GNG 2101 Report

Deliverable I - Video and User Manual

Submitted by

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ADHD - Attention Deficit Hyperactivity Disorder
FOTL - Fidgets on the Loose
CAD - Computer Aided Design
PLA - Polylactic Acid

Introduction

This product and user manual provides the necessary information for proper usage of the Modular Fidget Tool made by F.O.T.L. This document will go through the system navigation, instructions on how to use the fidget attachments, and troubleshooting methods.

Overview

ADHD is a common mental health disorder that affects individuals from all age groups, with the list of symptoms varying greatly by case. One of the most common symptoms is the reduced ability to sit still and focus on a single task. One method of dealing with ADHD is the use of fidget tools, allowing the user to keep their hands busy with stimuli which in turn allows their mind to focus on other tasks. Fidget tools are commonly found in retail stores and websites, however, their components vary greatly and cannot be adjusted; one would need to buy multiple fidget tools to meet every need. Our goal was to create a single fidget tool that could be modified by the customer to fit their own needs. Our product consists of a body frame with a variety of attachments that can be interchanged by the customer to fit their preference.

Figure 1.0: General frame with rocker switch and spinner attachment

The basic package of the F.O.T.L Fidget Tool includes an ergonomic general frame that includes grooves for the thumbs to rest on. The general shape can be bought in different sizes to better fit the hands of individuals from different age groups. As mentioned previously, F.O.T.L offers a variety of attachments, including a spinner, squishy components with different textures, a switch, and buttons. These are the few attachments that we currently offer, however, we are planning on generating more as the company grows. Having a variety of attachments ensures that the needs are met not only for one person, but for anyone who is suffering from ADHD. In addition, switching the attachment is very simple; you lift the current attachment out of the frame

with your fingers, select the desired attachment, and drop it in the attachment slot. The integrated magnets will ensure that the attachments stick securely to the general shape under all conditions.

Cautions and Warnings

This system poses a choking hazard for young children. Do not let infants play with the fidget tool as they may ingest the small components and can potentially choke on them. There is a chance of injury due to rough edges, however, said chance of injury is quite low. Always inspect the tool before use for any rough edges or sharp components to avoid injury. This system employs magnets and should be kept away from devices/objects which can be damaged by magnets (ie. credit cards)

Getting started

Set up Considerations

For setup, consider what attachments would like to be used. The frame can hold up to two attachments at once so consider the option of storing the remaining attachment(s) in some kind of case. The attachments attach magnetically and are designed to be dropped into their respective slots. If all the attachments are not able to be transported at once, consider which attachments the user would like to use and fit them into the frame as the user will only have access to two attachments.

User Access Considerations

Given the customizability of the tool, it can be adjusted for users with decreased range of motion or strength in their hands and fingers. The shape of the frame can be adjusted to be more ergonomic and make the attachments easier to reach.

Storing the Tool

The tool should be stored in a dry place away from any objects that can apply a large force onto the tool. The tool should be stored at room temperature as high heat can warp the plastic and cold can increase the risk of breakage if the tool is dropped. Ideally, it should be stored in a case which would allow for all the components to be stored safely and securely. A case is available for purchase; for more info, refer to the case section under the “using the tool” section.

Using the Fidget Tool

Main Frame

The main frame can be held with either hand (left and right) and it is recommended to rest the thumb in the groove located on both sides of the frame. To insert an attachment in the frame, select the desired attachment, orient it in the proper direction, and drop it in place. You should hear a clicking sound as the attachment snaps into place in line with the magnets. It is recommended to avoid very cold temperatures as it can make the frame more fragile which increases its risks or breaking if dropped.

Switch Attachment

To use the switch attachment, change the attachment that is in the general shape to the switch, hold the general shape in your preferred hand, and then rock the switch back and forth. You can apply as much force as you like, and can rock the switch back and forth at whichever speed feels more natural.

Clicky Button

To use the clicky button attachment, remove the current attachment that is in the general shape, and insert the clicky button attachment. Once the attachment is secured in the general shape, simply press on the button until you hear a clicking sound, release the button and then you can press it again. Repeat this process as many times as needed and at a speed that feels most comfortable.

