

Animatronics

Structural-Mechanical Hardware

Document

By: Jim Schrempp and Bob Glicksman; v1.0, 12/12/2025

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DOCUMENT OVERVIEW.

This document describes the structural and mechanical components of the Animatronic Head project. This project was designed for experimentation more than for any specific use. Therefore, a very flexible structural framework was developed. Figure 1 depicts this structure:

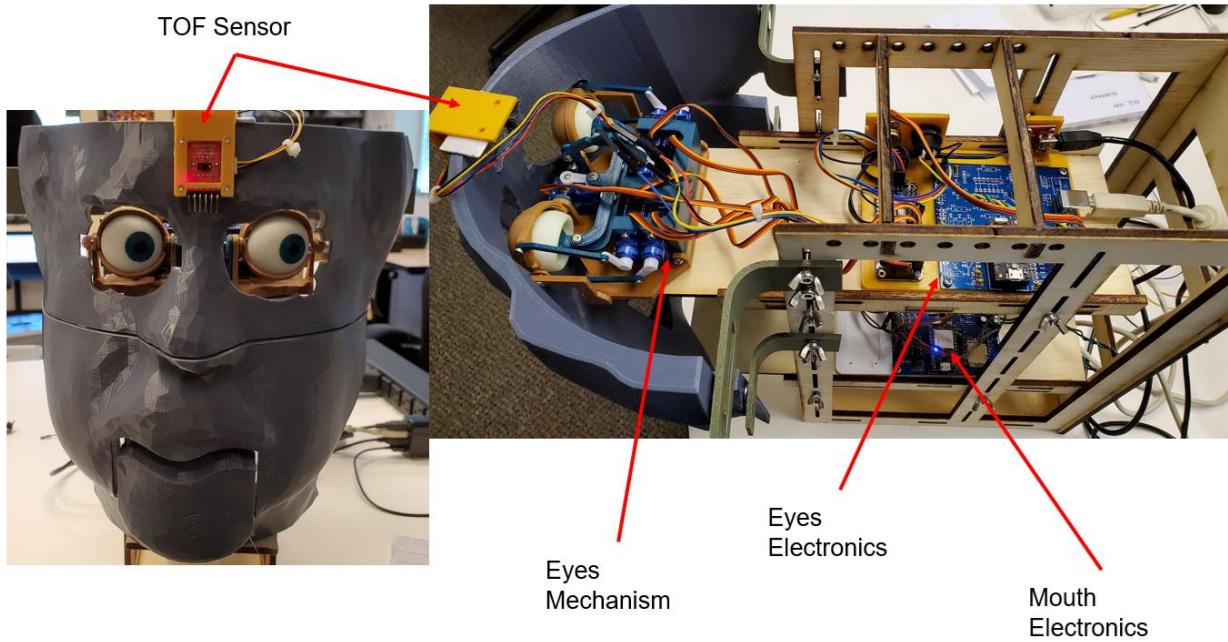


Figure 1. Structural Overview.

The main part of the structural assembly is the *frame*. The *frame* provides overall mechanical support for the electronic components, mechanical components, and the face. The *frame* contains moveable platforms onto which electronic and mechanical components are mounted. The *frame* also provides mounting for 3D printed *magnet holders*. Magnets are glued to these holders and are used to hold 3D printed *face* components onto the frame at adjustable positions.

2D and 3D mechanical CAD files for all of these structural and mechanical components are in the Mechanical folder in this Repository:

<https://github.com/TeamPracticalProjects/Animatronics/tree/main/Mechanical>

STRUCTURAL FRAME.

Figure 2 shows a side view photo of the Animatronic Head. This photo shows how the various electronic and mechanical components of the Head are mounted on, and supported by, the *frame*.

