

GNG2101
Design Project User and Product Manual

footRover User Manual

Submitted by:

FootRover – GNG 2101 A5.1

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
UPM	User and Product Manual
CAD	Computer Aided Design
MDF	medium-density fiberboard
HID	Human Interface Device
PDF	Portable Document Format
3D	Three Dimensions
PLA	Polylactic acid, type of plastic used for 3D printing
IDE	Integrated Development Environment
PWM	Pulse-width modulation

Table 2. Glossary

Term	Acronym	Definition
Universal Serial Bus Type A plug	USB-A	This is the regular type of USB plug that is present in most computers. It is rectangular.
Universal Serial Bus type C plug	USB-C	The new type of USB plug. It is present on most new computers. It is oval and smaller than USB-A

1 Introduction

This User and Product Manual (UPM) provides the information necessary for user of the footRover foot mouse to effectively use the footRover and for prototype documentation.

Abstract:

The document includes a comprehensive explanation of how to use the footRover, including an overview of the product, which touches on its purpose and goal. It provides a guide on its setup, considerations, and warnings, and then an explanation on how to use the project. Later in this document, we list any possible sources of error users may experience. And lastly, we have included the documentation for any materials that have been included in case the user would like to replace any parts, encouraging their right to repair. This comprehensive guide serves as a valuable resource for users, ensuring effective system interaction and support.

Purpose:

The purpose of this document is to serve as a comprehensive guide to ensure the users' effective system interaction. It includes several parts that will help the user from setup to storage. We hope that you can enjoy your footRover!

Scope of Activities:

1. Introduction:	<ul style="list-style-type: none">• Provide an overview of FootRover, its purpose, and the target audience.• Outline the structure and content of the user manual.
2. Getting Started:	<ul style="list-style-type: none">• Detail the setup process, including assembling FootRover components.• Highlight any safety considerations and precautions for users.
3. User Interface and Controls:	<ul style="list-style-type: none">• Explain the functions of each control element on FootRover.• Provide a visual representation of the user interface and control layout.
4. Operation Guide:	<ul style="list-style-type: none">• Walk users through the step-by-step process of operating FootRover.• Include instructions for basic movements, adjustments, and mode selection.
5. Advanced Features:	<ul style="list-style-type: none">• Describe any advanced features or functionalities of FootRover.• Provide tips and best practices for users to optimize their experience.
6. Troubleshooting:	<ul style="list-style-type: none">• Create a comprehensive troubleshooting guide for common issues.• Include error messages and possible solutions.
7. Maintenance and Care:	<ul style="list-style-type: none">• Instruct users on proper maintenance practices to ensure the longevity of FootRover.• Provide guidelines for cleaning and storage.

Intended Audience:

The intended audience for this product [FootRover] is people who have limited or not use of their hands, but possess the ability to control and move their feet. This includes individuals with paralysis, limb loss, motor control impairment that affect their hands. The foot mouse aims to provide an alternative and accessible means of computer interaction, enabling user to navigate, click, and perform various functions using their feet, thereby enhancing their ability to use digital devices and software.

However, this technology has the potential to expand beyond accommodations for those who are less capable. The FootRover also has applications in the medical field where doctors may be able to control a monitor of a patient's diagnostic, while operating with their hands. This would improve working conditions and ease of procedure during an operation.

Security/Safety:

There are no security considerations for the User Manual. Everything has been written to ensure those following the instructions aren't harmed in any way. However important considerations of the FootRover are that it uses electronic components. As you follow the manual, please ensure that food and drinks are kept away as they may cause a slight shock if spilt.

2. Overview

The problem of our user is that he is a disabled individual who can only use their feet. To be actively engaged, he operates a computer using a foot mouse, but this foot mouse has a limited capabilities restricting the programs the client can use.

The client's fundamental needs for the new foot mouse revolve around customization, functionality, and compatibility with their existing setup. Firstly, the user emphasizes the importance of size, expressing the need for the foot mouse to fit comfortably within the foot well of their wheelchair (A).

Additionally, maintaining the current spacing of buttons and controls is crucial for the user's satisfaction, indicating a preference for familiarity and ease of use (B).

