

MusArt Web Application

A Way To Create Musical Art Pieces

Final Report

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EXECUTIVE SUMMARY

The MusArt web application was created in the hopes of combining available audio and visual technology to be used for good. The origins of this project were inspired by Professor Ico Bukvic, my client, who conducts a significant amount of work at the intersection of music and technology. Many people, who will be recognized throughout this paper, helped in the ideation phase of this project, providing insights from their respective experience. As a result, this project rests on a very broad foundation, pulling together many different ideas into one cohesive final product.

The goal of MusArt is to provide users with an application that allows them to express themselves, regardless of self-perceived creative abilities. A parallel goal is to provide an activity to actively relax by using engaging audio and visual stimulation. This benefits the user due to the powerful effects that music has on our biological functions, combined with the benefits of tuning into our senses of vision and hearing. This idea of tuning in is common in meditation practices.

This product works on the idea of limiting the number of choices available to a user, giving them enough freedom to feel that what they are creating is theirs without giving too much freedom that would lead the user to feeling overwhelmed. Regardless of experience, anybody should be able to use this tool as long as they have access to a computer.

The MusArt interface consists of a control center, a workspace, and a visual display.

- The control center allows the user to choose from a set of given music/visual templates, which cover a wide range of styles, then play, pause, and reset this music-visual piece.
- The workspace is where the user is able to manipulate various aspects of the music/visual piece, using different input devices.
- The visual display is where the responsive visual appears.

Introduction

In our day to day lives, we are pulled in so many directions that it is hard to ever take a second to reflect on ourselves. Our days are spent in ways that are very taxing on both the mind and the body, and at the end of those long hours we look for a way to decompress, or as some put it, “to escape.” More often than not this activity comes in the form of passive consumption or entertainment, such as watching a show, scrolling through social media, playing a video game, etc.

These activities are not inherently negative, however they do function more as distractions. When this cycle of stress and distraction repeats, we lose sight of what matters and do not realize how non-stop we have been living until we are forced to confront it, a realization that can be very abrupt. Despite the many advances our modern society has developed, our ability to manage stress has not kept up.

One way to relax the mind that many people have discovered is mindful meditation^{[1][5]}, and the core ideas of MusArt are inspired by ideas associated with this practice. The goal of mindful meditation is to focus on what is happening in the present moment, which is something that occurs when we focus our attention on our senses. This idea of tuning into the moment is very relevant to creative outlets such as music and art, as it relies on listening or looking and consciously thinking about what is entering into our sensory inputs (especially eyes and ears).

Another way to relax the mind is by managing our breathing, which allows us to regulate our heart rate. Music has been found to have a noticeable effect on our breathing and heart rate – intuitively many of us know this. Just think of the different ways we use music: working out, partying, studying, and many other instances. MusArt was built keeping these powerful effects of music in mind.

Many people feel as if they do not have the creative ability to be a musician or an artist, and as a result they avoid these forms of relaxation. MusArt addresses this problem by working to bridge the “creativity” gap, making it easier for anyone to create a piece of audio/visual art that they are proud of and can call their own. However, the final product is not what matters. It is about the process during which the user is tuned in to what they are creating, giving them a time during the day to relax the mind.

RESEARCH

As mentioned before, the motivation for this project comes from research on the therapeutic effects of music, and current practices used to relax.

Intuitively, many of us are aware of the powerful effects that music can have on our state of being – we listen to music while studying to focus, in dance clubs to become energetic, while exercising to help push our limits. Music listening is a common part of our daily lives, and this is not a recent trend – musical activities have been present in every known culture on earth, extending all the way back to 250,000 years ago.^[8]

Researchers have investigated the physiological effects of music listening and have discovered a correlation between music and heart rates/blood flow. This was looked at in a few different contexts. Several studies examined the use of music in a medical setting. The first looked at the use of music in conjunction with anti-hypertensive medication on heart rate (HR) autonomic control in subjects with hypertension. Patients who listened to music were found to have an increased response to the anti-hypertensive medication when compared to their non-listening counterparts, as the music group's heart rates decreased while the non-listening group's heart rates remained the same.^[7] Similarly, in a study on patients undergoing endodontic treatment (such as root canals), musical auditory stimulation enhanced the heart rate autonomic modulation, meaning it assisted in slowing down the heart rate.

In another medical study where music was used in a medical setting, 80 conscious patients undergoing urologic surgery under spinal anesthesia were split into three groups – music, white-noise, and a control group. The group listening to music needed less calming medication than the other two groups^[3].

It was noted in one study that the musical effects on heart rate took place regardless of preference/repetition of a song^[2]. It also noted that the clearer a rhythmic structure was, the more pronounced the effects were. Those with previous training in music had a stronger response, presumably because musicians learn to synchronize their breathing with music as they play. It is also likely that they are able to hear the rhythms more clearly, allowing them to tune in to a greater degree.

