

GNG 2101
Design Project User and Product Manual

Zoom Box

Submitted by:

Captioneers 2.3

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
Pi	Short for Raspberry Pi, a minicomputer.
Ui	User interface
SD Card	Secure Digital cards
UPM	User and Product Manual

Table 2. Glossary

Term	Acronym	Definition
Zoom Box	N/A	Device that can connect to a microphone and zoom
Raspberry Pi 4	Pi 4	Fourth version of the raspberry Pi
G-code/STL files	G code/ STL	Files that are used for 3D printing

1 Introduction

This User and Product Manual (UPM) provides elementary information and details for undergraduate students with hearing impairments, educators as well and any other potential user who may have a learning disability leading them to utilize the Zoom Box, our innovative captioning solution. Furthermore, it serves as a guide about prototype documentation, showcasing details insights relating to the design, conception as well as overall use of the Zoom Box. This user manual lays the foundation for understanding of Raspberry Pi-based system, allowing users to navigate with ease the complexity of our product.

This product was developed in response to a client's need for a standalone device, eliminating the constant need for adapter changes in captioning systems. The Zoom box addresses fundamental user needs. The user manual will talk about the overarching problem, key features, and the Zoom Box's particularities, highlighting its portability, connectivity, and user-friendly interface.

It will equally guide the user through the initial setup process, including a Raspberry Pi configuration and any necessary software installations. Then, it will provide detailed step-by-step instructions on using the various functions of the Zoom Box. It will equally address the troubleshooting and support considerations, allowing users to have the necessary resources to address any potential issues about the device's overall use. Finally, it will detail the construction

of the final prototype including design considerations, material choices, instructions on building and testing subsystems alongside recommendations for future work.

2 Overview

The problem at hand is that our client didn't like constantly changing what type of adapters he needs to adapt his caption system. He wanted us to create a standalone device to eliminate the need for constantly changing adapters. This is important for a few reasons, notably, consistency, convenience, cost savings, future proofing and customization.

The fundamental needs of the user are that the device can easily connect to Wi-Fi, be easy to troubleshoot, be portable, have a long enough battery life to last through a day of classes, have zoom integration and a comfortable UI.

There are many things that set our product apart from others. First off, portability; at only 144 grams, our product is extremely lightweight and small enough to easily fit in someone's pocket. Second, seamless connectivity; our product ensures extremely easy connections to Wi-Fi as well as Zoom. Additionally, our product is easy to use and reliable. The UI is set up for any user to super easily connect to zoom to be able to connect before their class starts.



Figure 1. UI of our device

The key features of our device include its lightweight design at only 144 grams (about half the weight of a large grapefruit) making it highly portable and easy to carry around in your pocket. The UI is designed for simplicity and easy connectivity to zoom before classes. The device is built to be reliable and have easy troubleshooting features. This addresses the client's concern about constantly changing adapters that he emphasized.

The architecture of the system was constructed using a 3D printed case to hold everything together, a Raspberry Pi 4, a touchscreen for the Pi 4 and a stylus. The user access mode is via a UI on the Pi 4 touchscreen.

2.1 Conventions

For the remainder of the document, important actions for the reader will be highlighted by starting with the word 'Action'.

2.2 Cautions & Warnings

Before using the prototype, users should be aware of the following. First, ensure that you handle the device with care. The screen is attached using pin connectors which can be very fragile. For this reason, a user must ensure to not drop the device. Following this will allow the device to continue to be manufactured as lightweight and portable as it currently is. Second, when connecting to zoom users must ensure the security of their network to protect sensitive information stored on the device from being stolen.

3 Getting started

3.1 Configuration Considerations

3.1.1 Raspberry Pi Setup

1. Using a computer, click the following link <https://www.raspberrypi.com/software/> and click on the button to install the raspberry pi imager for windows.

