

# Motion Synthesizer

## User Manual

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# INTRODUCTION

The Motion Synthesizer is an electronic-musical instrument, and this user manual is intended to show you how it works. It is a device that allows you to control music by various methods. This is a complete guide about getting started with the Motion Synthesizer. There are step-by-step instructions on how to set the device up and navigate its modes of operation.

The Motion Synthesizer has two main operating modes. The first is Ultrasonic Control Mode, and the second is Camera Mode. Ultrasonic Control Mode uses the two ultrasonic sensors mounted on both sides of the device to track your hand movements. In this mode, each sensor controls a separate sound effect. You can mix and modify the sounds to create cool effects and tunes. In Camera Mode, the Motion Synthesizer uses the camera to track objects and capture your dance moves to control the music. Within these modes, there are many cool and interesting features. By going through this user manual, you will be able to play with all the features of the device.

# MATERIALS

*You will need one of each of the following items to get started (Figure 1 – Figure 7).*

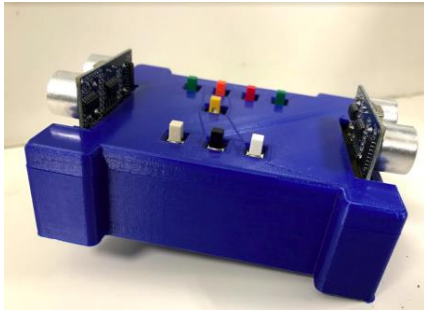


Figure 1 – Motion Synthesizer



Figure 2 – Power Supply (5V, 3A, Micro USB)



Figure 3 – HDMI Cable



Figure 4 – HDMI Screen (1280x1024)



Figure 5 – USB Camera



Figure 6 – Solid Color Balls (Easy to Hold)



Figure 7 – Headphones or Speakers (3.5mm jack)



# BUTTON & SENSOR NUMBERING

*The button and sensor numbering for the Motion Synthesizer can be seen below in Figure 8.  
The buttons and the ultrasonic sensors are referred to by the numbers labeled in this figure.*