Squishy Attachment

To use the squishy attachment, remove the current attachment in the frame and insert the squishy attachment. Once it is secured in the general shape orient your thumb so it can rest comfortably on top of the foam ball and begin squishing it. There are 2 foam balls of different texture and squishing strength to add variety for different preferences.

Roller Attachment

To use the roller attachment, remove the current attachment that is in the general shape and replace it with the roller component. Once the attachment is secured in the general shape, hold the general shape with your preferred hand, rest your thumb on the spinner, and rotate it as fast as you want. The roller offers resistance which can vary from one attachment to another.

Spinner attachment

To use the spinner attachment, remove the current attachment in the frame and replace with the spinner attachment. Once secured, hold the general shape with your preferred hand, rest the pad of your thumb on any of the grooves on the spinner, and spin it at your preferred speed.

Case

The case has custom slots to hold up to 8 different components as well as the general frame. There are magnets in the slots to secure each piece into place. If the case is swung around or in a bumpy car ride the pieces are not in danger of being broken. The lid is magnetic and can be held open, acting as a display case if desired. This also means that you can use each component separately without the general frame by magnetically attaching the component to the top of the case.

Troubleshooting and Support

Unusual Behaviors

Attachments not fitting in: In the event that the attachments are not fitting, consider the following possibilities and their troubleshooting.

- Debris in the frame or on the attachment
    - Try cleaning the attachments and the frame and try again
- Broken Frame/attachments
    - Assess the damage; if significant, purchase new components as needed.

Special Considerations

Try to take good care of the frame and pieces; dropping or throwing the tool can lead to the magnets breaking and losing their polarity. This would result in having to buy new attachments/frames/cases.

Maintenance

The maintenance of the tool is simple. If there is dirt or debris on the tool, wipe said grime off with a damp cloth. The use of sanitising wipes is recommended over spraying the tool with isopropyl alcohol for disinfecting. In the case of rough edges or sharp components, use a file to gently grind the sharp parts till they are no longer sharp. This is done to avoid injury and/or discomfort.

Support

For any troubleshooting help, reach out to our support team who will provide help.

Product Documentation

Subsystems LIST

Bill of Materials

Table 1.0 Bill of Materials

Material	**Price**
Magnets	$20
Radial Ball Bearings	N/A
Rocker Switch	$14.38

Equipment List

- 3D printer
- Different coloured filament
- Magnets 4x1mm diameter
- Rocker switch
- Rival Foam bullet balls
- Radial Ball bearings
- Flashlight Clicker
- Silicone button Cover
- White tin lunch Box
- Solidworks Software

Instructions

For all of the following components, we used standard PLA filament since it is what we had access to. Although this choice was limited by our resources, different materials could be implemented based on preferred properties (ie, weight, density, ductility, etc). For example, Polyterra PLA was used for the general frame because our client preferred the texture and finish.

Frame

Step 1. Create your general frame shape using any CAD software. Refer to Appendix A.1.1 and A.1.2 for the dimensions and shape of the general frame, but keep in mind that the size can be adjusted to accommodate your client and their needs. Note that the frame must be split into two pieces in order to fit the magnets and have a good surface finish at the end of printing. We recommend starting by making the whole frame as one part, creating a copy of it and then slice them at the same location but in opposite directions. (one part would be the lower half and the other would be the upper half) See Figure 1.1 and 1.2 for model references of the upper and lower halves respectively. If you are using magnets of different shape or size, you can adjust the shape of the hole that holds the magnets, just remember to make them slightly bigger than the actual size of the magnet since the print will not be 100% accurate.

Step 2. Create 2 symmetrical slots at both ends of the frame for the fidget attachments to slide in. Once again, refer to appendix A.1 for technical drawings of the attachment slot.