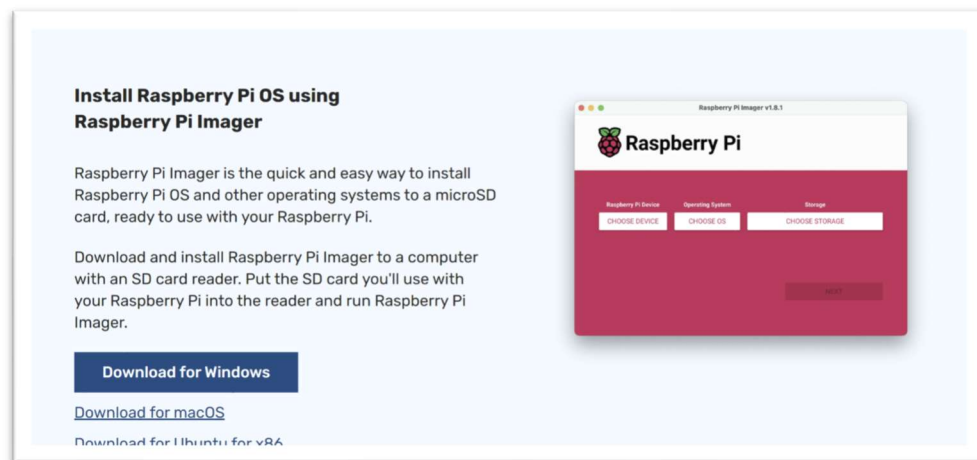


Figure 2. Raspberry Pi Installer.

2. Once downloaded click on the file to install the application.
3. Once the Pi Imager is installed, open it.
4. Plug a micro-SD card into your computer that is at least 8 Gigabytes.
5. Then select the storage device, and the following Operating System from the menu.

You want to select Raspberry Pi OS Legacy Full



Figure 3. Operating System Options.

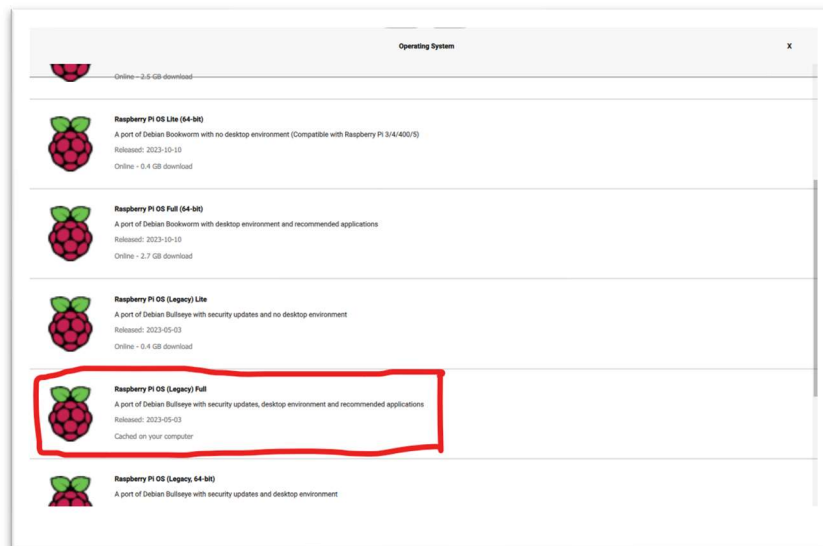


Figure 4. Operating System Options Cont.

6. Once Both those steps have been completed click on the “write” button.

7. Once it is done writing unplug the USB.
8. Insert the micro SD into the bottom side of the Pi.
9. Then plug in a mouse, and keyboard to setup the pi.
10. Plug in the USB C power and also connect it to a display using the micro-HDMI to HDMI cable.
11. Once the set up menu loads, go through the initial setup process setting up the internet, and default profile.
12. Make sure to accept the feature to check for updates while going through the menu.
13. Before we Install the display, we want to get the onscreen keyboard and zoom installed.
14. Open the command line

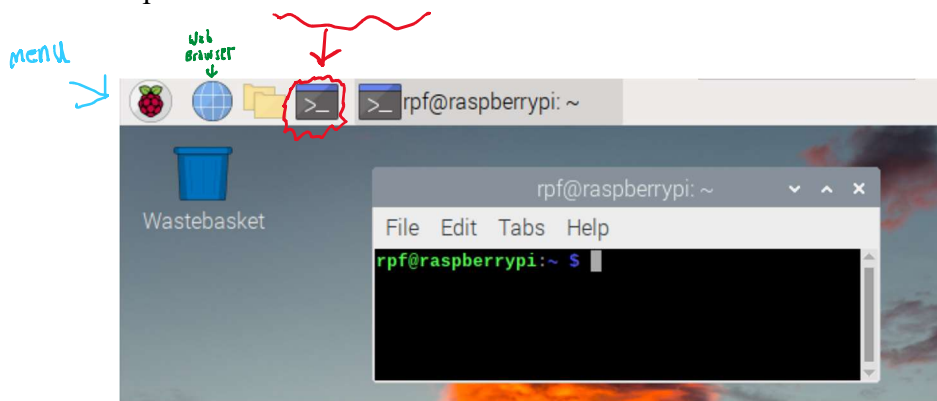


Figure 5. Command Line.

