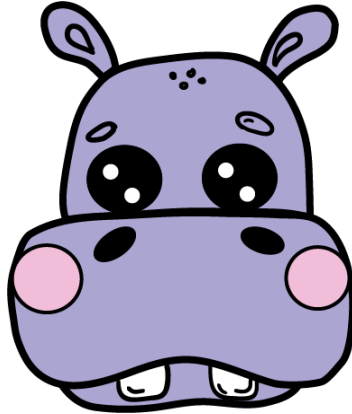


Project Deliverable J

User Manual



Group A3

Austin Wu [300129117]
Benjamin (Ben) Saulnier [300121338]
Callum French [300128814]
Eleanor (Ellie) Rumsey [8274066]
Matthew (Matt) Yakubu [300123797]

07/12/2020

GNG 2101 – Intro. to Product Dev. and Mgmt. for Engineers

Faculty of Engineering – University of Ottawa

Abstract

Digital photo making and art apps are notoriously complex. The thing is, they need to be and that complexity is not a bad thing. It allows for the creation of digital masterpieces and the embracing of a multitude of artistic styles into a single medium. That said, the complexity of a software does not make it very inviting for artists with a barrier. This barrier could be anything, from a disability to inexperience. This is where we step in to help with our product: Helpo.

Helpo is a photoshop assistant. It's job is to simplify photoshop and make it more accessible so that any artist with a barrier can still recreate the masterpiece in their mind in the digital landscape. Helo does this by being able to take in input in various forms, like button presses on a physical keyboard or with voice commands. It then uses this input to control photoshop through the keyboard shortcuts that are already built into the program. So a task that would have initially taken the opening of a menu, scrolling through it, and confirming the selection can now be done simply by saying a word.

This product was built and designed with accessibility in mind. The client Helpo was built for is a student who hopes to use art as a means of therapy. Being able to create is integral to their mental health, and it is a practice that they hope to share with others. Only one problem: they have a fluctuating disability. This means that one day, our client could be functioning just as well as anybody else and then seem almost catatonic on the next. To understand where our client was coming from, many interviews were conducted which ultimately resulted in certain design specifications that would be necessary to promote accessibility. These included a minimization of the colour red in the application (which could trigger seizures), including large buttons, the possibility to integrate the software into equipment they already owned, and the option for multiple forms of input and feedback. Keeping these specifications in mind, Helpo was born.

The Helpo product can be separated into two distinct sections: the software and the hardware. The Helpo software is built on top of a voice-to-keyboard input framework called GAVPI. It has been altered to include large buttons and so that a profile for the voice commands is already integrated. This software gives the user both auditory feedback on the switching of a tool and visual feedback in the form of a light up button for Photoshop twenty most common tools. Helpo's hardware component is a simple 4x5 keyboard with those same twenty most common tools. It can be plugged into any computer and be used in conjunction with a regular keyboard to make making art and switching tools even more seamless.

This document is a comprehensive user manual for all aspects of Helpo. It contains install instructions, troubleshooting, instructions on how to use the application, and optional further customization, as well as containing a technical summary of both the software and hardware guidelines. It also contains the health and safety guidelines to follow and concludes with an appendix detailing the final price and a list of every possible command that Helpo can perform.

Helpo is built for the user first. We hope that this product and manual can guide you on the journey to creating your own digital masterpieces no matter the personal barriers you may have.

Table of Contents, List of Figures, List of Tables

Abstract	2
Table of Contents, List of Figures, List of Tables	3
Introduction	4
Instructions for installation	5
Installing Helpo	5
Troubleshooting installation	8
Using Helpo	10
Introduction	10
Using Helpo with Photoshop	11
Making your own keyboard shortcuts	11
Master list of possible commands	12
Optional customisation	13
Building your own profile	13
Installing VIA for Custom Keyboard Mapping	18
How to use VIA	19
Technical summary	21
Software prototyping summary	21
Software troubleshooting	21
Hardware prototyping summary	21
Health and Safety Guidelines	23
Hardware Troubleshooting	23
Hardware Alteration	24
Conclusions and Recommendations for Future Work	25
Appendices	26
A1. The Helpo keyboard Bill of Materials (BOM)	26
A2. Comprehensive list of voice commands in the Helpo profile	27

Introduction

Understanding the fundamentals of Photoshop without prior technical experience can prove to be quite difficult, especially for any artists looking to transition into the digital medium. Helpo is here to make that transition a little easier, for every kind of artist looking to expand upon their creative side. The main focus of Helpo is to make it easier to maneuver around Photoshop in more ways than one. For users that may have a hard time using any form of hardware to control their device, Helpo has a voice command system that has been implemented to allow for users to navigate through the application hands-free. However, Helpo is not limited to just Photoshop.

Helpo was initially developed for a target audience, but has expanded since then. Originally, Helpo was intended to modify Photoshop into a more accessible platform for disabled young artists to create freely. Our client found that their struggles with Photoshop created more stress whenever they tried to use it, which limited their ability to execute their ideas online. During the various client meetings throughout the semester, we discovered that the UI was a point of focus, so we made it our goal to address that in our final product to improve our clients user experience. Photoshop has a cluttered and unfriendly interface that was especially challenging for our client, so our ideal solution would allow them to continue using Photoshop or other various digital drawing tools with a product that would provide additional and affordable functionality that could simplify the interface. This solution would allow multiple options for input, including voice and/or keyboard input.

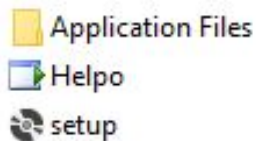
As previously mentioned, Helpo was developed to make Photoshop a more inclusive experience for any sort of artist. When the team was assigned this project, the only requirement was to develop a software solution that could meet all of our client's needs. Helpo took that one step further and added a hardware component at our clients request. Helpo works through the use of keyboard shortcuts, which were chosen specifically by our client with a corresponding keyboard that include the same shortcuts to accommodate for our on the days that they are unable to use the voice command system. The key caps were also designed with symbols that associated well enough with their respective tools to be considered self-explanatory at first glance. We also observed that some of our competitor's had diverted to other digital art software or created entirely new ones as an alternative to the solution our client specifically asked for at the beginning of the semester. Overall, we believe that Helpo is more versatile than other solutions may appear to be as it accommodates for all aspects of our client's fluctuating disability.