REQUIREMENTS

Considering the input of the many people I was advised by and considering the time constraints of a single semester, the following tasks were identified to be accomplished.

- 1) Identify the needs of a user who is unfamiliar with this type of interface and ensure that they will be able to use this product.
 - This involves a lot of thought in the UI of the system, making sure that any symbols used are clear, and that the layout is not confusing.
 - Options for this are:
 - Step-by-step tutorial
 - Explanations that appear on hover over a section
 - New elements that are introduced one at a time
- 2) Create several means of user control that allow the user to manipulate the provided templates.
 - Visual control
 - Colors that are used
 - Chosen from an RGB color-picker
 - Speed of change
 - Affected by the framerate of the visual
 - Randomness - To be done in the future
 - A variable included in the visualization code that will lead to unexpected changes
 - Audio control
 - Order of the melody – Completed but not currently in the app
 - Audio layers that are turned on/off
 - Recorded audio – To be done in the future
 - Include auto-tune like features that allow users to manipulate their voice

DESIGN

The final deliverable of this project is a web application. There are many technologies available to create this – the goal was to keep it as simple as possible while maximizing what the user is able to do.

This web-app is divided into three sections, the canvas, which is where the visual appears, the workspace, which is where the user is able to control the produced audio and visual, and the control center, where the user is able to play, pause, reset, and select a different template.

IMPLEMENTATION

The two important technologies that were used in this are the Howler.js^[9] library and the p5.js^[6] library

Howler.js:

- Supported across all browsers
- Allows for spatialization of audio
- Supports all browser-ready files

p5.js:

- Full set of drawing functionality
- Provides accessible creative coding
- Free and open-source

These two libraries together are used in conjunction to play music and produce responsive visuals. This web application was created using HTML, CSS, and JavaScript. The web application opens with a page which asks the user whether they consider themselves experienced or new. If the new user option is chosen, they are shown a tutorial which steps through how each of the tools functions. The experienced user will not be shown the tutorial, and instead will be able to create right away.

EVALUATION

The main priorities for this application are that it is 1) simple to use, so that regardless of being familiar with this type of technology or not, a user would be able to enjoy it and 2) engaging. Both of these criteria will be checked through usability tests, where those willing to evaluate this project will provide feedback based on the following questions:

1. Were the functions of each user input understandable?
 - a. What parts could be made clearer?
2. Were you able to understand how your actions affect the visual?
 - a. How could this be improved?
3. Did the tutorial/tooltips help your understanding of the tools?
4. On a scale of 1-10, how engaged did you feel?
 - a. Was the music engaging?
 - b. Was the visual engaging?
5. How long would you interact with this application?
6. Would you want more/less means of user control?
7. Are you happy with the audio/visual pieces that you created?

APP FUNCTIONS

The MusArt Web App UI:

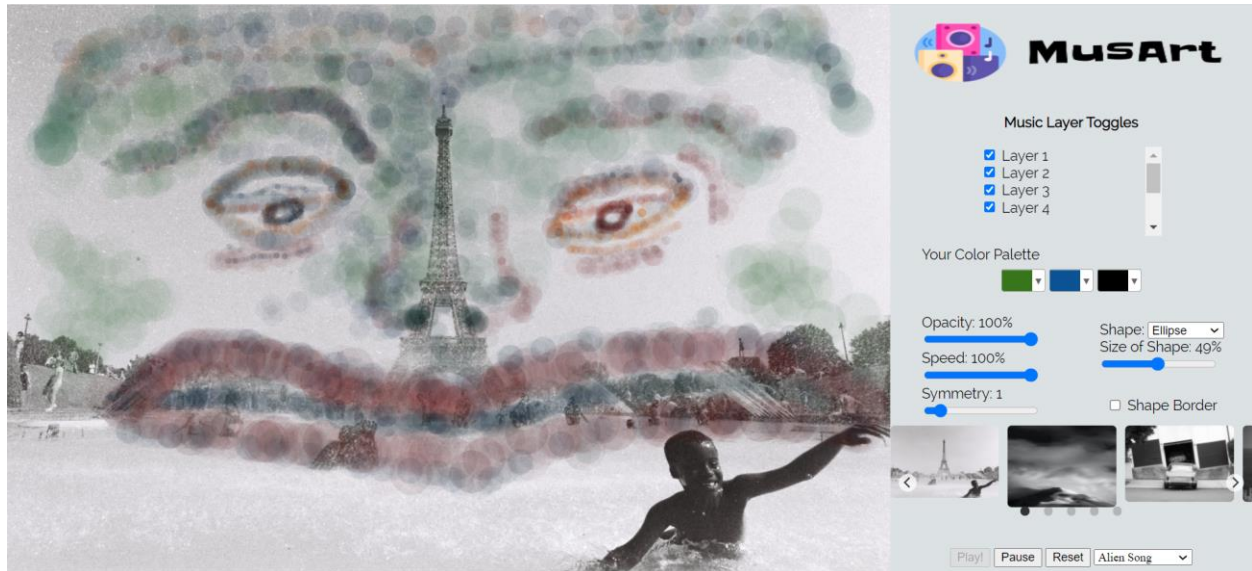


Figure 1: MusArt Web App

The MusArt Web Application, as shown in Figure 1, is a single page web application. Below the various parts are broken down.

