

# **Team 515: Music Machine**

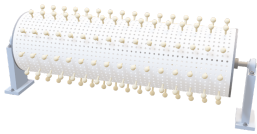
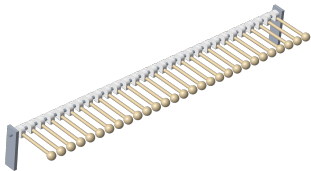

## **Operations Manual**


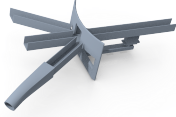
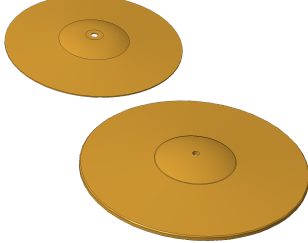
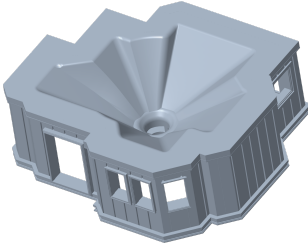

Jasmine Gay, Anjani Good, Isaac Guettler, Christian Morales, Taylor Shelby

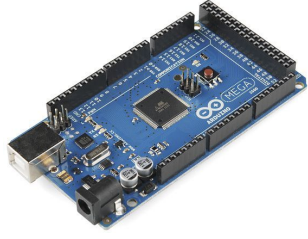

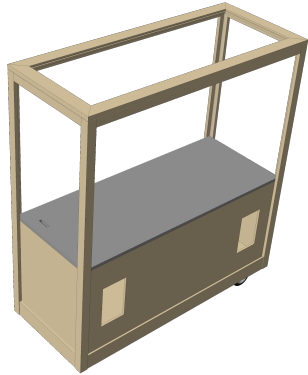
## Overview

The music machine is a public relations project with the purpose of attracting and entertaining an audience. The device plays and displays fun elements such as colorful lights, whimsical moving parts, motion triggered actions, and musical instruments which will play and move in time with our song. The various entertaining elements also represent the main branches of engineering. For example, the light towers which look like buildings represent civil engineering, while the lights themselves represent electrical engineering. It is also important for our device to draw crowds. To keep the crowd engaged, our machine will play well-known music. Specifically, our machine will play excerpts from the FAMU and FSU alma maters. This machine is also designed to inspire young people to take part in science, technology, engineering, and math career paths. Our machine will also have new electric versions of some classic percussion elements, such as drums and cymbals. Marbles and other moving parts will play these instruments while also providing fun visuals. The electronic instruments also keep the option to use the sounds of instruments which are hard to move. All in all, with the variety of music and visuals, our machine aims to engage audiences from all walks of life and showcase the fun side of engineering.

## Component Description

	<b>1) Music Roll and Pegs:</b> This controls the notes being played on the piano. The pegs hit the mallets.
	<b>2) Mallets and Mallet Holder:</b> The mallets are hit by the pegs on the music roll and play the piano. The mallet holder allows the mallets to rotate.
	<b>3) Keyboard:</b> Plays the melody of the song

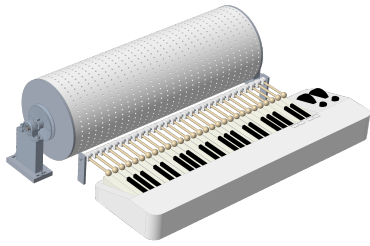
	<p><b>4) Marble Elevator:</b> Transports the marbles upwards. Provides a continuous feed of marbles to hanging instruments and the marble elevator.</p>
	<p><b>5) Marble Gate and Ramp:</b> The marble gate directs the marbles in one of three paths on the ramp which lead to either a cymbal, an electric cymbal, or back to the marble elevator base.</p>
	<p><b>6) Cymbals:</b> There are two cymbals used. One is a real cymbal and the other is electronic. The marbles have the option to hit either after exiting the marble ramp.</p>
	<p><b>7) House Funnel:</b> Provides a discrete funnel for the marbles bouncing off of the cymbals. The funnel also represents civil engineering</p>
	<p><b>8) LED Light Towers:</b> Towers built using LEDs which represent civil and electrical engineering.</p>

	<p><b>9) Arduino:</b> Controls the servo motor, and the DC motors in the marble elevator and music roll</p>
	<p><b>10) Raspberry Pi:</b> Controls the MIDI input as well as the communication between the music and the motors.</p>
	<p><b>11) Cart:</b> Houses all of the components listed above. There is a lid located at the top of the cart that allows for easy access during the troubleshooting process. There is also storage space in the bottom to hide any unappealing visual elements.</p>

## Assembly

The music roll is mounted and stands very close to the keyboard and mallets in order for the pegs on the music roll to hit the mallets. This is the main source of the song. The marble elevator is attached to the marble pathways and its respective gate, which directs the marbles onto a predetermined path which will, in turn, play one of the two symbols or be fed back into the marble elevator. The marbles that roll off the cymbal will fall into the house funnel and will also be fed back into the marble elevator. Two LED towers are simply placed to the right of the music wheel for visual effect. The final product is a working music machine which plays the FAMU and FSU alma maters while engaging an audience through visual elements including marble paths, an elevator, a tree, and a house.

## Module Assembly and Descriptions



### **Music Roll, Mallets, and Keyboard Subsystem:**

The **Music Roll and Pegs** (1) should be mounted on the ½ inch shaft and placed in the corresponding bearings such that the pegs of the music roll solidly impact the edge of the black and white mallet fittings of the **Mallets and Mallet Holder** (2). The **Music Roll** (1) is too short to hit all the mallets, so the leftmost peg should hit the lowest black key (a Db) on the keyboard. The mallets should touch the keys on the keyboard corresponding to the color of their shaft attachment. All molecule mallets should be on black keys, and no mallets should interfere with each other horizontally or vertically. (Check the troubleshooting section if this is not true.)

