GNG2101

Design Project User and Product Manual

HGB2 Fidget

Submitted by:

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Table 1. Acronyms

Acronym	Definition
CAD	Computer Aided Design
ADHD	Attention Deficit Hyperactivity Disorder

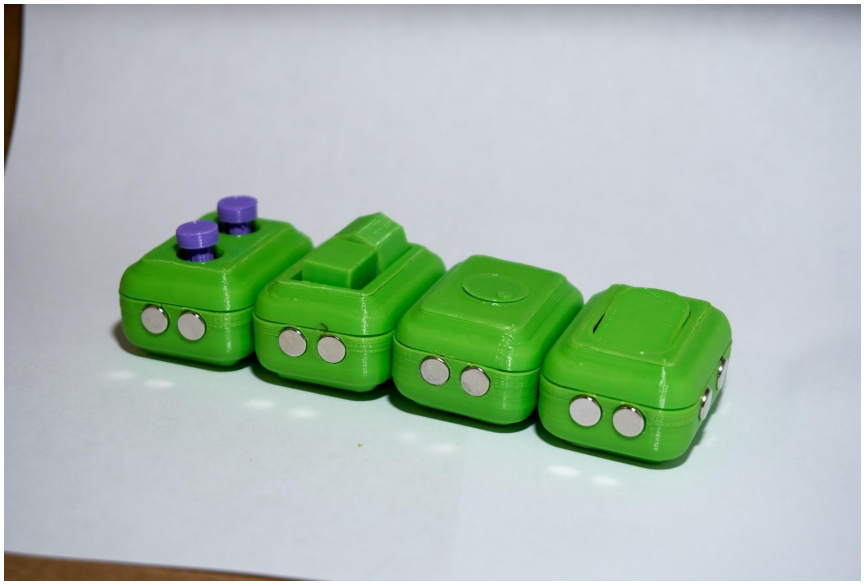
1 Introduction

This User and Product Manual (UPM) provides the information necessary for any individual to effectively use the HGB2 Fidget and for prototype documentation. This document is an outline of the final version of our Fidget Tool device. All of the necessary operational and technical information has been included so that the tool can be easily operated by any users, or potentially improved by another development team. The process of how the device was created is explained, as well as how to assemble and operate the device as a user. The document can be used by any user who wants to learn about the development process of this device as well as how to use each component. In addition, other individuals or teams who are interested in recreating this device can easily follow along with this document and be able to design and successfully produce this device. Challenges faced as well as next steps for this device will be included if someone wishes to improve this device and the list of challenges will help to ensure that no mistakes are made twice, and development goes smoothly for the next group of people who decide to recreate this device. The current capabilities and functions of the device are also highlighted. Regarding security and privacy, this device was originally created for our client who suffers from ADHD and required a device that would help create a baseline of distractions so it would be easier to focus on the task our client had at hand. With this in mind, we will be keeping all of our clients information confidential and it will not be shared in this document. With that being said, this device can still appeal to millions of individuals around the world who have also been diagnosed with ADHD as well as the general mass market.

2 Overview

The problem that we were presented with that sparked the development of this project was our clients' need for a small handheld fidget tool that could allow anyone who was suffering from ADHD to be able to refocus themselves. This is needed to aid the user to have a baseline of distractions to be able to focus on tasks that they have at hand. For a little background, ADHD is a chronic condition that affects children and can affect individuals into adulthood. Some individuals can get diagnosed at a very young age while others don't get diagnosed until later on in their lives. Certain symptoms that individuals with ADHD experience are being easily distracted, hyperactive, impulsive, poor organizational skills, fidgeting etc… Because of these symptoms, it presents a set of challenges when trying to stay focused on tasks and that is where our tool comes into place. Although ADHD can impact individuals differently, for the development of this device we went based on our clients' needs to design this tool. Our client wanted a sleek, lightweight, and customizable device that could easily be transported as well as used in a professional setting. Due to our device's customizability, many different people can use it based on what type of fidget device they prefer. Our device contains pieces that have different types of textures, components that can spin, buttons with different resistance, and magnets on the sides so users can customize the size and shape of the overall unit. Unlike another fidget device on the market that only has one function, our device has multiple and our device comes in multiple pieces so the user can choose what they want to use. The main goal of our device is that users have as much freedom as they want with the device. With this in mind, many different individuals with different needs can use this device and it can be used by the mass market as well. Below is an image of our final prototype. all the parts are detachable and each piece has its own unique function and can be used while connected to the other pieces or can be detached and used on its own.

Figure 1. Final Prototype



The key feature of this device is its ability to detach from its components. Users have the liberty to use the device as they wish and are able to choose from the different features. Eventually when a components' feature has been overused the action of fidgeting with it becomes slightly repetitive so the fact that there are many different ways for the device to be used keeps it stimulating for the user. When developing this device the main manufacturing process was 3D printing. All components were designed on SolidWorks, a computer program used for computer design, then converted to a file that supports 3D printing.

2.1 Cautions & Warnings

Due to the many small components on this device, this tool is a choking hazard and should be kept out of reach of children 3 years old and younger. In addition, the main body of this device is composed of 3D filament plastic, so the fidget tool must be kept away from high temperatures to avoid plastic deformation due to the melting of the plastic. No waiver use or copy permission is needed for the use of this device.

3 Getting started

The device currently is composed of four unique cubes, however additional parts can be made and added onto the device in the future. Each individual piece of the tool can be separated from the main body and still be able to function properly. The system is made as one singular unit with 4 parts so users can customize it to better suit their needs. All components of the device were created based on the request of the client. The entire device is a fidget tool that is intended for those who are diagnosed and living with symptoms of ADHD to operate in order to help them focus or simply act as a simple task they could use to keep their hands occupied. Although this device is made for individuals with ADHD, this device can be used by any individual who enjoys using fidget devices. There is no fixed way that the user is meant to use this device and that is what makes this device so unique. Users can choose to use all the parts or maybe just a couple of pieces. The user could also attach all the pieces together or use the component as a singular piece. Due to the device's lightweight and portable feature, once the user is done using the device they can easily store it in their pocket or bag to use it at another time or bring it with them.