15. Enter the following code:

```
sudo apt install onboard
```

16. Once installed open the menu (Top Left Corner) > Universal Tools > Onboard
17. You can either let the user know onboard is found their or you may pin it to the home screen by right clicking the onboard button and selecting the option that says to add to home screen.
18. To set up zoom go to the web browser by clicking on the globe logo. Refer to figure 4 if you cannot find the symbol.
19. Now enter the following link to get to zoom: <https://app.zoom.us/jc/home?webp=1>
20. Once there click on the 3 dots in the top right corner, then bookmarks> bookmark this tab.
21. If you would like to add zoom to the home screen do the following:

3 dots > More Tools > Create Shortcut
22. Now we want to install the display, to do so turn off the device and then attach the screen as shown below.



Figure 6. Example of What the Components Should look like Together.

23. Once installed, power on the Pi again, make sure the external hdmi display is still connected.
24. Open the command line again. Then enter the following commands:
 - I. `sudo rm -rf LCD-show git clone https://github.com/goodtft/LCD-show.git chmod -R 755 LCD-show cd LCD-show/`
 - II. `sudo ./LCD35-show`
25. Once these programs run, the device will restart, and the HDMI display may now be unplugged. If any errors occur, restart the process will need to be completely restarted from step 1. Otherwise at this point, the individual users may now follow the steps to set up the device for first time connections found in section 3.

3.2 User Access Considerations

Students with heart of hearing will be using this device as well as anyone else that needs help understanding lectures or presentations and would prefer to have captions.

3.3 Accessing/setting up the System

During First Setup, it is important to have a mouse and keyboard to make signing into Wi-Fi and zoom easier.

1. Plug the USB C power cable into the Pi (raspberry Pi). Wait for the device to load into the home screen.

2. On the top right corner, click the Wi-Fi button, and sign into the required network.
3. Then return to the home screen and click on zoom. Log in to zoom, make sure to save the password using the chromium password saver.
4. Plug in the microphone into the USB A port.
5. Join the zoom meeting, and click join audio, make sure you click allow zoom to use your microphone in the chromium pop up.

After first setup, signing into the network or zoom will no longer be needed, and will only need to be done again if you change accounts or networks.

3.4 System Organization & Navigation

Everything needed can be found in the taskbar found at the top of the screen.

On the left side, you will find the main menu, web browser, and command line.

Onboard can be found

3.5 Exiting the System

To turn off the system close any open applications, and then just unplug the power cord.

4 Using the System

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

4.1 Lid

The lid is meant to cover the screen while the Zoom Box is in the student's bag. The lid is meant to come off while the student is accessing the screen. To take off the lid pull the two tabs (tab show in picture) away from the center of the Zoom Box. The case should then lift right off. Do the same process but instead of pulling the lid off put it on.

