GNG2101

Design Project Progress Update

Group B5.4

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Term	Acronym	Definition

Introduction

This document contains the IEDP applied to the design of a painting assist device for impaired individuals. It is aimed a further developing an existing design to optimize areas of complaint from our client.

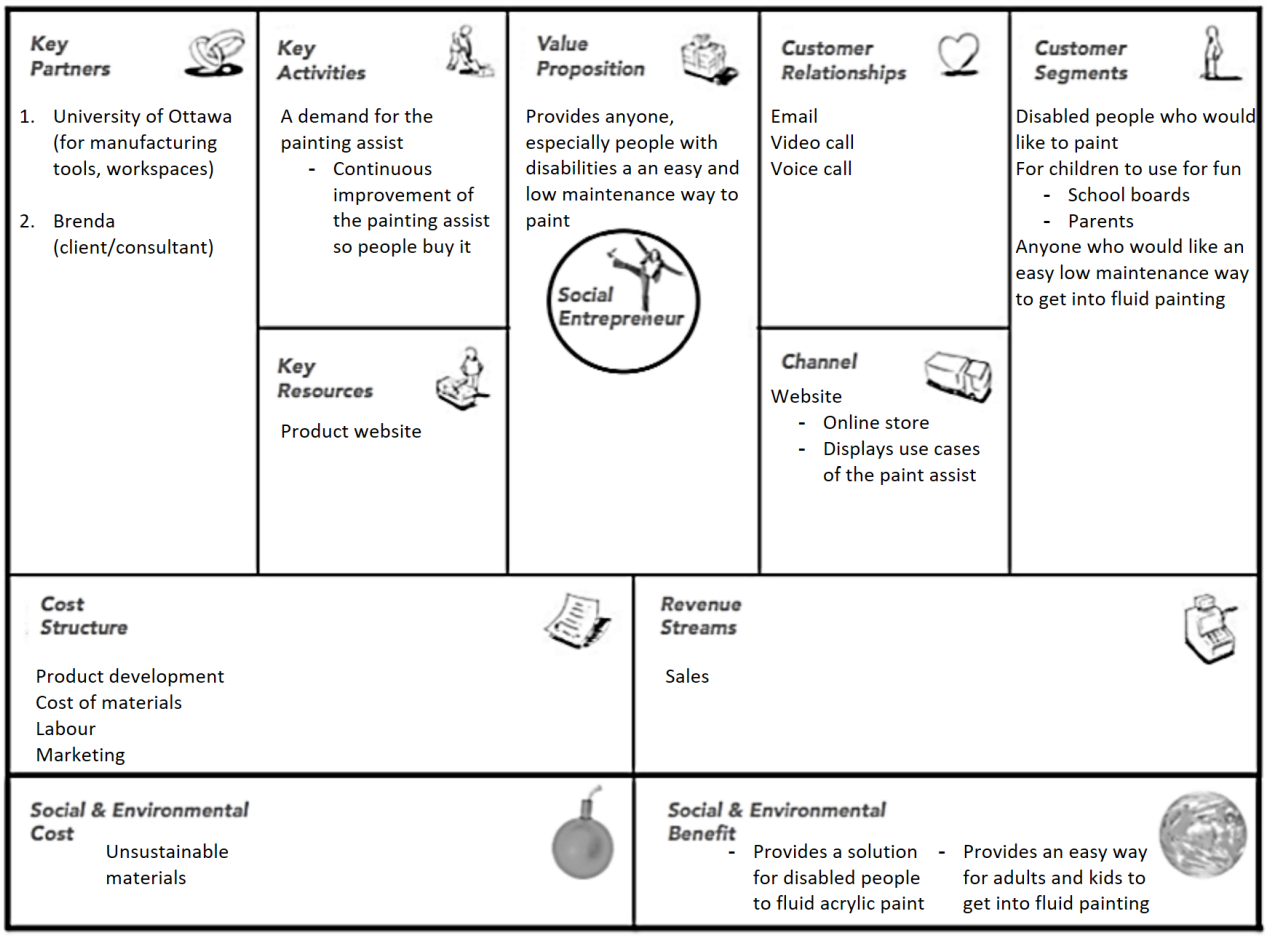
Business Model Canvas and DFX

1.1 Business model and sustainability report

1.1.1 Value Proposition

The Value proposition of our painting assist tools is it allows people with limited functionality on their arms or hands to be able to paint more freely and more easily with this tool. This product can also be used by kids and adults who have never done acrylic painting and give them a way to try it out without making it too complex for them and allowing them to open their eyes to new painting techniques. The impact this product will have been very beneficial to both parties as it gives people with disabilities who have struggles with doing acrylic painting by hand an opportunity to continue doing what they love without any major setbacks with the help of the painting assist tool. The beneficial impact it has for adults and kids is that it allows them to do acrylic painting for the first time with an easy pathway into this new type of painting as well as a cleaner way as the painter is not using their hands to move the canvas and instead using the joystick to control the movement of the acrylic paint. This product is special because the product cannot be found anywhere else in the market due to its nicheness. However, with the right marketing, not only can this product be marketed to people with disabilities, but it can also be marketed to first-time acrylic painters trying it for the first time as well as kids who are messy, it allows this product's value to increase by a significant margin.

1.1.2 Business Model Canvas & Key Assumptions



Key Assumptions:

1. The majority of customers will have limited mobility in their upper body so they are not able to paint without help.
2. We will be a for-profit organization with an online store where potential customers will be able to view the product and everything it can and can't do.
3. We have a direct sales business model where our only source of revenue is through sales.
4. The business would be based in Ottawa so we can still use uOttawa's resources manufacturing resources.

1.1.3 Sustainability Report

Positive Social Impact: Accessibility

The painting assist offers an alternative for people who have difficulties with fluid painting; they can now control the canvas using a joystick. This opens a lot of opportunities for both experienced and aspiring artists and promotes inclusivity within the art community.

Negative Social Impact: Technological Impact on Art Culture

While the painting assist is a useful medium to create paintings, it may create a technological divide within the art community. This includes the potential loss of traditional art skills as more people start using the device as well as bring up questions concerning the authenticity of the work if it was created through technological means. However, these do not take away from the overall growth of the community due to the inclusiveness the painting assist offers.

Positive Environmental Impact: Paint Conservation

The painting assist was designed with a component that can catch run-off paint, which allows it to be reused. Acrylic paint is non-biodegradable, and it takes a lot of energy to produce. While it is difficult to revive paint for future use, this will greatly increase its sustainability and will allow for less paint consumption.

Negative Environmental Impact: E-waste

The painting assist will need to be disposed of like e-waste, as most of its components are controlled electronically. E-waste consists of many hazardous chemicals that can enter the soil

and damage the environment if not handled properly, as well as being non-biodegradable. Proper disposal techniques are a must to limit the environmental impact this product will cause.

Positive Economic Impact: Reduce Unnecessary Alternative Devices

The painting assist will allow customers who require this device to paint the way they want using just our device. This will limit the number of alternative devices that people will need to purchase and hopefully replace them with just our device. Saving customers from purchasing multiple devices that don't work as well.

Negative Economic Impact: Increase in Consumerism

With acrylic flow painting being accessible to many more people, associated consumerism of products such as paint and canvases will increase causing an increase of such sales.

1.2 Design for X

1. Design for user interface: this device is designed to assist with painting for individuals who suffer from a range of disabilities that impact their ability to interact with the world. As such it is vitally important that our design maximizes easy of user interface, making it as simple as possible to interact with the device for as many people as possible.
2. Environment: our client values the environment highly and takes pride in doing her best to minimize her negative impact where possible. This device should be designed to have the minimal environmental impact possible. This will be primarily implemented through

minimizing waisted paint, and allowing runoff to be easily collected and potentially repurposed for art.