3.1 User Access Considerations

This device can be used by users ranging from 3 years older an over. The tool is targeted for individuals with ADHD, which is a disorder that most individuals get diagnosed with early in childhood and then carries onto their adulthood and for that reason the age of users that can use this device range drastically. In addition, individuals that are not diagnosed with ADHD can also use this device since fidget can benefit many different types or people. Whether the individual uses it as a toy or not this device is very versatile. Users will need to have at least one free hand to use to be able to hold on to the device and fidget with the different features.

3.2 Exiting the System

When the user is done using the fidget device make sure it is stored in a safe spot to prevent it from getting lost. There is no specific way that it needs to be stored.

4 Using the System

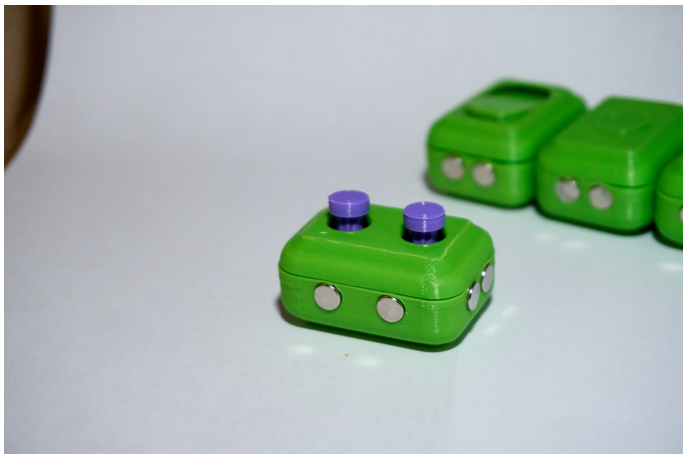
We will now be giving a breakdown of each component of the fidget tool. This will include a basic introduction of the component as well its benefits regarding how it can assist individuals with ADHD. An in depth description of the device will also be given which will explain what the part includes and the method that it can be used in.

4.1 The Button Cube

Basic Introduction and Benefits

The button cube is used to give the user a clicking device that many people who have ADHD have said helps them focus and is a stimulating tool to use. These buttons are to provide just enough resistance that maintains the users' focus on the task they have at hand but not too much where it is too tough and the user needs to use more focus to use them. There are differing resistances to the buttons so if one of the buttons doesn't have an effect on the user there are other options that they can use.

Figure 2. Button Cube



In depth description

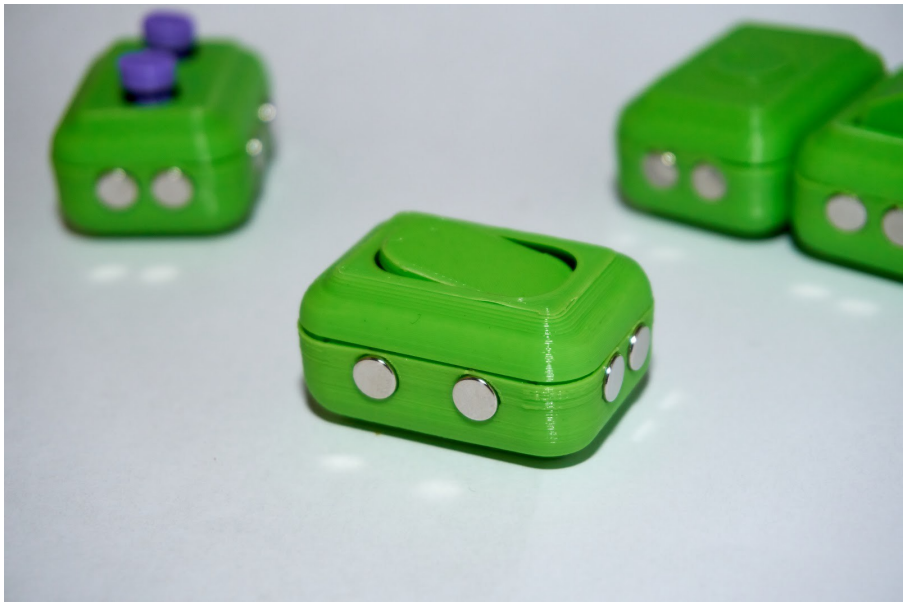
The first piece of this fidget tool is the button cube. This tool consists of two buttons, which both have a spring in them. Force is applied to a button and the spring creates resistance and allows the device to pop back up. The user is able to press on these buttons and it will provide a satisfying amount of resistance.

4.2 The Switch Cube

Basic Introduction and Benefits

The switch cube provides the same clicking effect as the button cube and this is boosted by the effect of the magnets inside the cube. This gives the user another clicking device at their disposal that has an alternative to the button's type of resistance. The switch cube gives the same ADHD benefits as the button cube where the clicking helps the user focus on the task they are completing.

