Analog Thumbstick
DESIGN RATIONALE

Makers Making Change
A Neil Squire Program

Introduction

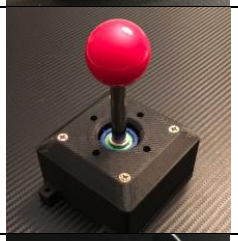
There is an identified need for cost-effective analog joysticks that can be used with the Xbox Adaptive Controller (XAC). There are currently not very many commercial joysticks on the market, and the ones that are can be costly. A joystick is required to play several games using the XAC as many users find it too challenging to use 4 switches as the alternative. This joystick is intended to be used with the XAC for anyone who may find it easier to game with a joystick.

Research

Commercial Joysticks:

Name	Price	Link	Picture
Ultra-Stik	95 UK	Accessible Gaming Shop - Ultra-Stik - OneSwitch.org.uk	
XAC MINI Stick	105 UK	XAC Mini Joystick - OneSwitch.org.uk	
Optima Joystick	219.60 UK	Optima Joystick - Video Gaming Assistive Joystick (pretorianuk.com)	
PDP One-Handed Joystick for Xbox Adaptive Controller	Out of Stock	PDP One-Handed Joystick for Xbox Adaptive Controller (microsoft.com)	
XAC Flat Thumbstick	$74.95	XAC Flat Thumbstick (evilcontrollers.com)	

DIY Joysticks:

Name	Price	Link	Picture
MINISTIX-TU	$75	MINISTIX-TU (USB Version) — Warfighter Engaged	
DPAD-T	$65	DPAD-T — Warfighter Engaged	
JOYSTIX-FPS	$75	JOYSTIX-FPS — Warfighter Engaged	
JoyCon® Style Joystick For XBOX® Adaptive Controller & PC (JoyToKey)	$60.40	Joycon® Style Joystick for XBOX® Adaptive Controller & PC | Etsy Canada	

Requirements

Goals

G01	To design a joystick compatible with the Xbox Adaptive Controller.
G02	That the joystick is cost effective.

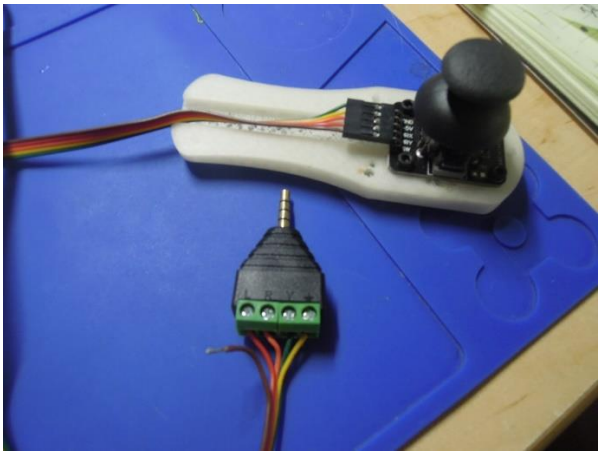
Functional Requirements

F01	That the joystick could accommodate different shaped toppers.
F02	The joystick should be able to be used with a low activation force
F03	Keeping the height of the base of the joystick to a minimum.

Ideation

Joystick

The inspiration for this device came from one of Ron Nelson's joysticks online. The joystick shown below is compatible with the Xbox Adaptive Controller. As you can see, this joystick is mounted in a 3D printed nun chuck shape housing. For this project, it was decided to expand on Ron's joystick design and design a rectangular 3d printed housing for the joystick so it would be able to lay flat on a surface easier and could potentially be used with Velcro.