3. Tilt angle: our client has emphasized that one of the primary drawbacks of her current device is the deficient angle of tilt achievable as it does not allow her to produce the level of art she desires. As such the device should be designed to be able to maximize the achievable angle of tilt.
4. Can incorporate all canvas sizes: our client would like to be able to use large variety of canvas sizes and shapes for her art and as such our device should be designed to maximize the variety and size of canvases it can support.
5. Easy to maintain, low maintenance: our client has a helper who assists them with certain tasks, however they would like our device to require minimal maintenance and operate as easy as possible so she can do as much as possible on her own.

Problem Definition, Concept Development, and Project Plan

1.3 Problem definition

1.3.1 Client needs/problems & relevant knowns

Needs	Priority: 1 (least) to 5 (most)
Assistance with pouring paint onto canvas	1
Device should not move during operation	5
Should be able to accommodate up to 36”x48”	3
Should be able to accommodate canvases of different shapes & sizes (round, oval, rectangular, etc)	5
Should not require disposable batteries	5
Should be able to tilt minimum 45^{o}	5
Tilt should be very responsive to user input	4
Device should be able to spin canvas	2
Runoff paint should be easily collected	4
Moving/electrical parts should be protected	5

1.3.2 Problem statement

While the world of acrylic painting offers a creative outlet and a source of joy for many, there are significant barriers for individuals with limited arm or hand functionality. Existing tools and techniques often fall short in providing an inclusive and accessible experience, limiting the artistic expression of those with disabilities. Furthermore, introducing newcomers, especially children and

adults, to acrylic painting can be intimidating due to the complexity and messiness associated with traditional methods. These challenges hinder both groups from fully embracing and enjoying acrylic painting. Our objective is to address these issues by offering a specialized painting assist tool that caters to the unique needs of individuals with disabilities and provides an easy and cleaner entry point for beginners. By doing so, we aim to make acrylic painting an enjoyable and inclusive activity for a broader audience.

1.3.3 Inspired metrics & units

Metric	Unit
Minimum tilt angle	Degrees
Canvas size	In^2
Canvas weight	Kg
Canvas rotation speed	Degrees per second
Power usage	W
Maximum paint runoff	mL

1.3.4 Target specifications

Need	Unit	Marginal Value	Target Value
Minimum tilt angle	Degrees	35	45
Canvas size	Inch x Inch	24 x 24	36 x 48
Canvas weight	Kg	2	6
Canvas rotation speed	Degrees per second	180	360
Power usage	Watts (W)	70	35

Maximum paint runoff	mL	1115	2230

Target & Marginal Value Justification

Tilt angle: as indicated by our client she would like 35^0 minimum tilt angle for the device to allow exceptional fluid paint flow, as such 45^0 is our target specification. Our marginal value is 35^0, as this would reduce potential torque required from our motors but still allow adequate paint flow.

Canvas size: the client has requested the device be able to support canvas sizes up to 48”x36” as she would like to get into painting on larger canvas sizes and as such this is our target specification. Our marginal value would be to support sizes up to 24”x24”, as this would allow our client to continue with the size of canvas which she currently uses.

Canvas weight: this is tied to canvas size, as a larger canvas will weigh more than a smaller canvas. The target specification is for a 48”x36” canvas covered in paint and the marginal value is for a 24”x24” canvas covered in paint.

Canvas rotation speed: the client requested the possibility of being able to rotate the canvas with enough speed for the paint to move outwards towards the edge of the canvas. Her current painting assist does not have that feature so our design has to be benchmarked against other versions. From researching the minimum speed for the canvas to rotate for the desired effect is 180 degrees/second, although for the paint to move at a decent speed the ideal rotation speed is 360 degrees/second.

Power usage: The current paint assist the client uses has two stepper motors that each draw 17.5W totaling to 35W which is the target value. Ideally the power draw remains the same. The marginal

value is double the target value in case two extra motors are required to compensate for the additional weight of larger canvases.

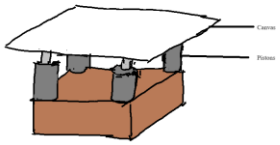
Maximum paint runoff: Because the client paints by tilting the canvas allowing paint to flow a large amount of paint flows off the canvas per painting session. Assuming a worst case scenario where the client is painting on a 3ft x 4ft canvas and the estimated height of the paint is 2mm. If all of the paint were to spill off the total volume would be 2230 mL which is the target value. The marginal value is 1115 mL which is half the target value.

1.4 Concept development

1.4.1 Sub-system concepts

1.4.1.1 Tilt Subsystem

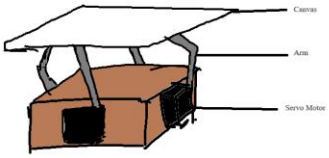
Pneumatic



- Uses pistons attached to the bottom of the canvas to change its tilt angle and height.
- Allows for smooth and precise control over motion, while also being durable and stable.

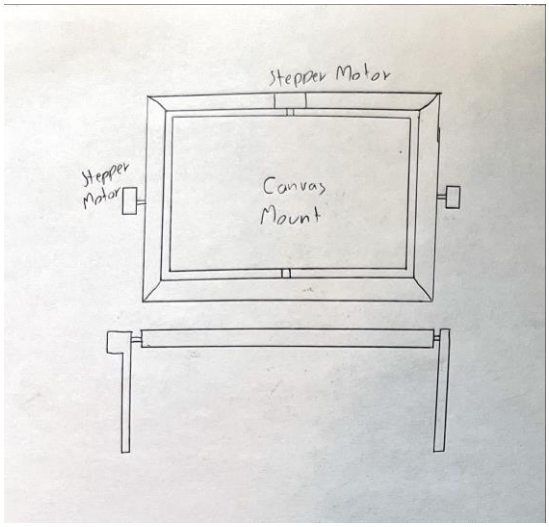
- The pistons being under the canvas would help protect the system from any run-off paint.

Servo



- Uses servo motors to control the tilt of the canvas.
- Servo motors typically offer sensors that can provide real-time position feedback, which helps ensure the canvas is facing the right way at any given time.
- Motors are energy efficient and offer high amounts of torque.

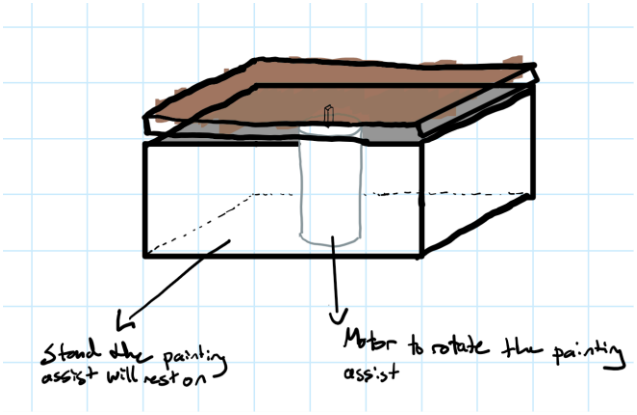
Double picture frame



- This concept places the canvas mount platform within an outside frame. The interior platform is connected to a stepper motor on the outer frame. The outer frame is connected to the base through another stepper motor.
- The combination of both motors allows the rotation of the canvas platform on both axes, allowing tilt in any direction.
- This system allows for maximal tilt angle as the tilt is a function of the motor angle.
- Downside is the frame will obstruct the view of the canvas.
- Responsiveness is limited by motor torque.