Functionality is highlighted through the desire for a right-click function to enable the use of specific programs like Tinker CAD (C).

The user expresses a clear preference for foot commands over eye-tracking technology (D), aligning with their comfort and control using a joystick for mouse control (E).

Lastly, the user seeks more options and features in the new foot mouse, expressing a desire for enhanced capabilities beyond the limitations of their current device (F).

In summary, the user's fundamental needs encompass ergonomic design, intuitive controls, specific functionalities, and an overall improvement in the range of options available with the new foot mouse. The product should ultimately be easy to operate with the ability to click and drag and allow the client to properly express their ideas through a variety of different computer programs.

While other products focus on the basics, our product explores a greater range of functionality. Our product focuses on mimicking the movements of a mouse (moving in all cardinal directions, scroll up and scroll down, right and left click), but also provides shortcut buttons to improve ease of access.



Figure 1 - Image of the footRover

The footRover's foot mouse is divided into 3 portions. The first set of arrows control the direction of the mouse. The second set of buttons on the right imitate the buttons of a mouse. The last set of buttons is what truly sets us apart and serve as the shortcut buttons of our foot mouse. There are the forward and backwards buttons to browse between pages of a tab, as well as buttons to save the client's favorite programs.

The system architecture of the foot mouse is designed to be user-friendly and durable to the needs of individuals with limited hand mobility. The device is made of MDF wood which is durable and light. At its core, a microcontroller (Raspberry Pi) serves as the brains of the system, managing and processing input signals from the detachable buttons that the client will use.

2.1. Conventions

Each executable action by the user will be prefaced by the word “action” in square brackets (i.e. [Action]). This will let users know the start of any instructions. At the end of the action(s) there will be a similar syntax convention (i.e [End of Action]). Moreover, whenever there is a message that we wish to pass to the user, we will write that instruction in *italics*. For example, sidenotes or opinions/perspectives of FootRover can be shared to improve the user’s understanding.

2.2. Cautions & Warnings

1. Physical Considerations: Ensure that the foot mouse prototype is placed securely within the wheelchair foot well to prevent any potential dislodging during use.
2. Control Familiarity: Familiarize yourself with the spacing of buttons and controls to optimize usage and prevent unintended actions.
3. Right-Click Function: Be mindful of the right-click function, especially when using programs like Tinker CAD, to avoid unintended commands.
4. Exploration of Options: Given the desire for more options, explore and understand the additional functionalities of the foot mouse to make the most of its capabilities.

Permissions and Waivers:

If there are specific permissions or waivers required for the use or replication of the prototype, please ensure that these are obtained through the designated process. Users should adhere to any legal or procedural requirements associated with the use, replication, or modification of the prototype to maintain compliance with applicable regulations.

3. Getting started

3.1. Configuration Considerations

The footRover is a plug-and-play device. This means that minimal setup is required to get the footRover working on any device of your choice. Because the footRover functions as an HID device, it should work on any device that would support a regular computer mouse. This includes Microsoft Windows, macOS, Linux, ChromeOS, Android, etc. The only configuration required is for the shortcut buttons and this will be explained in section 3.3.

3.2. User Access Considerations

The footRover was designed to be easy to use no matter how the user intends to use it. If you wish to get different functions out of your footRover, please contact support.

3.3. Accessing/setting up the System

To setup the device, simply connect the included cable with the USB-C cable going into the footRover and the USB-A side going into any USB port of your computer. It is also possible to use a USB-C to USB-C cable if your computer does not have a USB-A connection. It may be necessary to let your computer a few seconds to configure the device, but it should start working within 30 seconds. To set up the shortcut buttons, start by locating the program of your choice that you wish to open using one of the buttons. Right click on the icon and navigate to open the properties. Under the shortcut section left click on the shortcut key dialog box and make sure it is currently set to none. You can then press the shortcut button you want to use for this program.

3.4. System Organization & Navigation

Using the footRover is simple and should be approached like using any other computer mouse. If you experience any difficulties using a footRover please contact our technical support team or watch one of our online tutorials.