CANVAS



Figure 2: Canvas

The canvas, as shown in Figure 2, is where the visual appears. It consists of layers of semi-transparent colorings, which differ depending on: 1) the template used and 2) the user input. The reason that the layers build on each other is so that there is no feeling of “making a mistake,” rather, the art piece that is created is continually added to.

WORKSPACE

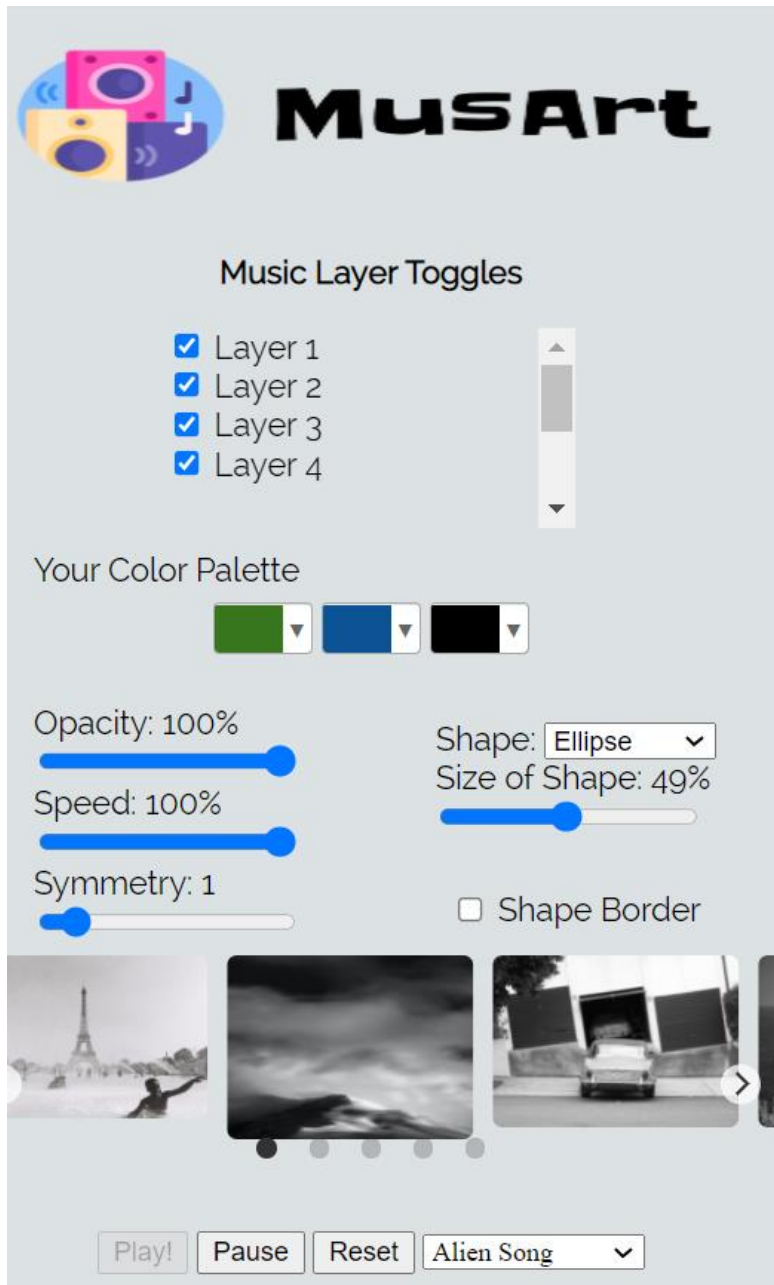


Figure 3: Workspace

The workspace is where the user is able to manipulate the sound and visual, pictured in Figure 3. It is divided into two parts, the music workspace and the visual workspace.

In the music workspace, you are able to toggle different layers of the song. In the future, you will be able to alter other properties of these individual layers, such as adding panning effects, changing their volume, and manipulating the sound waves. In the visual workspace, you are able to determine your color palette, and change various aspects of the drawing tool. Currently these options include the opacity of the color, the shape of the drawing tool, the size of the shape, the number of symmetries in the drawing (what you are currently drawing with your cursor will be repeated n number of times, where n is the number of symmetries chosen), whether the current shape will have a border, and the speed at which the drawing movements are captured.