Instructions for installation

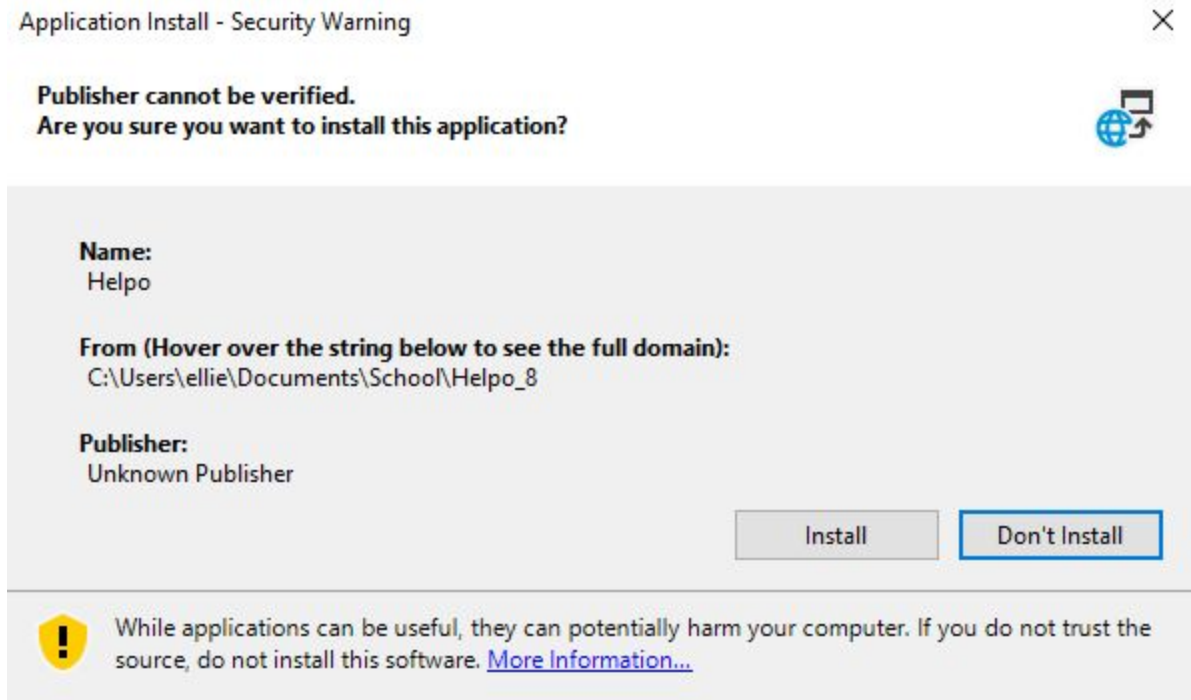
Installing Helpo

The following is a step by step instruction guide on how to get and launch Helpo to help you with your photoshop experience. Please note, Hello currently only works on a Windows operating system. If you have a Mac, this download will not work.

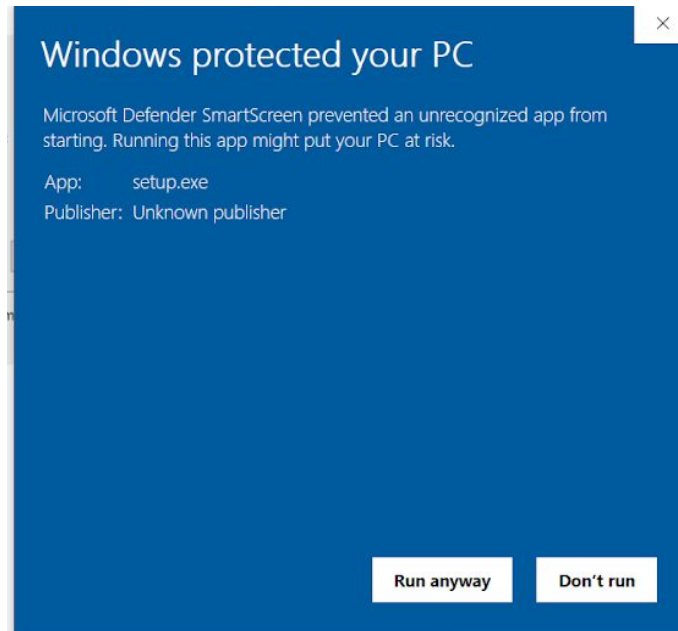
1. Visit the following link (<https://makerepo.com/Frenchfrie/helpo-your-photoshop-assistant>). Once here find the section labelled “project files” on the right side of your screen. Download the files labeled “Helpo_8.zip” and “Helpo.XML”. We recommend saving these into a folder that you can easily find.
2. Go to your folder in which the “Helpo_8.zip” file is located. Left click on the “Helpo_8.zip” file to select, then right click to open the menu. Once opened, select “Extract all”. This will open a window asking you for a save destination. If you are at your desired file location, select “Extract”.
3. A new folder should have appeared with the name “Helpo_8”. It will look similar to the .zip file, but no longer have the zipper sealing it shut. Double click on this folder. A second folder, also labelled “Helpo_8” should appear. Double click on this folder as well. It will open up and have three files in it, as shown below.



4. Double click on the file labelled "setup". A loading screen will appear, followed by one of the following windows:



5. If you got the first window, select "Install". This may open the second window. If it does, continue reading. Otherwise, jump to step 7. If you got the second window, click on the small underlined text that reads "More Info". This will update the window so it looks like the image below:



6. In this window, select “Run anyway”. A loading window will appear as the application installs. The application should then open automatically. See troubleshooting information below if any additional windows pop up.
7. Congratulations! Helpo is now installed and almost ready to run. The next step is to upload a profile so that Helpo knows what to do when you talk to it. In the top left corner of the application, find a button labelled “File”. Click on this, then find one named “Open Profile”. Click on this one as well. This will open a file tree. Remember that “Helpo.XML” file you downloaded? It’s now time to find that. On the left of the file navigator, find “This PC”. Navigate your file tree until you find the “Helpo.XML” file. Once there, select it with a left click and then press on open.
8. Helpo is now ready to take in a command! Test this out by pressing the “toggle microphone listening” button and saying “Thank you”. You should hear Helpo talk back with a nice robotic “You’re welcome”. If so, then Helpo is working and you are almost done. If not, then please see troubleshooting information below.
9. To make sure Helpo is always there and ready to help, it should be easy to access. For the final step in this installation, go to your desktop and right click. Navigate to “New” and then left click on the option near the top that reads “shortcuts”. This will open another file navigator. Navigate through the file tree until you get to where you originally saved your downloads. Double click through the “Helpo_8” folders until you get to the screen where you originally saw the “setup” file. This time, select the file named “Helpo”. Select “OK” in the file navigator and then “Next”. This will open a screen where you can name your shortcut. Leave it as “Helpo” and select “Finish”.
10. **Color picker:** In order to activate the Photoshop color picker using the key on the keyboard, you will need to set up a custom shortcut in Photoshop. We also recommend choosing the “System” color picker for ease of use.
 - a. See the section in this document for [making your own keyboard shortcuts](#)
 - b. Set the color picker to your system default, rather than Photoshop’s:

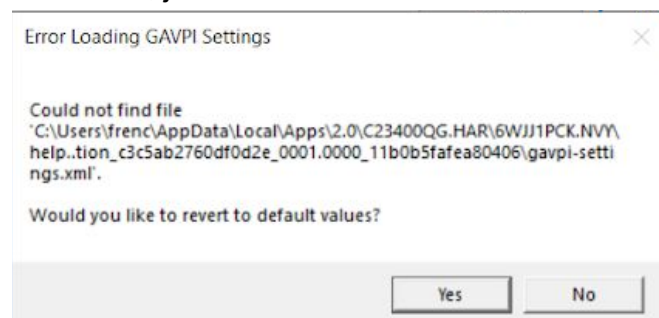
- i. Choose Edit > Preferences > General (Windows) or Photoshop > Preferences > General (Mac OS).
- ii. Choose the system Color Picker from the Color Picker menu, and click OK

Congratulations! You now have Helpo up and running on your computer. Next time you want to open the application, simply double tap on your shortcut and the application should start running!

Troubleshooting installation

If you experience any of the following errors during installation, don't worry! These are normal, since this is technically an unverified application.

- Something along the lines of **Do you want this program to make changes to your computer?**
 - You have to be the system administrator to approve this. If you are, approve it. Otherwise contact your system administrator.
- **“Could not find file...xml. Would you like to revert to default values?”**
 - This is fine, just click “Yes”



- Unable to reopen application after closing it
 - Please go to the Task Manager (Ctrl+Shift+Esc) and find the process called “Helpo” or “GAVPI”

Creative Cloud Helper	0%	3.1 MB	0 MB/s	0 Mbps
CTF Loader	0%	2.8 MB	0 MB/s	0 Mbps
Device Association Framework ...	0%	0.3 MB	0 MB/s	0 Mbps
Device Association Framework ...	0%	1.5 MB	0 MB/s	0 Mbps
GAVPI	0%	7.9 MB	0 MB/s	0 Mbps

- Click this task, then click “End task” at the lower right corner of the window.
- If you still aren't able to reopen Helpo, try restarting your computer.