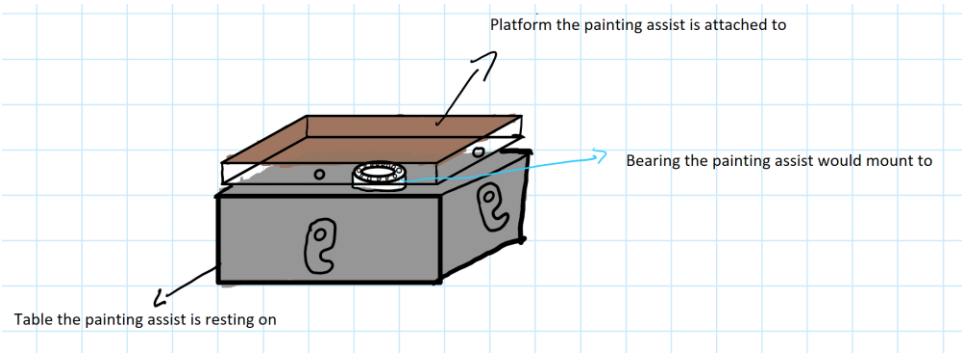
1.4.1.2 Rotation Subsystem

Double platform with motor



- The surface the painting assist is mounted on will be attached to a brushless DC motor.
- The motor is controlled by the same controller as the tilt assist.
- The motor will let the painting assist freely rotate at a high enough speed for the acrylic paint to move outwards towards the edge of the canvas

Bearing with support, assistant spins

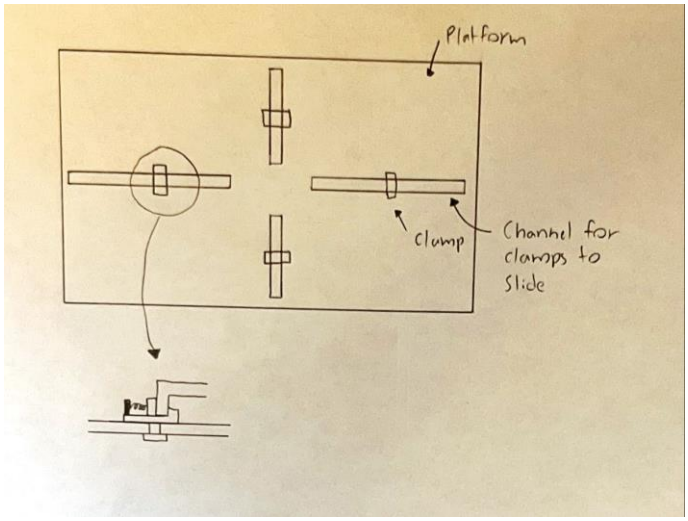


- The surface the painting assist is mounted on will be attached to a ball bearing which will be free spinning.
- The rotating platform the painting assist is attached to can be spun at a high enough speed by hand for the acrylic paint to move towards the edge of the canvas.
- The spinning platform and stationary platform have clips to prevent the painting assist from rotating when it's unwanted.
- Spinning the painting assist by hand provides more control than using a motor and a remote control.

1.4.1.3 Canvas Interface Subsystem

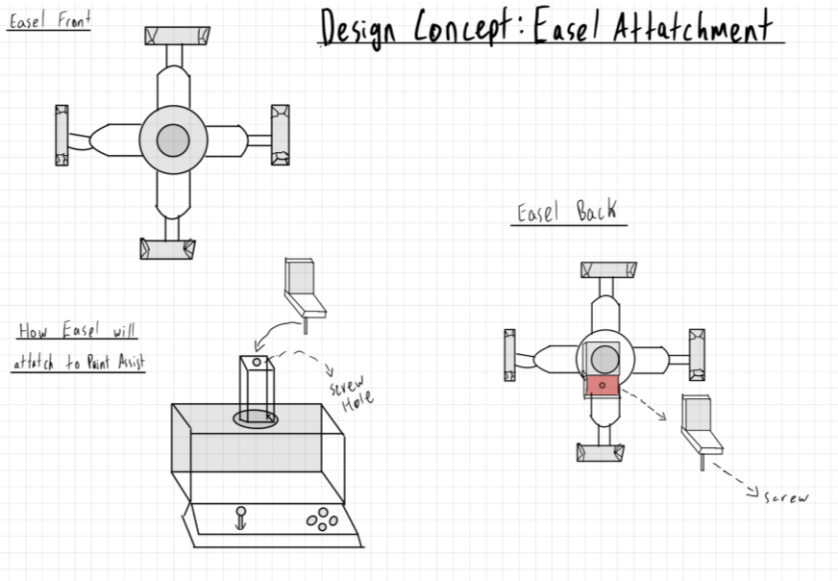
Peg

Floating clamp



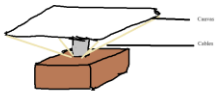
- Clamps glide in channel in the canvas platform. Vertical clamps attach to horizontal edges of canvas, horizontal clamps attach to vertical edges of canvas.
- Allows for interfacing with almost any shape and size of canvas.
- The downside is paint may slip through slot, and clamps/slot may get filled with pain rendering operation difficult.
- Cleaning may be difficult.

Easel attachment



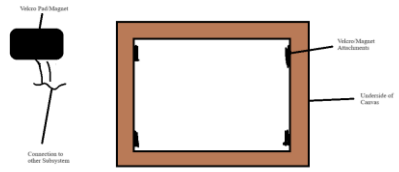
- Easy to attach to canvases of all shapes and sizes
- Easel has mobility function as well in addition to painting assist tool's motion
- Easel can be taken off easily by being unscrewed to make cleaning easier

Cable attachment



- Uses tension caused by cables to keep the canvas in place.
- Have secure connections and can evenly distribute force, while being flexible to allow for different shapes and sizes of the canvas.

Velcro



- Uses Velcro attachments to the inside of the canvas to secure the canvas to the paint assist.
- Easy to use and can be adjusted for a wide range of canvas shapes and sizes.

1.4.1.4 User Interface Subsystem

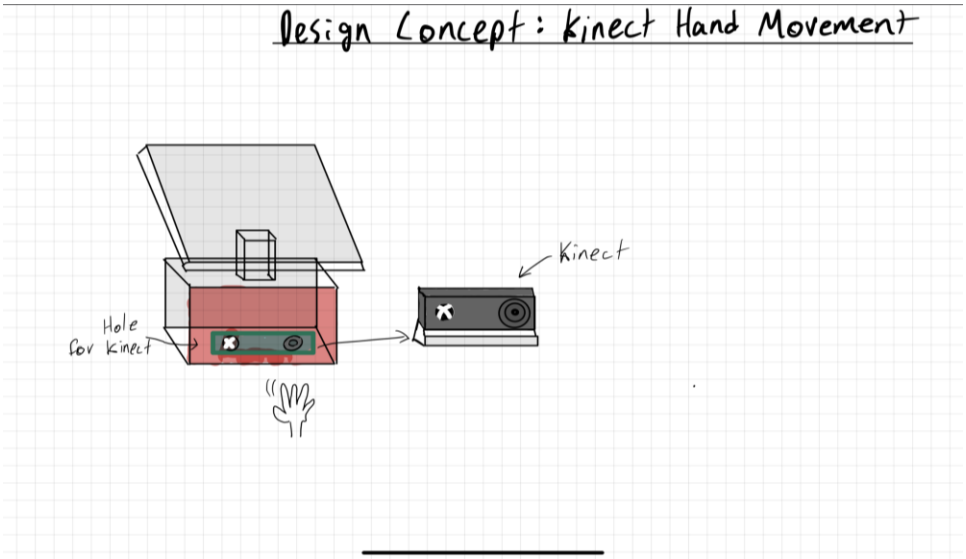
Joystick

Same as the device she currently owns

WASD controls

- This would use 4 keys to control direction of tilt (rotation about 2 axes both directions)

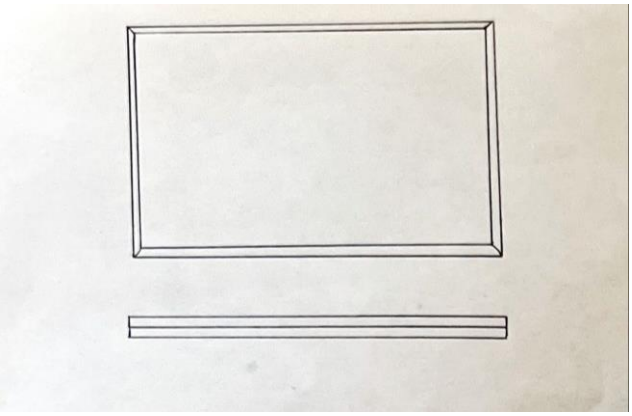
Xbox Kinect



- Allows the user to have hands free at all times
- Kinect will be protected by being inside the machine at all times in order to protect from paint dripping
- Allows the client whose hands have limited mobility to only have to move hand in order to control movement of canvas