CONTROL CENTER

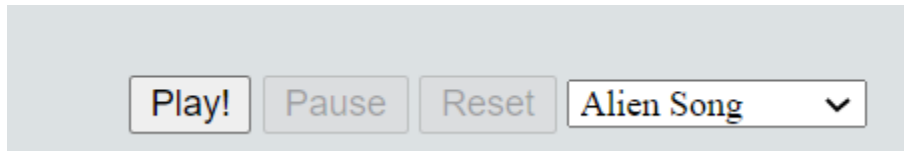


Figure 4: Control Center

The control center is where the user controls the playback of the audio/visual piece. This is shown in Figure 4. Play begins the music and the drawing on the canvas, pause pauses the music and the drawing, and reset sets the music back to the beginning and clears the canvas. The dropdown on the right is the song picker, which allows you to change the song.

USER MANUAL

At this point, in order to use MusArt you would have to download the source files and run it on a local server. The following steps will demonstrate how a user would go about using MusArt once they have the app running. The order of the steps is not strict.

Step 1: Choose a template



Figure 5: Template Slider

You will choose a template from the options available in the slider towards the bottom of the workspace, pictured in Figure 5. This template will serve as the background of your art piece. You have the option to choose a blank screen as a template, where you are free to create any image that you like.

Step 2: Choose the music

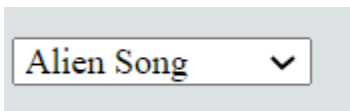


Figure 6: Music Selector

You will then choose the song that will be a part of this audio/visual experience from the dropdown in the controls section, which is shown in Figure 6. There are a variety of songs to choose from. If a song is already playing, its playback will stop. The new song will then be loaded and playback will start from the beginning when the play button is pressed.

Step 3: Play!

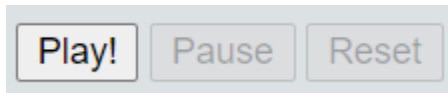


Figure 7: Play button enabled

Pressing the play button, shown in Figure 7, will begin the song, as well as allow you to begin drawing on the canvas. Once the play button is pressed, the pause and reset button will be enabled.

Step 4: Select the layers of the song

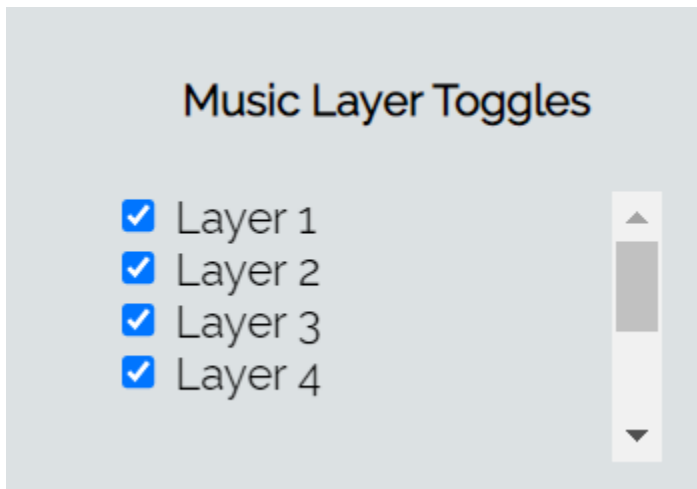


Figure 8: Music Layers

Figure 8 shows the Music Layer toggles, where you have the ability to select which layers of the song (i.e. drums, bass, piano, etc.) are playing. Leaving them all on will play the original song, otherwise you can refine it to the version that you enjoy most.

Step 5: Choose your color palette



Figure 9: Color Palette

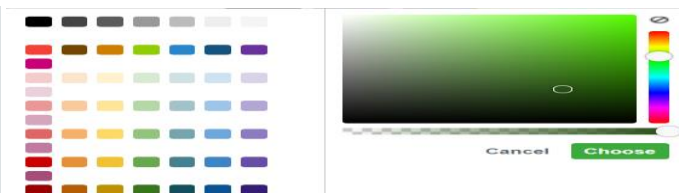


Figure 10: Expanded Color Picker

The colors you choose from these three color selectors, shown in Figure 9, will serve as your color palette in the drawing. The first will serve as your “primary color,” meaning it will be the most prominent, the second as your secondary, and the third as

your tertiary. Figure 10 displays the full color picker – you have the ability to choose from the entire RGB spectrum.

Step 6: Adjust Opacity

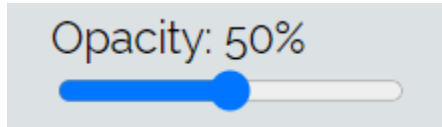


Figure 11: Opacity Slider

Moving the slider shown in Figure 11 changes the opacity, which will affect how opaque the current stroke is. Decreasing the opacity allows the user to add more layers without it becoming too dark. The initial opacity is 50%.

Step 7: Adjust Frame Rate

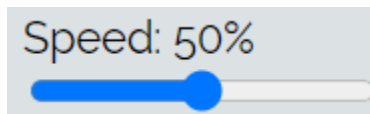


Figure 12: Speed Slider

The speed slider, shown in Figure 12, changes the frame rate of the canvas, which determines how fast the user movements are captured. The higher the speed, the more user movements will be detected per second.

