MARCHING BAND SIMULATOR

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Abstract

Marching Band Simulator is a 3D single-player sandbox game where players can customize their own marching band routines. To create performances, players arrange the members of their marching band on the field using a keyframe system and timeline, allowing for frame-by-frame editing to make elaborate formations. A large amount of freedom is given to the player to customize their band, allowing them to choose their band’s uniforms, color palettes, instruments, and music. The goal of this project was to make a game that was fun and imaginative, giving the player a flexible creative environment. This report illustrates the production process of Marching Band Simulator, and details the core elements of the game’s design, tech, visual art, audio, and playtesting procedure and analysis.
Acknowledgements

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1. Introduction

Marching Band Simulator is a casual creative game centered around the creation and performance of marching band routines. The player controls the placement of band members, their costumes, and their instruments. This leads to a highly customizable space that allows players to use their imagination to design their own marching band performances.

We were drawn to this project due to the uniqueness of the marching band aesthetic and how its open-ended nature would allow us to make our own design decisions rather than having to work within a defined design. The main goal with this game was to create a space where the player could design, format, and present their performances in a fun and engaging manner. Through our preliminary research, we found there were not many similar experiences that utilized marching bands as a form of creative expression. We wanted to make a game that encourages creativity and gives the player freedom to be expressive through the gameplay experience. We also wanted to ensure that our final product was well polished and presentable.

We will start by covering our research on marching bands and similar interactive experiences that already exist. Next, we will discuss the overall design of the project, including our experience goals and core gameplay mechanics. We will then explore the technological, artistic, and auditory elements of this project in depth, as those were our team’s three major areas of expertise. After detailing the development of the game, we will describe our playtesting process, present our results and analysis of data received from playtesting, and provide an evaluation of the project as a whole.
2. Background

A marching band performance consists of a marching band on a sports field that coordinates its movements and the music that it plays in order to form shapes, patterns, letters or designs when viewed from above. Band members typically march from place to place in order to form these shapes, and have to sync their movements with each other as well as the music in order to perform.

2.1 Researching Marching Bands

Research for Marching Band Simulator started at the very beginning of the project. Because none of the MBS team members were part of a marching band, we needed to learn as much as we could about how marching bands operated.

2.1.1 Dot Sheets and Marching Terminology

A common method for drafting marching band performances is the dot sheet. It allows drill writers and marchers to easily visualize the field and different positionings (Figures 1 and 2). “Dots” refer to the individual band members, and can be denoted with numbers, letters, and/or symbols. These sheets can also be condensed into a list of instructions, as seen in Figure 3. Some sheets describe the different types of movements that a marcher may need to perform in addition to where in relation to the field’s “hashes”, or the markings laid every five yards on the yard lines, parallel to the sideline. We made sure to familiarize ourselves with common marching tools and terminology (Appendix A) so that we could better understand these sheets.
Figure 1: Example of a dot sheet used for an official university marching band

- Piccolos
- Clarinets
- Alto Saxes
- Tenor Saxes
- Trumpets
- Mellophones
- Trombones
- Baritones
- Sousaphones

- Percussion (Snares)
- Percussion (Tenors)
- Percussion (Cymbals)
- Percussion (Bass Drums)
- Guard (Flags)
- Guard (Rifles)
- Guard (Twirlers)

Figure 2: Example of a key that is used for dot sheets
Figure 3: Example of a coordinate sheet to be used in conjunction with a dot sheet

2.1.2 Instruments

American marching bands most often include instruments from the brass, woodwind, and percussion families. While the composition of the band may vary, they will most often include: trumpets, mellophones, trombones, and tubas/sousaphones from the brass family; flutes, piccolos, clarinets, and saxophones from the woodwinds family; and snare drums, tenor drums, bass drums, and cymbals from the percussion family. Additionally, some bands may have a “front ensemble”, or PIT (Percussion Instrument Team), where larger, stationary instruments or instruments not suited for marching may be placed. These can include glockenspiels, xylophones, bongos, wood blocks, gongs, and chimes.

2.2 Prior Works

There have been a few attempts in the space of simulating marching band performances. There are existing marching drill simulation software, such as Drill Studio by AUCS, EnVision by Smith Walbridge Band Products, and Pyware by PrGraphics Inc., but these examples exist within a purely practical and simulation space. Our Marching Band Simulator aimed to be a more open and creative means of performance creation.
Micro Marching League (2007) (MML) is a web-based marching game developed by Joe Lesko. Using the online editor, players can create 2D, top-down marching band shows of their own design which can be shared and viewed on the website. The editor consists of a number of marchers on the field and a number of “Sets” that allows controlling various properties of the marchers, such as position and pose, over time. Using a variety of tools, the marchers can be coordinated to create intricate and detailed performances. If desired, performances can be shared on the website along with a description, allowing other users to view and “like” them. Interestingly, while the website itself does not have the ability to embed music into a performance, many users have worked around this by including a link to music or a video of the performance with music within the performance description.

MML was a major inspiration for several aspects of our project. The functionality of the show editor helped shape our vision for our performance editor, particularly the keyframe-like system allowing animation over time. The desire for users to create musical performances also inspired us to include music support directly in the game. Importantly, with over 150,000 players and over 260,000 created shows, MML also demonstrated that there was a demand for games in this genre.
Marching Band Simulator 2015 (MBS15) was a game developed in Unity by LD Smith Games. The game features a number of marchers on a field, and has several buttons allowing the marchers to be arranged in a number of fixed formations. Other buttons allow for additional actions like changing the song, instrument volumes, uniform colors, and camera angle. MBS15 was the first 3D marching band game we found, and was a major inspiration for the low-poly, stylized visual style that we used in our project.

Marching Simulator (2018) (MS) was a PC game released on Steam in early access. The game allows controlling a set of military marchers, with a score determined by how well they perform. MS was a somewhat minor inspiration for our project, since it did not align much with our design or visual goals.

Overall, we were surprised at how few existing projects there were in this space. The most complete and popular game we found was MML, and while it featured a large number of gameplay mechanics, we thought there was room to expand on the visuals. We knew early on that we wanted our game to be 3D in order to add more creative depth, but most of the projects we were able to find were 2D. The exception to this was MBS15, which had 3D visuals but very little gameplay. Each of these projects had different aspects that contributed to the final design of Marching Band Simulator.

2.3 Developing the Style

When developing the style for Marching Band Simulator, the team decided to focus on a low-poly style, characterized by the use of simplified shapes in place of realism (see Figure 5 for example). We wanted the game’s style to be abstract so that the focus could be on the overall performance. Even with the simplified shapes and style, though, we also considered the scale of models in the scene. We aimed to scale our assets as realistically as possible, but had to change the proportions of the band members in order to make them visible and easily readable from the game's camera perspective.
We also looked into different marching band uniform styles. We referenced WPI’s own pep band for some aspects of the costumes, as well as other college marching uniforms. For example, the marching bands for the teams in the Big 10 Conference, pictured below in Figure 6, were used as inspiration. Common themes in the uniforms that we wanted to include were the different shako sizes and the straps, buttons, sashes, and capes that appear on the jackets.