- Helpo is not taking in your voice commands
 - Make sure that you have a microphone attached to your computer. This can be done by going to your start menu at the bottom left of the screen and typing “Sound”. The sound settings menu will open. Make sure that you have a microphone available and that it works by testing with the “test microphone” bar.
 - Make sure that this bar moves when you talk and does not when you are silent. If the bar is constantly working, your room is too noisy and Helpo will have difficulty picking up commands. If this bar is not moving, your microphone is either disconnected, disabled, or hidden and cannot hear you. Make sure that this bar can move before continuing.
 - If the bar is moving but commands are still not working, ensure that all other programs using your microphone are closed. This could include internet chatting programs, video games, or web browsers.
 - Look at the bottom of Helpo at the “Voice History” box.
 - If you are talking and nothing is appearing in this box, make sure that you have a profile loaded into the software and that it is reading “LISTENING” in the bottom left margin. You may have to load in a profile every time you open the application, so have it in an easily findable location. If it says “NOT LISTENING” select the “toggle microphone input” button and try speaking again.
 - If you are talking and question marks are appearing in the box, Helpo is taking in your words but cannot link it to any commands. Make sure you are speaking the correct command words. Test this out with simple commands like “Zoom In”, “Brush”, or “Thank you”. The more you talk to Helpo, the better it gets at interpreting your voice, so keep trying.
 - If the above has not helped, try restarting the Helpo application fully by following the steps in the “Unable to reopen application after closing it” section of troubleshooting

Using Helpo

Introduction

The following section will be a quick overview of all of the features that Helpo uses. Helpo works by using voice commands already built into Photoshop. By building a “profile”, Helpo is given a list of command phrases to listen for. When it hears a command phrase, it will activate the control sequence associated with that command. For example, when the phrase “brush” is said, Helpo activates the control sequence associated with it and performs the actions in it; in this case, Key press B followed by speak action “new tool selected”. Let’s explore the Helpo software:

On the right of this document is the standard layout of the Helpo software. At the top, we have three buttons: “File”, “Profile”, and “Settings”. “File” is used to open new profiles into the software. Once uploaded, the “Profile” button is used to modify these existing profiles. We will be exploring this in a later section. The “Settings” button is primarily used by the GAVPI software, which Helpo is built on. It can be used to enable button-toggled listening, but this was simplified by the Helpo software. You should not have to use the “Settings” button.

The next section is our tool selection visible feedback. It contains 20 of the most common tools used in Photoshop and their logos. These logos are used as visual feedback for the artist. Whenever a command is made that activates one of these tools, it will turn blue, informing the artist that the tool has been selected.

The next section is our toggle buttons. Two buttons exist here, a “Toggle voice listening” and a “Toggle keyboard listening”. The voice listen button only becomes available once a profile is loaded in. When toggled off, the program is not listening, as seen in the bottom margin. Once a profile is loaded and commands can be made though, the button can be pressed and the margin will change to reading “LISTENING”. This means that any voice commands you now say will attempt to run through the software. The toggle keyboard button follows the same principle. Having it off will stop the 20 buttons above from becoming blue when a key sequence is pressed. When running the software and making art, both buttons should be toggled on.

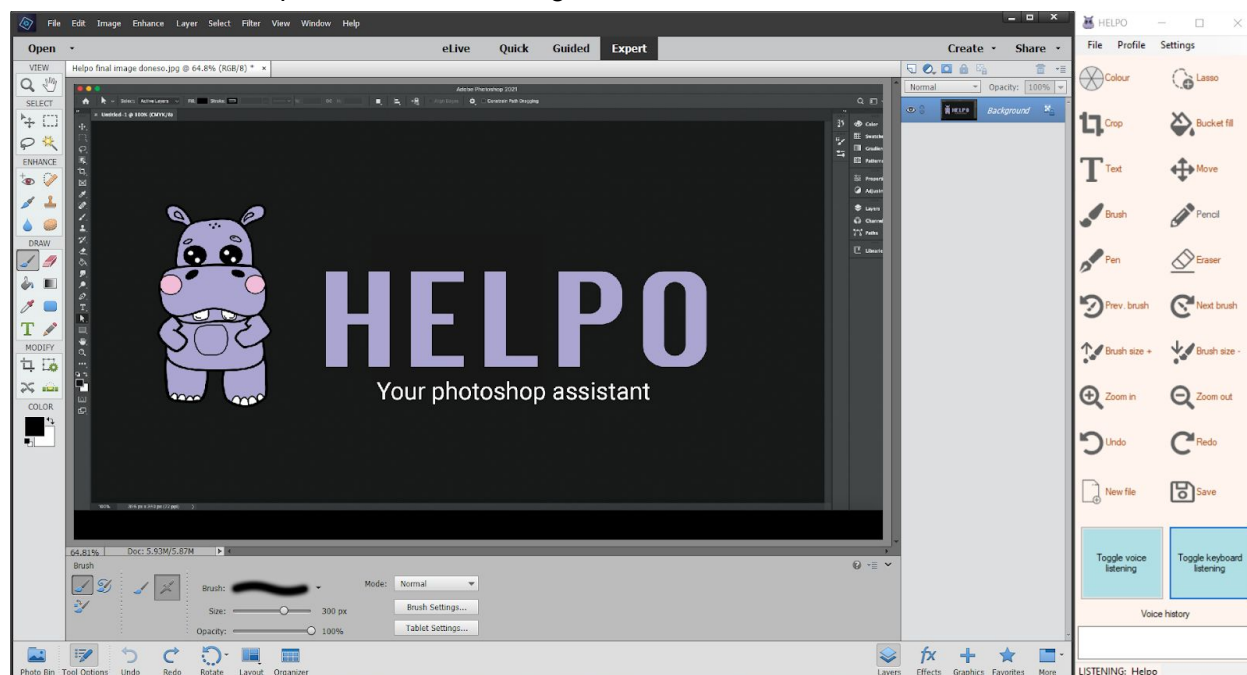
The final section in the software is the “voice history”, which simply shows the last three commands that have been run through the software. Successful commands will show the command title and unsuccessful ones will be read as a “?”. This



section is useful for seeing which command is being run on ones that sound very similar, like “Next” and “Text”.

Using Helpo with Photoshop

Helpo is designed to be run in conjunction with Photoshop. We recommend having it open and visible with Photoshop, as seen in the image below:



As it can be seen, a profile is open and listening, and both the “Toggle voice listening” and the “Toggle keyboard listening” buttons have been turned on. Now, art can be done in the main photoshop window but any commands can be seen in the side Helpo window. Note that with a Windows 10 operating system, the following can be set up quickly by opening both applications, dragging Helpo to the right edge of the screen, releasing, and selecting the photoshop application in the other box, and then dragging the separation line about three quarters of the way across the screen. Helpo should now be ready to help you create art!