Step 8: Adjust Number of Symmetries

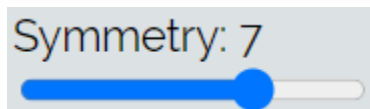


Figure 13: Symmetry Slider

The user is able to add symmetries to what they're drawing using the Symmetry Slider shown in Figure 13. The number of symmetries determines how many times what the user is currently drawing is repeated. For example, if the symmetry is set to 7 as in the above picture, seven objects would appear with each capture of the user's movement.

Step 9: Choose Drawing Shape

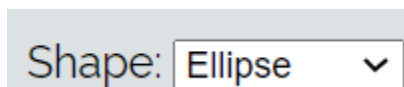


Figure 14: Shape Selector Dropdown

The shape selector allows you to change the shape of your drawing tool, which you select from the dropdown shown in Figure 14.

Step 10: Choose Size of Shape

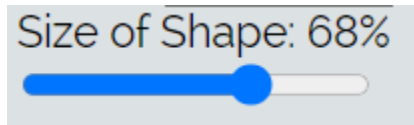


Figure 15: Size of Shape Slider

You then have the ability to change the size of your drawing tool, using the Size of Shape Slider shown in Figure 15.

Step 11: Toggle Shape Border



Figure 16: Border Toggle

You also have the ability to toggle whether there is or is not a border, using the Shape Border checkbox shown in Figure 16.

Step 12: Draw!



Figure 17: Drawing on the Canvas

Once you have chosen the various attributes of your drawing tool, you can click within the canvas and you will then be able to draw! Figure 17 shows a canvas, where the dots in the sky have been drawn in by the user. Wherever your mouse is will be where the shape is drawn. To stop drawing on the canvas, simply click the mouse. This will not pause the music. You have the ability to continually update the drawing tool attributes throughout the drawing process.

Step 13: Pause/Reset

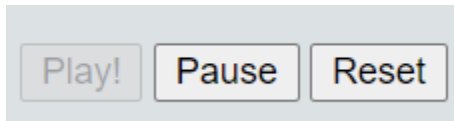


Figure 18: Pause and Reset Buttons

If the music is playing, the pause and reset buttons will be enabled. These are shown in Figure 18. Pressing pause will pause both the music and the drawing. If you were to press play afterwards the song would continue from the same point you paused it at. Pressing reset will reset the canvas to its original state, as well as stop the music which would start from the beginning on the next click of the play button.

METHODOLOGY

USERS OF MUSART

I am building a web application with two types of users - somebody who is unfamiliar with this type of interactive interface where certain elements are under the user's control (these elements are drag-and-drop boxes, color-pickers, and sliders), and users that are familiar with this type of interface.

- New user goals
 - Have them understand all tools of the app that they are able to control
 - Understand what it is that they're changing with each of their actions
 - Not get frustrated in the process of learning
 - Be able to create something interesting with minimal knowledge
- Experienced user goals
 - Not hinder them with redundant explanations
 - Still feel engaged even if they have used the app many times
 - Have more freedom
- Both types of users
 - Be able to create a responsive music/visual piece that is individualized
 - Engaging throughout the creation process
 - Have an adaptable screen

GOALS AND THE TASKS NECESSARY

1.) Have users understand all tools of the app. Figure 19 shows the general workflow of the tasks necessary for this goal.