![Marching Band Uniforms](image)

Figure 6: Marching band uniforms for the schools of the Big 10 Conference

While developing the user interface (UI) for *Marching Band Simulator*, we looked at other games from simulation, management, and other menu-heavy genres such as *The Sims* by Maxis and Electronic Arts, *Rise of Industry* by Kasedo Games, and *Humankind* by Amplitude Studios. We also took inspiration from other low-poly style games such as *OlliOlli World* by Roll7, and *Wonderbox: the Adventure Maker* by Aquiris Game Studio (seen below in Figure 7). We liked the sliding tabs because it allowed us to utilize as much screen space as possible for the performances while also keeping the necessary customization menus nearby. We also wanted a
simple, unobtrusive look to the UI so that it did not take away from the experience of making performances.

Figure 7: User interface examples from Wonderbox: The Adventure Maker

2.4 Programs/Software

We decided to use Unity to create our game. We chose this game engine because the team members were the most familiar with Unity over other major engines. We also noted the possible usefulness of the Asset Store for needed plugins or additional assets.

For 3D modeling and animation, Autodesk Maya was the primary software used. Adobe Illustrator was used for creating the user interface icons. In addition to Maya for the modeling and animation, we also used Blender to assist in a basic auto-rig for the costume pieces.

On the music side, we decided to use MIDI to handle our song playback, mainly since it would allow us to use a consistent set of instrument sounds across all songs. Since the instrument sounds are stored in a separate soundfont file, it meant adding new songs would be much easier than it would be if using a traditional wave-based music format. Another benefit of using MIDI would be that it can allow the ability to modify the notes of the song in real time, depending on the software library used supporting it. After analyzing the available options, we decided to use the Maestro - Midi Player Tool Kit (2018) Unity plugin, since it provided all of the tools we needed for MIDI playback and manipulation.

To compose and arrange the MIDI music for use in Marching Band Simulator, we used MuseScore 4, a free notation and arrangement software. Using MuseScore allowed us to easily
create original tracks as well as arrange pre-existing MIDI files for the instruments featured in the game. If necessary, extra sequencing was done using Ableton Live 11, a digital audio workstation (DAW) with extensive MIDI editing capability. For general sound effects, we used Reaper, an industry standard DAW, for recording and editing.
3. Design

The process of designing *Marching Band Simulator* began with a large brainstorming session. It was here that we laid out all of our ideas and decided on a direction to take the project. We discussed at length what we intended for the theme, mood, and style of our game, as well as some main features and goals for development.

3.1 Design Goals

The major goal for *Marching Band Simulator* was to design a creative and engaging experience for players. To accomplish this, we focused on a sandbox design, where the player could coordinate marching band members and use a variety of cosmetics in order to make whatever sort of performance they desire.

To tie in with the goal of inspiring creativity, we went with a light-hearted and laid-back mood. As discussed in Section 2.3, we went with a stylized and simple style so as to not overshadow the gameplay, and we wanted the mood to supplement this. To this end, we decided to allow certain unrealistic aspects such as allowing band members to move through each other and adding some unorthodox instruments like the kazoo. This decision to not focus on realism would give us more room to design fun gameplay, and would allow players greater freedom to create performances without the limitations of the real world. At the start of the project, we had plans to expand on this “unrealism” by adding more whimsical instrument, cosmetic, and setting choices, but these plans were later dropped as discussed in Section 8.1.

3.2 Player Experience

When deciding on what experience we wanted our player to have when playing *Marching Band Simulator*, we considered our target audience. We determined that we would have two main groups of people who would be interested in playing our game. The first group is people who are part of a marching band. These people would most likely be interested in the creative aspect of the game, and how it could help them create routines for their own bands. The other group would be people who were intrigued by the wacky style, and wanted to make marching band routines that would never be found in real life. While both of these player types have very different goals, we determined that we could satisfy both of these playstyles with our core experience.
At the center of our game, we decided to make an experience focused on open creative expression with plenty of customization options. By including traditional marching band instruments and costumes, players would be familiar with the initial game state, and be encouraged to explore the options available when it came to the creation of routines. Additionally, with the inclusion of strange and out of place cosmetics, such as the kazoo, we intended to allow the players' creative expression to surpass what traditional marching band performances would allow. This satisfies both groups, and allows all players to enjoy the core experience of creation and open expression.

3.3 Performance Editing

A Marching Band Simulator performance consists of a song and a routine. The player's band performs their routine to the beat of the chosen song, moving around the field as the routine specifies. In order to display a Marching Band performance, information about the band members, song, and positions over time must be maintained throughout the course of the performance.

First, the Keyframe system was set up as a core feature to track the position of each band member over the course of the song. Each keyframe lasts for 1 beat, and can be edited individually, with every band member linearly interpolating between their positions on each keyframe. This system is the basic platform upon which the rest of the features interact in order to create the player's marching band performance.

![Figure 8: The timeline for the WPI Alma Mater MIDI arrangement](image)

3.3.1 Choreography

In order to move around the people on the field, we decided to add the ability to transform marching band members in a similar way to the draggable “gizmos” used commonly for translating, rotating, and scaling in 3D editing software. When some number of band members are selected, a set of arrows appears at the group’s center that enables transforming them by clicking and dragging. By pressing certain keybinds, this gizmo can be switched between Translate, Rotate, and Spacing modes to allow positioning and rotating each person as
desired. The player can position band members wherever they want on the field, and even a short distance into the woods bordering the field.

Figure 9: Example of the gizmo in Translate, Rotate, and Spacing mode

The Draw Tool is a feature that allows the player to create freeform shapes from the current selection of band members. When the player clicks the Draw Tool button and drags their mouse along the field, the selected band members are spread evenly along the path. Because of the freeform nature of this tool, it is very useful for making curves or other shapes that are difficult or tedious to create by moving members individually.

Figure 10: An example of a line of band members drawn using the Draw Tool
The Circle Tool takes the current selection of band members and places them in a circle based on the average distance between the members. In concert with the scale function, a circle of any size can be created. Similarly, the Box Tool arranges the selected band members into an evenly spaced square, with any extra members being placed in a line to the side.

Figure 11: Examples of marching band members arranged using the Circle and Box Tools

In more complex performances, it can be useful to have similar band members grouped together for easy selection. To help the player with this, we added custom grouping, where the player can create up to ten groups of band members that can be selected with the number keys. The player can choose to group the band members in any way they wish, or not at all. Some common groupings include by instrument, by uniform variant, or by common position on the field.

In a competitive marching band performance, the dot sheet is sectioned into a simple grid, splitting the field into squares. Every 10 yards, there are 8 grid spaces, which allows the hash lines on the field to line up with the grid. We split our field into the same grid layout, to make it consistent with the convention, and to preserve the use of Marching Band Simulator as a tool for band directors. To aid with the usefulness of the grid, we allow the user to snap their current selection to the nearest grid point. This makes it easy to create a dot sheet from a Marching Band Simulator performance, or vice versa.