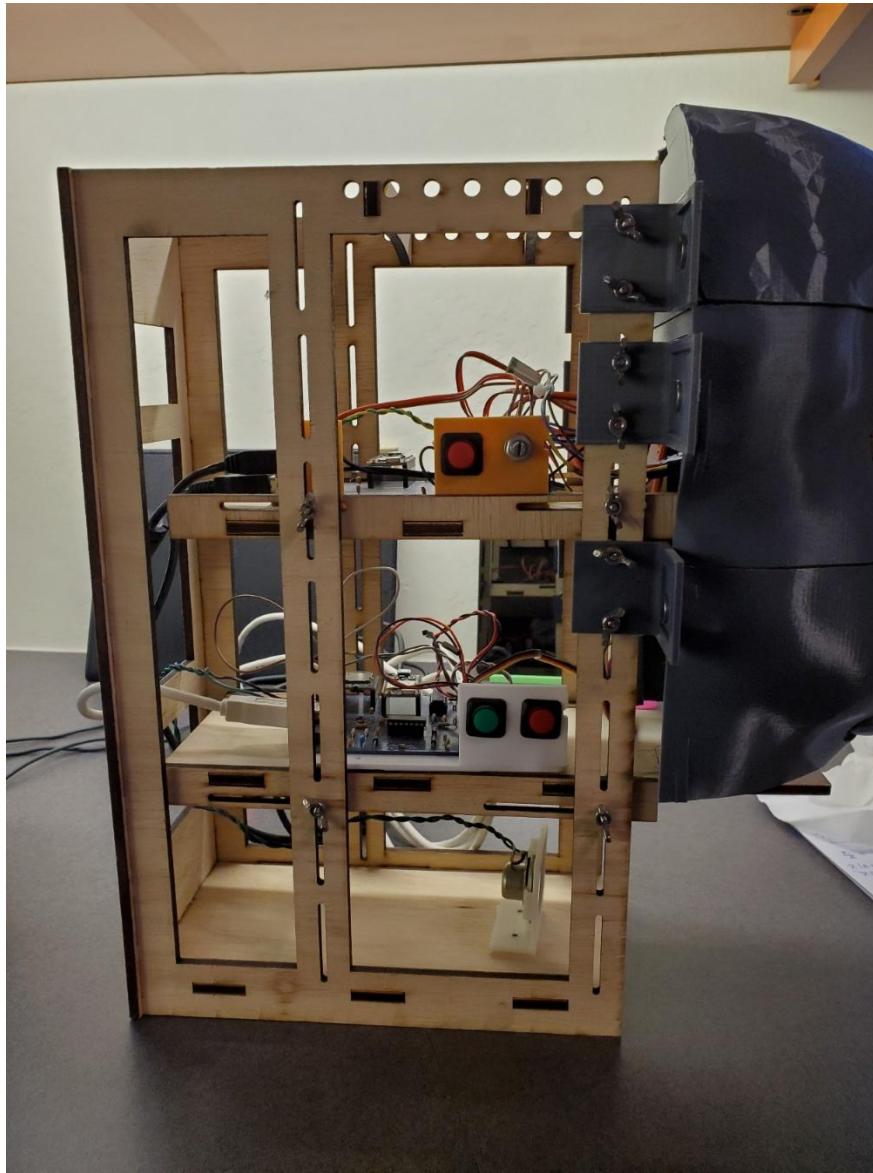


Figure 2. Structural Frame Photo.

The *frame* assembly has two movable shelves and a non-movable base. The top shelf holds the eyes mechanism and the eyes electronics. The middle shelf holds the mouth mechanism and the mouth electronics. The base (bottom shelf) holds the loudspeaker.

The shelf positions are adjustable using wingnuts. This adjustability allows each shelf to be positioned so that the mechanical components align with the openings in the face.

The face itself is in three pieces:

- Crown: the top of the head. Cosmetic only.
- Eyes: mounts the TOF sensor and has holes for the eyes mechanical assembly.
- Mouth: has a cutout for the movable jaw mechanism.

The three face components are held onto the frame using magnets. See the section on the face, below, for details.

Figure 3 is a 3D rendering of the frame.



Figure 3. Structural Frame 3D Rendering.

The *frame* components are laser cut from 6mm birch plywood. The frame, shelves and base pieces are glued together. The shelves are mounted using screws with wingnuts through the slots in the vertical rails so that they may be adjusted properly to fit behind the face.

CAD files for the frame are in the Mechanical folder in this Repository; see:

<https://github.com/TeamPracticalProjects/Animatronics/tree/main/Mechanical/armature>

EYES MECHANICAL AND ELECTRONIC MOUNTING.

The eyes mechanism and the eyes electronics are mounted on the top shelf of the *frame*, see figure 4.