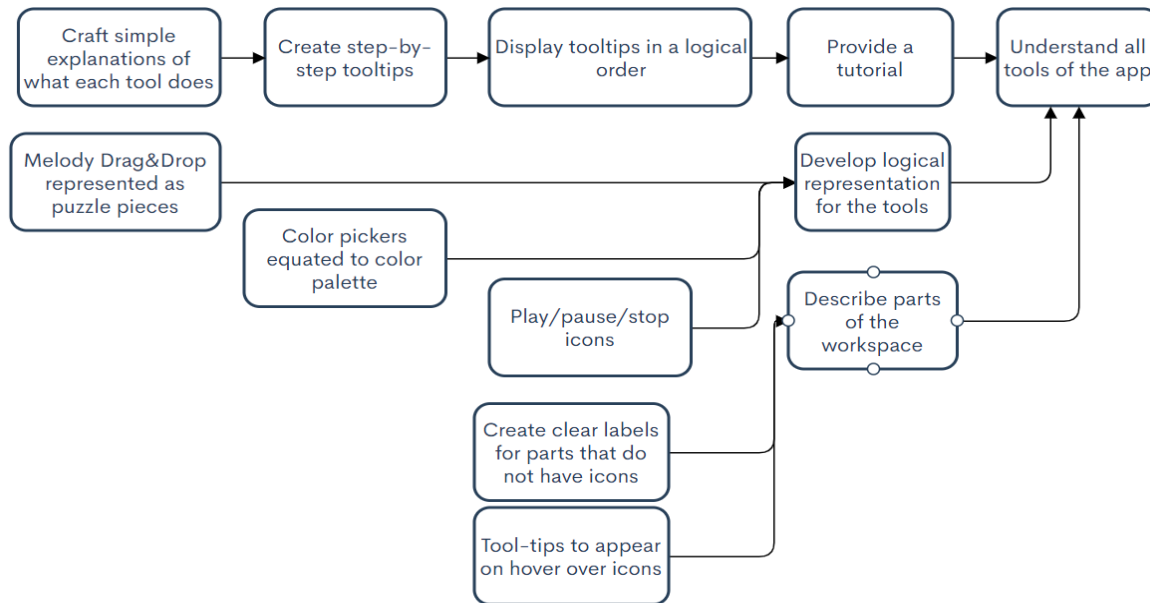


Figure 19: Task flow for users to understand the app

- Provide a tutorial
 - Step-by-step tooltips
 - Craft simple explanations of what each tool does
 - Display these to the user in a logical order
- Develop logical icons/representations for the different tools, have them reflect what is familiar to the user
 - Melody drag and drop-> puzzle pieces that can fit in any order
 - Color pickers ->Color palette
 - Play/pause/stop ->Common play/pause/stop
- Create clear labels for parts that do not have obvious icons
 - Workspace
 - Music workspace
 - Melody Drag and Drop
 - Visual workspace
 - Color palette picker
 - Controls
 - Song picker
- Tool-tips that appear on hover over icons

- Develop very short explanations of what's being hovered over
 - Only appear after long hover

2.) Do not hinder experienced users with information they already know. Figure 20 shows the workflow of the tasks necessary for this goal.

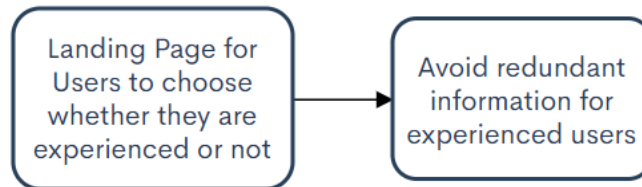


Figure 207: Task flow for differentiating users

- Create a landing page where user can choose whether they are experienced or not
 - Non-experienced user will have the option to step through a tutorial

3.) Give user control over music and visual. Figure 21 shows the general workflow of the tasks necessary for this goal.

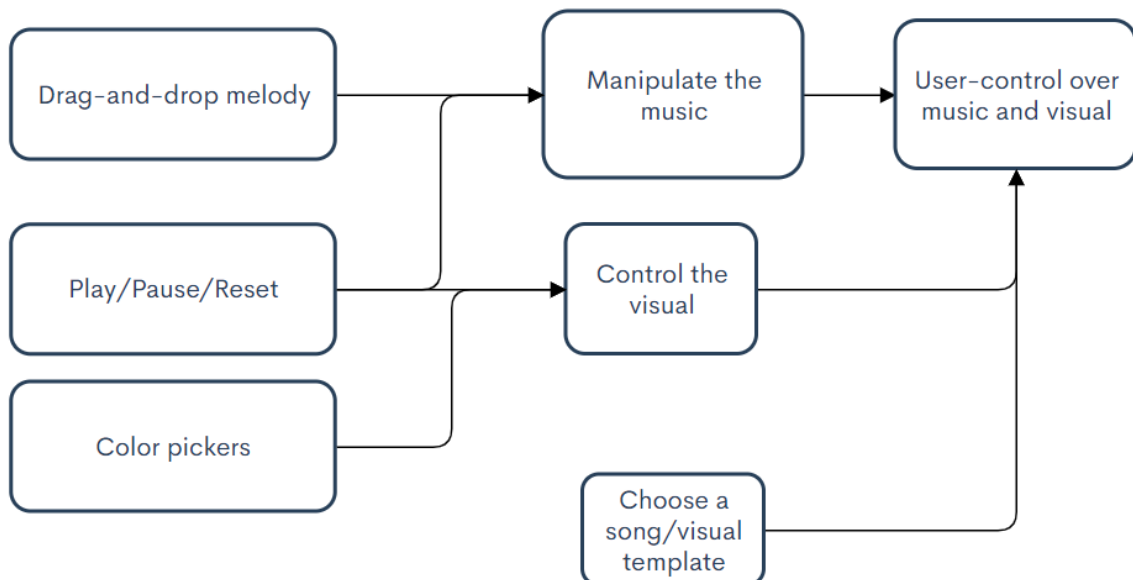


Figure 21: Task flow for giving user control over music and visual

- Incorporate user-controlled tools that change the music and visual

- Create drag-and-drop music
- Add color-pickers
- Allow user to play, pause, and restart
- Create templates which users can choose from
 - Build music that will be enjoyable to the user
 - Build accompanying visual template that outlines what the final music visual will look like

4.) Have an adaptable display. Figure 22 shows the general workflow of the tasks necessary for this goal.

