capacitors for the SMD mounting to control the smooth flow of current for other components on the PCB.

	Capacitor X 11	SMD Resistor Class C Y5V & Z5U Nonlinear capacitor	Same as above.
	Chip On Board X 1	Glop-Top Chip on Board. Blob of Epoxy covering the PCB.	This helps to produce a greater amount of luminous flux with the greater ability to dissipate the resulting heat from the mounted components.

WORK CITED

Chang Capacitors – Datasheet: https://www.rutronik24.com

SEMTECH Transistors – Datasheet: https://datasheetspdf.com

SMD Resistors – Datasheet: https://www.gmelectronic.com/

Resistors – Motley Electronic Topics: https://forum.digikey.com/t/resistors/13117

Find by Element and Type - Surface Mount Resistors: https://www.te.com/usa-en/products/passive-components/resistors/surface-mount-resistors.html?tab=pgp-story

How to read SMD Capacitor: http://techpeeks.blogspot.com/2012/01/how-to-read-smd-capacitor.html

Electronic packaging: https://en.wikipedia.org/wiki/Electronic_packaging#Glop-top

Understanding Speaker Impedance: https://geoffthegreygeek.com/understanding-speaker-impedance/

Chip on board: https://en.wikipedia.org/wiki/Chip_on_board

An Introduction to Flexible Printed Circuit Boards: https://www.rigiflex.com/faq/what-is-a-flexible-printed-circuit-board