Making your own keyboard shortcuts

Photoshop has too many tools to give them all shortcuts. Maybe there is a tool you like though and wish you could access faster, and that's where these steps come in. **Please note, to use the Color Menu command in Helpo, a custom keyboard shortcut must be set for the color menu and it must be keybound to the letter “n”.**

1. Select the edit button in the top left of the photoshop menu bar
2. From the dropdown menu, select keyboard shortcuts
3. Find the “Set Menu” option and select it
4. Select “Set of shortcuts”
5. Find the shortcut you want to modify

6. Save the selected set of keyboard shortcuts.

If a certain keyboard shortcut already has a sequence attached to it, Photoshop will give you a warning. Either delete the existing shortcut or find a different keyset to use. The following website has a complete list of photoshop shortcuts available:

(<https://helpx.adobe.com/ca/photoshop/using/customizing-keyboard-shortcuts.html>)

Master list of possible commands

Helpo has a lot of powerful commands built into it. To use it, we need to know what our command phrases are. The entire list of commands can be found in [Appendix A2](#). Now you're set to use Helpo with Photoshop!

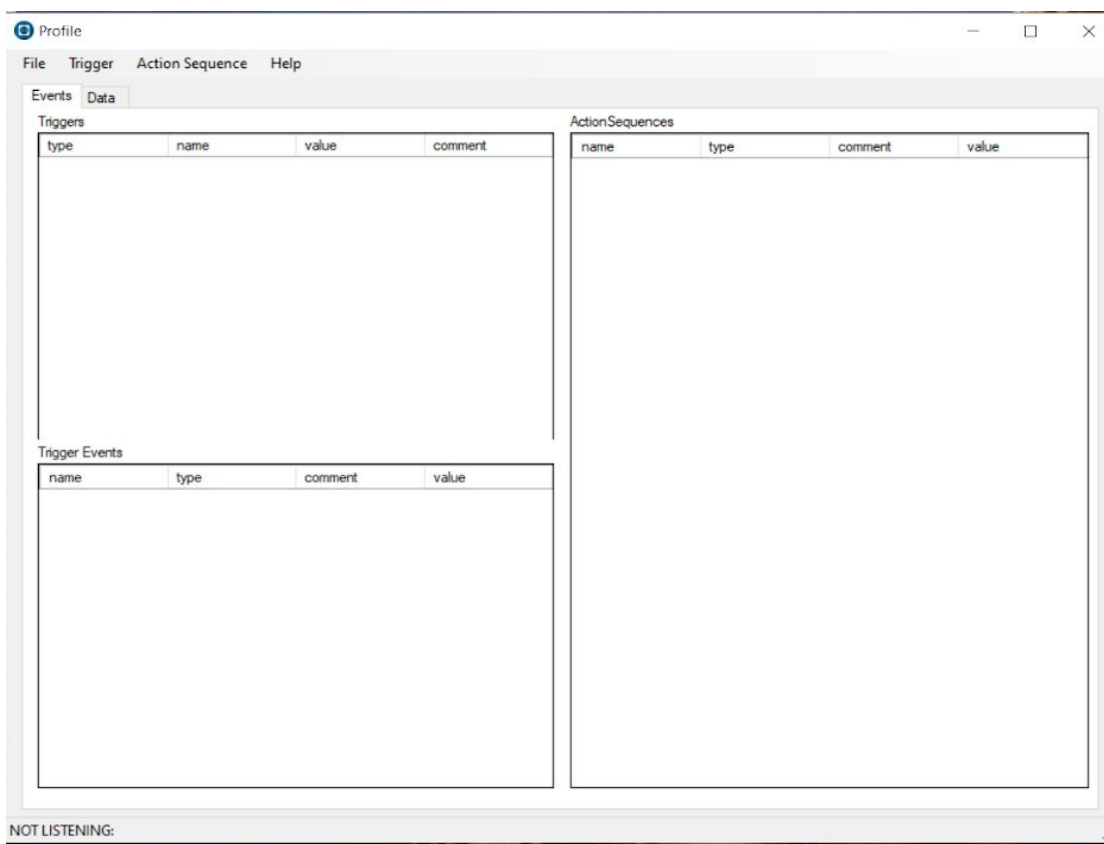
The remaining sections of this document outline optional customisation and a summary of how Helpo was built. If you only want to use Helpo, then feel free to ignore the rest of this information.

Optional customisation

Building your own profile

So, maybe you've found some commands that Helpo is not using. Maybe you're interested in using the software to help with other tasks. Maybe you don't like some of the command names and want to change them to something you would use more often. No matter the reason, this is the right section. Let's start by exploring the "Profiles" button in the GAVPI software.

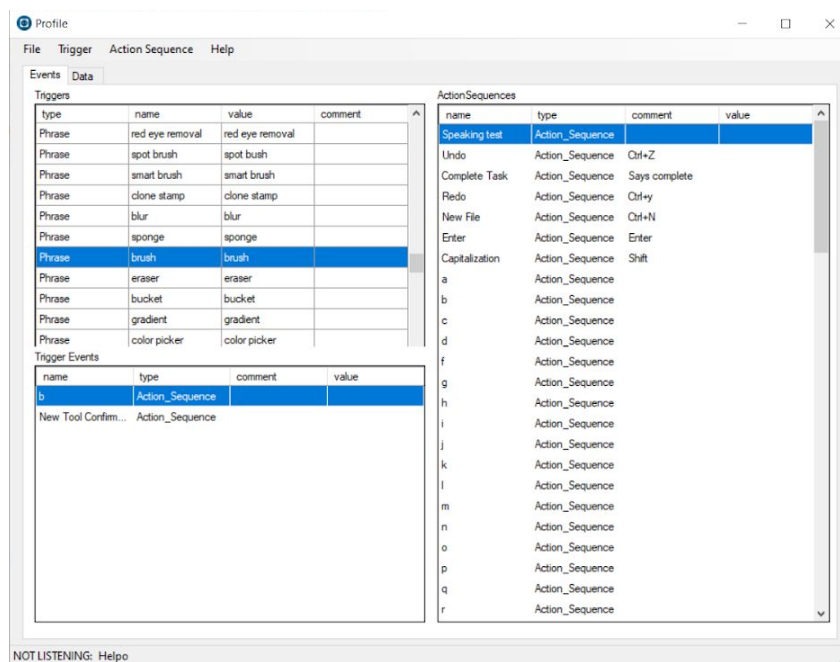
To access this section, select "Profiles" and hit "New". This will open the GAVPI profile builder. Any edits or creation you make will be done in the Events window. Let's explore what each of these three windows mean.



The "Triggers" window contains a master list of all of the commands built into your profile. These are the words you will speak to interact with the software. The name of a trigger and its command phrase should match for ease and simplicity.

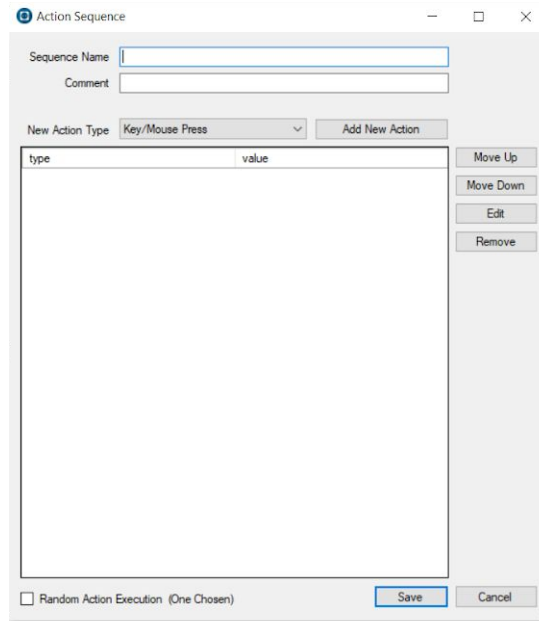
The "Trigger Events" window details the sequence of events that will follow when a command is spoken. To view this information, left click on a trigger in the "Triggers" window. The information in the "Trigger Events" window should update automatically, showing the sequence of actions that will be performed from top to bottom.