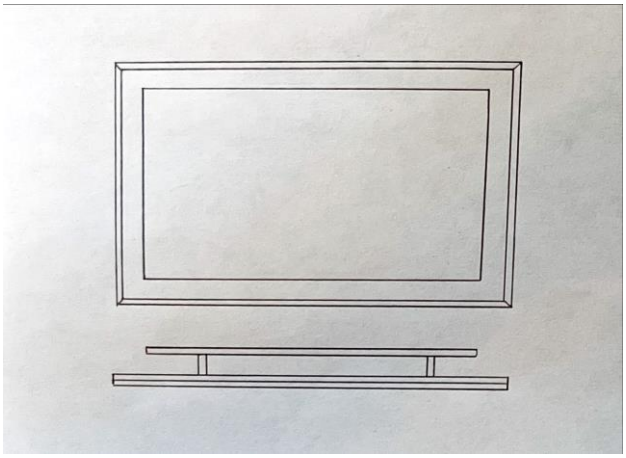
1.4.1.5 Paint Collection Subsystem

Platform below canvas with rim



- Rim around the edge of the platform which the canvas attaches to.
- Simple way to contain paint, however if the canvas interface requires holes/slots through platform paint may leak through.

Secondary platform below with rim



- Similar to system above but requires a bit more material.
- Allows for containment of paint leaking through holes/slots

1.4.2 Sub-system analysis

1.4.2.1 Tilt system analysis

Selection Criteria	Weight	Pneumatic	Servo	Double Picture Frame
Purchase Price	0.15	3	8	8
Ease of Use	0.35	8	8	6
Tilt Speed	0.2	2	8	8
Tilt Angle	0.3	7	9	8
Total Score		7.15	8.3	7.3

1.4.2.2 Rotation system analysis

Selection Criteria	Weight	Bearing with Support	Double Platform with Motor
Purchase price	0.2	8	4
Ease of Use	0.3	2 (need assistant to spin)	6
Speed of Rotation	0.5	9	6
Total Score		6.7	5.6

1.4.2.3 Canvas interface system analysis

Selection Criteria	Weight	Easel	Peg	Cable Attachment	Velcro	Floating Clamp
Purchase Price	0.2	10	6	5	7	5
Ease of attachment	0.3	9	8	7	4	6
Ability to attach different canvas shapes and sizes	0.4	7	8	7	8	7
Stability	0.1	8	5	5	5	8
Total Score		8.3	7.3	6.4	6.3	6.4

1.4.2.4 User interface system analysis

Selection Criteria	Weight	WASD Controls	Xbox Kinect	Joystick
Ease of use	0.4	5	5	7
Purchase Price	0.1	5	3	5
Mobility of hand needed	0.3	5	6	5
Difficulty of setting up UI	0.2	8	4	8
Total Score		5.6	4.9	6.4

1.4.2.5 Paint collection system analysis

Selection Criteria	Weight	One Platform below Rim	Two Platform below Rim

Purchase Price	0.2	8	5
Reliability	0.5	7	8
Amount of Paint Collected	0.3	6	8
Total Score		6.9	7.4

1.4.3 Promising Solutions

User interface

The best user interface is the joystick which she already uses in her current device.

Tilt system

The number one choice is to use servos similar to her current device. This system allows us to achieve the angles of tilt desired, the downside is there are more moving parts and so the device will be more complex, with a higher chance of failure.

The second choice is the double picture frame option. This option is good because it is very simple to implement and use, however the frame will obstruct view of the canvas which is not desired.

Rotation System

It was decided after analysis that the rotation system will not be implemented as it will incur too much complexity to the system and will require more time to implement than is available to our team.

Canvas interface

There are three good options. The option already used with pegs has been working well for the client, however it does limit canvas variety in terms of size and shape to a predetermined set.

The second option is to build the device to interact with the easel already owned by the client. This would reduce interfacing with the canvas to interfacing with the easel, and the easel has already been designed to allow for a variety of canvas sizes.

The third option is to use the clamp design. This design allows for almost any canvas size and shape and is also quite simple, however it may face issues with cleaning the device.

We would like to discuss both second and third option with our client in client meet 2.

Paint collection

The double layered platform with rim is the best option as it ensures no paint spill regardless of canvas size and interface method.

1.4.4 Global Concept

For our global concept we have chosen to use the joystick for user interface, servos for tilt, double platform for paint collection and clamps as canvas interface. See Figure 1 and 2 below for design.

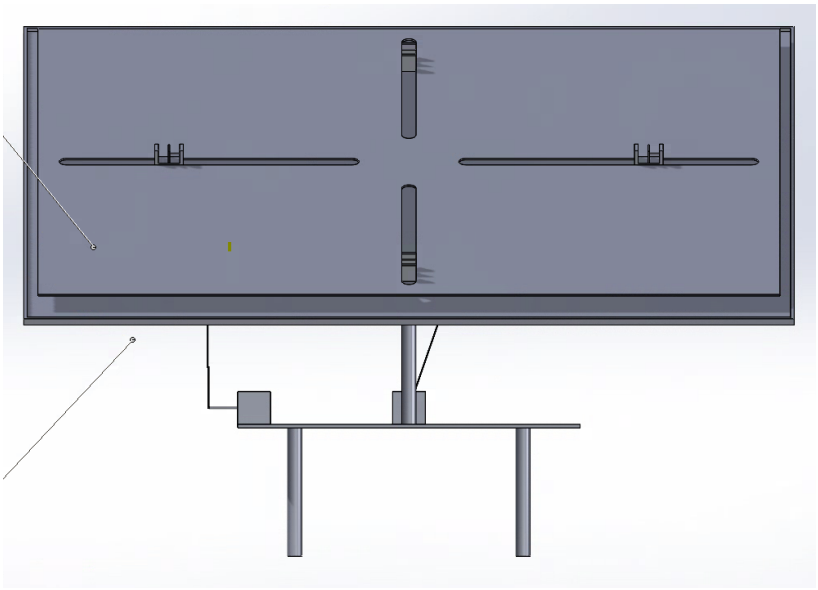


Figure 1: Front view of paint assist global concept with canvas platform view

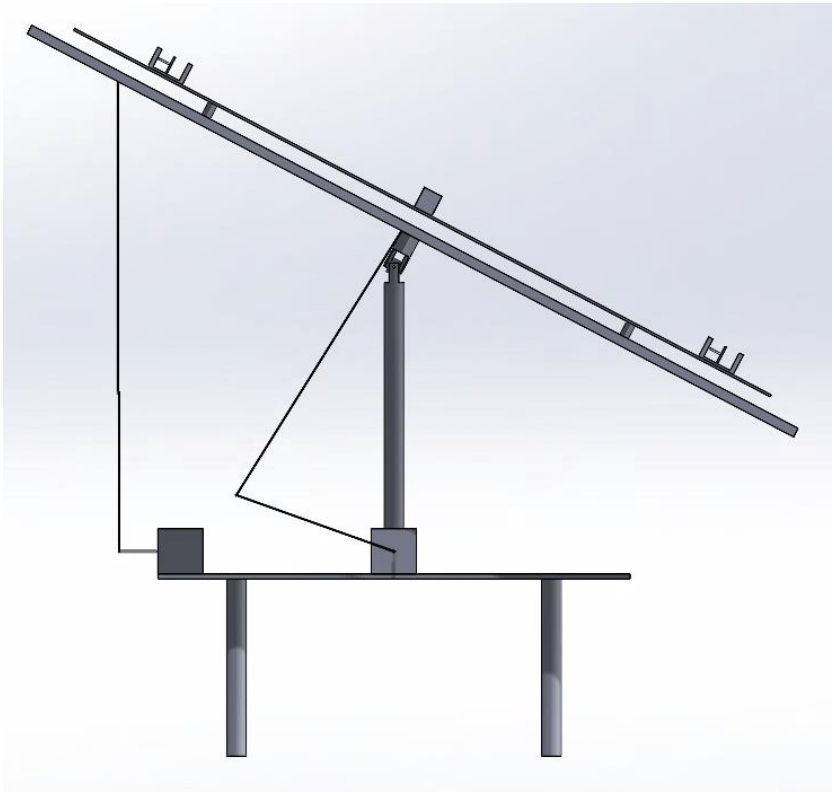


Figure 2: side view of paint assist

We would also like to present our client with the double picture frame tilt system and the peg and easel interface canvas systems.