3.4 Customization

Another important feature is the costume customization. This feature allows the player to change the different pieces of the costumes that the band members are wearing. Different parts of
the costume can be changed, such as the hat, shirt, pants, shoes, and color scheme. Each of these changes can be applied to a single band member, or added to multiple members at the same time, to ease the application of cosmetic adjustments by the player.

Figure 12: The main cosmetics tab, featuring dropdown menus for each costume piece and a dropdown menu for color palette selection

While there are certain common color schemes that marching bands use for their uniforms, there are many combinations of colors that are not typically used. We introduced a feature that allows players to design and add their own Color Palettes to the game that can be applied to their band members in each of their performances.
It is equally important that the player is able to customize what instruments are present on the field. As such, the player can choose which instruments are assigned to band members similarly to how they change the costumes. They can choose from the many instruments available to the band, such as the trumpet, trombone, kazoo, clarinet, flute, and pan flute.
Just as with marching band performances in the real world, the basis of performances in *Marching Band Simulator* is the music. The music is designed to be the main structural component of the performance, around which the player creates the routine for their band. The player is able to select the music that their band is performing from a collection of songs through a dropdown menu in the pause menu (Figure 15). Song selection is intended to be done at the start of the performance editing process, though the song can be changed throughout editing if the player wishes.

![Figure 15: The pause menu and controls screen](image)

Finally, if the player wishes to pause the game, they can choose from a list of options on the pause menu. The navigation options include resume, which returns to the game, main menu, which exits to menu, and exit game, which closes the application. As mentioned previously, this menu contains the option to change the song. Players also have the ability to save or load performances to the file system from this menu. We also chose to include a list of controls for players to reference whenever they need.
4. Tech

All of the core features in *Marching Band Simulator* revolve around the marching band members. Many structures in the project are based around “Person” objects, which represent individual band members. Throughout the game, various features can be used to interact with and modify these Person objects in order to accomplish different tasks, such as changing the uniforms or positioning them on the field.

4.1 Timeline and Performance Editor

One of the systems that we worked on as early as our initial prototype was the Timeline system, which was responsible for handling and storing all of the keyframe data. The Timeline contains definitions for multiple keyframe properties, such as position and rotation. Each of these properties contain their own list of keyframes for each Person, and each property knows how to apply a given keyframe to a given Person. The use of generics in this system meant that a lot of the code could be reused between multiple properties, and meant that the Timeline code would not have to change much to adapt to properties we would add in the future. The Timeline contains a list of all the types of properties, and enables the ability to apply all of the properties for a given point in time, interpolating the values if the time is between two keyframes.

The Timeline is controlled by the Performance Editor, which is the object that manages all editing features and keybinds, as well as parts of the user interface. The Performance Editor is also responsible for synchronizing the performance with the music, which can be started or stopped with the play button or spacebar. While the music is playing, the Editor synchronizes the Timeline with the music. When the music is stopped, the player can navigate through the Timeline manually.

The Performance Editor uses the functionality of the Timeline to update the people’s properties to match the current frame. This interaction between the Editor and the Timeline uses the MIDI’s position while the music is playing or the selected frame if the music is stopped. To work with the Timeline system, when an editing tool manipulates a property of a Person, such as position, it must set the value of the keyframe property for the current time, instead of directly changing the property of the Person. If a property were to be directly changed, it would be immediately overridden when the keyframe property is automatically updated by the Timeline in the next frame.
4.2 Placing People and the Grid System

Since *Marching Band Simulator* is heavily focused on editing and manipulating the properties of many different objects, being able to select both individuals and groups is essential to efficient creation. As such, the ability to select people was added very early on in one of the first prototypes of the game. To start, we added a simple selection system where clicking on a person would toggle their selected state, leaving the other people unchanged. While this was technically enough to allow any combination of selected people, we knew we would need a more robust way of selecting people, especially large groups.

To extend the selection system, we added the ability to select whole areas of people by adding a rectangle select tool. When clicking and dragging on the field, a rectangle will appear, continuously updating to fit both the starting point and the current mouse position. This rectangle is aligned flat on the ground in world space, since most of the time the band members will be aligned with the field and not with the camera orientation. When the mouse is released, every band member within the rectangle is selected. The way that a new set of people is combined with the current set of selected people is determined by what modifier keys (Alt, Shift, Control) are held when selecting. These modifiers give the player the choice of overriding, adding to, subtracting from, or inverting the selection. At first, the old click-to-toggle action was unchanged, but after feedback from playtesters, it was switched to follow the same set of modifier rules as the new system.

![Selection box when selecting multiple people](image)

Figure 16: Selection box when selecting multiple people
In early iterations of *Marching Band Simulator*, the only way to move selected band members around was by clicking and dragging with the middle mouse button. This was always meant to be a temporary solution while we researched alternatives, but seeing how people interacted with this initial system helped us decide on the implementation of the gizmo.

As described in Section 3.3.1, we decided on using a standard transform gizmo for band member manipulation. Since no such runtime gizmo is included in Unity by default, we decided to build off of an open source tool called *Unity3DRuntimeTransformGizmo*, which is a general purpose implementation of what we needed. To fit it more closely with this project, we made several modifications to it, including updating it to Unity 2022.1, restricting the motion to two dimensions, and making it interact well with the timeline and selection systems.

One feature that we planned to have early on was the ability to snap people to the gridlines on the field. But before we could work on that, we needed to add the gridlines themselves. Based on our prior research into real life marching band choreography, we knew what the field should look like in order to match the traditional dot sheet, including how many gridlines there should be and their spacing. In order to add these to the field, we created four different prefabs, or preset objects that allow for easy reusability and customization. Two prefabs were used for horizontal lines and two were used for vertical lines, with minor and major versions of both. These are placed procedurally, using the known counts and spacings from our research. Later on, we would expand on this concept by adding additional field elements such as the yard lines and numbers seen on typical football fields.

![Figure 17: In-editor view of procedural grid generation](image-url)
Once the grid system was created, we finished by adding the ability to snap band members to the grid. While translating with the transform gizmo, the player can hold Control to snap members to the grid, with the option to fine snap by also holding Shift. Alternatively, we also created a keybind to immediately snap all of the selected people onto the grid.

Additionally, in order to make the field feel like a cohesive space, we decided to add props to the background, which helped break up the infinite expanse of the flat field. We created some primitive props, such as trees, rocks, and grass, then scattered them procedurally around the world. The object that arranges the props in the world can be customized to add them to certain areas in the world and avoid others. This meant we were able to specify certain places, such as the field or the bleachers, where we did not want props to appear, while still allowing them to be randomly placed in the world.

When the player launches the editor, the camera starts in a default position to give the player a comprehensive view of their band. We wanted to give the player some degree of freedom to control the camera’s position within the editor. To accomplish this, we locked the camera's range of motion to the field, only allowing it to stray a certain distance past the bounds of the field into the woods. Additionally, while we wanted to allow the player plenty of agency when choosing a viewing angle, we limited the pitch of the camera. However, the yaw is fully controllable by the player. These constraints keep the player focused on the field, while still allowing them to choose various angles from which to view their performance.