The “Action Sequences” window is where all the magic happens. Any action you build will be placed in this window where it can be added to triggers so that your commands actually do something! An example of an action sequence would be “Pressing b”. This action involves two internal commands, “B Key Down” and “B Key Up”. The action of “Pressing b” could then be added to multiple triggers, like “brush” and “type b”. Both triggers use the same action sequence, but “brush” is followed by a “complete” action to confirm that a tool has been selected, while the “type b” command does not. The “complete” action in “brush” trigger is its own separate action, but the combination can be seen in the “Trigger Events” window. It is useful to break your triggers into individual action sequences for this reason, so that they can be reused and you can save time. An example of this in the Helpo software can be seen in the following image:

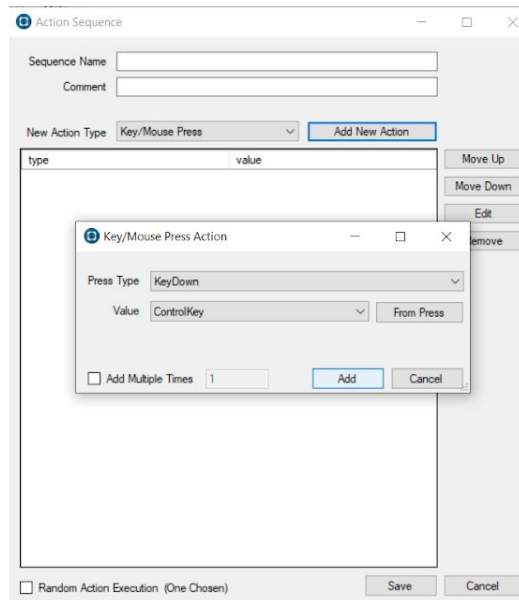


Now let's have a step-by-step look at how to make an entire profile.

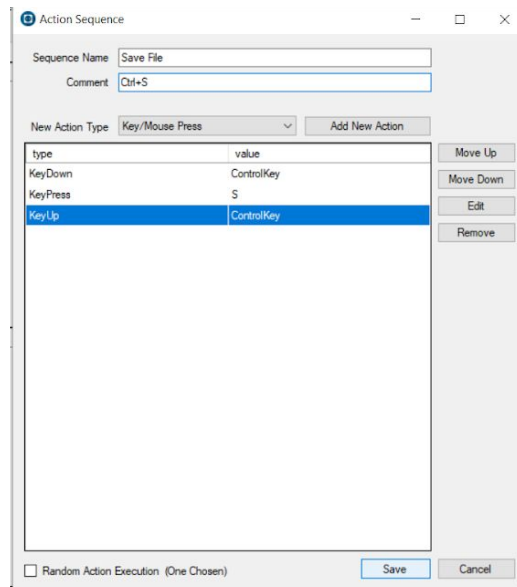
1. Decide on what your trigger will be.
 - a. For the purpose of this example, we are going to write a command that will save our file in photoshop.
2. Figure out all of the actions in your trigger
 - a. For a “Save File”, we need to complete the save and then give audio feedback confirming the save
3. Figure out the necessary keyboard shortcuts to complete your actions.
 - a. To save a file in photoshop, we must hold the “control” key and press the “s” key. A list of common keyboard shortcuts for photoshop and other applications can be found online. To build an audio feedback, we can use GAVPI's “speak” function
4. Create your action sequences
 - a. In the top menu bar, find the button labelled “Action Sequence” and select “New”. This will open up a new menu, as seen in the following image:



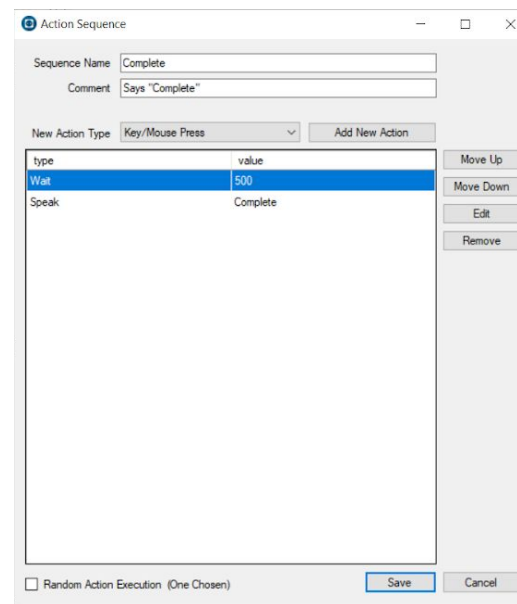
- b. Type out a name for your sequence and write any additional comments. In this example, the sequence name will be “Save File” and the comment will be “Ctrl+S”.
- c. Figure out what kind of action you will need in the drop down menu that reads “New Action Type”. Only worry about the “Key/Mouse press”, “Timing”, and “Speak Action” options. These will let you add keyboard presses, delays, and spoken words respectively. One figured out, hit the “Add New Action” button.
- d. This will open a new window again. This is where you will select what kind of key press you want (press vs. hold), how long of a delay you want, or what words you want spoken. Select the information you want and press “Add”. For this example, see the following screenshot:



- e. Repeat the previous step until every single command you need in the sequence is completed. For this example, we need a key press down Control, a Key press S, and a key press up (release) Control, since the S key needs to be hit while Control is being held. See the screenshot below.



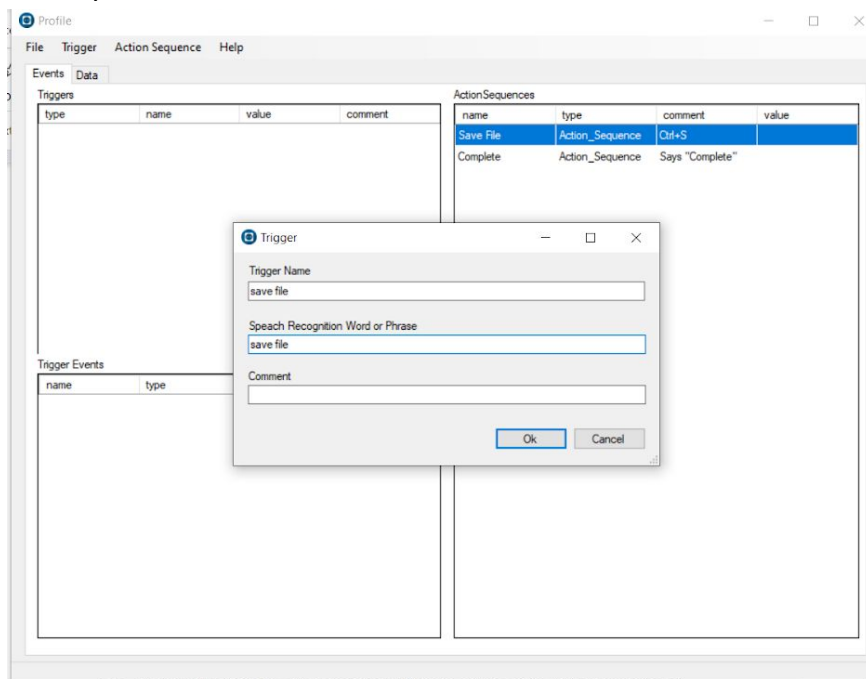
- f. These commands can be reorganized with the “Move up” and “Move down” buttons on the right. Make sure your sequence is correct from top to bottom. Once satisfied, press the “Save button”
- g. Repeat this process for every single action sequence in your trigger. An example of a speak trigger is shown below, which uses a timing delay to make the sequence feel a little bit more natural