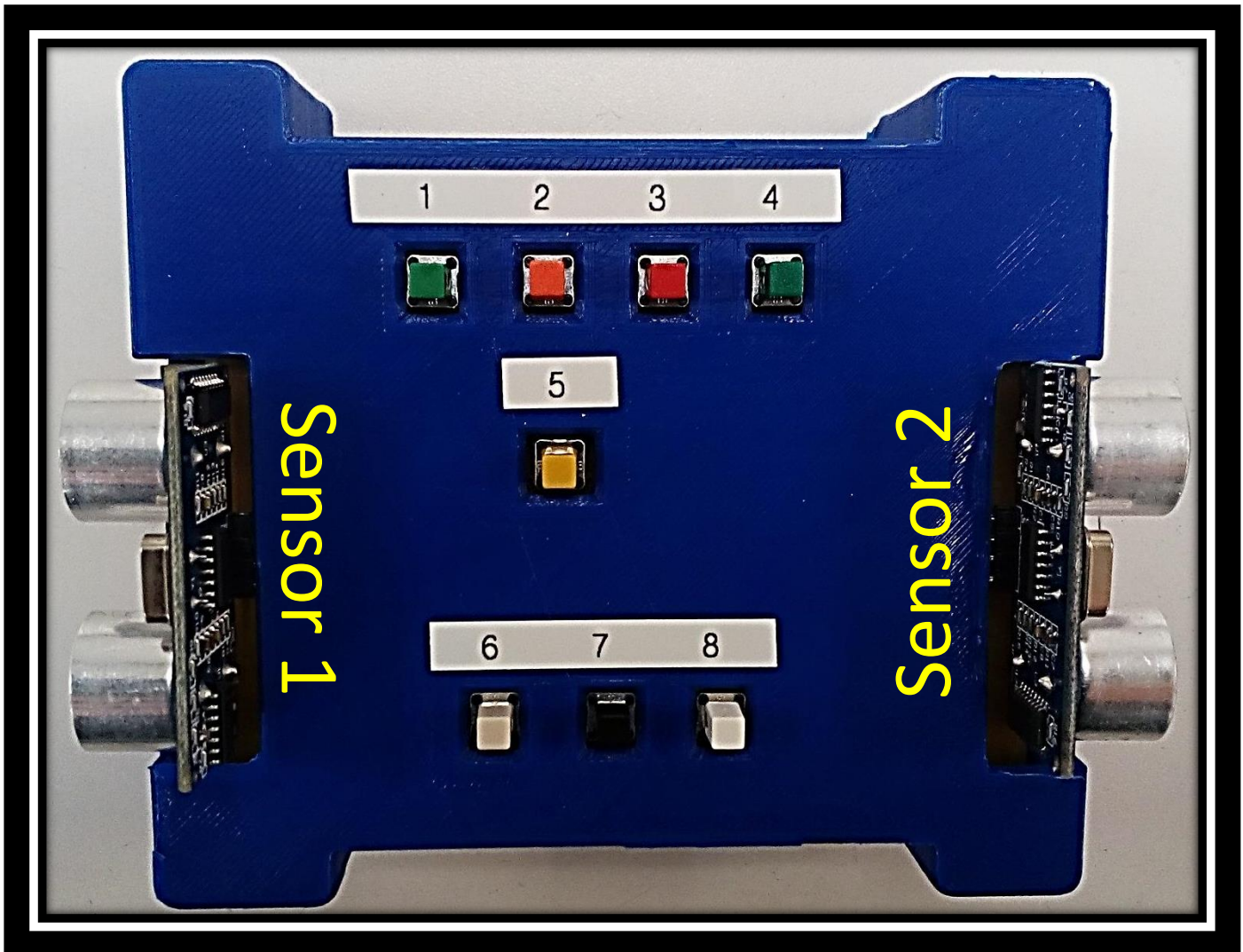


Figure 8 – Motion Synthesizer's Button & Sensor Layout

# INSTRUCTIONS

## SET UP

1. **Plug** in the HDMI monitor (Figure 9).
2. **Plug** in the audio output device (Figure 9).
3. **Plug** in the USB webcam (Figure 9).

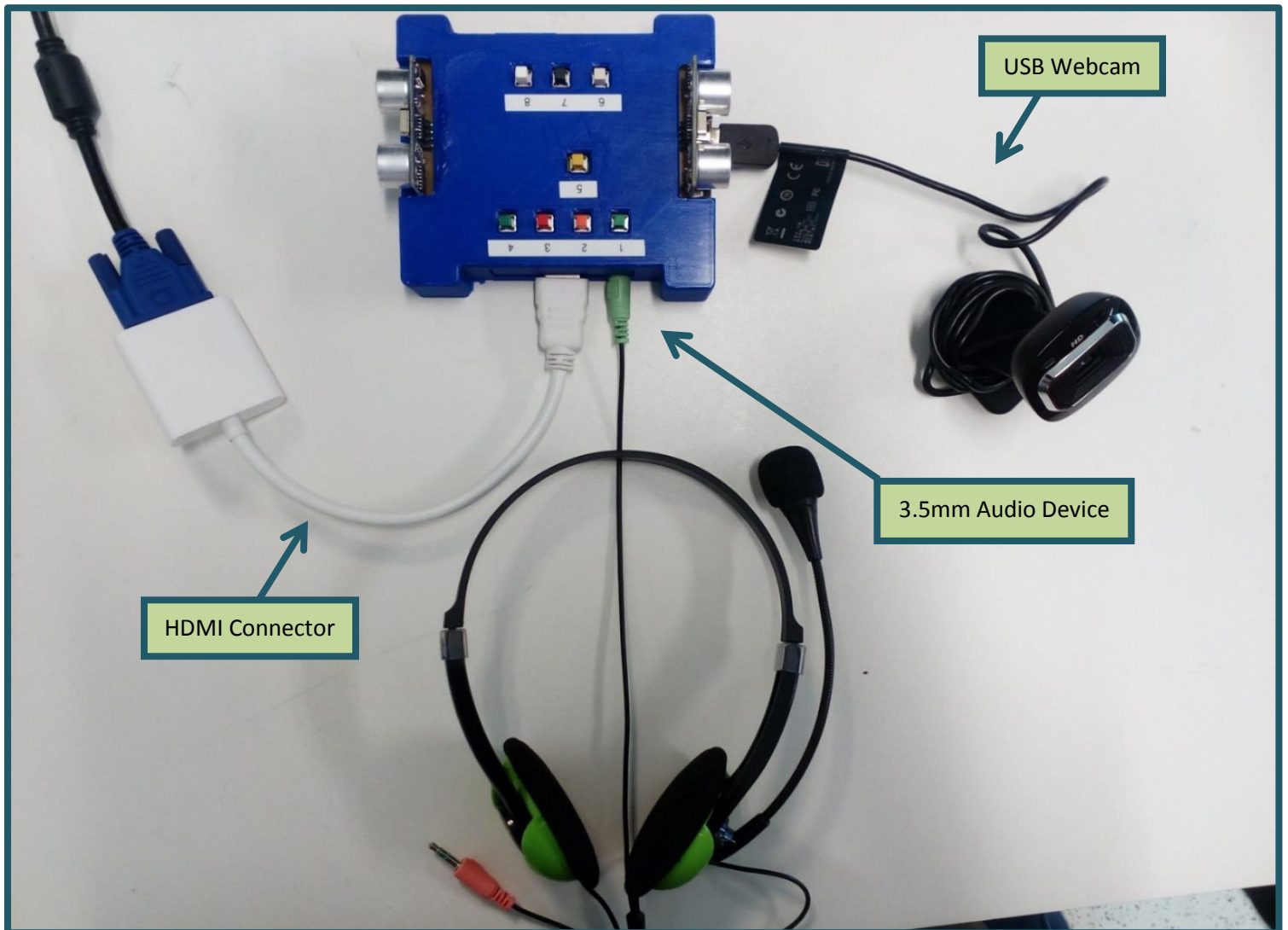


Figure 9 – Motion Synthesizer Peripheral Connections

4. **Place** the Motion Synthesizer on a flat surface.
5. **Remove** any objects within 30cm of the ultrasonic sensors (Figure 10).