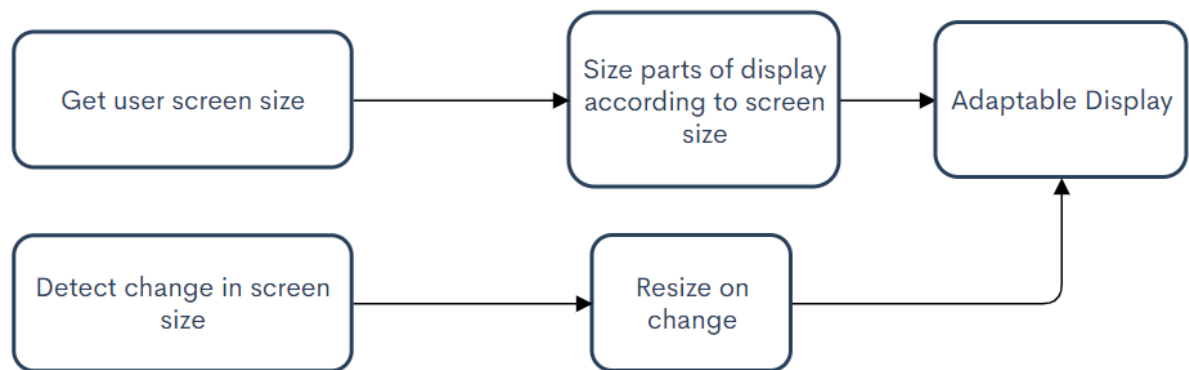


Figure 22: Task flow for creating adaptable display

- Canvas, workstation and controls appear in similar proportions regardless of screen size
- Resize on change in browser

TASKS BROKEN INTO SERVICES

Service ID	Service Name	Input file name(s)	Input file IDs (comma-sep)	Libraries; Functions; Environments
1	Tutorial	N/A	N/A	nextTutorialStep() exitTutorial()
2	Landing Page	N/A	N/A	isExperienced() displayUserTypes()
3	Melody Drag-And-Drop	#_songName.mp3 #_variable1_songName.mp3 #_variable2_songName.mp3 #_variable3_songName.mp3 #_variable4_songName.mp3	1,2,3,4,5	swapVarSong() nextVarSong() allowDrop() drag() drop() Howler.js
4	Change Songs	1<=i<=10 #_vari_songName.mp3	1,2,3,4,5,6,7,8, 9,10	setSong() resetIDs() updateState() setDrawID() updateColors() Howler.js
5	Choose song	#_songName.mp3	1,2,3...	songChange() Howler.js
6	Pause	N/A	N/A	pauseSong() frameRate(0) Howler.js p5.js
7	Reset	N/A	N/A	stopSong() resetAll() Howler.js p5.js

8	Play	N/A	N/A	playSong() frameRate(10) Howler.js p5.js
9	Full Screen	N/A	N/A	toggleFullScreen() p5.js
10	Resize Window	N/A	N/A	windowResized() p5.js
11	Pick Colors	N/A	N/A	updateColorOne() updateColorTwo() updateColorThree() spectrum-colorpicker2
12	Draw	N/A	N/A	draw() draw1(), draw2()... p5.js
13	Tooltips	N/A	N/A	showTooltip()

Table 1: App Services

Table 1, shown above, lists out the various app services provided. Combined, these form the goals, whose workflows are listed below.

Goal 1 – Understand all tools of the app:

- Workflow 1 – Provide a tutorial = Service 1 + Service 2
- Workflow 2 – Tool-tips that appear on hover = Service 13

Goal 2 – Experienced user still engaged by the app:

- Workflow 3 – Many song templates = Service 4 + Service 5

Goal 3 – Give user control over music and visual:

- Workflow 4 – Control playback of music = Service 6 + Service 7 + Service 8
- Workflow 5 – Change the playback of the song = Service 3
- Workflow 6 – Change the visual = Service 11 + Service 12

Goal 4 – Have an adaptable display:

- Workflow 7 – Display is dependent on screen size = Service 9 + Service 10

FUTURE PLANS

There will be many additions in the future. Currently it is at a proof-of-concept stage, where I have discovered that certain features are and are not possible (or just too complicated at this point). The crucial aspects to improve are

- 1.) User efficacy
 - a. The user should feel as if what they are creating is truly a product of their input, not just pushing a computer-generated art piece along.
- 2.) Music-Visual Interaction
 - a. Their needs to be a clearer link between the music and the visual being drawn. The user should be able to recognize exactly how the music is affecting the thing that they're drawing.
 - b. In the future, I plan to have the visual being drawn also affect the music being played, such as:
 - i. Changing the panning of layers based on the layers that appear
 - ii. Amplifying certain frequencies
 - iii. The colors that appear could affect the gain on individual frequencies
- 3.) Musically/Visually Interesting
 - a. The user should be completely engaged in this app (that's the whole point, to step away from all of the other distractions), and this relies on the music assisting in creating an environment of flow, along with visuals that are appealing to the user.
 - b. It should not be difficult for the user to create something visually interesting.