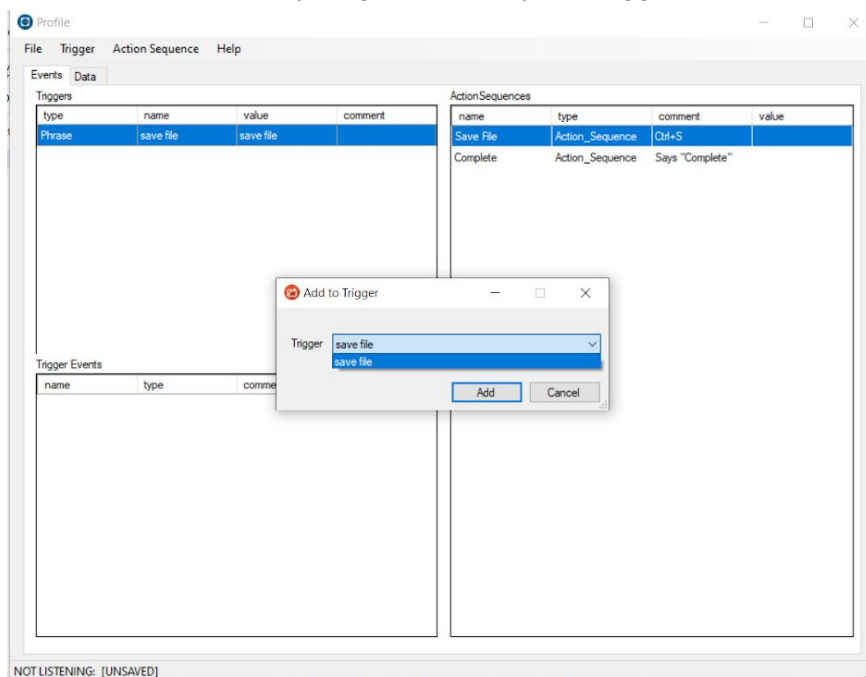
5. Create your Trigger

- a. In the menu bar at the top, select “Trigger”, then select “New”, then select phrase. This will open a new menu. Fill in the Trigger Name and Command word

with the same information and leave a comment if you so wish. Then, select “OK”
For this example, the information is as follows:

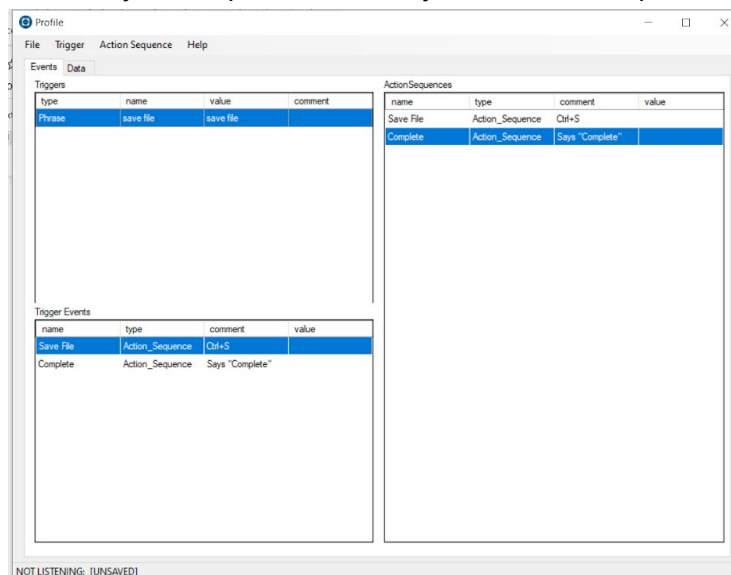


6. Add your Action Sequences to your Trigger
 - a. Right click on the first action sequence you want to add to your trigger. Select “Add to trigger”. Find the Trigger you want to add it to and select “Add”. You should see the appear in the “Trigger Events” box if you have your trigger selected. Repeat this for every single action in your Trigger.



7. Ensure proper action order

- a. Select your trigger in the “Triggers” window and look at the “Trigger Events” window. Ensure that your sequence is what you want from top to bottom.



8. Repeat steps 1 through 7 for every single trigger you want to include in your new profile
9. Once finalized, save your profile by going to “File” and selecting “Save as”. Make sure to name this file something you would recognize and place it in a folder you can find again. Now, you can upload this new profile into the Helpo software and use it to map any voice command to a keyboard shortcut for anything.

This may seem like a lot of steps, but once you get practice at it, creating profiles is easy. Just know what you want and then follow the steps to do it. Some examples of profiles you might want are for other modeling applications, like Blender, or for editing softwares like FinalCut. You can also use this to map voice to video game controls, which could put a fun spin on how you play. Anything that uses a keyboard can use your voice too!

Installing VIA for Custom Keyboard Mapping

The following section is specifically for the physical keyboard that comes with Helpo. While the keys will be mapped, it is possible that something breaks or you decide that you would rather have different keys mapped. This can be quickly fixed with the VIA custom mapping software.

1. Visit caniusevia.com to and click into the download page. This should lead you to a github repository.

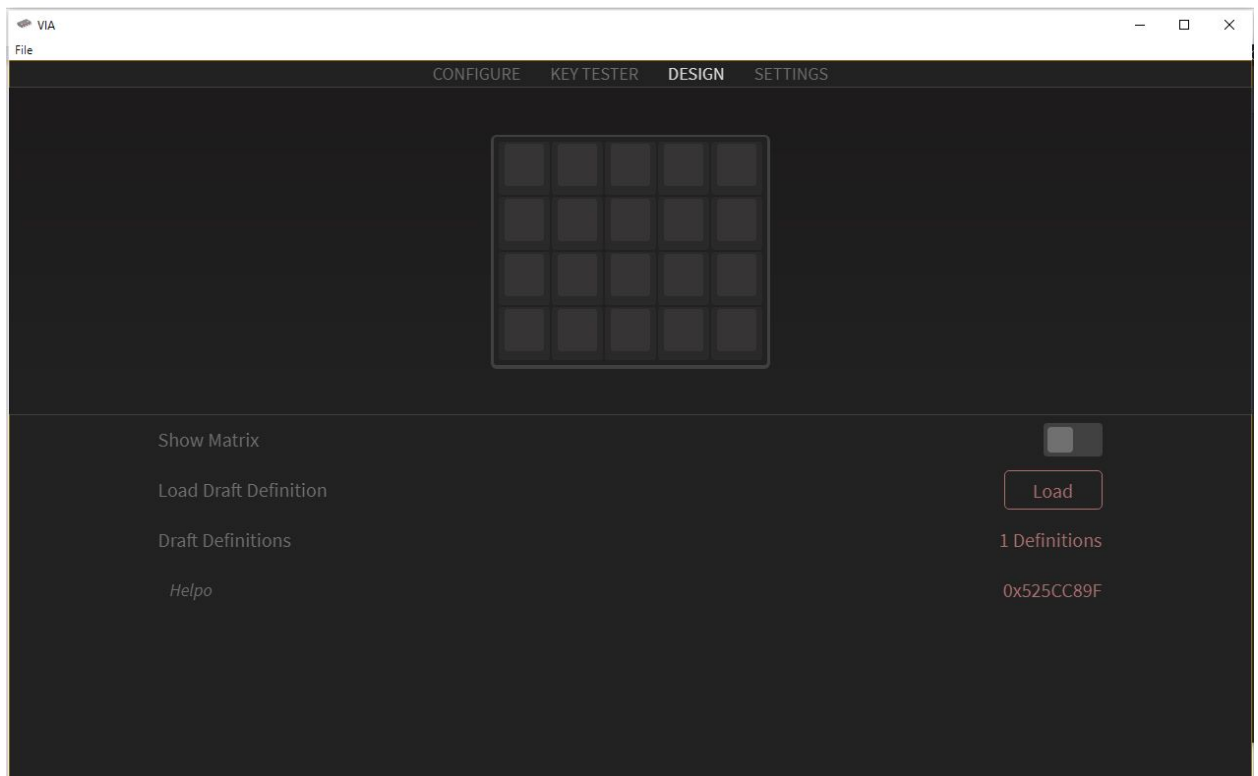
2. Select the correct download file for your operating system (In this case, via.1.3.1-win.exe)