1.5 Project plan

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=zQIesRgDAdmNlRQX5qUmoBEkI85aOBl3%7CIE2DSNZVHA2DELSTGIYA

Detailed Design and BOM

1.6 Detailed design

1.6.1 Client meeting feedback

1.6.1.1 Canvas interface system

The client liked the clip system to interface with canvases of multiple sizes and shapes. It was a new approach which she had not seen before and like that it allowed her to use a lot of different shapes and sizes of canvas.

1.6.1.2 Tilit system

The client liked our secondary design more, which featured the canvas attached to stepper motors on an outside frame. The frame is mounted to stepper motors perpendicularly, allowing the device to tilt any direction. The client liked that it was novel and she had not seen this design proposed before, and would prefer us to move forward with this design even if it meant making the device smaller.

1.6.1.3 User interface

The client specified that because she has low motor function in her hand, she needs a joystick that allows her to place her hand on top, instead of grabbing onto it.

1.6.1.4 Rotation

Currently we are not planning to implement a rotation ability. The client said it would be great if we are able to implement a manual rotation ability but it is ok if the device does not have this feature.

1.6.2 Detailed design

1.6.2.1 Overall design

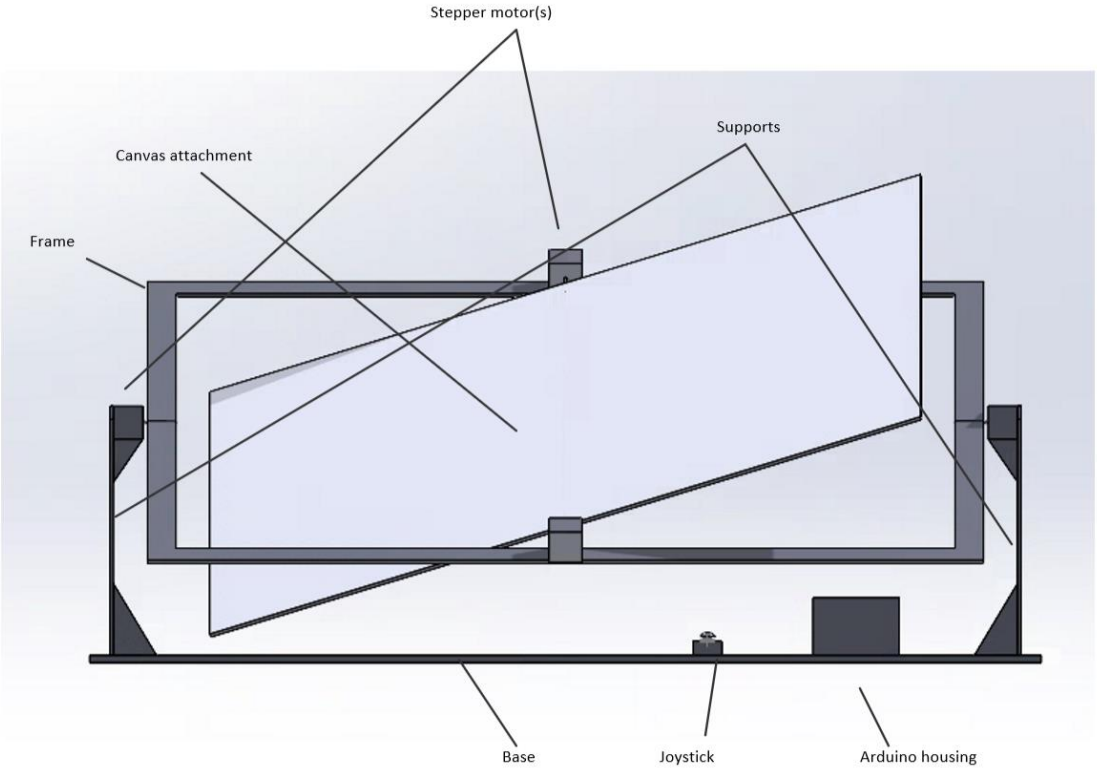


Figure 3: overall design layout

This is the general form of our design. Currently it is scaled to implement 24 x 24 “ canvas.