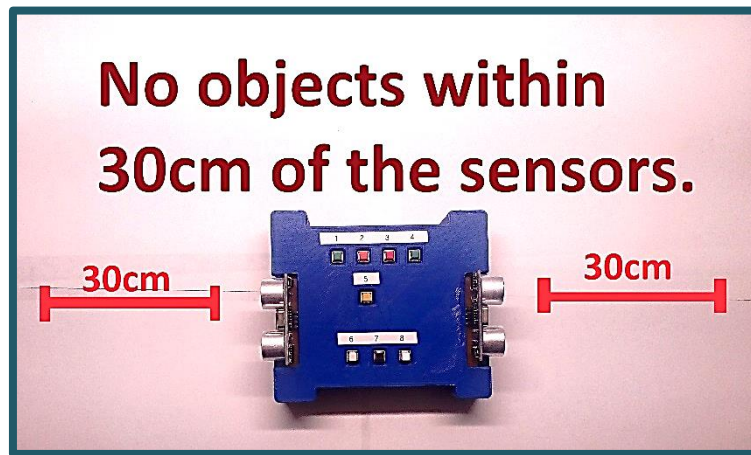


Figure 10 – Ultrasonic Sensor Clearance

6. **Place** the USB webcam on top of the monitor facing towards you.
7. **Plug** the Motion Synthesizer into a power socket.
8. **Wait** for the Motion Synthesizer to load (Figure 11).

*The Start Screen will be displayed after the Motion Synthesizer is done loading (Figure 12). It will take 40 seconds for it to load.*

9. **Press** Button 5, at the Start Screen, to get started (Figure 12).



Figure 11 – Loading Screen



Figure 12 – Start Screen



# ULTRASONIC CONTROL MODE

*The default mode in which the Motion Synthesizer enters is the Ultrasonic Control Mode. The monitor will display the Ultrasonic Control Screen (Figure 13).*

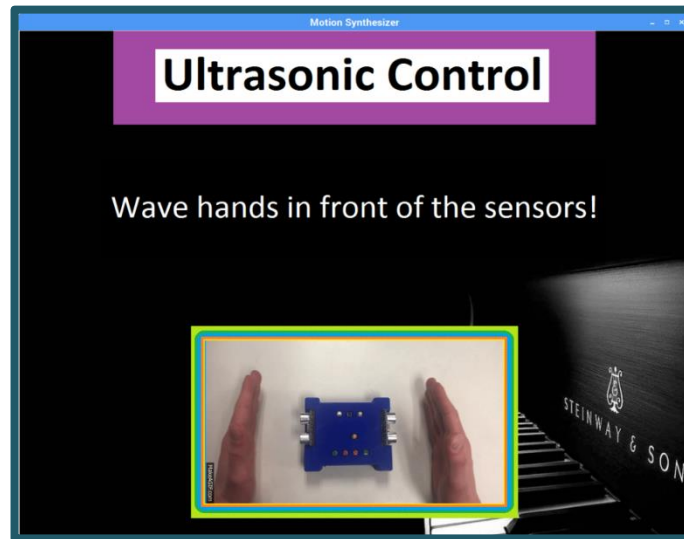


Figure 13 – Ultrasonic Control Screen

1. **Place** a hand in front of Sensor 1 (Figure 14).

*Your hand must be within 30cm of Sensor 1. The Motion Synthesizer will start playing different tones based on how far your hand is from Sensor 1.*

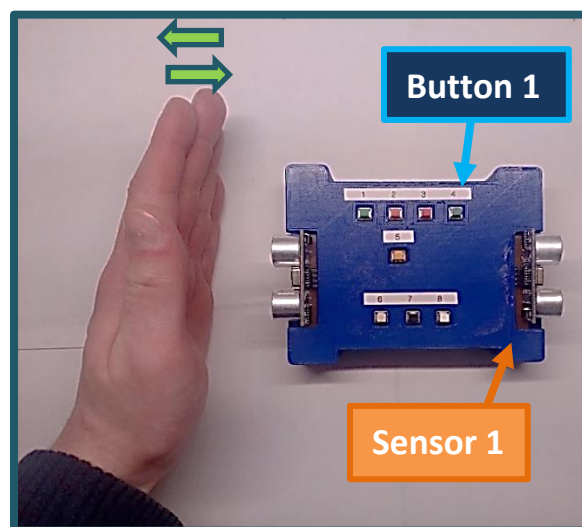


Figure 14 – Controlling Sensor 1



2. **Move** your hand slowly away from Sensor 1 (Figure 14).  
*This will increase the pitch of the sound effect.*
3. **Move** your hand slowly towards Sensor 1 (Figure 14).  
*This will decrease the pitch of the sound effect.*
4. **Press** Button 1 to change the sound effect controlled by Sensor 1 (Figure 14).  
*There are 10 unique sound effects for Sensor 1 that you can rotate through by pressing Button 1.*
5. **Remove** your hand from front of the Sensor 1.
6. **Place** a hand in front of Sensor 2 (Figure 15).  
*Your hand must be within 30cm of Sensor 2. The Motion Synthesizer will start playing different tones based on how far your hand is from Sensor 2.*
7. **Move** your hand slowly away from Sensor 2 (Figure 15).  
*This will increase the pitch of the sound effect.*
8. **Move** your hand slowly towards Sensor 2 (Figure 15).  
*This will decrease the pitch of the sound effect.*
9. **Press** Button 4 to change the sound effect controlled by Sensor 2 (Figure 15).  
*There are 10 unique sound effects for Sensor 2 that you can rotate through by pressing Button 4.*