3.5. Exiting the System

To prepare the footRover for storage, start by disconnecting the USB cable from the computer. You can then disconnect the USB-C cable from the footRover itself. It is important to remove the cable from the device to prevent it from damaging the connector. Store the footRover in a dry and warm place. Do not stack other objects on top of the device as this may damage the buttons.

4. Using the System

The following section contains a detailed description of each user function and/or feature. It also contains the corresponding system-output for each described feature within the product. Each function is described with subsections, listed in numerical order. It should be noted that depending on the customization of the device, the bases of screenshots, pictures and user-defined roles may adjust to an appropriate means that defines the newly designed product. The information in this section is specific to the user and changes on a system biases. This system is button-operated with 15 operation options.

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions or features of the footRover.

4.1. Cardinal Directions (general movement of the mouse)



Figure 2 - Moving the mouse in all 4 directions.

[Action] Click on one arrow at a time to get to your desired destination. [End of Action]

As highlighted in the figure above, the first feature is the 4 red arrows representing the 4 cardinal directions. Upon using them, a user may move their mouse in any direction on the monitor.

4.2. Left Click (Primary Button – Green Button)



Figure 3 - Showing the position of the left-click button as well as the hold button.

4.2.1. Left Click

[Action] Click the highlighted button above will allow you to select the button your mouse is hovering over. [End of Action]

The left-click button is commonly used to select items on the screen. This can include clicking on icons, files, folders, or any other interactive elements within a graphical user interface.

4.2.2. Hold and Drag

[Action] Click the highlighted button for 3 seconds will enable to drag feature. Using the red arrows (Cardinal Arrows) move the cursor to hover over your desired item. Then after clicking the green “L” button for more than three seconds, you will hear a *beep*. Once you hear this *beep*, release the “L”. You can then move the cursor using the red buttons to move your selected item. [End of Action]

[Action] To release your held item, click on the green “L” once again and you can move your cursor freely once again. [End of Action]

You can also use this function for the right click or center click with the scroll buttons.



Figure 4 - The “beep” will come from the speaker seen on the side of the foot mouse.

4.3. Right Click (Secondary Button – Green Button)



Figure 5 - Showing the position of the right-click button.

[Action] Click on the highlighted green “R” button to use the right click functionality [End of Action]

The right button on a mouse is typically used to provide additional information and/or properties of an item selected.

4.4. Scroll (Blue Buttons)



Figure 6 - The scroll buttons of the foot mouse highlighted in this image.

[Action] Click up or down on the blue buttons to scroll accordingly on a web browser or to zoom in and out. [End of Action]

4.5. Back and Forward Buttons (Purple Buttons)



Figure 7 - The back and forward buttons of the foot mouse highlighted in this image.

[Action] Click on the purple forward and backward buttons to browse between pages on a web browser. [End of Action]

4.6. Shortcut Buttons (Yellow Buttons)



Figure 8 - The shortcut buttons of the foot mouse highlighted in this image.

[Action] Click on either of the yellow shortcut buttons to access your shortlisted websites or applications. [End of Action]

The set-up for the buttons is in Section 3.3. Please refer to the appropriate page to save or change your shortcut buttons.

Commented [MA1]: Add the page number after the user manual is done

5. Troubleshooting & Support

Problem	Potential solution
The device is not responding to button presses	Disconnect and reconnect the footRover.
The buttons are stuck	Start by disconnecting the footRover. Then, try removing the button, or slightly moving it around to unstick it. Once the button is free again you can secure it in position and reconnect the footRover.
The device has a button that is not working as intended	See section 5.3.2 for changing buttons.
The cable is frayed or broken	Change cable for a new USB-C cable. This cable must be able to sync data and cannot be a charge only cable.

5.1. Error Messages or Behaviors

The footRover is easy to use and should not encounter issues in regular day usage. You may occasionally experience small bugs with the mouse. In that case, always try to disconnect and reconnect the mouse from the computer. If you notice behavior such as continuous movement in one direction or constant beeping noises, you have a defective button. Consult the troubleshooting section for more information.