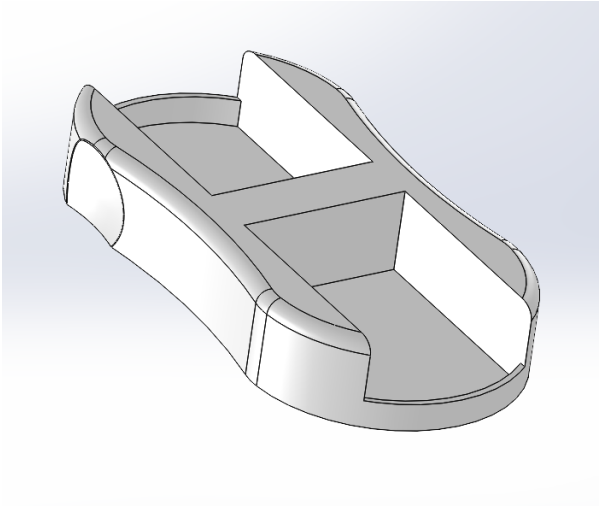


Figure 2.1: Upper half of the general shape

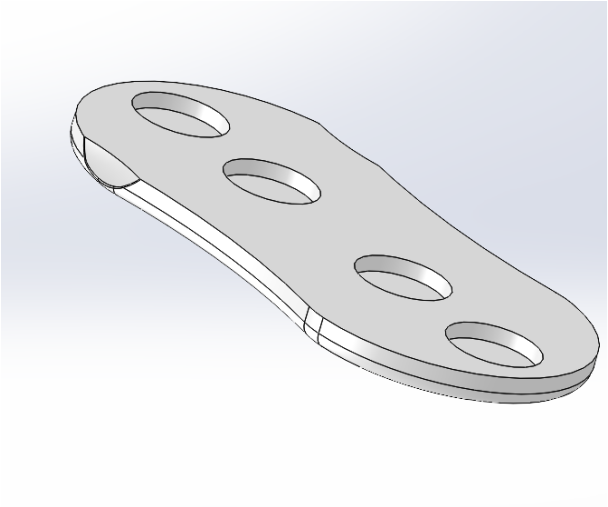


Figure 2.2: Lower half of the general shape

Figure 1.0

Step 3. Add features to the general shape for your client's needs. Our client wanted thumb grooves, so we added two thumb grooves on one end of the frame. At this step you can also add some textures (smooth, bumpy, coarse…) this can be a helpful stimulus for someone with ADHD.

Step 4. Print your frame. For the material, we used Polyterra PLA filament to get a more ductile frame (normal PLA is brittle which increases the chances of breaking if the user drops the fidget tool). This being said, any material or color can be used, but we found that having a black general shape makes the attachments pop-out more.

Step 5. Glue the magnets to the lower half of the general shape using super glue. Ensure that the magnets' poles are facing in the correct direction so that it will attract the attachments instead of repelling them and make sure they are all in the same direction. Then glue both halves of the general shape together while making sure they are well aligned.

Step 6. Inspect and test your prototype. Look for any flaws in the print or build, sand down any bumps or irregularities that were caused by the printing process or excess glue. If you already have some printed attachments, you can double check the fit before continuing. Also test out the frame feel in your hand, adjust the design as necessary

Case

For the case we bought a tin box and measured the inner dimensions. A model was created in a CAD software with extrusion cuts having the shape of the attachments (clearance fit) and slots for the magnets. We then 3D printed the piece and glued it to the bottom of the case. See Appendix 2.1 for a technical drawing of the printed shape that was glued into the tin box.

Spinner Attachment

Step 1: create a spinner model on Solidworks see figure 2.0.

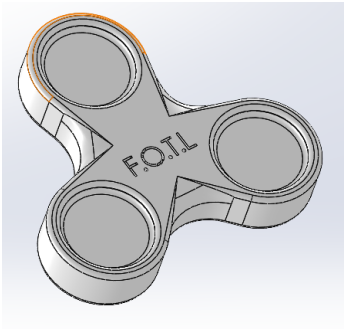


Figure 3.0 Spinner attachment

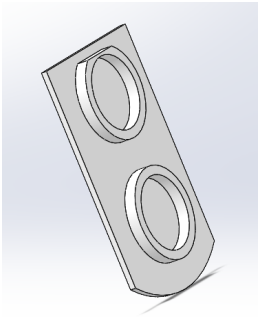


Figure 4.0 Bottom cover for attachment frame

Step 2: Create a hollow box using solidworks to fit inside the frame slot. See appendix A.1 for dimensions. Edit the model by making a small slot to hold a radial ball bearing.
Create a magnet holder. See Figure 3.0.
Step 3: Print out the models and briefly check for flaws in the print or build. Sand down any bumps or irregularities.
Step 4: Glue on the magnets to Figure 3.0. Glue the radial ball bearing magnet holder to the box. Connect the spinner to the ball bearing.