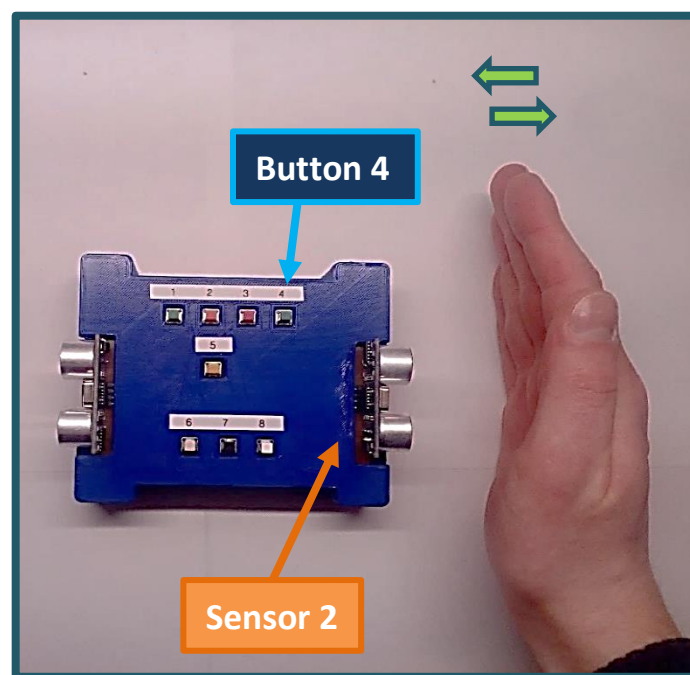


Figure 15 – Controlling Sensor 2

10. **Place** one hand in front of each of the ultrasonic sensors (Figure 16).

*Your hands must be within 30cm of the sensors.*

11. **Wave** hands slowly back & forth in front of the ultrasonic sensors (Figure 16).

*This will mix the two sound effects being controlled by each of the ultrasonic sensors.*

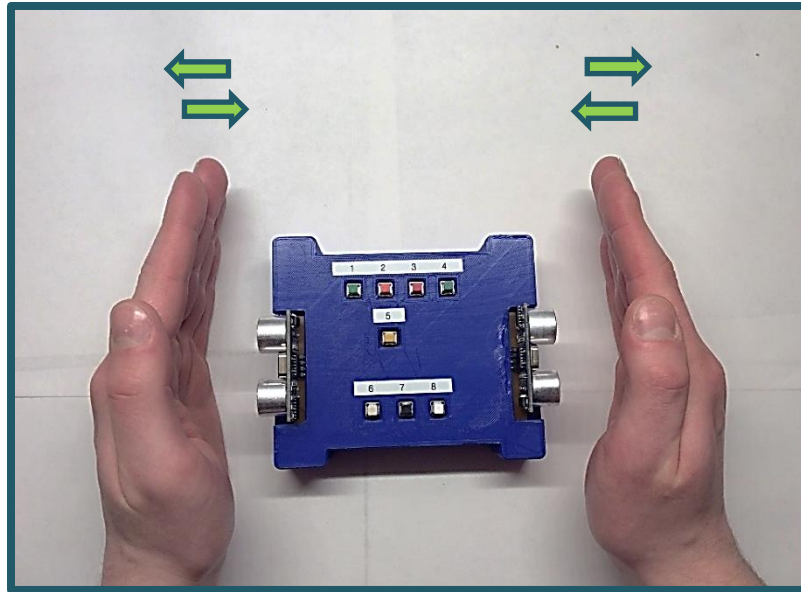


Figure 16 – Mixing Ultrasonic Sensors' Sound Effects

12. **Press** Button 3 to change the note rate.

*This will allow you to control how fast the Motion Synthesizer plays notes one after another. There are three note rates that you can choose (low, medium, high). The default note rate is medium.*

13. **Press** Button 2 to play arpeggios.

*The device will play the notes of a chord in succession. The chord that is played is determined by the distance from your hand to either of the ultrasonic sensors.*

14. **Press** Button 2 again to stop playing arpeggios.

15. **Press** Button 5 to exit Ultrasonic Control Mode & to enter Camera Mode.

# CAMERA MODE

1. **Wait** for the camera to load.