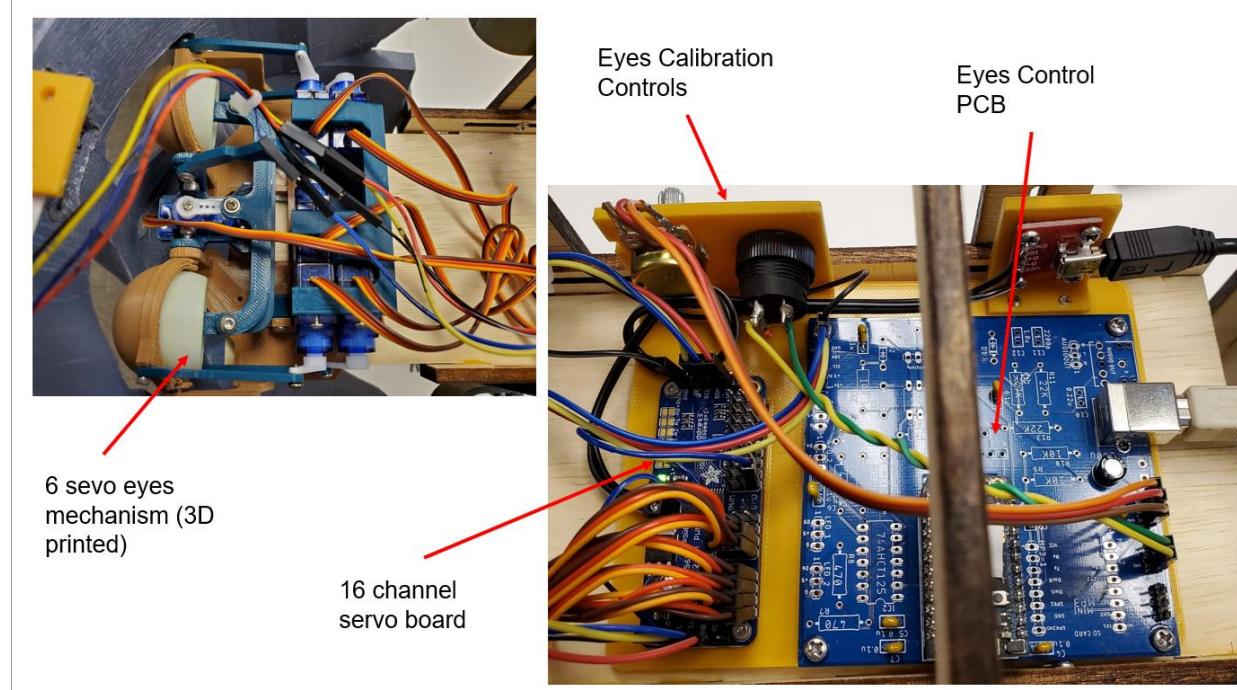


Figure 4. Eyes Mechanism and Electronics Mounting.

The eyes mechanism is attached to the shelf using double sided tape. It can be placed precisely to align with eye holes in the face. The electronics consists of a custom printed circuit board and a commercial 16 channel servo control board; for details, see:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Documents/Animatronic%20Head%20Electronic%20Hardware%20Document.pdf>

A 3D printed mounting plate is used to secure both of these electronic circuit boards. The assembled 3D printed mounting plate is attached to the shelf using double sided tape. The CAD file for this mounting plate is:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/PCBMount/eye%20base%20plate.3mf>

A potentiometer and a momentary push button switch are used to calibrate the eyes mechanism after assembly. A 3D printed mounting bracket holds these components and is attached to the shelf using double sided tape. Figure 5 is a detailed view of this assembly.

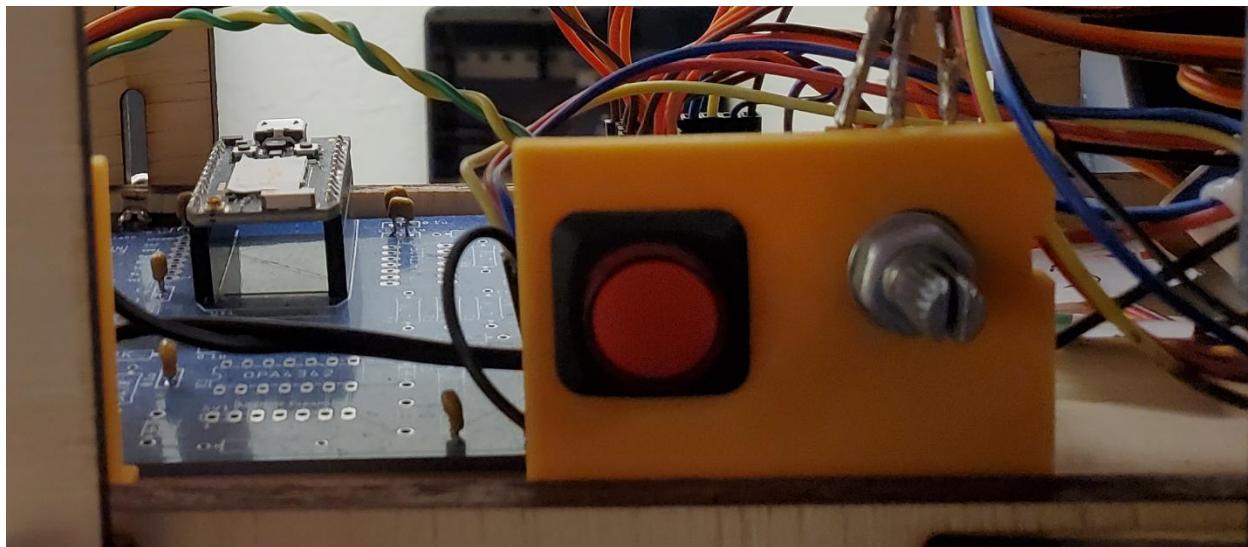


Figure 5. Eyes Calibration Controls Mounting Detail.