Figure 3. Switch Cube



In depth description

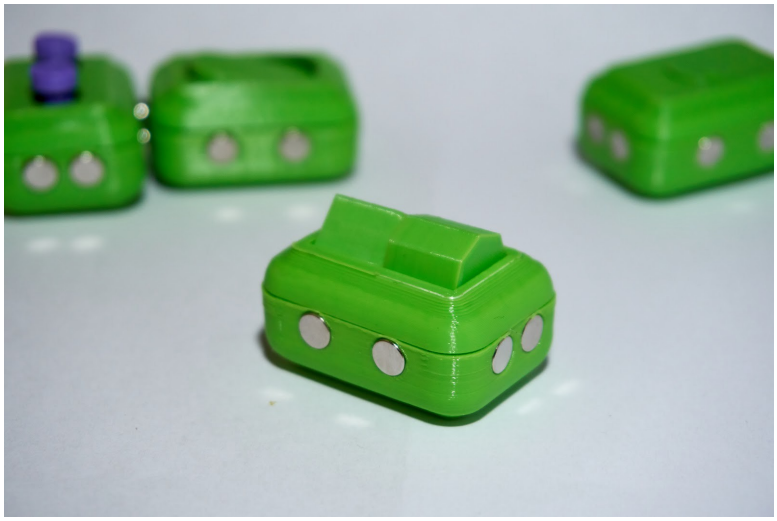
The second tool, the switch cube functions similar to a light switch seen everyday. This device is connected by having magnets be a part of the tool itself. Inside the tool there are magnets that allow the switch to snap back and forth and create a large satisfying sound while giving a good amount of resistance.

4.3 The Roller Cube

Basic Introduction and Benefits

The function of the roller cube is to give the user a device that they can roll around using one or two hands. The roller cube uses two different shapes in the roller so the user has different options in which one they want to use as a roller. The roller cube has a similar effect to that of the fidget spinner cube but it's on a much smaller scale. It gives the user something they can spin while also giving the user a variation in texture on the roller since it has different shapes.

Figure 4. Roller Cube



In depth description

The third fidget tool is the roller cube. The cylinder is not actually a cylinder but composed of two different shapes that connect together on the rotating axis. Because these two pieces are two different shapes, rotating causes these pieces to clash and create noise and resistance, which is what the client prefers. These can be rotated through a rod that is inside of the box itself.

4.4 The Fidget Spinner Cube

Basic Introduction and Benefits

The fidget spinner cube acts the same as a regular fidget spinner where the user can hold onto the circle on the top and bottom of the cube and can spin it in their hand. The size of the cube enables the user to hold the top and bottom of the cube while also spinning it with their free hand so it can be used as a one-handed fidget tool. This benefits the user since they will be using their entire hand to manipulate the cube allowing them to fidget with something while they are working on a task.

Figure 5. Fidget Spinner Cube

In Depth Description

The final tool is made for the user to spin with. It is heavily inspired by things like the fidget spinner. The magnets that are on the box allow two or more species to be attached onto the side and then spun. This is done through a mechanism in the middle of this box that allows the wheel to rotate. Thus allowing the entire thing to spin.

4.5 Magnets

The magnets that connect the cubes together also provide the users with a sort of fidget device. These magnets provide a clicking device similar to that of the button cube and switch cube. The magnets provide a unique feeling when trying to separate them as well as when trying to put them together. The benefit of this is also similar to that of the switch and button cube.

Figure 6. All 4 Cubes Connected

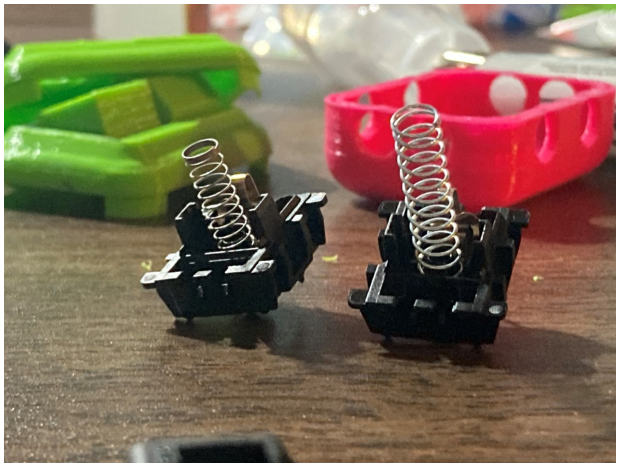
5 Troubleshooting & Support

While the errors with relation to this tool are fairly minimal, here we have included some possible challenges that a user might encounter and how they would go about solving the problem. The support ranges from technical problems when manufacturing the device and working with the CAD software to physical problems that the user can face when playing with the fidget tool. Instructions for maintenance are included to ensure that the user is able to keep their device in good condition for a long period of time.

5.1 Error Messages or Behaviors

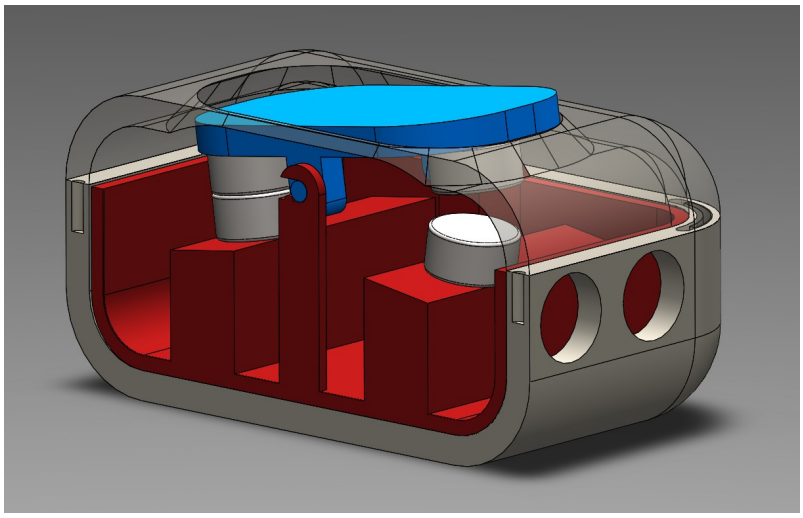
If there are any error messages that appear in Solidworks or Cura consult the links in 4.4 to seek support from the professionals that work at Solidworks and Cura. After repeated use of the button is inevitable that it will start to lose resistance or the spring could have been damaged or fallen out of alignment. To fix this the top cover of the part will need to be removed and the buttons that have the spring attached to them, as shown in the image below, will need to be replaced or realigned. As long as the spring is able to fit into the cap there is no specific type of spring that needs to be purchased and for that reason, the user will be able to pick a spring with a resistance that they prefer.