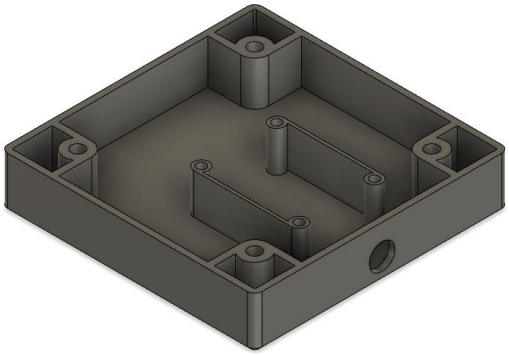
Joystick Topper

The inspiration for having a U-shaped topper for the joystick came from one of the participants in our Adaptive Gaming Pilot Project. This participant uses a similar shaped topper on the joystick that operates their wheelchair and thought it would be beneficial to them. They mentioned that the thumbstick topper being used for our joystick would be too small and difficult for them to use. Rather than designing one from scratch, it was thought to modify one that currently exists to fit the required joystick.

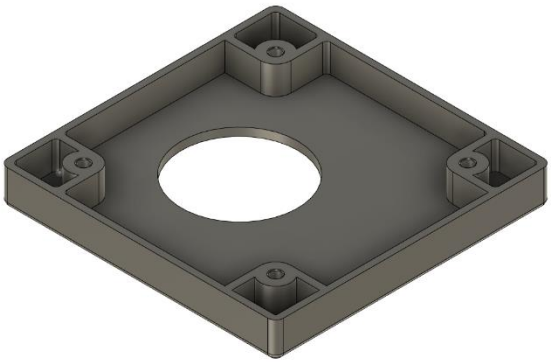
Conceptual Design

Joystick Housing

The initial concept for the joystick housing was to design a rectangular 3D printed housing to mount the joystick in. It was decided to print the housing in two pieces to eliminate the need for printing with any supports. The two halves are attached together using four #4 1/2" screws – one in each corner. There are walls connecting the screw holes to the outside edge of the housing for reinforcement. Four of the same screws are also used to attach the joystick to the centre of the housing base. The biggest flaw in the first design was that the two walls in the middle of the base that were holding up the joystick snapped off once the joystick was screwed in. This was partially because the screw holes were initially too small, but more likely because there was no support perpendicular to the direction of the wall. The walls were thin and broke very easily when any rotational force was applied.



Bottom



Top (flipped over)

Joystick Topper

It was thought to modify the joystick topper shown below, which was designed by EgonHeuson. The goal was to modify the base of the topper so that it was compatible with the joystick used.

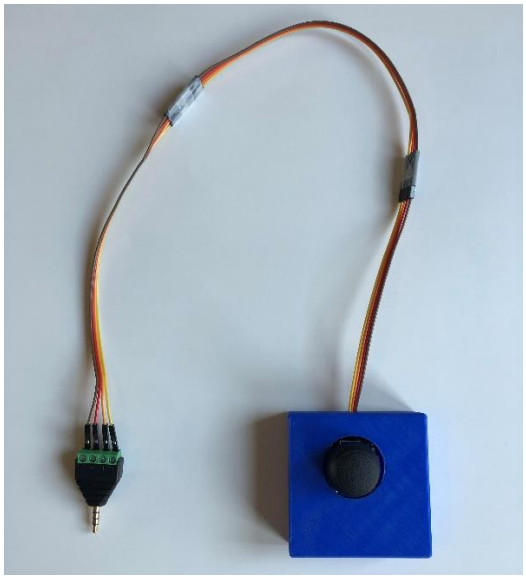
Prototyping

Prototyping was used to make sure the joystick was centered with the hole in the top of the housing. Initial prototypes identified that the joystick needed to be slightly moved to achieve this. Prototyping was also used to determine how tall the housing must be to fit the 1/2" screws. Initial prototypes had the screws slightly poking up into the top of the housing, so adjustments were made to fix this. Prototyping was also used to determine an appropriately sized hole in the base for the wires to go through.