 latest-linux.yml	370 Bytes
 latest-mac.yml	331 Bytes
 latest.yml	330 Bytes
 via-1.3.1-linux.AppImage	104 MB
 via-1.3.1-linux.deb	64.2 MB
 via-1.3.1-mac.dmg	95.6 MB
 via-1.3.1-mac.dmg.blockmap	103 KB
 via-1.3.1-win.exe	69 MB
 via-1.3.1-win.exe.blockmap	73.2 KB
 via-1.3.1-win.msi	74.4 MB
 Source code (zip)	
 Source code (tar.gz)	

3. Open the install file and allow it to be installed into your computer
4. VIA is now set up for your keyboard

How to use VIA

1. Download Helpo.json from the makerepo repository
2. Load Helpo.json into the load draft definition



3. Enter the Configure page

4. Select the key that you want to change on the top half of the software
5. Select what function you want that key to perform on the bottom half of the software
6. Once you are done with changing the keymaps you can close VIA at any time.

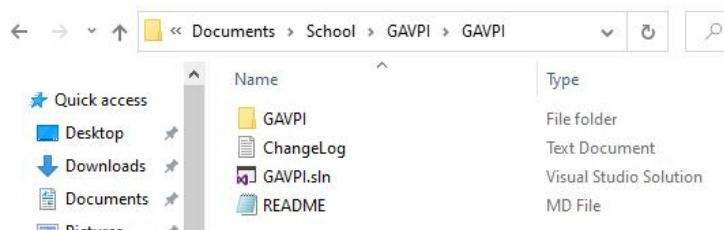
Technical summary


Software prototyping summary

The software was built as a Windows Forms application. It was important that we made this application run at a fairly low-level to the operating system so that it could detect keypress signals. This is not possible with more high-level languages, such as JavaScript (which is what we originally wanted).

The software was built on top of the pre-existing GAVPI application, which is an open source project. You can find the original GitHub repository here: <https://github.com/baykovr/AVPI/releases/tag/17.03.15>. We made a number of modifications to this code and removed unnecessary functionality, so we recommend that you use our source code from the MakerRepo for this project (<https://makerepo.com/Frenchfrie/helpo-your-photoshop-assistant>).

To open our project, download the GAVPI.zip file from the MakerRepo. Unzip (extract) the files. Open the “GAVPI” folder, the contents should look like this:



Visual Studio 2019 is the best IDE for Windows Forms applications. If you haven't installed it already, follow this link to download it: <https://visualstudio.microsoft.com/downloads/>. It is important that you use Visual Studio 2019 and not Visual Studio 2020, as they are very different IDEs. Once you have completed the installation, open the GAVPI.sln file in Visual Studio. You can press the “Start” button at the top of the screen to run the solution. 

Software troubleshooting












It is important that you run this solution as an administrator. If you are not logged into the system administrator profile for your computer, you may get an error message that prompts you to sign in an administrator and restart VSCode. If you follow the steps on the screen, the code should then run.










If at any time you get a “Build failed” message or are unable to run the solution without any error messages shown, you will just need to quit Visual Studio and restart it.

Hardware prototyping summary

The keycaps were designed in Fusion 360 by extruding the symbols found in the table below into the keys. Once designed they were 3D printed and placed onto the keyboard. The

file containing all of our keys can be found in the Makerrepo. Each row of keys is shaped slightly differently for ergonomics.

Pencil	
Pen	
Eraser	
Zoom In	
Zoom Out	
Brush	
Brush Size Up	
Brush Size Down	
Next Brush	
Previous Brush	
Pick Colour	

Move	
Lasso	
Crop	
Bucket	
Text	
New File	
Save File	
Undo	
Redo	

Health and Safety Guidelines

The keyboard is soldered together using solder. Solder may or may not contain lead. Do not open up the keyboard and touch any of the solder joints.

Hardware Troubleshooting

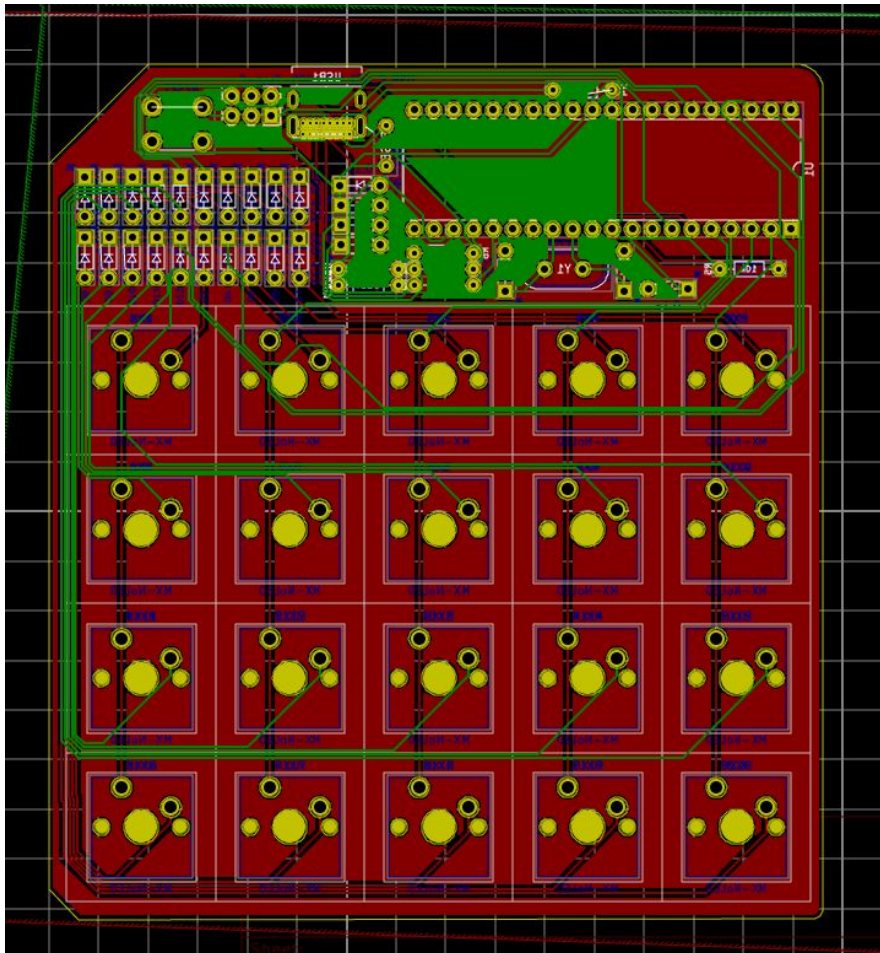
- If keys are not working
 - Check using the VIA software if keyboard inputs are being registered, then check if the corresponding key is mapped to anything. If the key is not mapped to anything, map it to the desired key commands
- If the keyboard is not being picked up by the computer

- Try switching cables and check if the connection between the keyboard and computer is secure.
- If the computer picks up ATMEGA32A:
 - Refer to https://www.youtube.com/watch?v=VR53Wo9Z960&ab_channel=MechMerlin and flash axolstudio_helpo_via.hex onto the board

Hardware Alteration

In the event that the schematics are to be changed, it can be referenced to the gerber output files. The location of the footprints can be changed however the routing of the traces will have to be redone. The diodes are primarily grouped on the top left, whereas the MCU takes up most of the space on the top right.