Figure 7. Springs of the Button Cube



Although the longevity of a magnet's magnetic force is fairly long, if problems do arise and the user is not satisfied with the way it is functions, just like the previous fix, the user may open up the cover of the piece and purchase a new magnet to replace it. Ensure that the dimension of the magnet is the same as the one previously in the piece to ensure that everything will fit it properly.

Figure 8. Inside View of the Switch Cube



5.2 Special Considerations

One thing that should be taken into consideration about the fidget cube is that it isn't meant to be used in a rough manner. Even though it is designed to be resistant to damage, continuous rough treatment can cause there to be damage. If damage is obtained by the cube the components may need to be repaired or fixed if it's causing a decrease in performance. In addition, since there are many magnetic components to our device it is possible that some items that you have around the house may have a tendency to stick to it, so ensure that you keep the device separate from any other magnet device you might also have.

5.3 Maintenance

Routine cleaning needs to be performed every so often when it seems necessary. To clean the fidget tool the user will have to separate the top half from the bottom half of the fidget cube and use a q-tip or pipe cleaner to remove any debris from inside. This is important to do because sometimes debris could get inside and restrain the function of some of the components. Most of the cleaning for the outside can be done with a cloth or any normal type of cleaner. It is important that the users refrain from eating food with many crumbs while using the fidget tool because it can lead to pieces getting stuck within the fidget tool.

5.4 Support

If there are any issues met with Solidworks that aren't answered in this manual answers can be found on the Solidworks forums where Solidworks themselves provide help with their software.

https://my.solidworks.com/support

If there's not an answer provided at the source above, Solidworks also has a forum where questions can be posted and get answered by professionals.
https://my.solidworks.com/forums

If there are any issues with the 3D printing software Ultiamaker Cura that aren't answered in this manual, assistance can be found on Ultimakers support website.
https://support.ultimaker.com/hc/en-us

If there's not an answer provided at the source above, Ultimakers also has a forum where questions can be posted and get answered by professionals.
https://support.ultimaker.com/hc/en-us

Another place where help can be found is on youtube but this should only be used as a last resort as it can often be wrong or dated.

6 Product Documentation

6.1 BOM (Bill of Materials)

Down below we have a breakdown of all the materials we used for the production of this device. As uOttawa students, we were fortunate enough to be able to use the 3D printer for free and not have to pay for any filament use. When reproducing this device you don't necessarily have to use a certain type of filament, the only requirement is that it is suitable for the printer you are using. 3D filament also comes in many different colours so you will have many different options. In addition, the magnets we used were a perfect fit for the dimension of the main cube since all pieces were pretreated with a hole to fit the magnet inside and they were then glued in place to ensure extra security. Any type of magnet can be used; it is just essential that the dimensions stay consistent to ensure a proper fit. The key set was then used but since the resistance was not up to our clients' needs we had to replace it with scrap springs that we found around our house. Unfortunately, we were unable to include textures in our final design but we were able to find some 3D printer scrap that incorporated a great honeycomb texture that can be used in the future. Furthermore, the rubber wheels were never incorporated so we were able to return the items because initially we were planning on using them to secure the magnets in place but instead we realized by simply dimensioning the cube differently and gluing it in place the wheels were not needed.

Magnets - https://www.amazon.ca/DIYMAG-Multi-Use-Refrigerator-Magnets-Industrial/dp/B07WCN5FGD
Gorilla glue - https://www.amazon.ca/Gorilla-7805201-20g-Super-Glue/dp/B07W47FCSR/ref=sr_1_7?crid=1QFAEVUA0HUF6&dchild=1&keywords=strong+glue+for+plastic&qid=1633370133&sprefix=strong+glue+%2Caps%2C180&sr=8-7
10mm rubber wheels - https://www.amazon.ca/ONLYKXY-Pieces-Rubber-Silicone-Elasticity/dp/B08HGS6FJP/ref=sr_1_26?dchild=1&keywords=10mm+rubber+bands&qid=1634757556&sr=8-26
Key tester set - https://www.amazon.ca/dp/B0933FXH29/ref=sspa_dk_detail_3?psc=1&pd_rd_i=B0933FXH29&pd_rd_w=N4rMO&pf_rd_p=a2b32c5b-02b0-4273-a3c7-c6bfabb067a2&pd_rd_wg=o6FmF&pf_rd_r=0S5J5JZP07Y6CJEDV4Q0&pd_rd_r=5b9701f8-4ce2-4b4b-b178-bbb4ddc129dc&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUExTU9GMFhaRDVJSU5RJmVuY3J5cHRlZElkPUExMDI0ODMwMVc1U0RaRExMTlQ1QSZlbmNyeXB0ZWRBZElkPUEwODY5NjUwUEwzTEFaU1hDQUdaJndpZGdldE5hbWU9c3BfZGV0YWlsJmFjdGlvbj1jbGlja1JlZGlyZWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ

Table 2. Bill of materials

Item number	Part Name	Description	Quantity	Unit Cost	Extended Cost
1	3D printer filament	1kg/2.2lb(250gx4), 0.25kg/spool	1	Free	N/A
2	Magnets	6 x 3 mm	100	$11.99	$13.55

3	Gorilla Glue	0.71oz/20g	1	$8.48	$9.58
4	Scrap metal	Small pieces from MTC	5+	Free	N/A
5	Sample textures	Small pieces from hardware stores	5+	Free	N/A
6	10mm rubber wheels	10mm	8	7.99	9.03
7	Key tester set	Keys with different resistance	12	18.73	21.16
					$53.32

6.2 Equipment list

During the development of our fidget tool the main equipment used is all listed in the figure below. It is essential that you have access to a 3D printer because the main base of each piece of the unit is all printed. Prior to printing, all models were initially designed on Solidworks so you will need to have access to a computer to input all of the data to send to the 3D printer. Any CAD software will work so Solid Work does not necessarily have to be used. All in all, with these two pieces of equipment you will be able to complete the main portion of the manufacturing process.

