Deliverable F: Prototype I and Customer Feedback

Maysam Jaber 300297879

Rachelle Kim Salazar 300201500

Charlie Tourangeau 300398298

Nick Mesquita 300361908

Introduction

For the first prototype, the 3D printing of the jig and cut-out template was executed using a 0.8 mm nozzle due to the delicacy of the teeth. The jig was printed in two separate halves since the 3D printer was insufficiently large to accommodate the entire length of the jig. The union of these two parts was facilitated using duct tape. Testing of the jig involved its placement in various door widths. The cut-out template underwent testing by being inserted into the jig with different increments of the teeth to assess the smoothness of placement. The screw clamps were also 3D printed; however, they were short and loosely fitted, preventing comprehensive testing.

The objective of this deliverable was to enhance the prototype based on the obtained results. For the second prototyping, a bevel will be added to the top of the jig. Since the template performed effectively in the first prototype, it will be retained for the second iteration. The screw clamp will be 3D printed again, this time with increased length and a tighter fit. Rubber pads will be introduced for the screw clamp to evaluate its efficiency without causing dents to the door. The screw clamp will be tested by tightly clamping onto the door, ensuring a secure hold without causing any dents. The jig will be shaken aggressively to assess its stability and check for any signs of movement. This test will be performed on as many surface thicknesses as possible.

Analysis of Components and Systems

For prototype 1, we elected to construct our prototype out of plastic, through 3d printing. The setup time of our current components is very low, given that this prototype solely includes the cutout plate and does not have a fully functional fastening system as of yet. Critical systems include the cutout plate and the fastening system. In later prototypes, the fastening system will be made of metal, the threaded rod, the exact type of which is currently unknown. Additional plastic parts will be used for both ends of threaded for ease of use, and for force distribution.

Prototype 1 Test Results

Test 1

When making the prototype, the screws of the 3D-printed model were too small for the holes in the frame. To perform the test, we used a pre-existing hinge jig that one of the group members already owned as it used a similar screw clamp fastening system as our design. The purpose of testing the setup time was mostly concerned with the time it takes to fasten the jig to the door, so using the hinge jig seemed to be an appropriate substitute for the test. Three timed tests were conducted. the starting position of the screws became further with each test. The times collected are 15.81 seconds, 25.97 seconds, and 28.9 seconds. The test results show that the screw clamps allow for an efficient setup.

Test 2

This test was performed using the hinge jig as a substitute to allow the group to observe the performance of screw clamps. Test 2 and Test 3 were done together by clamping the jig to the side of a table. The observations from the test showed the fastening process can be completed smoothly and both hands can be used to fasten the jig more efficiently.

Test 3

Test 3 was done by having a team member pull and shake the jig that had been fastened to the side of a table. During this test, the table moved while the jig remained firmly attached. The results of the test show the screw clamps are capable of creating a secure attachment onto the door.

Test 4

This test was performed using the 3D-printed model. It was done by having a team member put the cutout plate into place. During the test, the cutout plate snapped into place. This demonstrates that the cutout plate is easy to install.

Test 5

Test 5 was done on the 3D-printed model. The test was performed by placing the jig with the cutout plate inserted sideways and pushing on the cutout plate. while conducting the test, the cutout plate did not move. This shows that the cutout plate is secure in the jig.