4.3 Cosmetics/Instruments

One of the major draws of Marching Band Simulator is the interesting cosmetics and instruments that can be equipped to the band members. In order to ensure easy expansion of the available options, we used Cosmetic and Instrument prefabs that can be configured with unique data such as models, animations, display names, and valid cosmetic slots. These objects are stored internally, which allows them to be referenced directly by the cosmetics menu. The dropdown for selecting a specific costume piece or instrument will automatically populate with any costumes or instruments present in the target directory, such as the user-created color palettes shown in Figure 18.
In order to simplify the creation of costumes, we decided to represent different parts of a uniform with different colors. As such, costume pieces are colored with either a primary, secondary, or tertiary color. These three colors make up a color palette.

Since we wanted to allow a selection of instruments to be assigned to band members, we needed a system that would allow for the changing of instruments. Each band member’s instrument is placed as a child of their instrument slot, meaning it is positioned relative to the member. In order to ensure that the people hold their instruments in a way that makes sense, we used Unity’s inverse kinematics system to automatically pose the arms. Using hand positions defined in the instrument, the position of the arms is extrapolated. This reduces the work needed to add new instruments by removing the need to manually animate or pose the person’s upper body.
4.4 Saving Color Palettes and Performances

Some information, such as user-created color palettes or performances, needs to be saved between game sessions. In order to access color palettes later, we saved them as a custom file type with the extension “.pal.” A .pal file contains information about the name of the saved palette, as well as the RGB values for the primary, secondary, and tertiary colors. When using the “Save” button in the palette creation menu, a .pal file is created and saved to Unity’s default user data folder. Any .pal files in this folder are also automatically loaded the next time the game is started, allowing the player to save palettes across sessions.

Figure 20: The color palette creator, used for saving a user created palette

The data format for performances is more complex because of the amount of data stored, but generally uses a similar system to the one used for palettes. Performances are saved as “.mbpf” files which contain all of the information needed to replicate a performance, including the song selection, the cosmetics and palette for each person, and the data for each keyframe. As described in Section 4.1, this data includes properties such as position and rotation. While the data is in a binary format, optimizing for small file size was not a priority, so the format has very verbose data that could be compressed greatly. However, even uncompressed, the size of these files is very small, with shorter performances often being less than 100KB. The player can choose to save their performance to a file at any time by using the “Save” button in the pause
menu, which opens a file selector allowing the .mbpf file to be saved anywhere. Similarly, the “Load” button in the pause menu opens a file selector that allows the player to load a performance from a .mbpf file.

4.5 Version Control

In any large project, it is crucial to use a version control system to track project files in order to ensure the project is not lost due to issues like disk failure or file corruption, and to allow rolling back to prior versions in the case that changes made to the project contain unwanted side effects. In determining which system to use, we examined a few of the main options for version control, including Git with Git LFS, Perforce, and Plastic SCM. Out of the three, we were the most familiar with Git, but the limits on GitHub’s Large File Storage service were so low that we would likely have had to pay for an upgrade, and setting up a custom server would have been needlessly complicated. We also had some experience using Perforce before, but only once for an Unreal Engine class project. We had overheard the complicated steps needed to get Perforce set up for the class, and decided it would be overkill for this project. The last option we reviewed was Plastic SCM, which is the main version control system that Unity recommends, even coming with an official Unity plugin. While we had no prior experience with it, we decided Plastic SCM was the best option for our project given that it was the official recommendation. For the most part it served its purpose, but in the end, the Unity Plastic SCM plugin ended up being a major barrier for progress throughout the project, which we discuss later in Section 8.3.
5. Art and Visual Development

We took care in developing the art style for Marching Band Simulator, starting with the concept art, then moving into modeling, and finally rigging and animating the people in the game. We were also conscious in the development of our user interface, as we knew that it would be important to the core gameplay.

5.1 Concept Art

During our pre-production, we developed concept art for what we wanted our game to look like. We wanted to have a low-poly, geometric style that used solid colors and simple shapes to create a playful, creative setting for the game, while keeping focus on players’ performances.

5.1.1 People

![Figure 21: Style study on Godus](image)

For the people in our game, we started by breaking down the styles of our references, as seen above in Figure 21, isolating the parts we wanted to emulate and noting what we wanted to change. We determined that achieving our “low-poly” look would involve simplifying the human figure into basic shapes. Though we ideated on including different body shapes, sizes, and even having the body parts “float” alongside the body similar to Mii and Overcooked characters, as seen in Figure 22, we decided on following our initial inspiration, Godus. It incorporated the low-poly, geometric appearance we aimed for, while also allowing a wider array of clothing options because it still used a full body as a base.
We also started to draft ideas for how we would break down the costume and uniform elements so that we would be able to make them customizable assets. We decided to break down the costume pieces by clothing type: head/hat, torso/jacket, legs/pants, and footwear. Using real marching band uniforms as a guideline (see Figure 6 in Section 2.3), we sketched out ideas for the costume pieces, as seen in Figure 23.
5.1.2 User Interface

We spent a lot of time drafting Marching Band Simulator’s user interface. Both the creation of routines and the customization of the band were reliant on information being readily available to the player through clear, navigable menus. We wanted the main performance space to take center stage and be visible at all times. We originally considered giving the costume creation a separate screen, as seen drafted in Figure 24, but we decided to condense it into side menus, as seen in the second concept in Figure 25.

![Figure 24: Main UI Concept (Left) and Costume UI Concept (Right)](image)

![Figure 25: Alternate main UI concept](image)
5.2 Modeling

Marching Band Simulator is a 3D game, and as such all the assets for it needed to be modeled within 3D software, mainly Autodesk Maya. This section focuses on the essential assets (the instruments, people, and costumes), however images of the environment art can be seen in Appendix I.

5.2.1 Instruments

To develop the instruments for the game and keep to the low-poly style, our instruments, as seen below in Figure 26, were built using octagonal prisms as their base. This provides the implication of rounded shapes while keeping the style low-poly and abstract. As stated in Section 2.3, we wanted to keep the scales of the instruments proportional to the people and the environment. Most instruments were able to follow this precedent, however some, specifically the flute and clarinet, had to be made larger so that they would be more recognizable at a far distance.

![Figure 26: Instrument Models](image-url)
5.2.2 People

Following our concept art and low-poly style, the band member model was kept simple and geometric. It was built from a simple cube that was subdivided and extruded to construct the base person. Using this simple style, allowed the focus to remain on the performance as a whole, and the colors of the costumes were able to stand out more. The original model was made with as few polygons as possible, but for animation purposes the model was subdivided, as more polygons meant that there were more points in which the model could bend without completely breaking. Having a whole body to build off of was also important when we started developing the costume pieces.