Table 3.Equipment List

Equipment List
CAD Software
3D Printer

6.3 Instructions

The first step you will need to take when recreating this project is downloading a CAD software. We used Solidworks, but any other CAD platform will suffice. For each unit, we design a special inner structure that can then be slid into the universal platform. By doing this, we are able to give each unit a unique function. To create the first cube, the button cube, you will need to follow the dimensioning shown below in Figure.9 to create the base of the part. The support and casing cover can be printed out following Figure 11 and 10. Once these parts are printed out the

two keys (that were in bought from the BOM), will be inserted into the inner support that are on the base. Once the keys are in you can put the cover on and place the inner support into the universal casing. Now you will need to take 8 magnets and glue them along the sides where there are openings for them.

Figure 9. Universal Casing

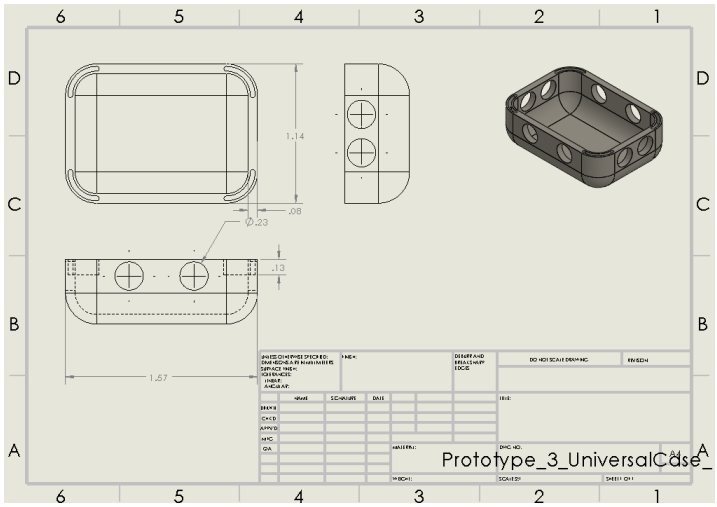


Figure 10. Inner Support for Key

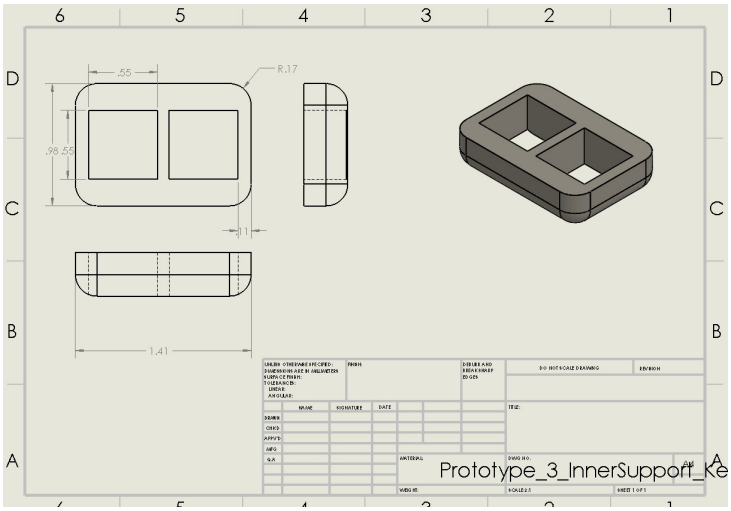
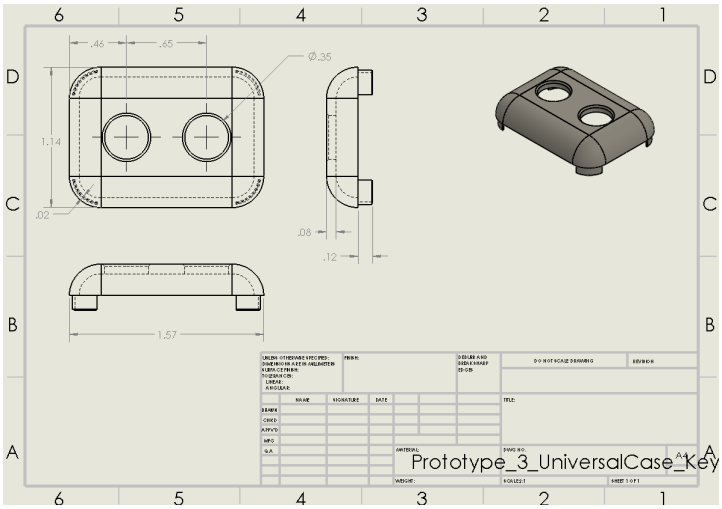


Figure 11. Casing for Keys



For the second cube, the switch cube, two bases will be needed to be printed which can be found in Figure 9 and 12. The case covering and the switch can be made following Figure 13 and 14. Once these parts are printed, the base of the switch cube will be placed into the universal casing. Two magnets will then be glued onto each end of the switch part and additional two magnets will be glued onto the base. Now, like the first cube, glue around 8 magnets on the outside of the base where the openings are present on the universal casing.