5.2. Special Considerations

Please ensure to use the device in an appropriate environment. The device will break if too much force is applied to the buttons if it is mishandled or used in a dusty or wet environment. Make sure to keep food and drinks away from footRover.

5.3. Maintenance

The footRover was designed with sustainability and repairability in mind. As such, many parts are easily replaceable in case of failure. The following sections include explanations on how to service the footRover.

5.3.1. Removing the back

To remove the back panel, place the footRover with its top facing down. It is recommended to place it onto a towel or soft surface to prevent scratching or damaging the buttons.

5.3.2. Changing a button

To change one of the buttons on the footRover. Start by visiting the troubleshooting section to verify that the button is broken. Once you have confirmed that a button has failed you can proceed with the replacement procedure. Start by twisting the button in a clockwise direction. **NOTE:** this is opposite to regular twisting motion for most screws and lids, please be careful not to try to turn it in the opposite direction as this may damage the button or internal structure. Once the button has been twisted about one sixth of a turn, it can be removed by pulling up on it. Both cables can then be disconnected from the bottom of the button. Make sure that you pull on the metal part of the connector and not on the cable itself. Make sure that you don't drop the cables into the housing. You may slightly pull on the cable if more length is needed. If needed, the back panel may be removed to route the cables back through the hole. To replace with a new button, simply repeat these steps in reverse order. **NOTE:** Please make sure to only change one button at a time. Failing to do so may result in incorrect wiring.



Figure 9 - View of one of the buttons rotated 45 degrees in preparation for removal.



Figure 10 - View of one of the buttons being removed.

5.4. Support

If issues are encountered when using the device, please contact David Gagnon at support with the following email: dgagn010@uottawa.ca

6. Product Documentation

6.1. Subsystems solutions

6.1.1. The housing

In the context of this project, we considered a variety of different options. In the end, these are the methods, tools, and materials that we have chosen for the housing.

Laser Cutting: Laser cutting was something new to us, but we quickly realized that it would be extremely efficient. It was a lot faster than 3D printing and provided a product that was a lot more precise. The only drawback was that the shapes that were possible were a lot more limited, but in the end, we didn't need this as our housing was quite a simple shape

MDF: Although MDF wood is not the most premium of materials, it ends up looking very nice once painted and allows our product to be very nice looking. For the button covers, we considered using PLA with 3D printing to allow for better shapes, but the simple MDF circles ended looking a lot better and are working ok. There was an issue with these button covers where they were getting stuck on the inside walls of the button holes, but a little bit of electric tape to reduce the friction fixed our problems.

6.1.2. The Micro-Controller

Raspberry Pi: We considered several different micro-controllers but settled with the Raspberry Pi Pico in the end. This was mainly because it worked as an HID device and could easily function as a mouse with no extra software required. It is also easy to use and can be coded using the Arduino IDE. Finally, it was cheap and easily accessible.

The code: Initially we considered using a python script to code the Raspberry Pi. However, we were all a lot more familiar with the Arduino IDE C coding and ended up using this instead. Because our code is very simple, it can use existing libraries for Arduino and PWM sounds instead of audio files.

6.1.3. The wiring

Buttons: The buttons were built using 30mm arcade buttons and a MDF wood 45mm cylinder to go on top the button, so it was larger and easier to press. Initially, we wanted to use large 45mm arcade buttons, but these would not fit since they would have been too tall. We also made the buttons easy to replace with a simple twist and pull motion. We also connected them using quick disconnect cables. Initially, all buttons were supposed to be replaceable, however, we miscalculated the size of the button, and the shortcut buttons are not replaceable as of now. This could be easily changed in a future iteration.

6.2. Production of Product

6.2.1. BOM (Bill of Materials)

This is the cost of parts considering we are building a finished product once on the market.