*The Camera Loading Screen will be displayed (Figure 17). You will need to wait 3 seconds for the camera to load.*

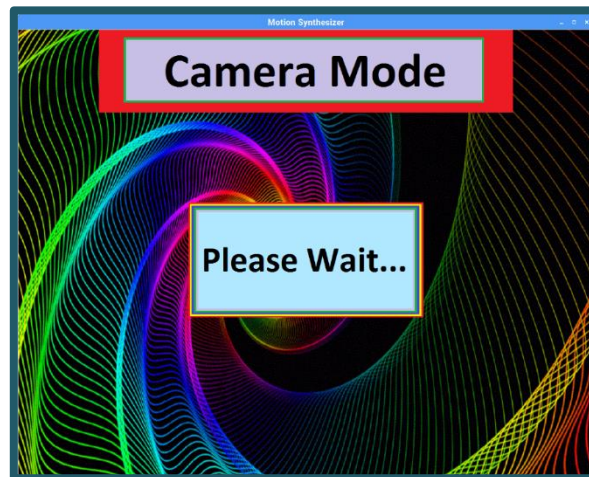


Figure 17 – Camera Loading Screen

*Once the camera has loaded, you will see the Camera Start Screen (Figure 18). In Camera Mode, the frame of the video stream is always displayed in the same location on the monitor.*

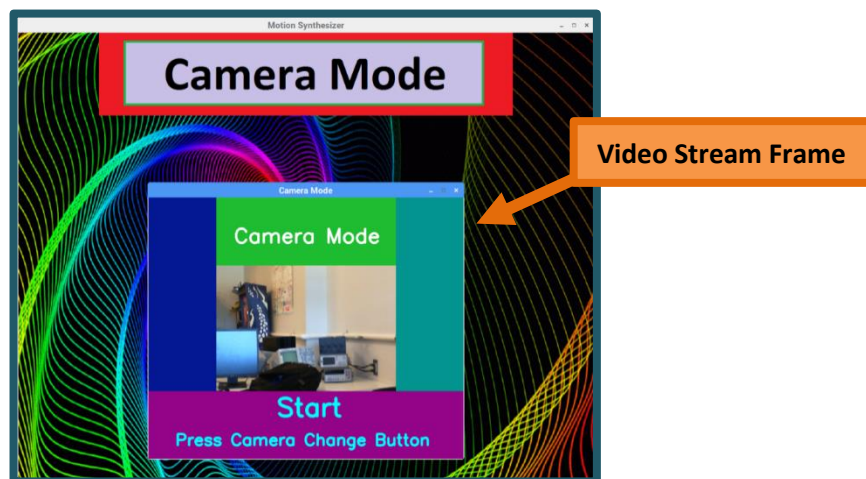


Figure 18 – Camera Start Screen

2. **Press** Button 8, at the Camera Start Screen, to start Camera Mode (Figure 18).

*In Camera Mode, there are two modes that you can play with. The default mode is the Ball Tracking Mode, and the other one is Dance Mode.*

## Ball Tracking Mode

*The Ball Tracking Calibration Screen will be displayed on the monitor (Figure 19). The camera's video stream is displayed on the monitor. You will initially have to calibrate the Motion Synthesizer for the color of the object you want to track.*

1. **Choose** a solid colored ball.

*You can choose any object, but it is recommended that you choose a bright colored ball that is easy to hold. The ball should only be of one color, and the color should not clash with background objects.*

2. **Fill** the bright pink circle displayed on the Calibration Screen with your ball (Figure 19).

*You will get five seconds to fill the bright pink circle with the ball you have chosen.*

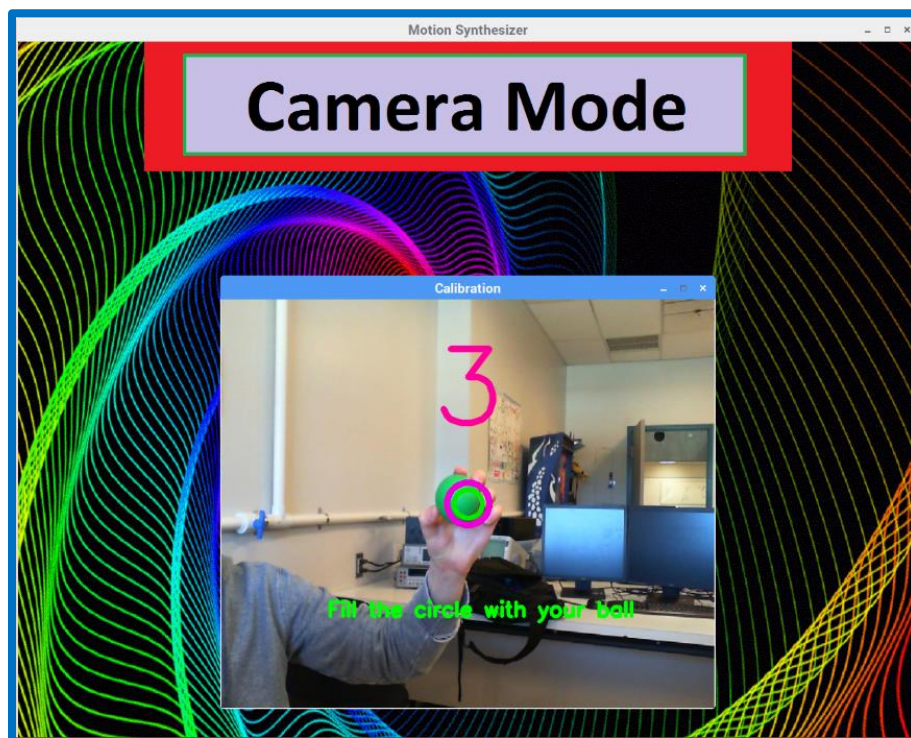


Figure 19 – Calibration Screen

3. **Hold** the ball still until the calibration is finished.