Figure 12. Base of Switch Cube

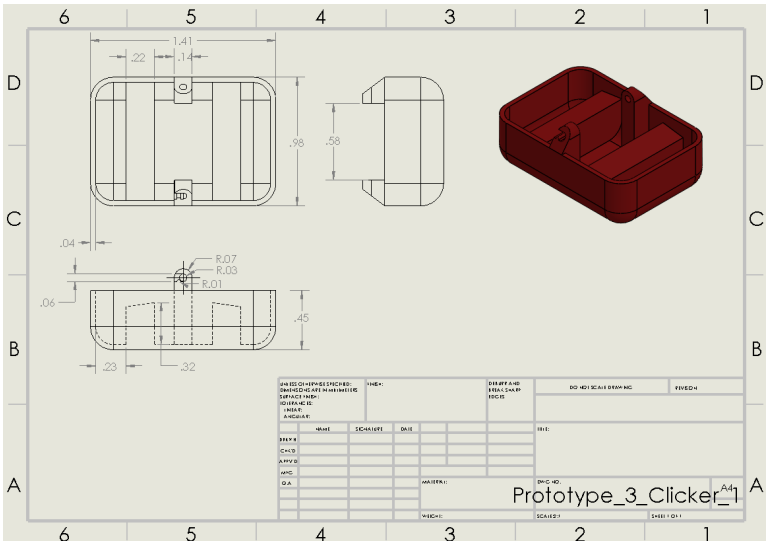


Figure 13. Switch Part

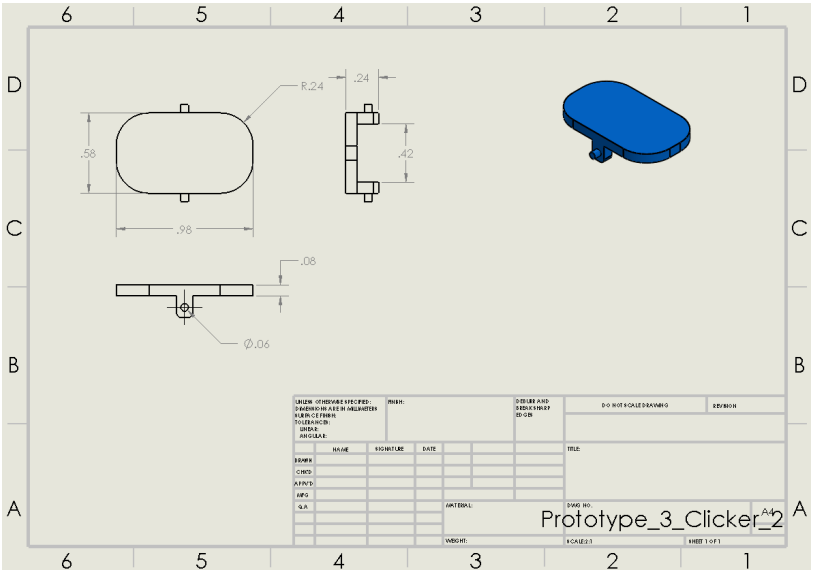
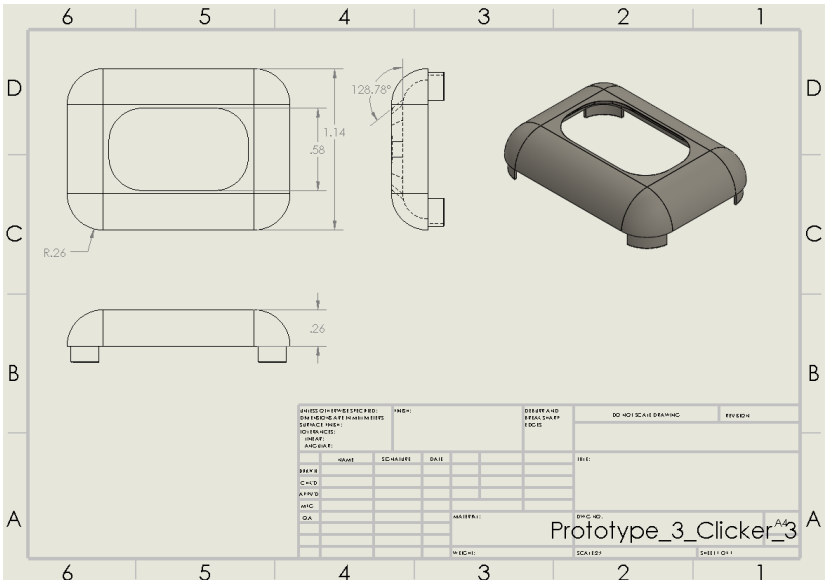


Figure 14. Casing of Switch Cube



For the third cube, the roller cube, follow dimensioning on Figure 9, 15, 16, and 17 to print out all parts correctly. Once all the parts have been printed out glue the flat ends shown in figure 16 and 17 together. Once those parts are glued together place them into the divots that are on the side of the casing and ensure that when the casing is placed onto the base that the divots all line

up. You will know that the casing is secured if it makes a clicking sound when closed. Once the parts are all together take 8 magnets and glue them all along the exterior of the universal casing.