1.6.2.2 Canvas attachment

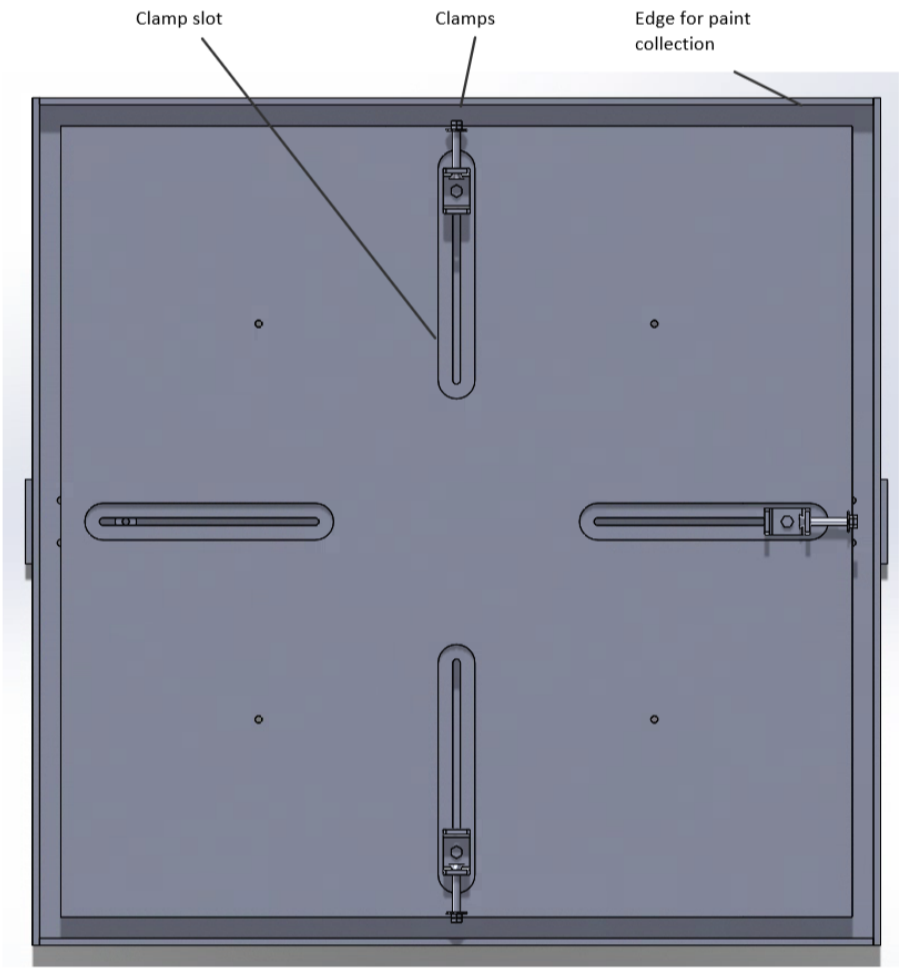


Figure 4: canvas attachment overview

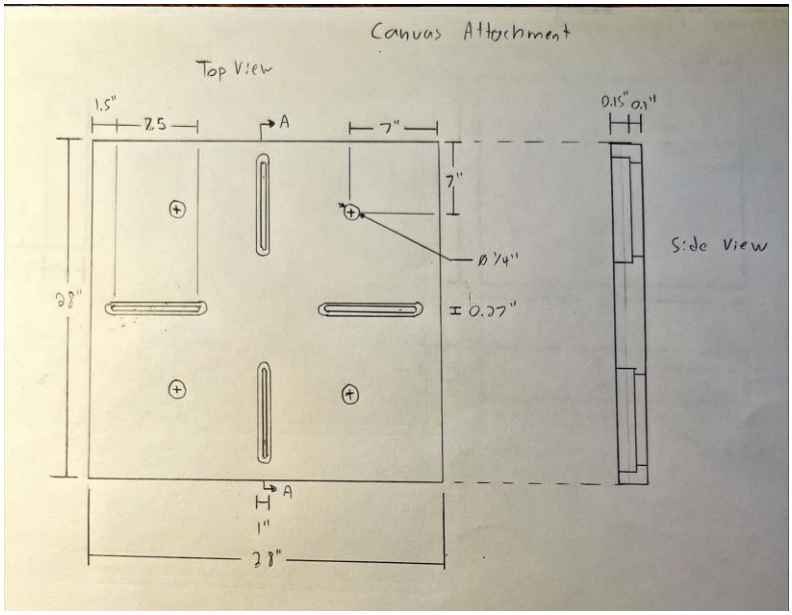


Figure 5: Canvas attachment piece

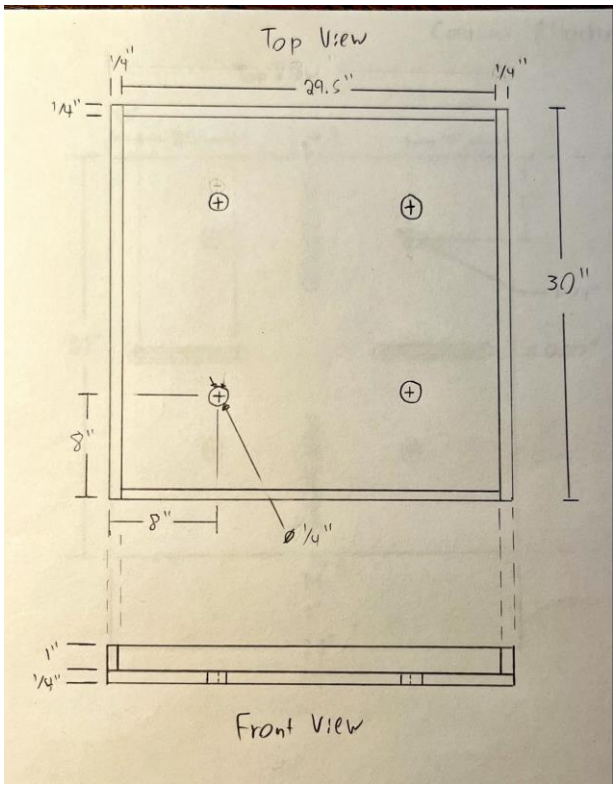


Figure 6: paint collection piece

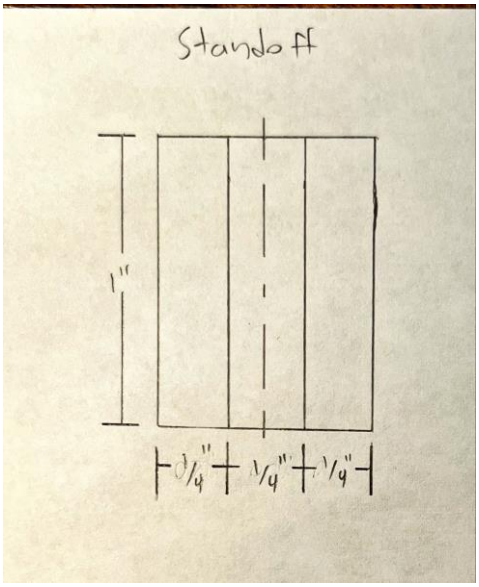


Figure 7: standoff piece

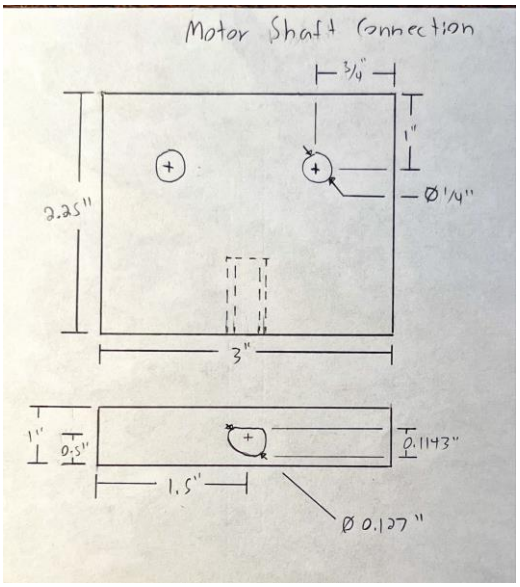
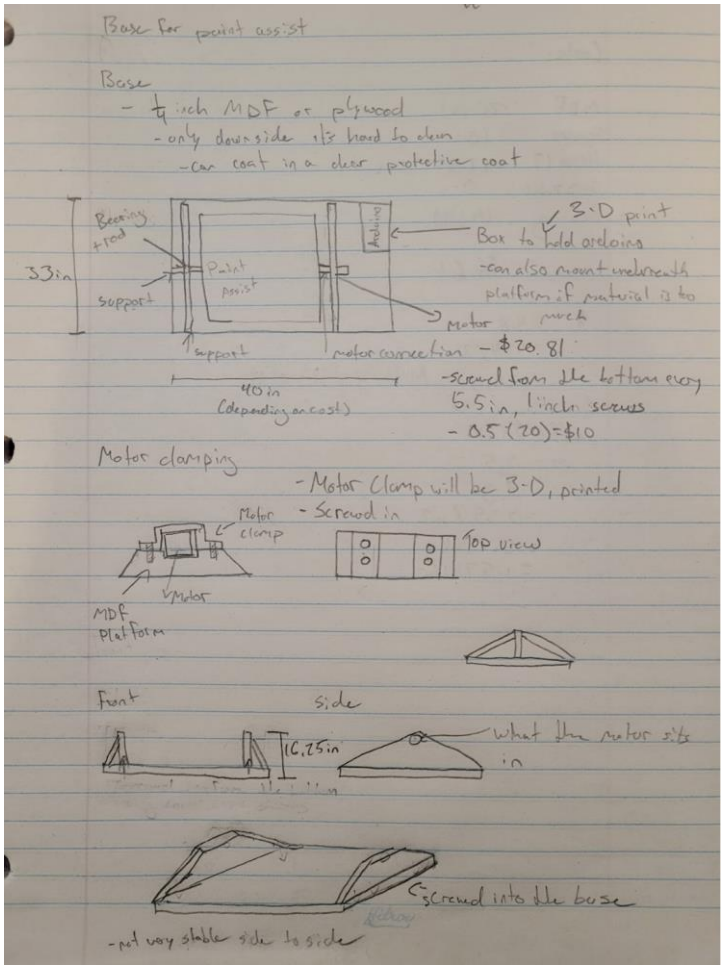
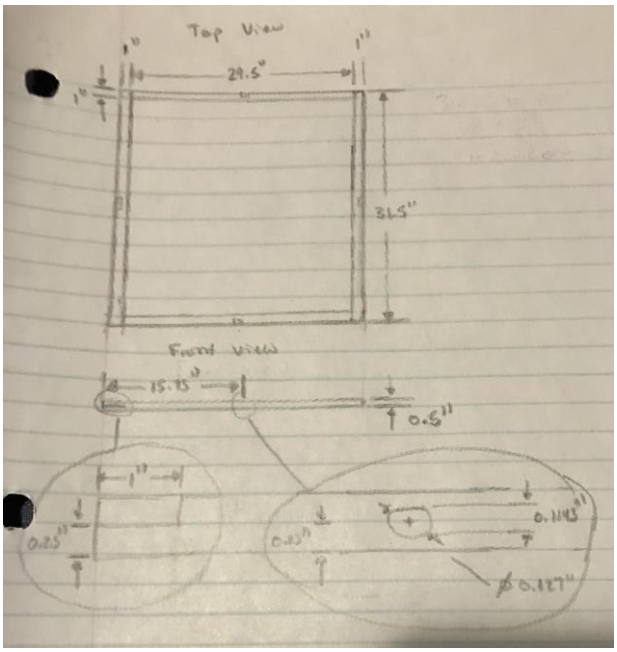