![Figure 27: Base Person model for the marching band members](image)

5.2.3 Costumes

Using the “Base Person” model as a foundation, the clothing was constructed on top. Each uniform piece was split into four different materials: primary, secondary, tertiary, and static. For purposes of modeling, these were represented by red, white, yellow, and black, respectively. This was done so that each section would be able to be tied to a different material shader in Unity. By having each costume piece connected to the same material, we could dynamically change the colors for the costume palette customizations. The final costume pieces can be seen in Figure 28 below.
Figure 28: Models of each costume piece

5.3 Rigging and Animation

To save production time, we utilized Maya’s “Quick Rig” tool to give the base person model an animatable skeleton. We opted to use go step-by-step instead of the automatic function to give us a bit more control over where the joints were on the model. The Quick Rig is not perfect, however, and there was cleanup needed so that the mesh would deform correctly when animated. This was done by manually changing the weight painting on the joints of the model, which you can see in Figure 29 below. The topology on the base person was not optimized, and though an optimized model was created, there were complications implementing it. This is discussed more in Section 8.2.
Using the Quick Rig, the base model was animated to do two essential marching steps: roll step and chair step. Roll step is meant to minimize the amount of upper torso movement and allow band members to move even distances smoothly. Chair step, the main step featured in *Marching Band Simulator*, has an emphasis on larger leg movement.

The people's bodies were manually animated, but in order for the costume to move with them, we used a simple Blender script to automatically transfer the person rig to the cosmetics. The results were not perfect and had some places where the character model would clip and be seen through the clothing, but it saved a lot of time for the project.

For the arm animation, we used inverse kinematics to place the arms where the instrument was. While this was not always accurate to how the instrument is realistically, it was easier for us to implement in our given time frame. The animations were layered on top of each other in Unity itself, so the feet would always move regardless of which instrument an individual model was playing.

### 5.4 User Interface

For the UI, we wanted to focus on making the necessary buttons and tools as clear as possible, as well as make sure the menus were as navigable as possible. We used a color scheme that was reminiscent of a traditional red, white and gold themed marching band, and the menus
were semi-transparent, using a black background to provide contrast. See Figures 12-14 in Section 3.4 for images of the main UI and menus.

For the game, we also wanted our icons to be easily recognizable on any screen at any distance. We made the icons rounded to stand out from the geometric of the 3D aspects of the game, but a simple color scheme and design to keep it subtle and in line with our menus style. The main icons were used to denote the menu tabs and the draw tool for the game. The control icons, though unimplemented, were meant to allow the player to quickly tell what tool they are currently using, and the audio/timeline icons are meant to help the player navigate the performance timeline. See Figure 30 below for a full size image of the icons created for the game.

![Main Icons](image)

**Main Icons**
- Costumes
- Color Palettes
- Instruments
- Draw Tool

![Control Icons](image)

**Control Icons**
- Camera
- Move Tool
- Rotate Tool
- Scale Tool

![Audio/Timeline Icons](image)

**Audio/Timeline Icons**
- Song Select
- Play
- Pause
- Reverse
- Help

Figure 30: Icons used for the user interface
When it came to font, we opted to use the Collegiate font for the title screen, because it is a bold display font that fits our theme of school bands very well. It is attention-grabbing and fun, and implies the casual atmosphere of the game that we are trying to capture. Cabin was chosen as the primary font for the UI because it is a clear, sans-serif font that is easy to read at a glance, as well as visually pleasing when contrasted with Collegiate. See Figure 31 below for a full example of the fonts.

![Font examples for Collegiate and Cabin](image)

**Figure 31:** Font examples for Collegiate and Cabin
6. Sound

The development of the sound design for Marching Band Simulator consisted of two main elements: music and sound effects.

6.1 Music

One of the most integral aspects of a marching band is the music. For Marching Band Simulator, the music is the basis for the user’s entire experience, making up the foundation for their routine. As mentioned in Section 3.4, the player is able to choose what song they would like their band to perform, and has the freedom to do so at any time during the editing process. For streamlined playback, we decided to have the music sequenced in MIDI and played back with a soundfont. This was done to make the music compatible with our keyframe system, as detailed in Section 4.1. The main program used for composition and arrangement of music was MuseScore 4, a free notation software and digital audio workstation with an extensive instrument library and MIDI capability. To guarantee that some files were compatible with the project, extra sequencing was done in Ableton Live 11, a digital audio workstation that allows for in-depth editing. There are currently eight songs in Marching Band Simulator that players can choose between, including “Stars and Stripes Forever,” originally composed by John Philip Sousa, the Alma Mater of the Worcester Polytechnic Institute, originally composed by Willard Hedlund and arranged by Braden Arnold, and “Marching Band Blue Bossa” composed by Braden Arnold, to name a few. A collection of the music composed and arranged by Braden Arnold for Marching Band Simulator can be found in Appendix H. “Stars and Stripes Forever” was chosen as the featured song for Marching Band Simulator due to its recognizability and popularity as a marching band standard. The MIDI files for “Stars and Stripes Forever” and other songs were sourced from midkar.com, a website with an extensive database of free, user-submitted MIDI files. We included the Worcester Polytechnic Institute Alma Mater to honor the institution that gave us the opportunity to create our game and to add some school spirit to the experience. The Alma Mater was arranged in MuseScore by using sheet music found through Lastly, “Marching Band Blue Bossa,” shown below in Figure 32, was composed for the game. The song is a bossa nova in C minor written to be performed by piccolo, flute, clarinet, trumpet, trombone, snare drum, and bass drum.
Figure 32: The first two pages of the sheet music for “Marching Band Blue Bossa,” an original song composed for *Marching Band Simulator*

### 6.2 Sound Effects

Another integral aspect of *Marching Band Simulator* is the sound design. We wanted the sound effects to fit the low-poly aesthetic of the visuals, and hoped to avoid a soundscape that would be obtrusive and interfere with the playback of routines. To ensure the sound effects do not intrude on this aspect of the game, we decided that the main source of audio in the game would come from the user interface and the player’s interactions with the menus. When the player’s band is performing, the only audio is the music, as that is what we felt the player would want to be hearing when watching their marching band perform. All of the sound effects featured in *Marching Band Simulator* are made from original recordings. Initial recordings of instrument samples were recorded using a ZOOM H4n Pro Handy Recorder paired with an Audio-Technica AT897 shotgun microphone. The instruments that were recorded with this setup include clarinet, flute, piccolo, trombone, trumpet, bass drum, and snare drum. To gather these recordings,
volunteers from WPI’s Marching and Pep Band were recruited with the help of the current band president. Recording sessions were held to collect recordings of each instrument playing notes of different lengths and other various samples such as slides, glissandi (glides from one pitch to another), and mistakes. For the sounds for the user interface, recordings were collected using a ZOOM F8n Multitrack Field Recorder as a USB interface with an MXL 770 condenser microphone recording directly into Reaper, an industry-standard DAW used for sound effect editing. Recording directly into Reaper proved to be the best way to record sounds because it provided the ability to listen back to recordings instantly and apply effects and processing directly to the raw recordings. This process was done to record the sound effects for the user interface, which include the button clicks, person selection sound, and uniform equipping sounds.
7. Testing

We had multiple rounds of playtesting for *Marching Band Simulator*, where we brought people in to play our game and give feedback. At each stage, we actively observed testers while they played and had them complete a survey with questions about their gameplay experience. Our main objective with each round of playtesting was to learn more about how players interacted with our game and how we could improve it. We had different goals at each stage of playtesting based on the current iteration of the project. As it continuously evolved, so too did the type of feedback that we needed to gather.