Figure 15. Case for Roller Cube

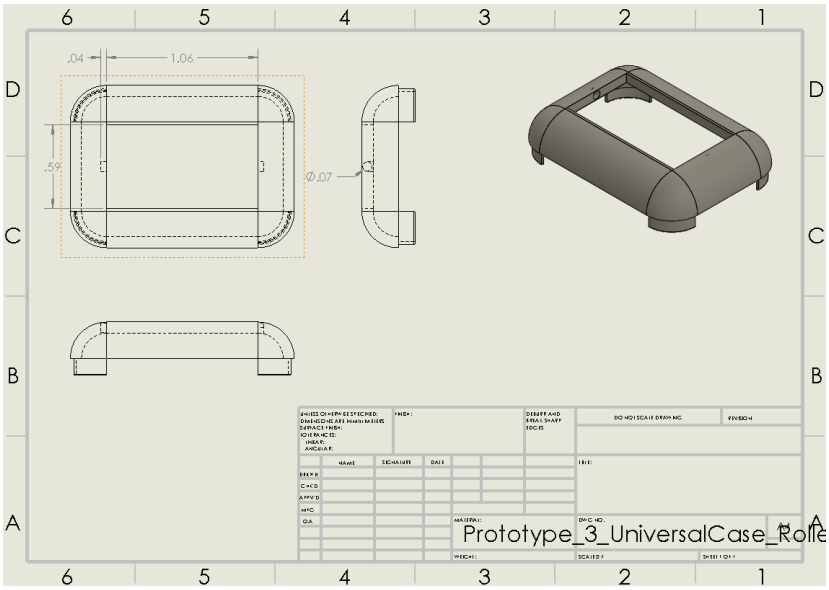


Figure 16. First Half of the Roller

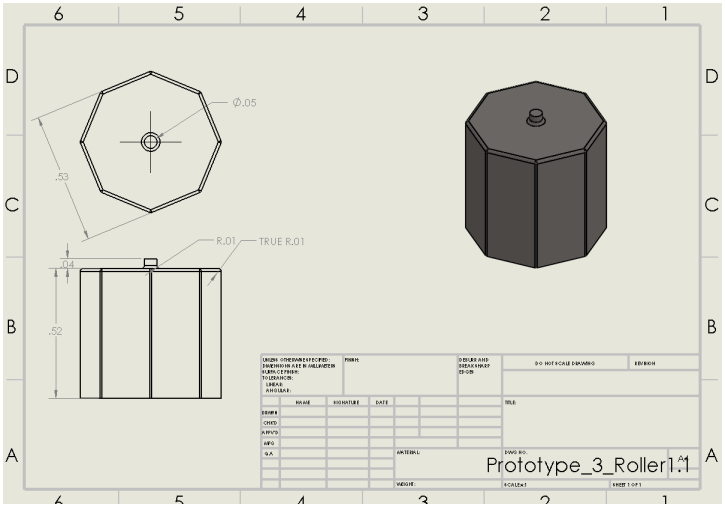
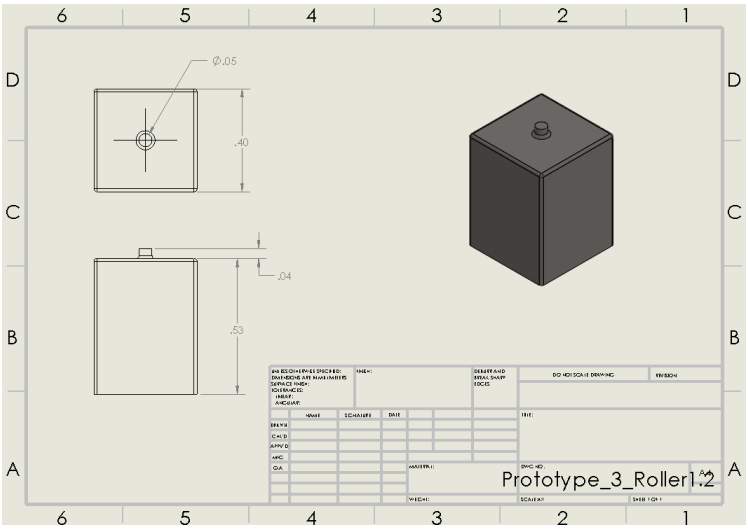


Figure 17. Second Half of the Roller



For the final cube, the fidget spinner cube, follow figures 9, 18 and 19 and print out all the parts. You will need to print out both figure 18 and 19 twice. To assemble this part connect glue together both parts that have the flange of the two figure 18 parts that were printed. That part will then slide through the hole of the figure 19 part. The casing will then be used as the top and bottom part of the tool and can then be placed into the universal casing. Once those parts are together, again like the previous components, glue 8 magnets all around the outside of the base.

Figure 18. Spinner Part of Fidget Spinner Cube

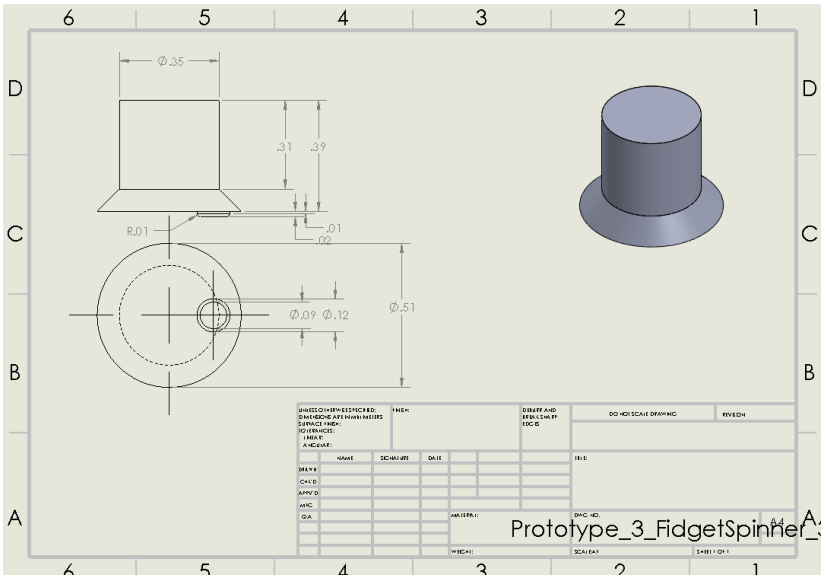
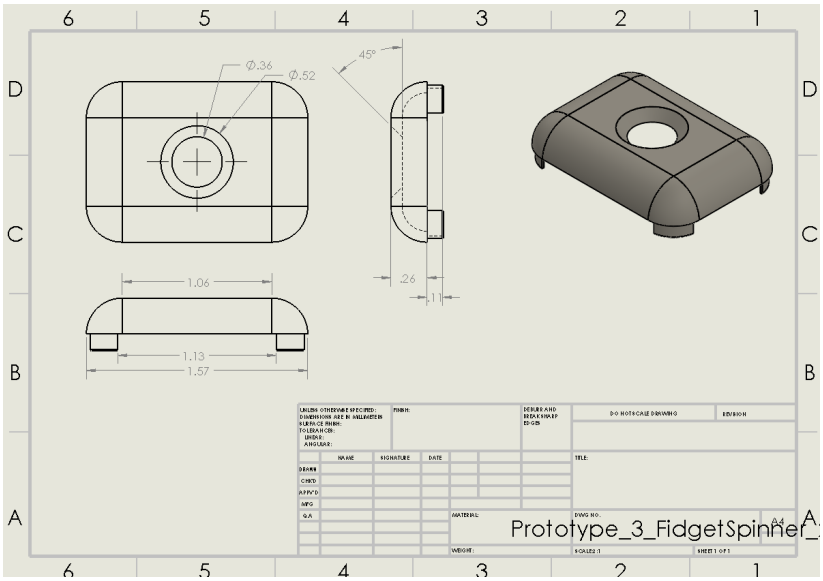