Squishy Attachment

Step 1: Create a hollow box using solidworks to fit inside the frame slot. See appendix A.1 for dimensions. Edit the model by making a small circle at the top.
Create a magnet holder. See Figure 3.0.
Step 2: Print out the models and briefly check for flaws in the print or build. Sand Down any bumps or irregularities.
Step 3: Cut a Rival Foam bullet ball in half and glue into the inside of the box, having it stick out of the circular hole.
Step 4: Glue on the magnets to Figure 3.0 and then glue it all to the box.

Switch Attachment

Step 1: Create a hollow box using solidworks to fit inside the frame slot. See appendix A.1 for dimensions. Edit the model by making a small rectangle of dimension 21 x 13 mm and then extrude this rectangular hole by 3.5mm.
Create a magnet holder. See Figure 3.0.
Step 2: Print out the models and briefly check for flaws in the print or build. Sand Down any bumps or irregularities.
Step 3: Glue the rocker Switch to the inside of the box, having the switch mechanism appear on the top.
Step 4: Glue on the magnets to Figure 3.0 and then glue it all to the box.

Roller Attachment

Step 1: Create a hollow box using solidworks to fit inside the frame slot. See appendix A.1 for dimensions. Edit the model by making a small rectangle.
Create a magnet holder. See Figure 3.0.
Step 2: Create a small stick using Solidworks.
Step 3: Print out the models and briefly check for flaws in the print or build. Sand Down any bumps or irregularities.

Step 4: get a radial ball bearing and insert the small printed stick through it. Next glue the stick to the inside of the box, allowing part of the radial ball bearing to stick out through the rectangular hole. The bearing should be able to spin.
Step 5: Glue on the magnets to Figure 3.0 and then glue it all to the box.

Clicker Attachment

Step 1: Create a hollow box using solidworks to fit inside the frame slot. See appendix A.1 for dimensions. Edit the model by making a small circular hole of dimension.
Create a magnet holder. See Figure 3.0.
Step 2: Print out the models and briefly check for flaws in the print or build. Sand Down any bumps or irregularities.
Step 3: Get a silicone cover and flashlight clicker. Stick the silicone cover through the hole so it is partially sticking out and glue it to the inside of the box. Next glue the flashlight clicker to the inside of the box so that you can click it from the top, through the silicon cover.
Step 4: Glue on the magnets to Figure 3.0 and then glue it all to the box.

Testing and Validation

Frames

The testing for the frames consisted mostly of checking for imperfections and confirming that the frame fit comfortably in the user's hand. The prints were revised for any inconsistencies or defects that could cause the part to break after sustained usage.

Attachments

Given the amount of attachments and their relative simplicity of design, the main testing for them was the verification of their functionality. When an attachment was designed and put

together, it was tested by ensuring that it completed its assigned function. Their durability was tested experientially as our team frequently used the attachments throughout the design process (around 3 months) and deemed them fully functional and durable.

Conclusion and Recommendations for Future Work

During the development of our product, our team learned a lot in terms of working as a group and creating a product from scratch. We began work on our product right after an initial client meeting. As a group we came up with multiple ideas and various mechanisms to incorporate into our design which was then translated into design criteria and design needs. We used the design criteria to create target specifications which would aid us in evaluating potential ideas in the design process. Once our initial prototype was decided, we quickly began working on our design.