*Once the calibration is finished, the Ball Tracking Mode will start. You will see the Motion Synthesizer displaying a red dot in the center of the ball to show it is tracking it (Figure 20).*



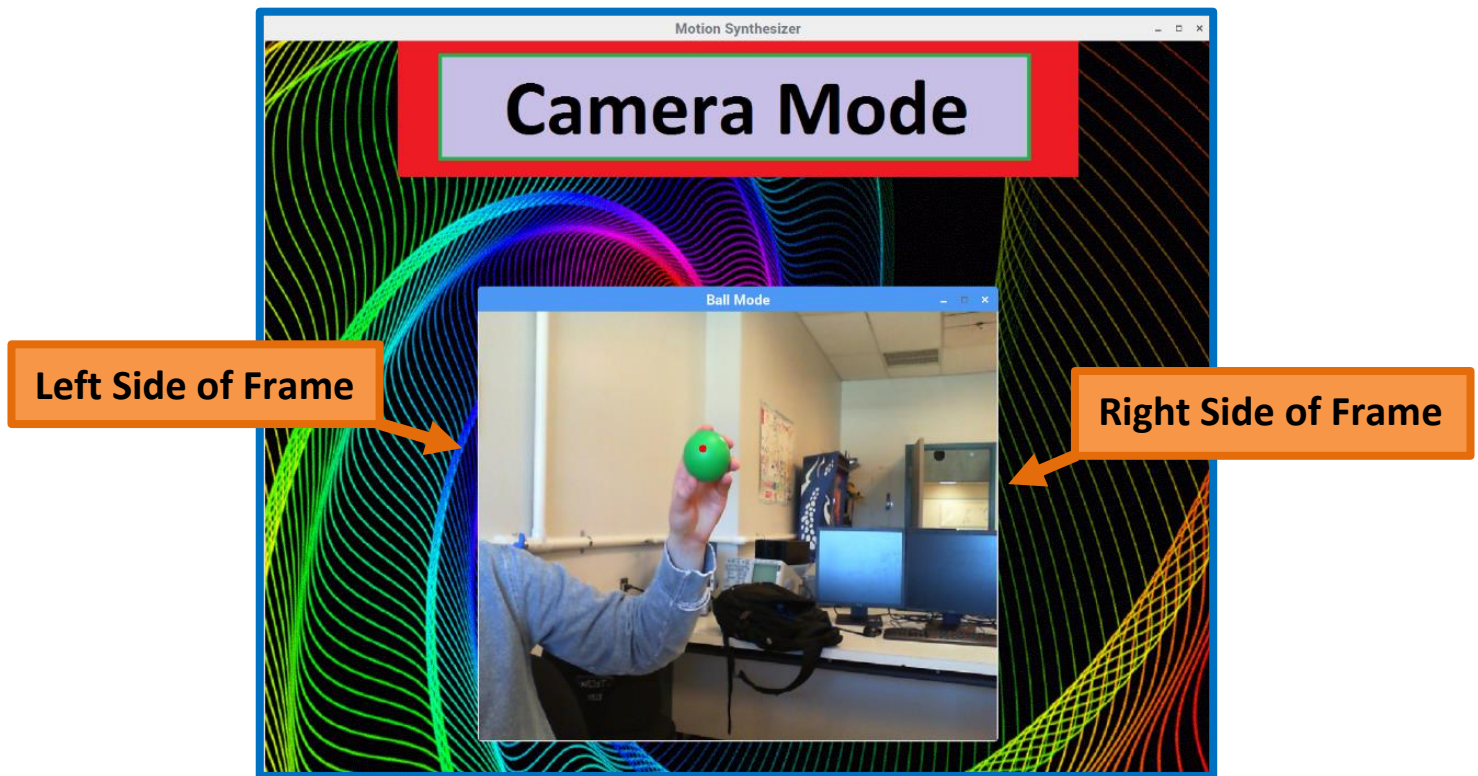


Figure 20 – Ball Tracking Mode Screen

*You can control the pitch of the sounds and note rate by moving the ball within the camera's frame. The Motion Synthesizer will only play music once the ball is in the frame.*

4. **Move** the ball to the right side of the frame to increase the pitch of the sound effect (Figure 20).
5. **Move** the ball to the left side of the frame to decrease the pitch of the sound effect (Figure 20).
6. **Move** the ball up or down from the center of the frame to reduce the note rate.
7. **Press** Button 7 to change the sound effect of the synthesizer.  
*Try out the ten different sound effects in this mode!*
8. **Press** Button 8 to exit Ball Tracking Mode & to enter Dance Mode.