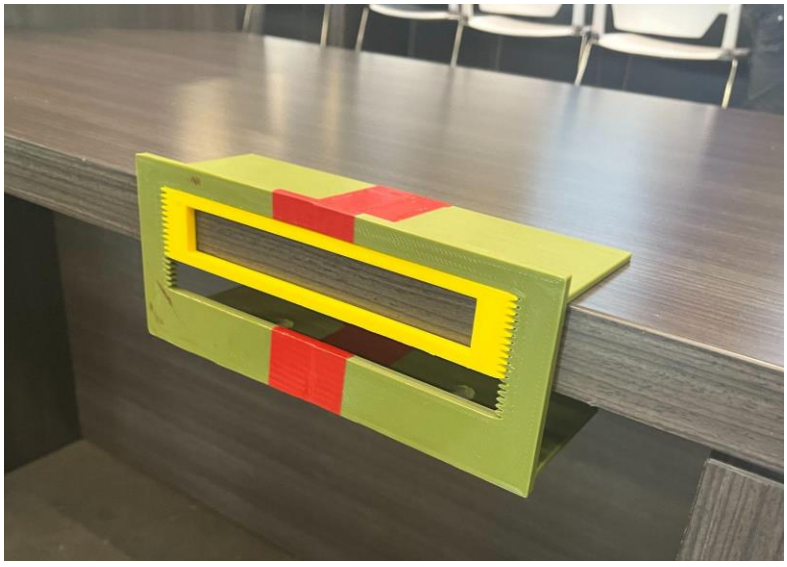

Figure 1. 3D Printed Model

Figure 2. Hinge Jig

Customer Feedback

Customer feedback included comments on the size of the main jig body, as well as the lack of a fastening system. Initial client feedback included adding a beveled edge to fit with doors better, as well as increasing the surface area of the connection point between the fastening system and the veneer of the door to reduce possible breakage. These will be taken into account for the following prototypes.

Revision of Specifications, Design, and BOM Following Test Analysis

The size of the main jig part needs to be adjusted to accommodate the cutout plate more comfortably, as its current size is too tight for proper fitting. Additionally, longer screws, whether printed or purchased, are required to securely fasten the jig. Finally, the second prototype will include a beveled edge that matches that of the doors at AMBICO.

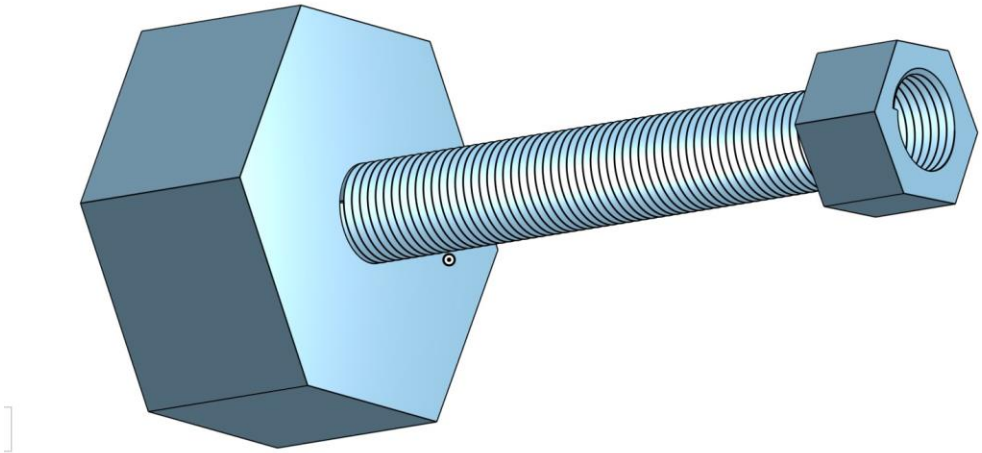

Figure 3. Proposed CAD Design for Jig Screws

The figure above displays a potential jig design intended for use during the second prototype test. This design was developed by our group, incorporating precise dimensions tailored to accommodate our specific needs and requirements.

Table 1. Bill of Materials Spreadsheet

BOM			
Part	**Quantity**	**Cost ($)**	**Provider**
First 3D-printed half of the jig	1	0	Makerspace
Second 3D-printed half of the jig	1	0	Makerspace
3D-printed cutout plate	1	0	Makerspace
3D-printed screws	2	0	Makerspace
3D-printed screw nuts	2	0	Makerspace
Duct tape roll	1	1.41	Dollarama

Second Prototyping Test Plan

Table 2. below outlines the series of tests to be conducted on the second prototype, along with the corresponding measurements of results and related information.

Table 2. Prototyping Test Plan for the Second Prototype

Test ID	Test Objective (Why)	Description of Prototype Used and Basic Test Method (What)	Description of Results to be Recorded and How These Results Will be Used (How)	Estimated Test Duration and Planned Start Date (When)
1	Test setup time of the prototype. The test will allow the team to: -Learn the approximate setup time for the current design. -Determine whether improvements need to be made to the product's efficiency. -Communicate the efficiency of the design with the client to receive feedback. This test is designed to determine whether the jig is efficient enough for the	The second prototype will be utilized for this test. Prototype #2 represents an improved version of prototype #1, featuring enhancements such as functional screws and a better fit for the cutout plate. Additionally, it incorporates a beveled design in the jig to accommodate the beveled door edge. The setup time will be assessed by having one person handle the jig as a user would, while another person records the time it takes for fastening/tightening the screws onto the door and correctly placing the cut-out plate at the designated	The results of this test consist of the time taken to set up the jig at various door thicknesses. These results will be averaged to determine if they fall within the minimum time limit required to ensure the jig remains efficient. This will determine whether the jig needs further optimization for the final design.	The planned start date is March 6, 2024, and the test should not exceed 30 minutes.