Steps I foresee in the near future:

As I will no longer have the deadlines required by class, I will step back and think about this project on a more modular level. My plan is to start by improving the music, mostly because that is where my interest lies at the moment. More specifically, I'll be thinking about what options can be given to the user in order to make them feel as if they are genuinely creating their own version of a song. One option for this, inspired by [The Rick Astley Remixer](#), is to create several versions of the same song. For example if there were 8 layers in a song, and 4 different styles of each of these layers, that would create the possibility of $5^8=390625$ different songs (since you are able to choose from four options for each layer, along with the additional option to

not include a layer). This will be difficult musically, but the end product is promising. I will also be looking deeper into generative music, as that has the ability to streamline much of the music creation process.

There is no end in sight for this project, and what the “final” product will look like is anybody’s guess. Probably the most important next step, which my client Dr. Bukvic has stressed, is figuring out the “why” of this project. It’s become clearer over the past semester, but it still very hazy. A clear purpose will provide much clearer use cases, setting realistic constraints on what I should be building towards. It’s possible that this application will have many purposes in the future, but it’s important at this point to focus on one.

Dr. Katherine Biddle, an expressive arts therapist at Carilion Clinic, has provided valuable insight into the artistic tools used in arts therapy and has expressed interest in this project. One goal is to have this product be useful to programs like hers, creating a virtual tool which goes along with the rest of the resources they use.

I will be sure to keep anyone who has assisted in this project updated on my progress. I hope to be able to share something I am proud of, a product that I think others would enjoy and actually want to spend time in.

ACKNOWLEDGEMENTS

I would like to thank my client, Dr. Ivica Ico Bukvic, for his guidance throughout this semester and his willingness to let me pursue a project that I was genuinely interested in.

- Currently serves as inaugural director of Creativity + Innovation transdisciplinary community at Virginia Tech
- Founder and Director of the Digital Interactive Sound and Intermedia Studio (DISIS) and Linux Laptop Orchestra (L2ORK)

I would also like to thank Dr. Edward Fox, the instructor for this course, for allowing me this freedom to pursue something I genuinely cared about, and constantly providing me new avenues to explore. It has sparked an interest that I don't see dying out any time soon.

Finally, I would like to acknowledge the people that provided valuable insights – bringing in new worlds of thought to expand my own limited worldview:

- Enma Navarro
- Dr. Benjamin Knapp
- Dr. Katherine Biddle
- Keith Ebeltoft
- Ruchi Maniar

REFERENCES

- [1] Bayes-Fleming, N., Bullock, G., Boyce, B., Goh, C., Newman, K., & Graham, L. (2021, March 10). Getting started with mindfulness. Retrieved May 10, 2021, from <https://www.mindful.org/meditation/mindfulness-getting-started/>
- [2] Bernardi, L., Porta, C., & Sleight, P. (2006, April). Cardiovascular, cerebrovascular, and respiratory changes induced by different types of music in musicians and non-musicians: The importance of silence. Retrieved April 08, 2021, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1860846/>
- [3] Harvard Medical School. (2011, July). Music and health. Retrieved April 08, 2021, from <https://www.health.harvard.edu/staying-healthy/music-and-health>
- [4] Martiniano, E., Santana, M., Barros, É, Do Socorro da Silva, M., Garner, D., De Abreu, L., & Valenti, V. (2018, January 17). Musical auditory stimulus acutely influences heart rate dynamic responses to medication in subjects with well-controlled hypertension. Retrieved April 08, 2021, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5772659/>
- [5] Mayo Clinic. (2020, September 15). Can mindfulness exercises help me? Retrieved May 09, 2021, from <https://www.mayoclinic.org/healthy-lifestyle/consumer-health/in-depth/mindfulness-exercises/art-20046356#:~:text=Mindfulness%20is%20a%20type%20of,mind%20and%20help%20reduce%20stress>
- [6] McCarthy, L. L. (2021). P5.js. Retrieved May 10, 2021, from <https://p5js.org/>
- [7] Santana, M., Martiniano, E., Monteiro, L., Valenti, V., Garner, D., Sorpreso, I., & De Abreu, L. (2017). Musical auditory Stimulation Influences heart Rate autonomic responses to Endodontic Treatment. Retrieved April 08, 2021, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5274691/>
- [8] Schäfer, T., Sedlmeier, P., Städtler, C., & Huron, D. (2013, August 13). The psychological functions of music listening. Retrieved April 08, 2021, from <https://www.ncbi.nlm.nih.gov/pmc/articles/pmc3741536/>
- [9] Simpson, J. (2021). Howler.js - javascript audio library for the modern web. Retrieved May 10, 2021, from <https://howlerjs.com/>