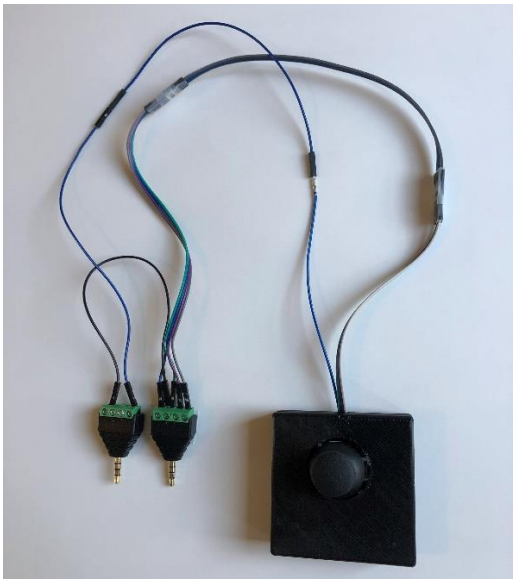
Detailed Design

The analog thumbstick used in this project is compatible with the Xbox Adaptive Controller. There are 2 different versions of the joystick offered: one with the “press down” option (1), and one without (2). The press down function on the joystick is activated by pressing down on the top of the joystick. This function is used in some games, but not most. For this particular joystick, it requires a moderate amount of force to do so. An alternative to using the press down function of the joystick would be to map that function to a different switch. It was decided to offer both versions of the joystick as it is an easy add on if requested by the user.

1. Analog Joystick without Pressdown Feature



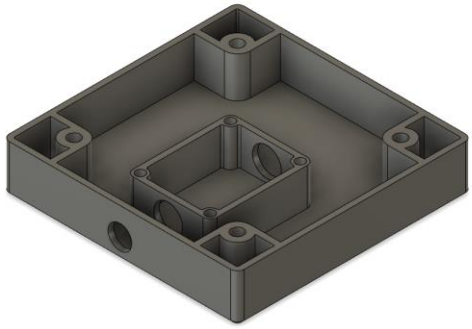
2. Analog Joystick with Pressdown Feature



The housing for the joystick was designed in 2 parts: the top and the base. This model is fairly similar to the enclosure previously described in Concept One. The following were key improvements that were made between iterations of 3D printed enclosures:

- Increasing wall strength where the joystick gets screwed into.
- Optimized the joystick hole size and joystick positioning to align with this hole.
- Modified the height of both 3D printed pieces to work with the 1/2" screws used to hold the enclosure together.

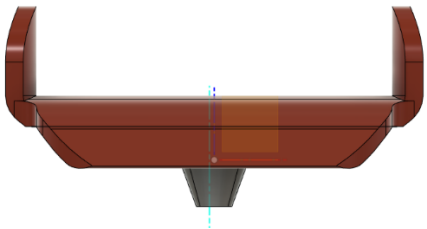
Bottom



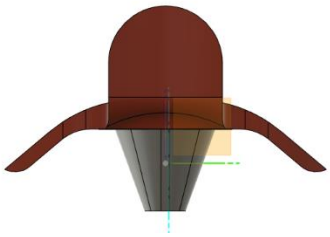
Top

Joystick Topper

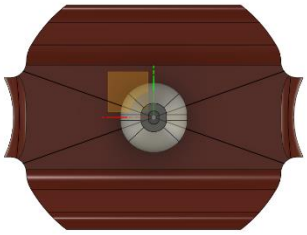
The U-shaped joystick topper was designed by modifying the base of the original joystick topper by EgonHeuson. The joystick topper was modified by adding a new base to it that would connect to the PS2 joystick used in this project.



Front



Side



Bottom

Testing

The joystick was tested out by plugging it into the Xbox Adaptive Controller and connecting wirelessly to a computer. The online Gamepad Tester was used to test all the functions of the joystick. This could also be done by using the Xbox Adaptive controller on a gaming console and using the joystick to navigate the window.

Opportunities for Improvement

- Minimizing the height of the joystick base.
- Snap fit between joystick top and base.
- Making the base more easily customizable (ex. possibly adding switches right into the base).
- Adding additional joystick toppers.