Table 3. BOM

Part	Name	\$	QTY	\$ Total
Spray paint	White Paint for the housing	\$ 2.50	1	\$ 2.50
Housing	MDF wood, 18x24 sheet, plus 12x24 1/8 sheet	\$ 4.00	2	\$ 8.00
Micro controller	Raspberry Pi Pico	\$ 5.86	1	\$ 5.86
Wiring	Wires and connectors	\$ 2.00	1	\$ 2.00
Speaker	Thin Plastic Speaker w/Wires - 8 ohm 0.25W	\$ 0.39	1	\$ 0.39
Micro-USB to USB-C	USB Type C Female to Micro USB Male Adapter	\$ 0.96	1	\$ 0.96
Micro-USB extension	Micro USB 2.0 5Pin Male to Female	\$ 1.99	1	\$ 1.99
Glue	Wood glue for one item	\$ 1.64	1	\$ 1.64
JB Weld	Button adhesive	\$ 2.75	1	\$ 2.75
Magnets	Bottom Housing holder	\$ 0.20	6	\$ 1.20
Buttons	30mm arcade buttons	\$ 0.64	12	\$ 7.73

Total \$ 35.02

6.2.2. Equipment list

- Paintbrushes
- Laser cutters
- Soldering irons
- Glue guns
- Pliers

6.2.3. Instructions for building

6.2.3.1. The Housing

To build the housing you first need to download the PDF files for the footRover. You can then upload them to a laser cutter to cut the MDF according to the settings of your laser cutter. Once the pieces have been cut you can assemble them together and gluing them together using wood glue. It is important to not glue the bottom part right away. It is also important to stick the 1/8 piece under the ¼ inch MDF piece for the top part. The top part is in fact dual layered. You can the glue supporting MDF 0.5inx0.5in pieces in all corners except the one where there will be the speaker. Then you can glue the magnets to each of these supporting pieces making sure that they align to the ones you will also glue on the inside part of the bottom panel. Make sure that the polarity is right.

6.2.3.2. The buttons

Start by using the pdf to laser cut the buttons. Then you can paint each one the correct color. After that, they can be glued with JB Weld onto each button. Make sure to use the right amount of adhesive and that they are aligned properly.

6.2.3.3. The wiring

Solder quick disconnect connectors to 16 cables with a female end. Make sure to make each one the right length. Have one go into a common ground that will then connect into the ground of the Raspberry Pi Pico and the rest into the correct IO pins of the micro-controller. You can then stick the Raspberry Pi to the middle of the interior housing and route the USB wires appropriately.

You can now also stick the speaker to the walls and connect it. Finally, the buttons can be inserted and connected. Follow the image for more information.

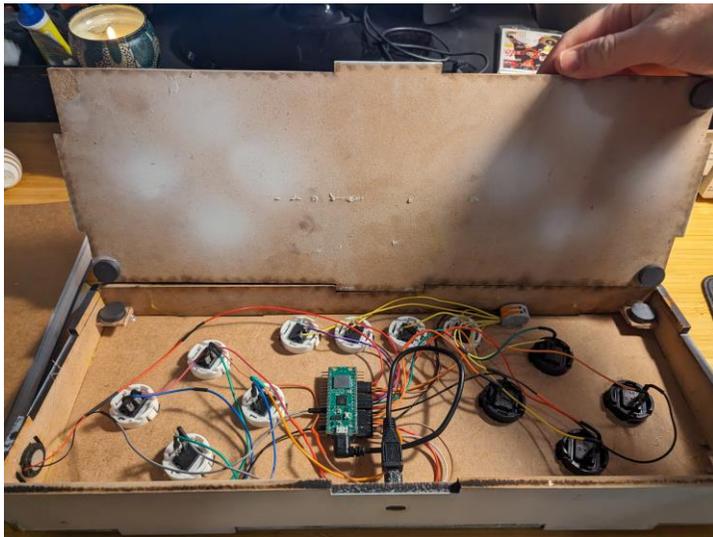


Figure 11 - View of the inside of the footRover.