Below features the schematic in the PCB drawer tool in KiCad.



Conclusions and Recommendations for Future Work

The development of Helpo was nothing short of difficult. Due to the restrictions of COVID-19, the team had to learn how to collaborate efficiently in various remote locations. Thanks to very detailed scheduling and a winning team dynamic, Helpo has become a product that is beneficial for everyone, accomplishing more than it was required to. With the help of multiple deliverables that were required to be completed on a weekly basis, we all understood as a team how crucial it was to stay organized within our personal schedules as well. To accommodate for that, we all agreed on a specific time to meet up every week to discuss what objectives needed to be completed for the present week. As a team, we learned to work to each individual's strengths which became easier to execute with time. By handing out tasks that were better suited for each respective member, this sped up the development process and increased overall productivity within the team. However, the journey was not as smooth as it seems, throughout the semester we faced multiple issues ranging from the software to hardware when trying to create Helpo. Initially, we had trouble finding the right software framework that could function smoothly with Photoshop's interface, and found ourselves switching multiple times. We also faced some delays in trying to send our keyboard from one member who made the keyboard and another with the custom keycaps for our client. Through all the hardships that we faced as a team throughout the semester, Helpo was a result of everyone's efforts which shows in the quality of the product.

For more information regarding the development of Helpo, visit our [Helpo Repository](#) at makerepo.com. For any additional questions, feel free to contact any one of the following email addresses:

- [Austin Wu](#)
- [Ben Saulnier](#)
- [Callum French](#)
- [Ellie Rumsey](#)
- [Matt Yakubu](#)

Appendices

A1. The Helpo keyboard Bill of Materials (BOM)

Comprehensive Bill of materials (BOM) for the keyboard prototype			
Component	Description	Quantity	Price (\$)
ATMEGA32A-PU	Microchip	1	4.67
1-2199299-5	DIP Socket	1	1.15
512-1N4148TR	Semiconductor	Number of switches	0.07*20
TZX3V6A-TR	Semiconductor	2	0.27
MF-R050	Circuit protector	1	0.46
603-CFR-12JR-52-75R	Carbon-Film resistor	2	0.14
MFR-12FTF52-1K5	Resistor	2	0.19
MFR-12FTF52-10K	Resistor	1	0.19
UMT1H4R7MDD	Capacitor	1	0.28
RDER71H104K0M1H03A	Capacitor	2	0.41
RCE5C2A220J0A2H03B	Capacitor	2	0.64

ABL-16.000MHz-B4Y	Timing crystal	1	0.45
MJTP1230A	Tactile switch	2	0.26
LTL-4222	LED light	1	0.16
68602-406HLF	Wire housing	1	0.39
USB4085-GF-A	USB receptacle	1	1.3
PCB	Printed Circuit Board	1	7
Switches	Switches	Number of switches	0.2*20
Keycaps	Keycaps	Number of switches	0.3*20
TOTAL:			\$ 29.6

A2. Comprehensive list of voice commands in the Helpo profile

Command Phrase	Command Actions	Keyboard Shortcuts
Undo	Undoes the last action	Ctrl+z
Redo	Redoes the Undone action	Ctrl+y
New File	Opens a new file	Ctrl+n
Next	Tab's to the next option in a menu	Tab
Enter	Submits a menu	Enter
Type a, Type B, etc...	Types a letter of the alphabet, a through z	Press *letter*
Type Capital A,	Types a capitalized letter of the alphabet, A	Hold Shift, press

Type Capital B, etc..	through Z.	*letter*, Unhold Shift
Type Space, Type period, etc..	Can be used to type different commands, like spacebar, period, dash, and underscore	Press *symbol*
Type 1, 2, etc..	Type any numbers	Press *keypad*
Go up, Go right, etc..	Hits the arrow keys in directions up, down riht, left.	Press *directional arrow*
Zoom	Selects the Zoom tool	Press z
Hand	Selects the Hand tool	Press h
Move	Selects the Move tool	Press v
Lasso	Selects the Lasso tool	Press l
Select	Selects the Select (Marquee) tool	Press m
Quick Select	Selects the Quick Select tool	Press a
Red Eye Removal	Selects the Red Eye Removal tool	Press y
Spot Brush	Selects the Spot Brush tool	Press j
Smart Brush	Selects the Smart Brush tool	Press f
Clone Stamp	Selects the Clone Stamp tool	Press s
Blur	Selects the Blur tool	Press r
Sponge	Selects the Sponge tool	Press o
Brush	Selects the Brush tool	Press b
Eraser	Selects the Eraser tool	Press e
Bucket	Selects the Bucket tool	Press k
Gradient	Selects the Gradient tool	Press g
Color picker	Selects the color picker tool. Used to be called the “eyedropper”	Press i
Color Menu	Opens the color menu	Press n (must be set up manually)
Pen	Selects the Pen tool	Press p
Pencil	Selects the Pencil tool	Press b x2

Text	Opens the Text tool	Press t
Crop	Selects the Crop tool	Press c
Open	Open's the "Open" menu in photoshop	Ctrl+o
Close	Closes a file in photoshop	Ctrl+w
Close all	Closes everything in photoshop	Alt+Ctrl+w
Save as	Opens the save menu to save a file	Alt+Ctrl+s
Save	Saves the active file	Ctrl+s
Print	Opens the print menu	Ctrl+p
New Layer	Creates a new layer	Shift+Ctrl+n
Merge layers	Merges the visible layers	Shift+Ctrl+e
Select all	Selects everything in a layer	Ctrl+a
Deselect	Deselects everything	Ctrl+d
Invert Selection	Inverts the selected pixels	Shift+Ctrl+i
Refine Edge	Refines the selected edge. Useful for smoothing out curves and blending edges.	Alt+Ctrl+r
Zoom in, Zoom out	Zooms the camera in or out	Ctrl++, Ctrl+-
Fit to screen	Fit's the canvas to the screen	Ctrl+0
Toggle rulers	Toggles rulers to work as guides	Ctrl+r
Cut	Cuts the selected pixels	Ctrl+x
Copy	Copies the selected pixels	Ctrl+c
Paste	Pastes the selected pixels	Ctrl+v
Left Click	Performs a left mouse click	Left Mouse button
Right Click	Performs a right mouse click	Right Mouse button
Decrease Size, Increase Size	Decreases or increases the brush size on a selected brush	Press [, Press]
Decrease Hardness, Increase Hardness	Decreases or increases the hardness of a brush. This is usually useful for airbrushing or for pencils	Press {, Press }

Previous Brush, Next Brush	Changes brush selection one at a time	Press ,(comma), Press .(period)
First Brush, Last Brush	Jumps to the first or the last brush option in the brushes menu	Press <, Press >
Access menu, Access file, etc...	Accesses any of the more specific files in the top bar of photoshop. Useful for accessing any of the stronger photoshop tools. Options include Menu, File, Edit, Enhance, Layer, Select, Filter, View, Window, Help, and Image. Navigate the menu using the “go ___” commands and “enter”	Alt, right directional arrow for varying amounts, down directional arrow
Toggle toolbars	Toggles the toolbars on and off	Tab
Hello World	Speaks “Hello” and “Goodbye”	No keyboard input
Thank you	Helpo says “You’re Welcome”	No keyboard input