Using SOLIDWORKS, a computer aided design program, we were able to create our design. Our design consisted of an ergonomic, oval-shaped tool which consisted of two parts. One part was the main body which we would attach our attachments to. The other part would have four extruded cuts that would fit four magnets. This bottom part will have the magnets clued into place and then the bottom part will be glued to the bottom of the main body. The magnets help the attachments stick in place. Once the design for our frame was complete we needed to create the attachments for the product. Using SOLIDWORKS we created small attachments which would fit snug in the spot for these tools in the mainframe. Each attachment was different and needed to be designed factoring in multiple things. Once our design was complete and we were satisfied, we used the Ultimaker, a 3D printer to print out our design and make sure everything works. We made multiple different prototypes and met with our client to see which one she prefers and with her feedback we made a few adjustments. We used a softer PLA, we went with Polyterra PLA filament for a softer smooth finish. We made sure to take the clients assistance in designing the fidget tool to make sure we didn't make the tool too big for her hand.

Throughout the span of this project, we all learned a plethora of skills that we can apply in the near future. We improved our 3D printing skills, developed our CAD strengths, and enhanced our teamwork skills. Our group was given multiple tools and instruments that aided us in putting together our final product.

For groups working on similar projects in the future, we recommend making multiple prototypes and meeting with the client regularly to discuss and receive feedback on how your product is progressing. This will ensure that you're spending time efficiently. Overall we learned a lot from this project, were successful in some areas and had some setbacks in others, and we hope that future groups will learn from us and improve themselves.

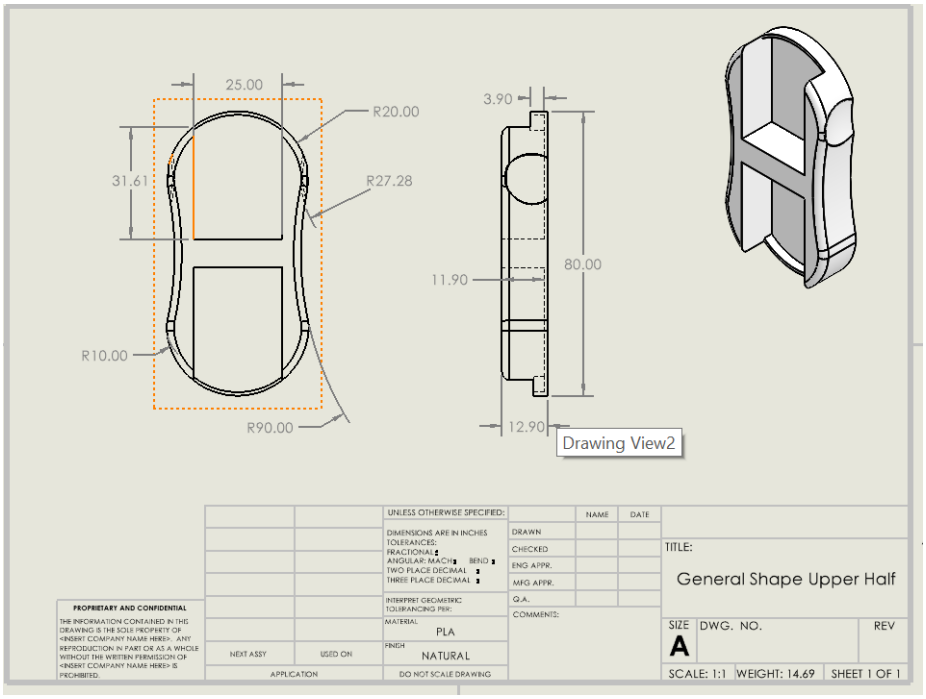
Bibliography

CHADD. (2019, January 31). *Fidget Toys and ADHD: Still Paying Attention?* https://chadd.org/adhd-weekly/fidget-toys-and-adhd-still-paying-attention/