The 16 channel servo board has its own 5 volt power source via a USB power connector (see figure 4, above). A 3D printed mounting plate holds this connector and is attached to the shelf using double sided tape.

3D CAD files for these mounting brackets are in:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/PCBMount/eye%20control%20mount.f3d>

The eyes mechanism itself is an intricate assembly consisting of six hobby servos and an integrated set of 3D printed parts. We adapted the following excellent mechanism from Will Cogly's design on the Internet; see:

<https://www.instructables.com/Simplified-3D-Printed-Animatronic-Dual-Eye-Mechani/>

The maker, Will Cogley, is incredibly inventive. His YouTube channel has a lot of amazing things:

https://www.youtube.com/channel/UCkUD_8b1JoTL2ipOVtxfNKw

We modified a few of the eye mechanism parts, see:

<https://github.com/TeamPracticalProjects/Animatronics/tree/main/Mechanical/EyeMech>

MOUTH ELECTRONIC AND MECHANICAL MOUNTING.

The mouth mechanism and the mouth electronics are mounted on the middle shelf of the *frame*, see figures 6, 7 and 8. Figure 6 shows the mouth control electronics. Details of the electronic design are in the document:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Documents/Animatronic%20Head%20Electronic%20Hardware%20Document.pdf>

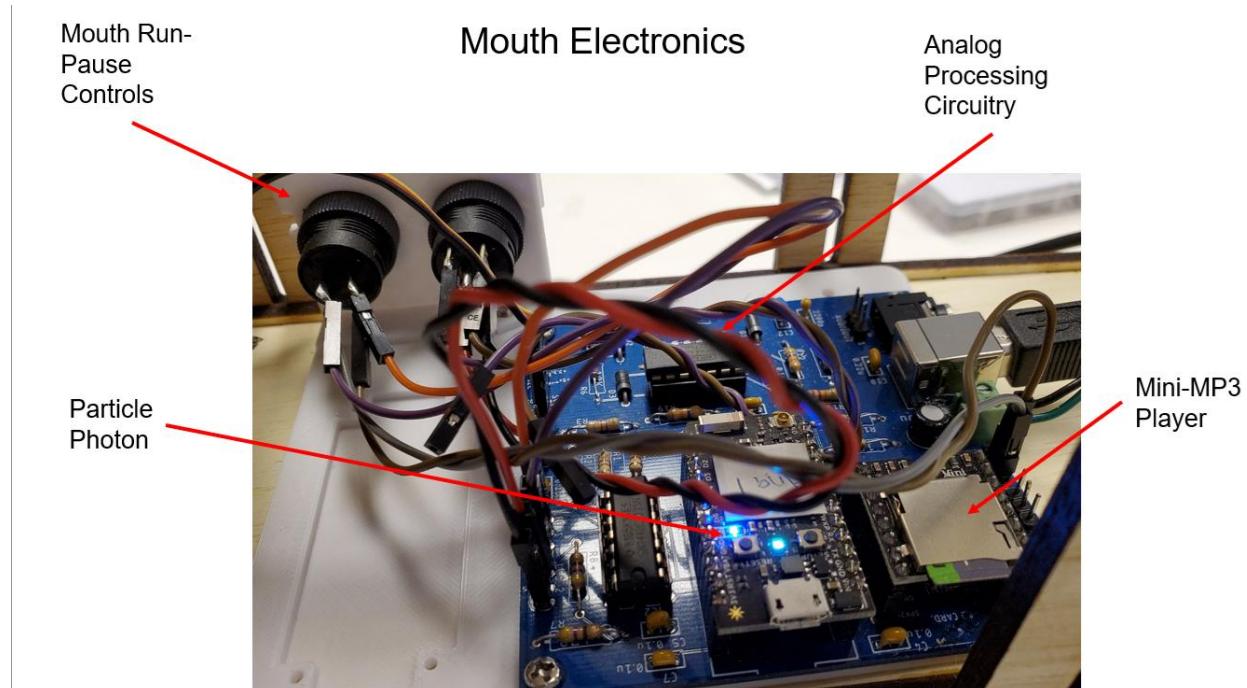


Figure 6. Mouth Electronics Mechanical Assembly.