7.1 Protofest

The IMGD department hosted Protofest in October 2022, where MQP teams could showcase their project prototypes and gather feedback from fellow students. For the Protofest exhibition, we had only the very basic structure of our game to show to attendees. As shown in Figure 33, capsules representing marching band members were displayed in a plain environment holding simple shapes to represent their instruments. A timeline was shown at the bottom of the screen, where players could scroll through keyframes to watch the capsules move around in the environment. Players were able to move the capsules around the environment and assign their positions to keyframes, and capsules that were not manually moved by the player would have random movement by default. There was also a side menu, where players could change the color of the capsules using a selector, as well as assign headwear to the capsules, which could be either a cube or a sphere chosen from a dropdown menu. Our main objective for Protofest was to give people an idea of what the game might look like, and a basic concept of the core mechanics of keyframing, uniform customization, and color selection. Music selection had not been implemented yet, but there was a default track that players could listen to when they watched the capsules move around.
Figure 33: Protofest build of the routine editor with capsule models, simple timeline, color picker, and hat selector

The main feedback we were looking for was a sense of whether or not the general concept of *Marching Band Simulator* was something people would enjoy playing and what their expectations were for a fully fleshed out interactive experience. To collect this feedback, we had players fill out a quick survey (Appendix B). Initial feedback was very positive. While the controls were basic, and the visuals barely grayboxed, the players seemed to enjoy the concept, and had a good time watching the capsules dance around on the screen. Most people liked the concepts we proposed, and with the context from the demo, considered our project an interesting experience. Figure 34 shows that playtesters especially liked the idea of judges who would rate players’ created performances. There was also a strong interest in customizability, as evidenced by Figure 35.
Figure 34: Playtesters’ ratings of the concept of judges, showing an overall positive response

Figure 35: Playtesters’ ratings of the concept of customizable costumes, showing an overall positive response

7.2 Alphafest

Not too long after Protifest came Alphafest in November. Alphafest was a vital opportunity for IMGD MQP teams to show off progress on their projects and demonstrate an alpha build. Alphafest signified the midpoint of the development of Marching Band Simulator, as it was at this point that we had the basic design figured out and a lot of the major features implemented such as keyframe editing, uniform creation, character and instrument models, and MIDI playback. The goal at this stage was to gather feedback about the way that the players
interacted with the game, and the extent to which players could use the game as a form of creative expression. As such, we asked the players to experiment with the game, allowing them to spend as long as they wanted creating a marching band routine. We wanted to study how players would interact with the routine editor if given an unlimited amount of time to explore its capabilities. A playtesting survey (Appendix C) was used to collect feedback from the players. We used the survey to ask players for feedback on aspects of the game such as menu navigation, timeline operation, and the overall gameplay process. Alphafest proved to be a valuable opportunity, as we were able to gather feedback from members of the WPI Pep Band. Certain features such as the dot sheet grid system were implemented as a direct result of the recommendations made by testers from the Pep Band.

![Figure 36: Alphafest build of the routine editor with character models, more detailed user interface, timeline, and field](image)

By the end of Alphafest, we were pleasantly surprised with how many interesting and unique performances the players had created. Additionally, we had learned more about player preferences for features and controls to implement as the project continued. The concept of the marching band dot sheet was introduced, as well as the inspiration for the grid system.

The results of the Alphafest testing were also encouraging. It was interesting to note that 25% of our playtesters had participated in marching bands in the past (Figure 37). Testers
generally enjoyed the game and the process of creating routines, though many players struggled to understand the costumes and timeline systems.

Figure 37: Percentage of Alphafest playtesters who have participated in a marching band

Feedback from these playtesters was very valuable, as they provided many ideas for useful features that would make our project useful as a tool for designing real marching band performances. We also noticed that our testers had mixed results when it came to understanding the keyframe system (Figure 38, Figure 39). This led us to prioritize the overhaul of the timeline display to make it more readable by enlarging it, adding measure numbers to correspond with the music, and including a play/stop button.

Figure 38: Playtesters comprehension of our keyframing system
We also used the feedback we received about costume creation (Figure 40) to reconstruct the customization menus. We found that playtesters had a generally positive experience with uniform creation, but it still required additional revision. The layout of the menus was modified to be easier to navigate by splitting customization into the three sections of costumes, color palette creation, and instrument selection.

Lastly, and arguably most importantly, the majority of playtesters at Alphafest enjoyed the core gameplay process of creating marching band routines (Figure 41). We saw this as a great accomplishment and a step in the right direction towards the achievement of our experience goals. We were glad to see that players responded positively to having creative freedom and used this motivation to incorporate new features that encouraged creativity such as the draw tool.
7.3 General Playtesting

During the final general playtesting phase of *Marching Band Simulator*, we sought feedback for multiple newly implemented features in our game as well as features that had been updated from our Alphafest build. Additionally, we wanted to gauge user experience and general ease of use of the editor. At the beginning of each playtesting session, we showed the tester the basic controls to help give them an idea of how to interact with the game. Next, we gave them specific tasks to complete, such as changing costumes and instruments, creating palettes, and assigning formations to keyframes. This was done to help acquaint them with the menus and general features and introduce them to each component of the editor. After they completed the given tasks, we gave them the rest of the session to create a marching band routine using everything they had learned. This free-form style of testing allowed us to easily pay attention to playesters’ interactions with the editor and gather feedback about how the testers used the available features. We were also able to observe which methods of placing and moving people were preferred and any emergent behaviors that arose from the use of the tools that were provided.

While this iteration of playtesting was fairly focused on finding and fixing flaws, we did receive relevant responses regarding the navigation of the interface. Compared to Alphafest, there was marked improvement in the playtesters' intuitive understanding of the game's menus, as seen in Figure 42. We also noticed a large increase in the playtesters’ understanding of the user interface, showing that we adequately improved upon it from our Alphafest build (Figure 43).
Figure 42: Playtesters' ratings of menus

Figure 43: Ratings of the general interface for creating performances

7.4 Major Findings

Overall, we found that players enjoyed the experience of playing *Marching Band Simulator*. Some players found the game hard to learn, but most were content to spend 30 minutes to an hour messing around with the controls. Playtesters had a lot of feedback and differing opinions regarding what keys should correspond with different actions, especially swapping between the Translate, Rotate and Scale features. Playtesting helped us root out a handful of major bugs in our game, and allowed us to heavily improve the final product.

In addition to the mainly useful data that we collected, there were some less useful, but very interesting things that we noticed throughout playtesting. First, our players found ways to interact with the game that we had not intended. For example, some players would neglect to use the translate tool for moving people on the field, instead opting to place people directly using the Box Tool. Additionally, we noticed that multiple people would attempt to create a rotating circle
by using the rotate tool. Due to how the members interpolate, this ended up creating an interesting effect where the band members would all walk through the center of the circle at the same time, expanding on the other side back into a circle.
8. Conclusion

Marching Band Simulator was an exciting project to work on, and one with which we are happy with the outcome. We succeeded in achieving our goal of creating a fun, useful, and lighthearted experience that captures the aesthetic of a marching band. We have suggestions for how this project could be improved, and how to approach similar projects in the future.