## Dance Mode

*In Dance Mode, the frame will be black before you start dancing.*

1. **Stand** in front of camera at a distance of about 3m.
2. **Dance** to start the music (Figure 21).

*When you start dancing, the black frame lights up with color contouring your body, and the music will start playing (Figure 21). This mode is very easy to use, and there are no rules on how to dance. The more you dance, the more color will be displayed in the frame.*



Figure 21 – Dance Mode Screen

3. **Stop dancing** to stop the music.
4. **Press** Button 5 to exit Camera Mode & to return to the Ultrasonic Mode.



## PAUSE SCREEN

1. **Press** Button 6 to pause the device at any time.

*The Motion Synthesizer will be paused, and the Pause Screen will be displayed (Figure 22).*



Figure 22 – Pause Screen

2. **Press** Button 6 to exit the Pause Screen.

*After exiting the pause menu, the system will resume from where it left off.*

## Shut Down the Device

1. **Unplug** the power supply from the power socket (Figure 23).

# TROUBLESHOOTING

## Frozen Screen

*If you experience a frozen screen and the system is unresponsive, you should reset the Motion Synthesizer.*

1. **Unplug** the power supply from the power socket (Figure 23).



Figure 23 – Power Supply Unplugged

2. **Wait** 30 seconds.
3. **Plug** the power supply back into the power socket.



## Black Screen After Booting

*If the motion synthesizer is booting into a black screen, you may need to clean the MicroSD memory card.*

1. **Unplug** the power supply from the power socket (Figure 23).
2. **Remove** the Motion Synthesizer's lid (Figure 24).

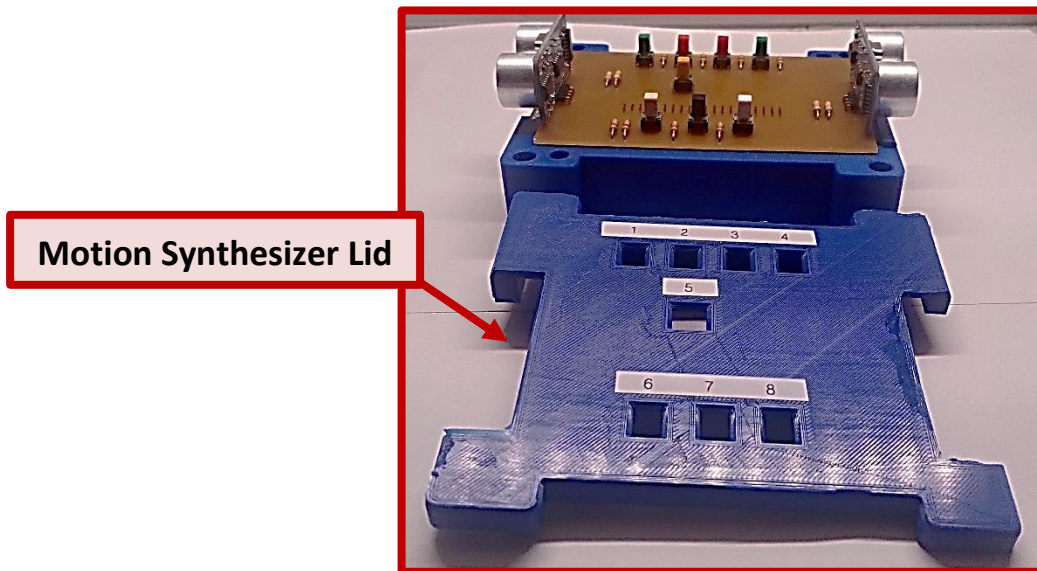


Figure 24 – Motion Synthesizer's Lid Off

3. **Remove** the Motion Synthesizer's internal circuitry from the case (Figure 25).