6.3. Testing & Validation

Table 4. Tests and results

No.	Design Criteria: Functional Requirements	Verification Method	Importance (5>1)	Testing Outcome Prototype 1	Testing Outcome Prototype 2	Testing Outcome Prototype 3
1	Ease of Use	Trial Testing	5	Further Construction Required	Successful	Successful
2	Functionality/Utility	Trial Testing	5	Further construction required	Successful	Successful
3	Connection to computer (Compatibility)	Trial testing	4	Further Construction Required	Further testing to be conducted at client meeting 3	Successful
4	Ability to right-click and drag	Trial testing	5	Further Testing Required	Pending	Successful
5	Ability to use computer faster than current solution	Trial testing	4	Further Testing Required	Further testing to be conducted at client meeting 3	Successful
6	Input method	User feedback	4	Further Construction Required	Further inquiry to be conducted at client meeting 3	Successful
No.	Constraints	Verification Method	Importance (5>1)	-----	-----	
1	Deadline	-	5	On Track	On track	Successful
2	Cost	Estimation	5	Below Limit	Below limit	Successful
No.	Design Criteria: Nonfunctional Requirements	Verification Method	Importance (5>1)	-----	-----	Successful

1	Aesthetics	User feedback	3	Plans in place for prototype 2	Pending	Successful
2	Ease of repair (Disassembly time)	2 nd Party Testing	3	Plans in place for further success with prototype 2, but still successful for prototype 1	Plans in place for further success with prototype 3, but still successful for prototype 2	Successful
3	Adaptability	Assembly Testing	2	Further construction required	Further construction required	Successful
4	Weight (Portability)	Trial Testing	3	Successful	Successful	Successful
5	Connection to computer (Compatibility)	Trial testing	4	Further Testing Required	Further testing to be conducted at client meeting 3	Successful
6	Lifespan (Reliability)	Weathering testing	4	Further Construction Required	Further Construction and testing required	Successful
7	Size	Estimation, final verification	3	Proper dimensions for prototype 1	Proper dimensions in place for pending prototype 3	Successful

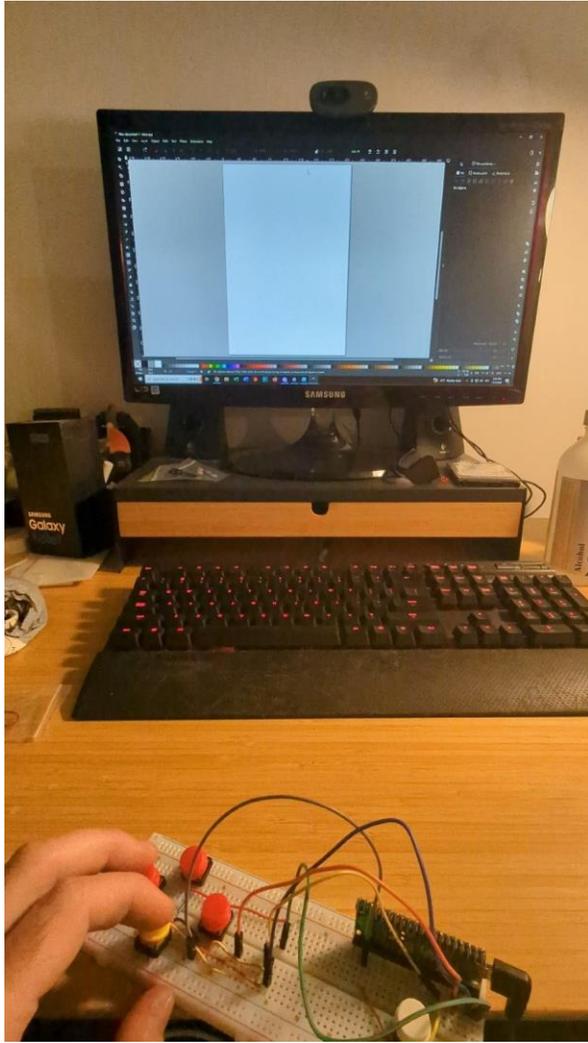


Figure 12 - A picture of testing software with the second prototype

7. Conclusions and Recommendations for Future Work

In the end, we have learned a lot of new skills thanks to this project including laser cutting and CAD software to name a few. If improvements needed to be made on this project, I think it would be most important to focus on the reliability of the product, most importantly the buttons and consider changing the layout for different users. In the end, we would have liked to make this project a little more precise, maybe with slightly better painting quality or speaker sounds. However, we still think that this product will suit the needs of our client and potentially others as well.