When this subsystem is working properly, the pegs on the music roll should hit the mallet fitting, causing the mallet to rise and fall on its key, pressing the note and sending the signal to the Sonic Pi software in the **Raspberry Pi** (10).



### **Marble Subsystem:**

To begin with, the marbles go up the **Marble Elevator** (4), down through the **Marble Gate and Ramp** (5), which is attached to the **Marble Elevator** (4). When the marble roll down the **Marble Gate and Ramp** (5) they will either hit the **Cymbals** (6) then the **House Funnel** (7), or go straight into the **House Funnel** (7). The **Cymbals** (6) hang from fishing line hooked on the top of the **Cart** (11). The **House Funnel** (7) is placed at the opening of the **Marble Ramp** (5) to catch the falling marbles. From there, they are connected via a clear tube back to the **Marble Elevator** (4) base, where they can climb the tower again.



### **Electronic Coordination:**

The **Raspberry Pi** (10) and **Arduino** (9) work together to coordinate the motors of the **Marble Elevator** (4) and the **Music Roll** (1), and the **LED Towers** (8). The **Keyboard** (3) feeds MIDI input to the **Raspberry Pi** (10), which plays the corresponding notes through the speakers in synchronization with those from the **Arduino** (9).

# Operating the Machine

Two switches will be used to start the Music Machine. One switch turns the machine on or off. The other switch is used to select a continuous performance or a single performance. A continuous performance will play the machine on a cycle until it is turned off, the single performance plays the song once, then stops. Any time the machine is turned off, the

## Troubleshooting

### **LED Light Towers:**

Lights stop working: If any of the lights on the towers stop working ensure that all of the soldered connections are secured. Also, make sure the LED cathodes are not touching any of the other LED anodes.

### **Marble Gate and Ramp:**

Servo motor not moving: Ensure power source is active and connected. If the gate is not aligning with marble pathways, try adjusting the marble pathway on the branch to match the gate rotation. If still mismatched, adjust the gate to ensure it is not hitting the tree or getting caught on the marble pathway itself.

Gate not aligning to pathway: The code for the servo can be adjusted to compensate for any problems with gate and marble pathway mismatches, but this should not be necessary.

The marbles are not rolling down the pathway: The pathway could slip off of marble elevator connection, ensure this connection is flush with both the beginning of the branched marble pathway and the top of the marble elevator. The path that leads back to the marble elevator may slip from the connecting piece; ensure the marble path and marble tube on the other side of the connector are both flush and connected to the black printed connector on both sides, otherwise marbles may become hindered.

### **Marble Elevator:**

Marbles are not moving upward smoothly: If tilted unnaturally, marbles may not roll smoothly or may become hindered, disrupting the timing. Ensure marble elevator base is resting flatly on the wood, if not it may need to be redrilled into the wood. Ensure the wheels at the base of the marble elevator and the slides that move vertically on the marble elevator are not hindered in any way. Check the power source to the marble elevator, ensure the connection is secure and the source is active.

### **Funnel:**

Marbles are not falling into the funnel: The connector on the bottom of the funnel to which the marble tube is connected may become turned or detached; check the connection, it should fit snugly and is meant to point towards the marble elevator. This is a difficult piece to move, so

adjusting it back to the correct position will also be difficult. Additionally, check that the marble tube is securely connected to this black connector piece at the bottom of the house funnel, if not the marbles may become hindered or stop and disrupt the timing. Ensure that the funnel is close enough to the marble output. There will be markings on the cart indicating the correct position.

### **Mallets:**

Mallets are not moving: Check that the music wheel is close enough for the dowels to make contact. Additionally, ensure that the black and white pieces at the base of the mallets match the color of the keys they are hitting. Otherwise, see the music wheel section.

Two mallets are moving at the same time: Make sure the washers and black and white bases are spaced out enough. If the spacing must be modified, remove the shaft from the mount and slide the pieces off until the desired intersection is reached, then add or remove washers as necessary.

Mallets are not triggering the piano: Make sure all of the washers are positioned near the head of the mallets.

The material on the mallets falls off: Replace the entire mallet by sliding the wooden pole out of the black or white base then putting a new one in.

### **Music Roll:**

Pegs aren't triggering the mallets: Make sure the music wheel is positioned close enough to the mallet assembly. There should be a marking on the cart to show where this should be positioned.

Pegs are not hitting all the notes: Slow down or speed up the speed of the motor by adjusting the Arduino code. Additionally make sure all of the pegs are on the music wheel, if not replace the missing pegs with the ones provided in the bottom of the cart.

Music roll isn't spinning: Check all connections to the motor and motor driver. Make sure the machine is powered.

## **Transporting the Machine**

In order to transport the machine more effectively, a few elements in the machine are removable. When getting ready to transport the device ensure the following steps have been followed.

### **Removing the cymbals:**

To remove the cymbals for transportation, lift the lid on the top of the cart. Then remove the four hoops connected to the lid to release the cymbals. These can be stored in the bottom of the cart until needed.

### **Untethering the Cords:**

When transporting the device unplug all cords to avoid damage during transportation.

**Securing the lid:**

Ensure that the plexiglass lid is held in place and that the components inside the machine are stable and will not move or disturb other components as this may cause severe damage to some of the sensitive subsystems.

**Loading onto vehicle:**

Maneuver machine onto a suitable transportation platform/vehicle. Secure the machine with ratchet straps to ensure movement during transportation is kept to a minimum and that machine will not fall and the components insides are not exposed or susceptible to damage.