8.1 Scope

During our original brainstorm for this project, we did our best to be conscious of the scope of the project. We wanted to make sure that we would be able to complete all of our main objectives, and create a cohesive and polished experience. However, as we worked on the game, it became apparent that we would have to redefine the scope of our game even further in order to make sure we would have a polished final product.

Originally, we intended to include a career mode for Marching Band Simulator where the player would craft performances to progress through a story, gaining favor from judges and using profits to upgrade their band. We decided to pivot from having a career mode to just having a more polished sandbox mode, as we felt it would be the best representation of the functionality of the game. The career mode would have included the ability to compete against other bands in scored competitions. Each event would have a panel of judges, each with different tastes, and different ways of scoring a performance. Additionally, the player would unlock different instruments, costume pieces, and color palettes as rewards for performing. Through this basic progression system, the player would be able to grow their band, attend more performances, and travel to new venues in order to explore a large amount of content.

8.2 Future Work

There were many features that we sought to implement that never made it into the final build. The ability for the player to upload their own MIDI files to score their own marches was a fairly important feature that was never fully realized in our game. Additionally, other useful movement tools, such as the ability to form more shapes, were left out.

There were also more instrument and character models that did not make it into the game. The character model has some problems with weight painting, where the model will break or costume pieces will overlap where they should not. An updated model of the base person with
optimized geometry was made, but was not able to be implemented due to time constraints (see Figure 44 below). The optimized model uses even fewer polygons, and at critical points of the model that bend, the geometry would retain its shape instead of crunching and folding in on itself (see Figure 45 below).

Figure 44: Optimized Model (Top) Compared to Original (Bottom)

Figure 45: Bend Comparison
Additionally, there were instruments that were modeled, but we were unable to add them because we could not get recordings for them, or could not generate animations for them. While we were able to implement the woodwind and brass instruments that were modeled, complications prevented us from implementing the percussion instruments. These instruments are displayed in Figure 26 in Section 5.2.1.

In the future, there is the potential for these missing features to be added. The ability to upload custom music to the game would have a dramatic effect on the creative extent of the experience. Additionally, one of the positives we discussed in brainstorming was the ease of expandability. The structure of Marching Band Simulator makes it easy to add more costumes, instruments and color palettes. We also originally planned for there to be many settings to choose from. Adding more fields in new and interesting locations would help diversify players' performances, and add more options for customization.

8.3 What Went Wrong

We ran into multiple difficulties throughout the course of this project. First of all, it was difficult to record sound samples for our game. While we reached out directly to the pep band in order to find people to record, scheduling sessions was difficult, and finding people to play all of the instruments we wanted to add was near impossible. As a result, we had to supplement the recorded samples with pre-recorded ones. We recommend for people looking to record custom instrument samples to set aside a lot of time for recording, and source from multiple locations, rather than a single band.

Additionally, something that we had difficulty with was the Plastic SCM plugin for Unity, which we used for version control. The plugin contained a lot of bugs, one of which caused the editor to crash or hang often when editing any property of the UI. This made UI work very time consuming, and ended up adding many hours to the development of the UI. We also ran into problems with submitting changes, with the plugin often requiring repeated attempts for submissions to work. This became so bad for some team members that it forced the use of Plastic’s standalone client, rather than using the embedded version in the plugin. We recommend that future projects consider how the choice of version control could affect the development process, and take additional time before working on the project to experiment with available options before making a decision.
8.4 What Went Right

This being said, there were also plenty of things throughout the project that went well. Firstly, and arguably most importantly, the people who played our game enjoyed their experience. This is a great success, as the most important part of designing a game is to ensure that it is fun to play. Additionally, we are happy with our decision to utilize MIDI for music storage and playback, as it proved easy to work with and modify as needed. We also found it relatively easy to edit a custom soundfont in order to implement our custom instrument sounds. Finally, we believe that playtesting went well. At each stage of testing, the playtesters were all eager to try out our game, and enjoyed themselves while testing. We managed to get a lot of valuable feedback, which allowed us to fix problems and improve usability quickly.
9. References


## 10. Appendices

### A. Glossary of Useful Marching Band Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadence</td>
<td>Tempo of the music, dictates the movement of the marching</td>
</tr>
<tr>
<td>Chair Step</td>
<td>Type of step that raises the knee high</td>
</tr>
<tr>
<td>Dot Sheet / Drill Chart</td>
<td>Visual sheet for writing and learning marching band performances, or “drills”</td>
</tr>
<tr>
<td>Drum Major(s)</td>
<td>Conductor(s) directing the marching band</td>
</tr>
<tr>
<td>Gauntlets</td>
<td>The wrist/lower arm coverings</td>
</tr>
<tr>
<td>Hashes</td>
<td>Markings laid every five yards on the yard lines, parallel to the sideline</td>
</tr>
<tr>
<td>Pep Death</td>
<td>Informal name for when band members collide during a performance</td>
</tr>
<tr>
<td>Plume</td>
<td>Feather on the Shako</td>
</tr>
<tr>
<td>Roll Step / Glide Step</td>
<td>Type of step to minimize upper body movement</td>
</tr>
<tr>
<td>Shako</td>
<td>The standard cylindrical marching band hat</td>
</tr>
</tbody>
</table>
B. Protofest Playtesting Survey

Do you play an instrument? *

☐ Yes
☐ No
Prototype Questions

How would you rate the concept of the judges?

1  2  3  4  5  6  7
Very bad  ○  ○  ○  ○  ○  ○  ○  Very good

How would you rate the concept of costume design?

1  2  3  4  5  6  7
Very bad  ○  ○  ○  ○  ○  ○  ○  Very good

How would you rate the concept of item upgrades?

1  2  3  4  5  6  7
Very bad  ○  ○  ○  ○  ○  ○  ○  Very good

Are there any specific instruments that you would like to see included?

Your answer

Your answer
How useful do you think the grouping system will be?

1  2  3  4  5  6  7

Not useful at all  ○  ○  ○  ○  ○  ○  ○  Extremely useful

Are there any customization options you'd like to see in the game?

Your answer

How much would you pay for this game?

Your answer

Any other comments, questions, suggestions, etc?

Your answer
Marching Band Simulator Alphafest Survey

Do you play an instrument?
- Yes
- No

If so, which instrument(s)?
Your answer

Do you/have you ever played in a marching band?
- Yes
- No
How much did you enjoy the game?

1  2  3  4  5  6  7
Not at all  ○  ○  ○  ○  ○  ○  ○  A lot

How intuitive was the uniform creation?

1  2  3  4  5  6  7
Unplayable  ○  ○  ○  ○  ○  ○  ○  Super Easy

How useful was the Colors menu?

1  2  3  4  5  6  7
   ○  ○  ○  ○  ○  ○  ○

How well did you understand how keyframes were displayed?

1  2  3  4  5  6  7
Not at all  ○  ○  ○  ○  ○  ○  ○  Perfectly
How well were you able to navigate the timeline?