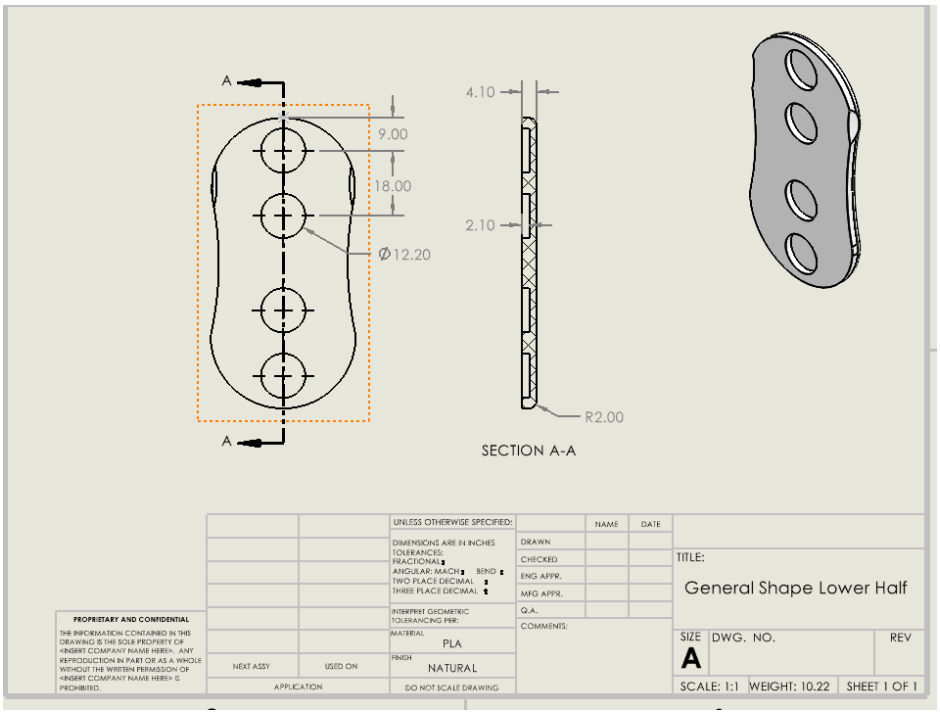
Appendices

Appendix A: Design Files

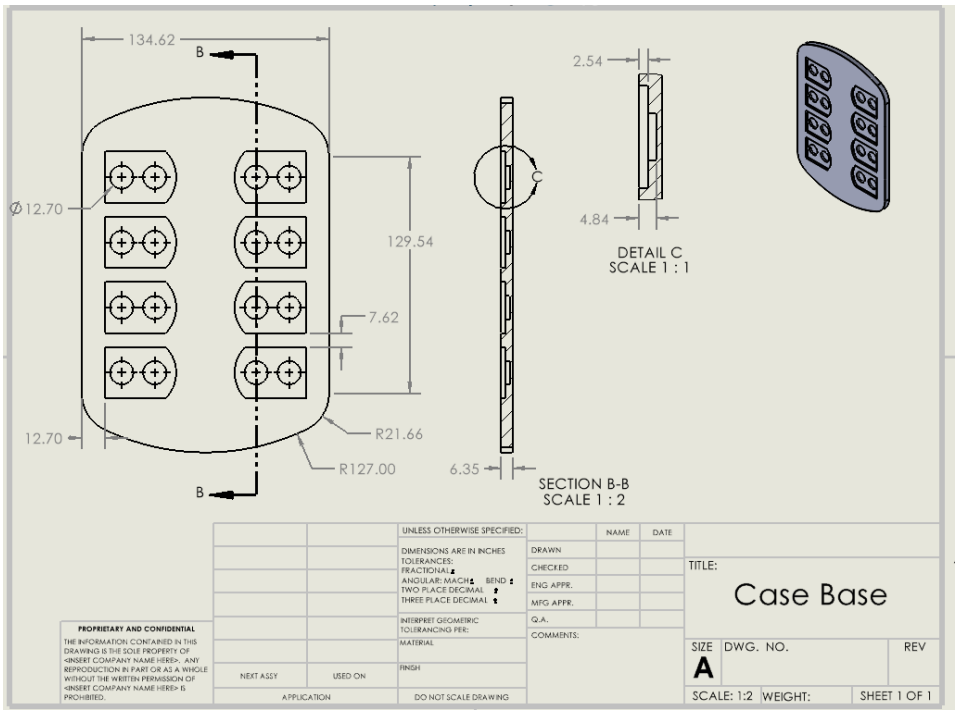
A.1.1: General shape upper half technical drawing



A.1.2: General shape lower half technical drawing



A.2.1: Case base technical drawing



Appendix B: Other Appendices