Figure 8: motor attachment piece

1.6.2.3 Base


Base for point assist
Base
- ¼ inch MDF or plywood
- only downside is hard to clean
- can coat in a clear protective coat
Bearing + rod
33in
Point assist
support
Arduino
3-D print
Box to hold arduino
- can also mount underneath platform if material is too much
Motor
support
motor connection - $20.81
40 in (depending on cost)
- screwed from the bottom every 5.5 in, 1 inch screws
- 0.5(20)=$10
Motor clamping
- Motor Clamp will be 3-D, printed
- Screwed in
Motor clamp
Motor
MDF Platform
Top view
Front
Side
16.75in
What the motor sits in
Screwed into the base
- not very stable side to side

1.6.2.4 Frame



1.6.3 Skills and resources

Archie: lathe, Arduino, coding, various hand tools, woodworking

Keenan: mill, woodworking, basic electronics, various hand tools

Hashim: Coding, Arduino, lathe, basic woodworking machines

Alex: mill, Arduino, various hand tools, coding, basic woodworking

1.6.4 Time assessment

Time to implement: this project will take substantial time to implement. There are still many issues with the design in terms of feasibility and budget that need to be worked out. Additionally 3D printing parts will take a lot of time, as will assembly and leaving room for potential issues that will need resolving along the way.

Group member time availability:

Hashim: is in four courses and so will have more time available, estimates 10 hours a week to be able to commit.

Alex: is in full 6 course load and so will have limited time available, estimates 5-10 hours a week to commit.

Keenan: is in 5 courses and will have an estimated of 5-10 hours a week to commit to the project.

Archie: full 5 course load + capstone, estimates 5 hours a week.

1.6.5 Critical assumptions

The main assumptions we made had to do with the size of canvas our model is compatible with. Our client was looking to work with canvases up to 36”x48” in size, which is very difficult to achieve with our current design and budget. A canvas of this size would also put a lot of force on the motors and require a much greater torque to allow for smooth motion. We restricted the size to a maximum of 24”x24” and are looking to lower it even further to limit budget issues as well as ensure we meet our target specifications.

Our other assumptions pertain to the setup of the painting assist. Our client has told us that they have an assistant who can help her with placing and removing the canvas, as well as with general cleanup. This assumption was necessary as our design is clamp-based, meaning it would be hard to

set up with limited hand mobility. Additionally, our design for run-off paint collection requires manual cleaning which can only be done by their assistant.

1.7 BOM

1.7.1 BOM Canvas attachment

Material	Cost	Quantity	Link
Arduino Uno	27.60	1	Link
Motor driver	9.99	1	Link
28"x28"x0.25" acrylic	100.00	1	Link
30"x30"x0.25" acrylic	106.00	1	Link
Printed shaft attachment	0.00	2	
Printed standoff	0.00	4	
1/4-20 x 2 bolt	1.09	8	Link
1/4 flat washer	0.16	16	Link
1/4-20 lock nut	0.24	8	Link
M6 flat washer	0.34	4	Link
M6-1.00 x 16mm	0.40	4	Link
M6-1.00 lock nut	0.47	4	Link
Clamps (4 pack)	18.99	1	Link

1.7.2 BOM Base

Material	Cost ($)	Quantity	Link to Material
Strand Board 7/16 x 4ft x 8ft	23.36	1	https://www.homedepot.ca/product/7-16-4x8-oriented-strand-board/1000108771
Screws #8 x 1 inch phillips head self tapping	20(0.53) = 10.6	20	Link
Bearing 30mm bore 50mm OD 13mm thick	14.49	1	Link
Nema-17	21.31	2	Link

1.7.3 BOM Frame

Material	Cost	Quantity	Link to Material
Steel (31.5x1x0.5)	8(14) = 112.00	8	Link

1.7.4 BOM Circuit

Material	Cost	Quantity	Link to Material
Arduino UNO	**15.25**	**1**	**Link**
Arduino Motor Shield	**13.89**	**1**	**Link**
Wires Pack	**12.99**	**1**	**Link**

Joystick	**3.00**	**1**	**Link**
Stepper Motor Pack	**21.99**	**1**	**Link**
Power Supply	**12.59**	**1**	**Link**

1.8 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=rjniFLxXE2iTLx2XNmRhiBwc7i2R2tZ9%7CIE2DSNZVHA2DELSTGIYA

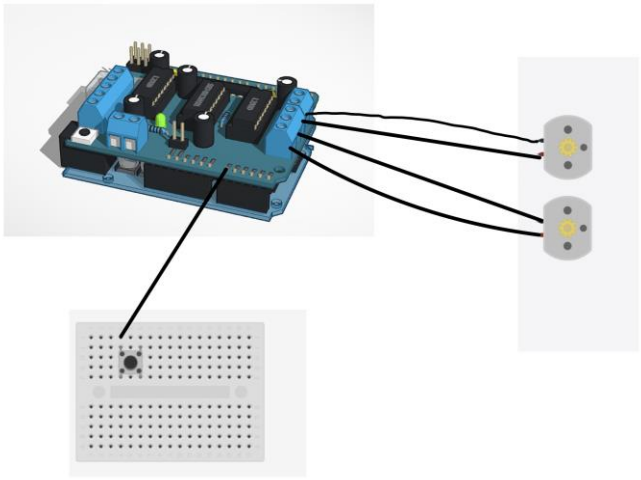
Prototype 1, Project Progress Presentation, Peer Feedback and Team Dynamics

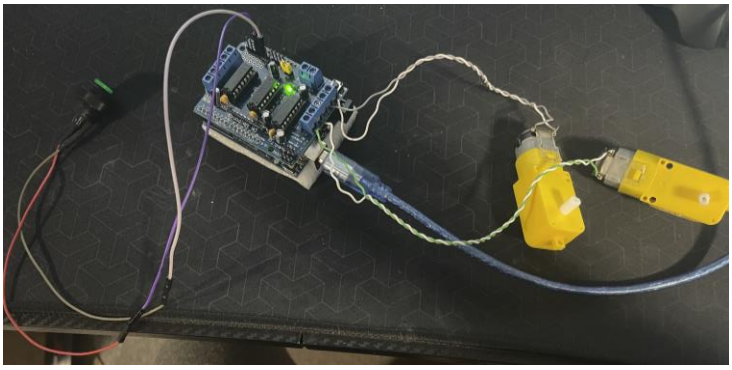
1.9 Prototype 1

Our first prototype is the electrical system and Arduino circuit for our device. The purpose of this prototype is to test the validity of our system to ensure that the stepper motors can be appropriately controlled via a joystick. By verifying our electrical system and Arduino circuit function as predicted, we can move forward with additional prototyping with confidence that our final proposed solution can work. Additionally, with our electrical system complete we can then do further testing on the amount of torque required to tilt the canvas appropriately.

The Arduino circuit images provided below prove to us that our system can function well even if we replace a joystick with buttons. In this circuit, we use a button to control the motor by making it so that each time the button is pressed, the motors will change their rotational direction from clockwise to counterclockwise and vice-versa. We also tested how the speed of the motor would change with the press of a button and how the motors would go to a stop by pressing the button. All of these functions were validated with prototype 1 and using this data, we can move onto development of prototype 2 and forward.

1.9.1 Electric circuit/Arduino





1.10 Project Progress Presentation

Progress Presentation.pptx

1.11 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=fX0GA0hYYuwaW0NQM7rFy50AVkNvntem%7CIE2DSNZVHA2DELSTGIYA

Design Constraints and Prototype 2

1.12 Design constraints

Non functional design constraint 1: must support the canvas

Currently the 21N radial load limit of the NEMA 17 motors is not sufficient to support the desired weight of canvas that matches the target specification size. Two good solutions are available to pursue: solution one reduces the weight of the of the assembly and or canvas, and solution two increases the load limit to accommodate the larger canvas requirement. In solution one the motor is offset and connected to the shaft via a belt, this would allow us to increase the gear ratio and allow for higher torque and lower speed, improving controllability. The shaft diameter would allow us to control the weight limit. solution one is the best solution but would increase the cost of the device far above the budget. In solution two the allowable canvas size is reduced to 12” x 12” resulting in the canvas and assembly weight force to drop below the 21N limit. Solution 2 also decrease the cost because all components are smaller, and some can be entirely replaced with 3D printed components.