[1-7 scale with options Not at all and Perfectly]

Do you have any comments regarding the keyframes and timeline usage?

Your answer

How much did you enjoy the process of creating routines?

[1-7 scale with options Not at all and Very enjoyable]

Do you have any comments regarding routine creation?

Your answer

Do you have any comments regarding the artistic style of the game?

Your answer
Did anything break?

Your answer

How much do these words represent your experience?

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A little</th>
<th>Somewhat</th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frustrating</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Boring</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Enjoyable</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Inspiring</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Fun</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Satisfying</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Confusing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Creative</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tedious</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Are there any other words you would use to describe the experience?

Your answer

How much would you pay for this game?

Your answer

Any other comments, questions, suggestions, etc?

Your answer

Do you need playtesting credit? If so please leave your WPI email.

Your answer

Submit  Clear form
**MARCHING BAND SIMULATOR CONTROLS:**

**Mouse:**
- Left Click to Select
- Left Click + Drag to Select Multiple
- Middle Mouse Click to Move Selection

**CTRL + A:**
- Select All

‘C’ Key:
- Form Your Selection into a Circle

**Space Bar:**
- Start/Stop Performance

**Arrow Keys:**
- Scroll Through Timeline

**FEEDBACK SURVEY:**

![QR Code]
E. Statement of Research Methods

Marching Band Simulator MQP
Research Methodology

Overview: The Marching Band Simulator MQP team intends to perform playtesting sessions in order to test the game and get an idea of the new player experience.

The team will send out a recruitment email to WPI students containing information about the project and testing process and a link allowing subjects to sign up for a time slot. At the start of their time slot, the subject will be informed in more detail about the process and the usage of any data collected. They will then be asked to spend about 10-15 minutes playing the game, first performing a set of pre-selected tasks and then doing whatever they want. After playing, the subject will then be asked to complete a survey about the game. This survey contains primarily questions about usability and their experience with the game during the session. If desired, the subject may provide their email in order to receive IMGD playtesting credit, but this is not required (as with all other questions) and will not be released in any other way. Any other non-personal aggregate data will be used to analyze how the experience compares to the team’s expectations, and may be used as talking points in the team’s final MQP report.
Marching Band Simulator Playtesting Form

Introduction:
You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study:
This study aims to test the functionality and player experience of our marching routine creation game, Marching Band Simulator. By participating in this study, we hope that you will be able to provide feedback that will help the team further improve and polish the project.

Procedures to be followed:
At the start of the session, you will be sat in front of a provided computer which is running the Marching Band Simulator game. After a short introduction from a team member, you will be given a list of a few tasks to complete within the game. Afterwards, you will be given some time to play on your own. Once you are finished, you will complete a short survey about your experience during the session.

Risks to study participants:
This study has very minimal risk. The experience of our game is intended to be calm, and there are no known issues that could reasonably cause discomfort or harm. However, while we have tested the project ourselves, it is possible that unknown issues are encountered that could cause some minor discomfort. At any time, you may stop playing and quit the study if you feel uncomfortable.

Benefits to research participants and others:
By participating in the study, you will have the opportunity to be one of the first to experience our game in its most polished form yet. Your feedback will help us to prioritize areas to focus on for polish so we can present the game to a wider audience in the future.

Record keeping and confidentiality:
Records of your participation in this study will be held confidential so far as permitted by law. However, the study investigators, the sponsor or its designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury:

There is no foreseeable risk of injury associated with this study. However, you do not give up any of your legal rights by signing this statement.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact:

Marching Band Simulator Team (gr-marchingmpq@wpi.edu)

- Braden Arnold (bjarnold@wpi.edu)
- Sydney Gardner (skgardner@wpi.edu)
- David Mahany (djmahany@wpi.edu)
- Jake Matthews (jwmatthews@wpi.edu)

IRB

- IRB Manager: Ruth McKeogh
  - Tel. 508 831-6699
  - Email: irb@wpi.edu
- Human Protection Administrator: Gabriel Johnson
  - Tel. 508-831-4989
  - Email: gjohnson@wpi.edu

Your participation in this research is voluntary. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.
* Indicates required question

**Signature** *

Your answer

**How navigable were the menus?**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**How easy was it to learn how to operate the user interface?**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very difficult</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Do you have any comments regarding the design of the user interface?**

Your answer
How intuitive were the controls?

1  2  3  4  5  6  7

Very confusing

1  2  3  4  5  6  7

Not at all

Very intuitive

How much did you enjoy the game?

1  2  3  4  5  6  7

A lot

How useful were the orientation shortcuts (W for move, E for rotate, and R for scale)?

1  2  3  4  5  6  7

A lot

Do you have any comments on the orientation shortcuts (ie. were there any you would change? If so, what would you change it to)?

Your answer
Do you have any comments on the orientation shortcuts (ie. were there any you would change? If so, what would you change it to)?

Your answer

How useful were the selection shortcuts (CTRL to snap, CTRL+SHIFT to fine snap, etc)?

1 2 3 4 5 6 7
Not at all ○ ○ ○ ○ ○ ○ ○ A lot

Do you have any comments on the selection shortcuts (ie. were there any you would change? If so, what would you change it to)?

Your answer

How useful was the Colors Menu?

1 2 3 4 5 6 7
Not at all ○ ○ ○ ○ ○ ○ ○ Very Helpful
How useful were the Color Palettes?

Not at All  ○  ○  ○  ○  ○  ○  ○  Very Helpful

How well were you able to navigate the timeline?

Not at all  ○  ○  ○  ○  ○  ○  Very Well

Do you have any comments regarding the keyframes and timeline usage?
Your answer

How much did you enjoy the process of creating routines?

Not at all  ○  ○  ○  ○  ○  Very enjoyable

Do you have any comments regarding routine creation?
Your answer
Do you have any comments on the artistic style of the game?
Your answer

Do you have any comments on the design of the menus?
Your answer

Did anything break?
Your answer
How much do each of the following words describe your experience?

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A little</th>
<th>Very</th>
</tr>
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Are there any other words you would use to describe the experience?

Your answer

Any other comments, questions, suggestions, etc?

Your answer

Do you want playtesting credit? If so, please leave your WPI email (will not be used for any other purpose)

Your answer
G. Playtesting Instructions

Instructions:
- Set up the experience on a laptop
- Show the subject the controls
  - Mouse to select
  - Middle mouse and WASD for camera
  - Scroll to zoom in and out
- Change the costume setup
  - Change the different costume pieces
  - Make the color palette
  - Assign to Band members
- Assign instruments to certain band members
- Ask the subject to move the band members around the screen using:
  - Translate Tool (E)
  - Rotate Tool (R)
  - Scale Tool (T)
  - Snap to grid using CTRL
- Have the subject display usage of the draw tool
- Ask the subject to use the keyframe system to add basic movement to the routine
  - , and . For frame to frame movements
- Allow the user to experiment with the game systems
  - Mention ESC for other controls
H. Music Collection

Marching Band Blue Bossa

Music Collection
I. Environment Art

Field Overview

Bleachers
Goal Post

Outer Environment