Figure 19. Casing of the Fidget Spinner Cube

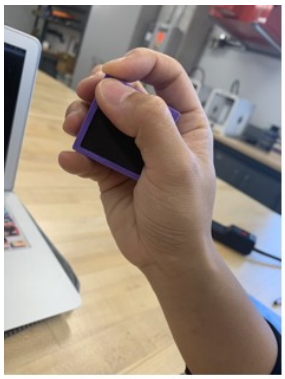


Now that you have all your parts you are able to connect them all together or use them individually.

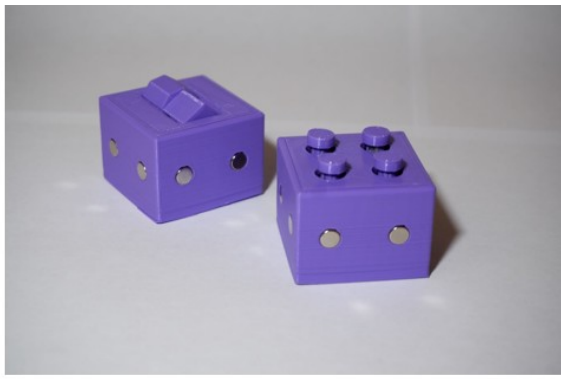
6.4 Testing & Validation

For the testing of the product, the group provided our client with the prototypes that we created. Our main method of testing was by getting different individuals to try out our prototype and give feedback on the shape, size, and function of each part. Having the client feedback was very helpful in terms of improving the product. Since our product was specifically tailored for our client the feedback that we received from them was what we implemented when making updates to our prototype. From the feedback/data we collected, we noticed some improvements that we can make. (1) Our product has sharp edges. To fix that, we changed the degree of fillet in order to achieve a smoother edge. (2) The size of our product was slightly too big to fit our client's hand size. To fix this, we redesign the case into a smaller fit, also at the same time redesigning the inner structure to suit the newer designed casing. In addition to getting our client to play with the device, we also did drop tests to ensure that our product was durable. From the drop test, we noticed the importance of ensuring that all magnets were glued in properly to prevent them from falling apart easily.

Figure 20. Testing Methods



The grabbing gesture our client prefers



Our original product with sharpe edges and oversize design

Our newer designed product with rounded edges and smaller fits

7 Conclusions and Recommendations for Future Work

As a group, we are beyond proud of the final product accomplished in just a couple of months of working on this project! With that being said if we were to have a few more months to work on this there are definitely a couple of other features that we would like to see incorporated as well. To start, one of the many features that our client wanted this tool to have is different variations of textures which unfortunately did not make it into the final design. Initially, we had incorporated a soft rubber-like texture which our client did not fully enjoy so we decided that we would reconvene as a team and come up with a solution for that but since there were many other aspects we had to make changes to we decided to abandon that idea and spend our time on the bigger concerns such as size, shape, and resistance of components. The goal was to have a fidget component on the top of each individual cube and some sort of texture on the base. With that being said, a variety of different textures would be a great addition and really make the design prototype stand out. In addition, it would be ideal if the colour of the overall unit was changed to a less stand-out colour such as grey, white, or black. Due to the fact that our client spends the majority of their time in a professional setting, they wanted this device to be able to blend in and not stand out since fairly bright colours can resemble a childrens' toy.

Many important lessons were learnt during the design process of this tool and we hope that other groups reading this user manual can learn from us to further develop our work. To begin, our client was very generous and gave us a lot of freedom with incorporating our own design ideas into the final design but unfortunately that lead to our group having some difficulty when trying to conceptualize different designs. We recommend that in the future all group members put a set time on how long they want to spend on conceptualizing different features. When the design conceptualization period is complete, a concrete decision should be made and no switching back and force on designs should be done once the manufacturing process has started. With that being said never rush the initial design phase because that is where you will weigh your different options then finally land on a feature you want to pursue. With many ideas at hand, we found that once we were manufacturing our fidget tool we still had many ideas so sometimes we got confused on what we wanted to do which then led to us wasting a lot of time. In addition, a big setback we faced was when working with the 3D printers. It is important to note that 3D printing takes quite a bit of time so before you commit to printing anything out it is essential that every piece is dimensioned preciously. Unfortunately, we initially didn't dimension a couple of pieces correctly so we found ourselves back in the lab printing out the same piece but with different dimensions multiple times to get all the pieces to fit together properly. In addition, ensure that all parts of your 3D printer work properly because a situation arose where the fan that cools off your piece while printing had stopped running so the object printing out had started to drop and lost a big part of its shape. This lead to us spending additional time printing out pieces that didn't come out properly. All in all, it is important to add as much variation as possible to keep this tool as stimulating as possible for the user.

APPENDICES

8 APPENDIX I: Design Files

Table 4. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
HGB2 Fidget	All document deliverables and CAD drawings can be found in our Makerepo	November 29th, 2021