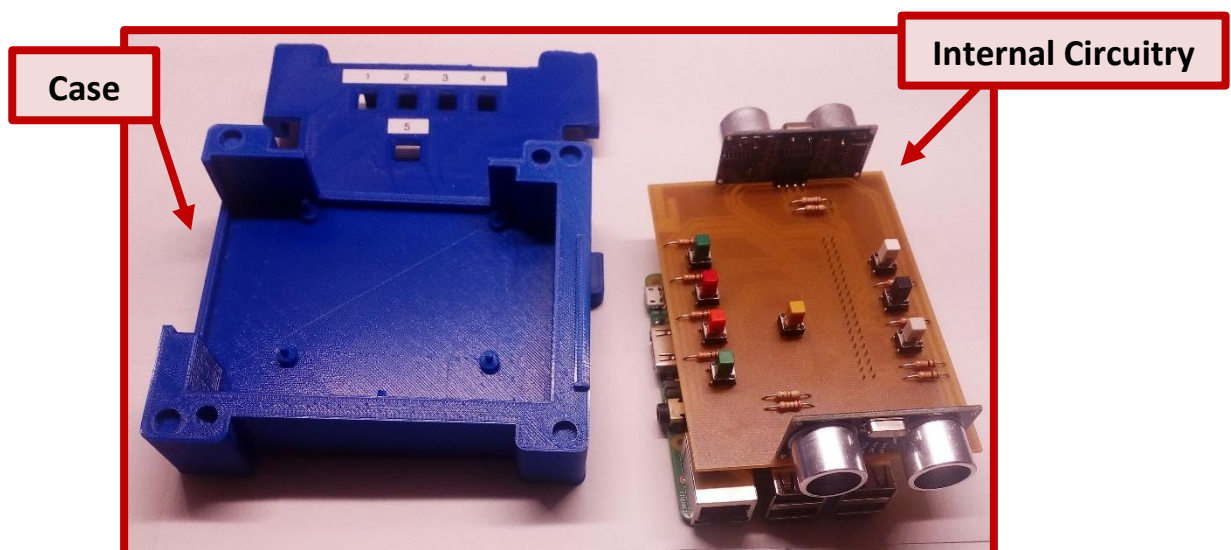


Figure 25 – Motion Synthesizer's Internal Circuitry

4. **Turn** the internal circuitry upside down (Figure 26).
5. **Pull** the MicroSD memory card out of its slot (Figure 26).

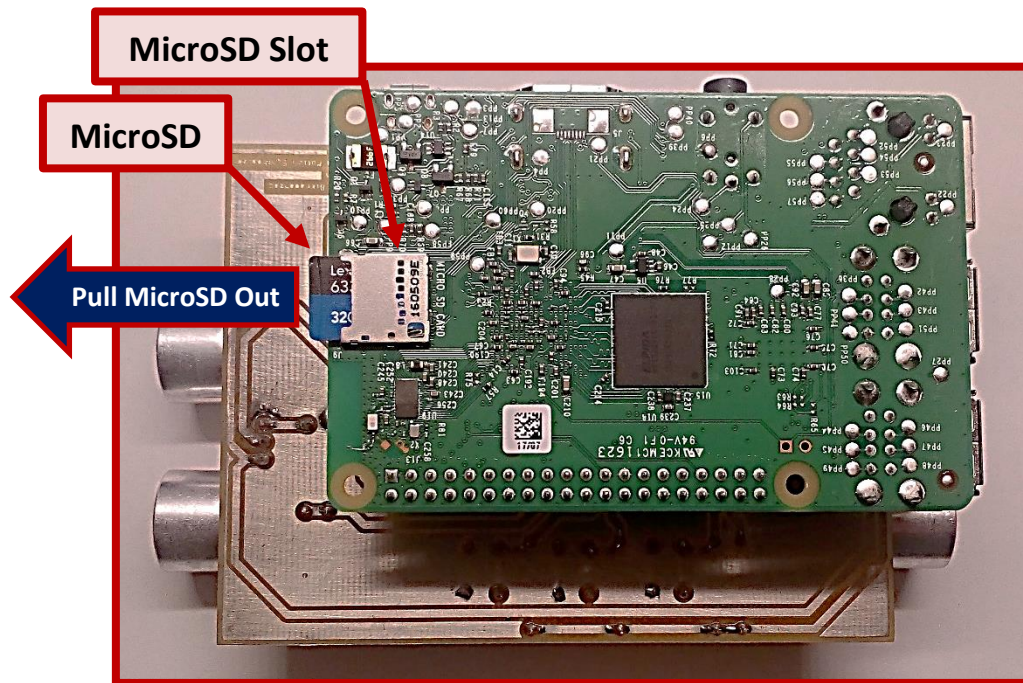


Figure 26 – MicroSD Card Removal

6. **Wipe** the MicroSD memory card contact area with clean paper towel (Figure 27).

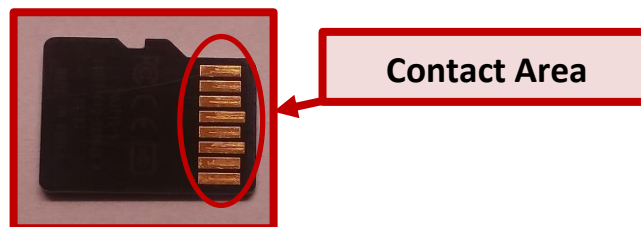


Figure 27 – MicroSD Memory Card Contact Area

7. **Put** the MicroSD card back in its slot.
8. **Put** the Motion Synthesizer's internal circuitry back inside the case
9. **Put** the Motion Synthesizer's lid back on.
10. **Plug** the power supply back into the power socket.

# CONCLUSION

The Motion Synthesizer offers unique ways to create music with your body motion. This device will give you hours of entertainment creating and playing music. This device also demonstrates you some cool features of modern technologies like computer vision and machine learning. This user manual provides you with some basic tools that you can use to start your musical journey using this device. If there is any other difficulty/issue using the device, contact us at [bikramazac@gmail.com](mailto:bikramazac@gmail.com).