	user and identify any necessary fixes for the final design.	increment for the door thickness used in the test. The test will be performed on various door thicknesses.		
2	Test how the fastening system operates. The test will allow the team to learn about any unforeseen issues with operating the current design or the areas where the design needs improvement. This test is designed to check the functionality of the fastening system's design.	The main subsystem that will be tested is the screws. To evaluate the performance of the fastening system, the screws will be tightened and loosened multiple times across varying door thicknesses.	The recorded results include assessing the smoothness of tightening and loosening the screws, along with evaluating the tightness of the screws to the jig. Analyzing these results will enable us to decide whether new screws need to be 3D printed or purchased to enhance the reliability of the jig.	The planned start date is March 6, 2024, and the test should not exceed 5 minutes.
3	Test the reliability of the fastening system. This test is designed to check the fastening system's ability to keep the jig secured to the door	The main subsystem that will be tested is the screws. The reliability of the fastening will be tested by tightly clamping the screw onto the door, ensuring a secure hold without causing any dents. The jig will then be shaken aggressively to assess	The recorded results consist of observations regarding whether the screw remains tightly secured and does not damage any surface during the test. it will also assess if the screw works for all the required	The planned start date is March 6, 2024, and the test should not exceed 20 minutes.

		its stability and check for any signs of movement. This test will be performed on as many surface thicknesses as possible. One team member will be responsible for taking notes on the observations from this test.	door thicknesses. This test will enable the team to determine if any changes need to be made to the screw subsystem.	
4	Test how the cutout plate operates. The test will allow the team to learn about any unforeseen issues with operating the current design and/or the areas where the design needs improvement. This test is designed to check the functionality of adjusting the cutout plate.	The parts utilized for this test are the main jig part and the cutout plate. The functionality of the template will be tested by inserting it into various preset increments and verifying the accuracy of each increment. Additionally, the ease of placing the template onto the jig for each increment will be evaluated.	The recorded results consist of observations regarding whether the cutout plate smoothly goes in and out without being too loose and whether its dimensions are correct for all the necessary door thicknesses. This test will allow the team to determine if any dimension adjustments need to be made for the cutout plate.	The planned start date is March 6, 2024, and the test should not exceed 10 minutes.
5	Test the stability of the cutout plate. This test is designed to check the cutout plate's ability to remain in	The parts utilized for this test are the main jig part and the cutout plate. To test the stability of the cutout plate, a	The recorded results consist of observations made by a team member. These observations include whether	The planned start date is March 6, 2024, and the test should not exceed 5

	place.	team member will shake the jig while it is fastened to a surface. Another member will record their observations.	the cutout plate falls out of place or loosens while the jig is shaken by a team member. These observations will assist the team in determining whether any dimensions need to be modified.	minutes.
6	Test the reliability of the beveling of the jig. This test is designed to determine if the beveled design of the jig matches and accurately aligns with that of the beveled edge of the door.	The main part of the jig, excluding the cutout plate and screws, will be utilized for this test. To test this, first, the angle will be measured, and then the jig will be placed on a door with a beveled edge.	The recorded results for this test will determine whether the beveled edge of the jig accurately matches that of the door. Any observed differences or inaccuracies will prompt modifications to the beveled edge for the final design.	The planned start date is March 6, 2024, and the test should not exceed 5 minutes.

Conclusion

After assessing both the passed and failed tests of the first prototype, several changes have been identified for implementation in the second prototype. These modifications primarily involve fixing the design of the fastening system screws to ensure their proper functionality in securing the jig in place. Furthermore, adjustments will be made to resize the jig to perfectly fit the cutout plate. Additionally, a beveled edge will be incorporated into the jig design to accommodate the beveled edges of the client's doors.