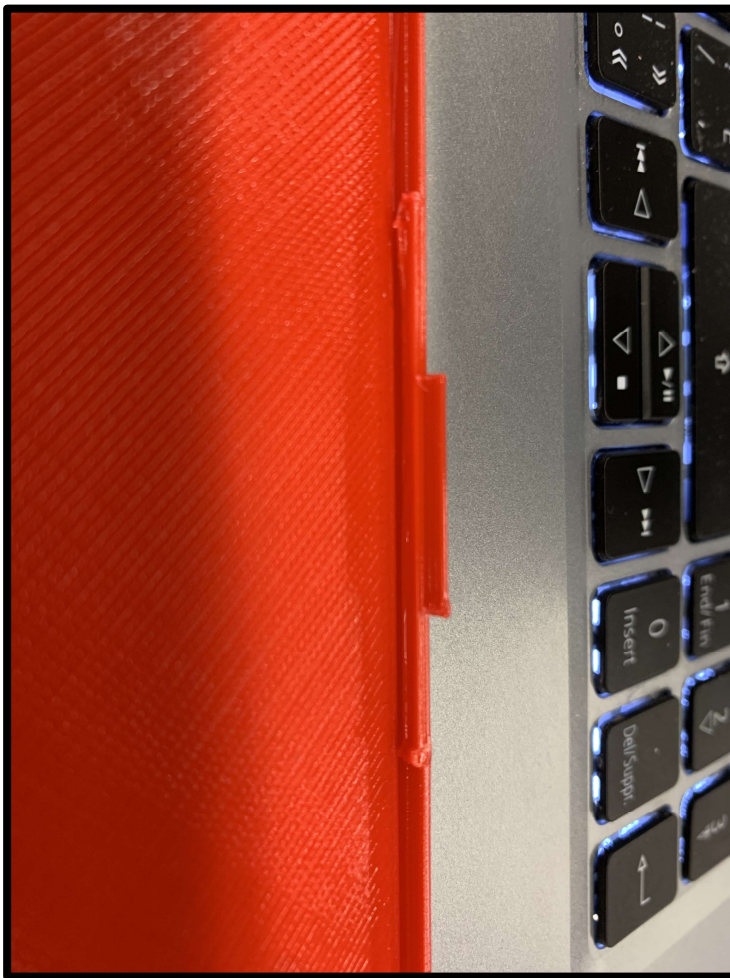


Figure 7. Clarification of the tab on the lid.

4.2 Battery Pack

The Battery pack is used to supply power to the electrical components (Raspberry Pi and Screen). The battery pack could be any battery pack that is rechargeable or uses interchangeable batterie (AA), the battery pack also needs to connect to the Raspberry Pi via USB-C. To change battery pack simply undo the Velcro and detach the USB-C cable from the Pi. Do the opposite to re-attach it.

4.3 RODE

The RODE microphone is provided by the professors. This microphone will have a USB-A port. To attach the Zoom Box simply use a cable that would be connected to the USB-A port on the raspberry Pi and connect that cable to the USB-A port on the RODE microphone. Once the microphone is connected go into zoom and click on “connect by computer audio” to allow the zoom meeting to pick up the microphone audio.

4.4 Zoom

To use the web browser, open the internet on the raspberry Pi screen using the stylus. There will be a zoom icon bookmarked on the browser and simply click that. For the first time the user would have to input their username and password for both the Wi-Fi and zoom.

To input your password, open the Wi-Fi or zoom login (like you would on any computer). Open the keyboard by pressing on the respective icon on the utility bar. Type in your password and

username then login, the device will ask you if you would like to save your password and press accept. Finally, close the keyboard and now your password and username are saved I the device.

Once the user is on their Zoom account, they follow the regulated process controlled by the client; this would either be creating a zoom meeting for the captionist to join or joining a meeting that the captionist would create. It is important to recognize that the Raspberry Pi is a minicomputer so consider this process to be like if you were to open zoom on your personal device.

5 Troubleshooting & Support

5.1 Error Messages or Behaviors

In terms of connectivity issues, battery management, and UI navigation users may encounter error messages. Regarding connectivity problems, an error message may indicate a failed Wi-Fi or Zoom connection. The apparent causes would seem to be an incorrect network credential or insufficient internet signal strength. To resolve the issue at hand, the proper way to proceed would be to make sure of an adequate Wi-Fi range as well as check network settings. When it comes to battery-related error messages, it might signal low battery levels or power malfunctions. It is up to the user to verify battery connections, make sure the external pack has an adequate amount of charge left as well and replace batteries as needed. Regarding UI navigation issues, they may manifest as unresponsive touchscreens or difficulty connecting to Zoom. This would require the user to wipe and clean the screen, restart the device, and as a last resort, consult the user manual. Finally, physical damage, indicated by unannounced shutdowns or reduced battery levels, may necessitate more careful handling and further protective measures.

5.2 Special Considerations

Special considerations include the following. The user must handle the device with care to prevent physical damage. The user should be cautious about their network security when connecting to Wi-Fi to protect their information. For troubleshooting, users are encouraged to follow the step-by-step guidance provided and avoid taking their own complex steps to avoid messing up the setup of the device.

5.3 Maintenance

Regular maintenance for the device includes checking for software updates in the Pi Operating System. Review, screen cleanliness and check the batteries often. Additionally, users should maintain a secure Wi-Fi connection and update their passwords periodically to ensure system security.

5.4 Support

Emergency assistance and system support are available via the provided help desk support. Any urgent issues or questions can be redirected to Pavel Karmaker at pkarm042@uottawa.ca. Clear, concise, and identified problems should be reported rapidly through the designated reporting and support-related channels outlined in the user manual.