To pursue option two our design remains almost the same but scaled from maximum 30” x 30” to 18” x 18”.

Non-functional design constraint 2: canvas rotation

Canvas rotation us difficult due to the torque issue for a large canvas and the limited space and load limit available. Due to this limitation, there is no way to allow for canvas rotation. Rotation has been completely removed to enable the primary functionality of tilting the canvas to perform optimally. However if the load limit was better, the canvas could be mounted to a bearing to enable free rotation, and potentially attached to a third motor to enable controllable rotation. However instead the rotation will be completely removed.

To pursue this in our design the top layer will be attached directly to the lower layer through permanent standoffs. The top platform can be detached by removing the screws to clean underneath.

1.13 Prototype 2

Client meet 3 notes:

- Was informed about rescaled size and rotation removal. Client remained optimistic, cited the would prefer it to work well with a small canvas than barely with a larger canvas. They did offer to increase our budget herself if they did get a product which worked as we originally intended.

- Was shown the prototype 2 video demonstrating the proposed responsivity. Client was impressed with the response speed.
- Client noted that if we could rotate more than the target 45º that would be better. We will incorporate this into our new design.

What we have not tested yet was how quickly the canvas could be able to rotate. We had some simple analysis and calculations but this amount is very important to our client so it should be tested.

Prototype 2 will test the responsiveness at different input torques, ranging from the maximum output torque of the NEMA 17 motors of 290mNm to half this value, in five stages. Prototype 2 is shown below.



The wood piece has a maximum allowable mass of 5kg and is the width of the widest section of the part which will be tilted and approximately the same height. This is a good approximation to the resistance to rotation the device will demonstrate. The shaft is 0.5” in diameter, by wrapping the shaft with twine and suspending a bucket, the amount of water in the bucket can be varied to control the torque. This way we can test the response to the different amounts of torque. We tested the time to rotate on a single axis from -45^{o} to flat at 6 different torques from maximum NEMA 17 torque to half that value. The input torque and response time is given in the table below.

Input Torque (mNm)	Time from -45^{0} to flat (ms)
290	875
261	921
232	1098
203	1170
174	1334
145	1532

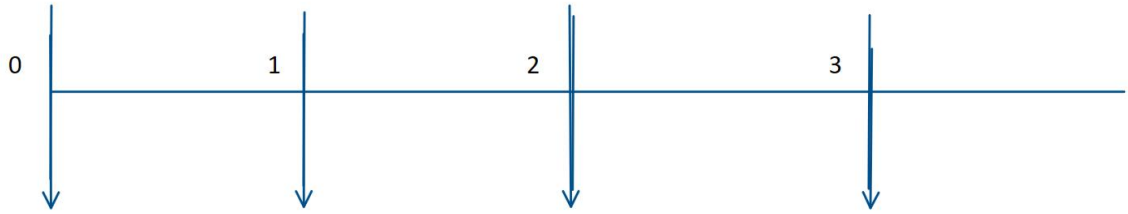
1.14 Project plan update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=EqWqFwNcXeKhGKqD81Cm5W4UEnM8bnhi%7CIE2DSNZVHA2DELSTGIYA

Other Considerations

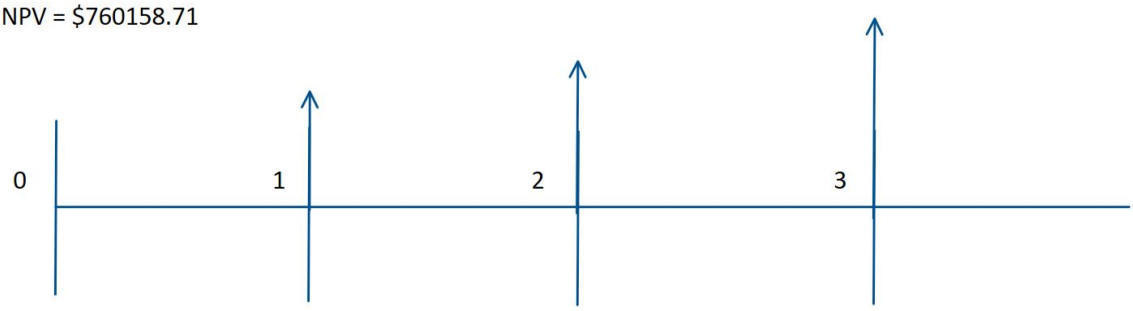
1.15 Economics report

	Material	Labor	Expense
Direct	Painting assist components	Salaries	Depreciation of manufacturing equipment Amazon tax Manufacturing equipment
Indirect		Salaries	Rent Electricity Interest Advertising Website domain
Fixed			Rent Electricity Interest Advertising Depreciation of manufacturing equipment Website domain Manufacturing equipment
Variable	Production materials	Salaries	



Manufacturing	Depreciation of	Depreciation of	Depreciation of
equipment: $24000	equipment: $666.67	equipment: $666.67	equipment: $666.67
Interest: $2500	Rent: $40800	Rent: $40800	Rent: $40800
Advertising: $776.67	Electricity: $3000	Electricity: $3000	Electricity: $3000
Website domain: $10	Interest: $2500	Interest: $2500	Interest: $2500
Total: $27286.67	Advertising: $776.67	Advertising: $776.67	Advertising: $776.67
	Website domain: $10	Website domain: $10	Website domain: $10
	Materials: $84375	Materials: $185625	Materials: $388125
	Total (Compound i): $125836.51	Total (Compound i): $211681.03	Total (Compound i): $395354.50

NPV = $760158.71



Sales: 0	Sales: $150000	Sales: $330000	Sales: $690000
	Total (Compound i):142857.14	Total (Compound i): 299319.73	Total (Compound i): 596047.94

NPV = 1038224.81

Break Even point is at 900 units sold

Assumption:

- We own 80% market. There aren't many products that are similar to ours. The client mentioned that she tried looking for a painting assist previously but was unable to find the right product. The painting assist product would be unique because it would

be primarily used by disabled people, professional artists who need precision when fluid painting, and people who want an easy way to get into fluid painting.

- Will only sell the painting assist in Canada
- The painting assist will be sold through our own online website and Amazon.ca webstore
- Will ship the painting assist in parts similar to Ikea
- Will 3D print enough parts to create 4 painting assists a day
- Take a $50000 loan at the beginning with 5% interest rate

1.16 Intellectual property report

Intellectual property 1: https://www.freepatentsonline.com/WO2022245391A1.html

Intellectual Property 2: https://www.freepatentsonline.com/6390433.html

- Understanding and respecting intellectual property rights are crucial for ethical and legal business practices. Failing to do so can result in legal disputes, reputational damage, and financial losses. It's essential for businesses to conduct due diligence, seek legal advice, and secure the necessary permissions and licenses to avoid infringing on intellectual property rights.
    - Importance: Patents grant inventors exclusive rights to their inventions, preventing others from making, using, or selling the patented product or process for a specified period. This exclusivity provides an incentive for innovation, as inventors can recoup their investment and profit from their creations.

- Legal Constraints: Developing a product that infringes on a patented invention can lead to legal action, including injunctions and damages. Businesses must conduct thorough patent searches to ensure they are not violating existing patents. In our case, we would need to make sure that our mechanism to attach the paint canvas to the machine is not similar enough to the patent which we have provided to make sure that there are no legal problems with our version of the attachment mechanism. For the other patent, we need to make sure that our rotating mechanism for a painting canvas is not similar enough to the patent in order for the same legal issues as the painting attachment mechanism to not occur

Bibliography

Insert your list of references here.