8. Bibliography

- Aliexpress. (2023). *10pcs Arcade Copy Sanwa Button Games Buttons Replace Parts Of Games Parts Accessories*. Retrieved from Aliexpress:
https://www.aliexpress.com/item/1005001935186319.html?spm=a2g0o.productlist.main.7.36deMA6fMA6fW6&algo_pvid=4b5537c6-ab55-4c3c-ba94-9be17b617235&algo_exp_id=4b5537c6-ab55-4c3c-ba94-9be17b617235-3&pdp_npi=4%40dis!CAD!9.54!6.3!!!6.83!!%402101f4a016968768863
- Aliexpress. (2023). *Arcade Button 5 Colors LED Light Lamp 60MM 45MM Big Round Arcade Video Game Player Push Button Switch*. Retrieved from Aliexpress:
<https://www.aliexpress.com/item/33024428631.html>
- Aliexpress. (2023). *Micro USB 2.0 5Pin Male to Female M to F Extension connector Adapter Long plug Connector 90 Degree Right & Left Up Down Angled*. Retrieved from Aliexpress:
https://www.aliexpress.com/item/1005004638877705.html?spm=a2g0o.productlist.main.1.79734NSY4NSYJB&algo_pvid=acb61ddf-45f7-430a-92d4-e92d2586e0f1&algo_exp_id=acb61ddf-45f7-430a-92d4-e92d2586e0f1-0&pdp_npi=4%40dis!CAD!1.98!1.98!!!1.42!!%40210325411696877180
- Aliexpress. (2023). *USB Type C Female To Micro USB Male Adapter Connector Type-C Micro USB Charger Adapter for Xiaomi Redmi Huawei Phone Converter*. Retrieved from Aliexpress:
https://www.aliexpress.com/item/1005005355282976.html?spm=a2g0o.productlist.main.1.59250p4Y0p4Yqq&algo_pvid=1d75df02-7d5d-457a-8353-011f2697d62b&algo_exp_id=1d75df02-7d5d-457a-8353-011f2697d62b-0&pdp_npi=4%40dis!CAD!4.79!2.88!!!3.43!!%40210339911696877089
- Anis, H. (2023). *Lecture 3 Powerpoint*. Retrieved from Brightspace:
<https://uottawa.brightspace.com/d21/le/content/390888/viewContent/5529276/View>
- Arduino. (2023, September 19). *Keyboard and Mouse Control*. Retrieved from Arduino:
<https://docs.arduino.cc/built-in-examples/usb/KeyboardAndMouseControl>
- Fentek Industries. (2023). *Footime™ Mouse*. Retrieved from Fentek Industries:
<https://www.fentek-ind.com/footime.htm>
- Maker Store. (2023). *MDF*. Retrieved from Maker Store:
<https://makerstore.ca/shop/ols/products/mdf>
- Maker Store. (2023). *Raspberry Pi Pico W*. Retrieved from Maker Store:
<https://makerstore.ca/shop/ols/products/raspberry-pi-pico-w>

Maker Store. (2023). *Thin Plastic Speaker w/Wires - 8 ohm 0.25W*. Retrieved from <https://makerstore.ca/shop/ols/products/thin-plastic-speaker-wwires-8-ohm-025w>

McDarris, A. (2022, January 31). *Small business owners can fight carbon emissions without decimating their budget*. Retrieved from Popular Science: <https://www.popsoci.com/diy/carbon-neutral-small-business/#:~:text=But%20achieving%20carbon%20neutrality%20for,worry%E2%80%94e%20everything%20you%20do%20helps.>

Special Needs Computers. (2023). *Boomer the Foot Mouse*. Retrieved from Special Needs Computers: https://www.specialneedscomputers.ca/index.php?l=product_detail&p=7035

APPENDICES

9. APPENDIX I: Design Files

MakerRepo link : <https://makerepo.com/dave181/1708.footrover-team-a51-gng2101>

Table 5. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Parts to cut.zip	MakerRepo	Dec 1 st 2023
Solidwords files	MakerRepo	Dec 1 st 2023
codeForFootMouse.txt	MakerRepo	Dec 1 st 2023