6 Product Documentation

6.1 Hardware

6.1.1 BOM (Bill of Materials)

Item	Price (\$)	Link
Raspberry Pi 4 Computer Model B 2GB (micro SD card included)	54.99	https://makerstore.ca/shop/ols/products/raspberry-pi-4-computer-model-b
Raspberry Pi Touchscreen, 3.5inch RPi Display	25.69*1.13=29.02	https://www.amazon.ca/Raspberry-Touchscreen-3-5inch-Display-Resistive/dp/B08GCRWY7M/ref=sr_1_1_sspa?crid=1IYVAT84HJ99E&keywords=raspberry+pi+with+screen+3.5&qid=1696613589&sprefix=raspberry+pi+with+screen+3+5%2Caps%2C88&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&psc=1
15W Power Supply	15.00	SHNITPWR 5V 3A USB C Power Supply Charger for Raspberry Pi 4, 100~240V AC to DC 5 Volt 3000mA Type C Power Cord Adapter Compatible with Raspberry Pi 4 Model B 1GB / 2GB / 4GB : Amazon.ca: Electronics
3d Printing Material	Free	Makerspace
Velcro	0.50	Maker store

6.1.2 Equipment list

The only equipment required is a 3D Printer to print the case. For the software you need a computer that has a micro-SD card port or an adapter.

6.1.3 Instructions

6.1.3.1 Case

1. Save the G code file onto an SD card.
2. Insert the SD card into the 3D printer (Ultimaker 2+, 0.8mm nozzle size).
3. Start the print and wait 20 minutes, then check for print errors.
4. If there are no errors after 20 minutes, then the print should take 3 hours and 34 minutes to complete.
5. Once the print is done remove all the supports and excess materials (If confused, compare to the G code file to see what material does not belong).
6. Snap the case together and remove it a few times to build familiarity with the case connections and wear down the connections allowing for easier dismantling once the electrical components are inside the case.
7. Put the electrical components in the case and snap the two parts of the case together.
8. Adhere a piece of Velcro to the bottom of the case using a permeant adhesive of your choice. (i.e. super glue or gorilla glue)
9. For whenever the lid needs to put on simply pull the two sides of the case, by the tabs, outwards and place on top of the zoom box.

If editing the 3D printing setting is desired follow these steps:

1. Download the Ultimaker Cura software.
2. Open the STL file in Cura.
3. From there you can choose different nozzle sizes, infill pattern, print speed, wall thickness, support blacker placements, etc.
4. Finally, slice the design and save as a G code file.
5. Follow steps 2-7 above to print and build.

6.1.3.2 Raspberry Pi

Refer to Section 3.1.1 for instructions on how to setup the Pi.

6.1.4 Testing & Validation

6.1.5 Case

The access to the ports was validated. The print setting for the case were very important and they were tested and optimized. We tested how the electrical components fit in the case. The last thing we tested was the lid and if it would protect the screen from damages in the bag, this was verified.

6.1.6 Raspberry Pi

For the Raspberry Pi we Validated setting up zoom, and making sure it was possible to get setup in under 5 minutes. On average with the Pi 4, we were able to get it done in under 2 minutes.

We also tested the mic and made sure that the audio could be uploaded and captioned in zoom which it did, and it had no problem.

Finally, we tested the display making sure the setup was useable without a mouse and keyboard, and so we decided to install an onscreen keyboard tool to make it that an external keyboard would not be necessary.

7 Conclusions and Recommendations for Future Work

Throughout the development of our prototype, several lessons have been learned. During the design process, we encountered minimal challenges related to the functionality of the product. The biggest was when we misprinted the case and broke the micro-SSD card for the Raspberry Pi, we did not notice the damage until it had fried its' adaptor while plugging it into the computer.

If we had a few more months to work on the device, we would work on the following:

- Energy Efficiency: As our metric for the battery of the device is 12 hours but we only achieved 6, we would attempt to optimize power consumption to enhance the device's energy efficiency.
- Security Measures: We would try to implement security measures to safeguard user data and ensure the device's defence against potential cyber threats.
- Scalability: It would also be more beneficial if the Zoom Box did not only work for ZOOM but for other applications as well. We would further explore options to accommodate a larger user base and other online lecture applications.
- User Interface: As we were testing out the device, we realized that the captions and the screen is very small. We would like to create an application that would capture these captions and present them in a bigger form, which will accommodate for students with vision problems.

8 Bibliography

Raspberry Pi Display: http://www.lcdwiki.com/3.5inch_RPi_Display

Raspberry Pi OS: <https://www.raspberrypi.com/software/>

9 APPENDIX I: Design Files

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
G-Code file for 3D printing	https://1drv.ms/u/s!AogowNqwt-XhyZHTIVLD8QLYQkC?e=V2UBPz	23/11/29
STL file for 3D printing	https://1drv.ms/u/s!AogowNqwt-XhyOOUKqLaNrCk2ck?e=7CRLAX	23/11/29