The electronic printed circuit board is affixed to a 3D printed mounting plate – the same mounting plate design that is used to mount the eyes electronics:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/PCBMount/eye%20base%20plate.3mf>

The electronics assembly is attached to the shelf using double sided tape.

Two, backlit, pushbutton switches are used to indicate when the mouth is speaking and to allow the demonstrator to mute the loudspeaker. These components are mounted on a 3D printed bracket that is affixed to the shelf using double sided tape; see figure 7. A 3D CAD file for this bracket is found in:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/PCBMount/mouth%20switch%20mount.3mf>

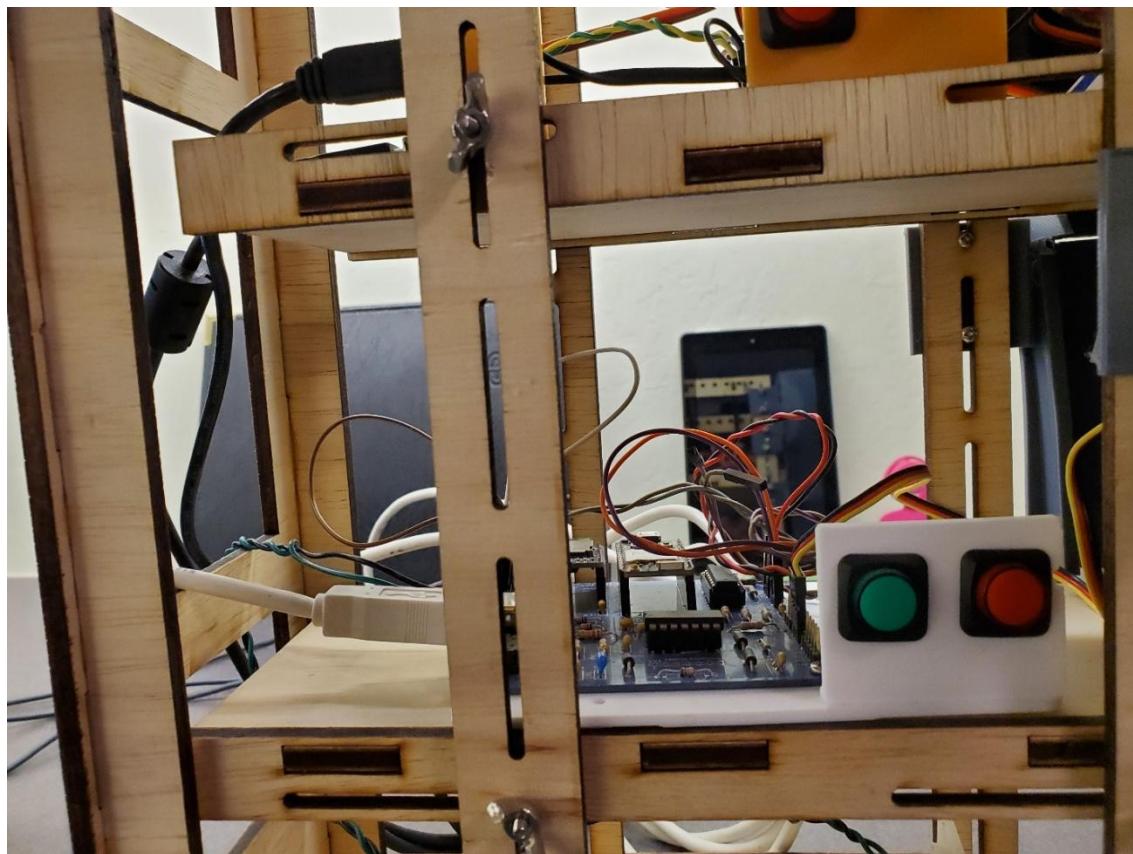


Figure 7. Mouth Mute Controls.

The mouth mechanism itself is shown in figure 8, below. It is mounted on the same middle shelf as the mouth electronics, see figure 8.



Figure 8. Mouth Mechanical Assembly.

The mouth is driven by a servo that connects to the jaw of the face with a 3D printed adjustable assembly. CAD files for these 3D printed parts are in:

<https://github.com/TeamPracticalProjects/Animatronics/tree/main/Mechanical/MouthMech>

The jaw itself is 3D printed; see:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/Head/mouth.3mf>

SPEAKER MOUNTING.

A small loudspeaker is used to play back audio clips. It is mounted on the base of the *frame* using a 3D printed bracket; see figure 9.

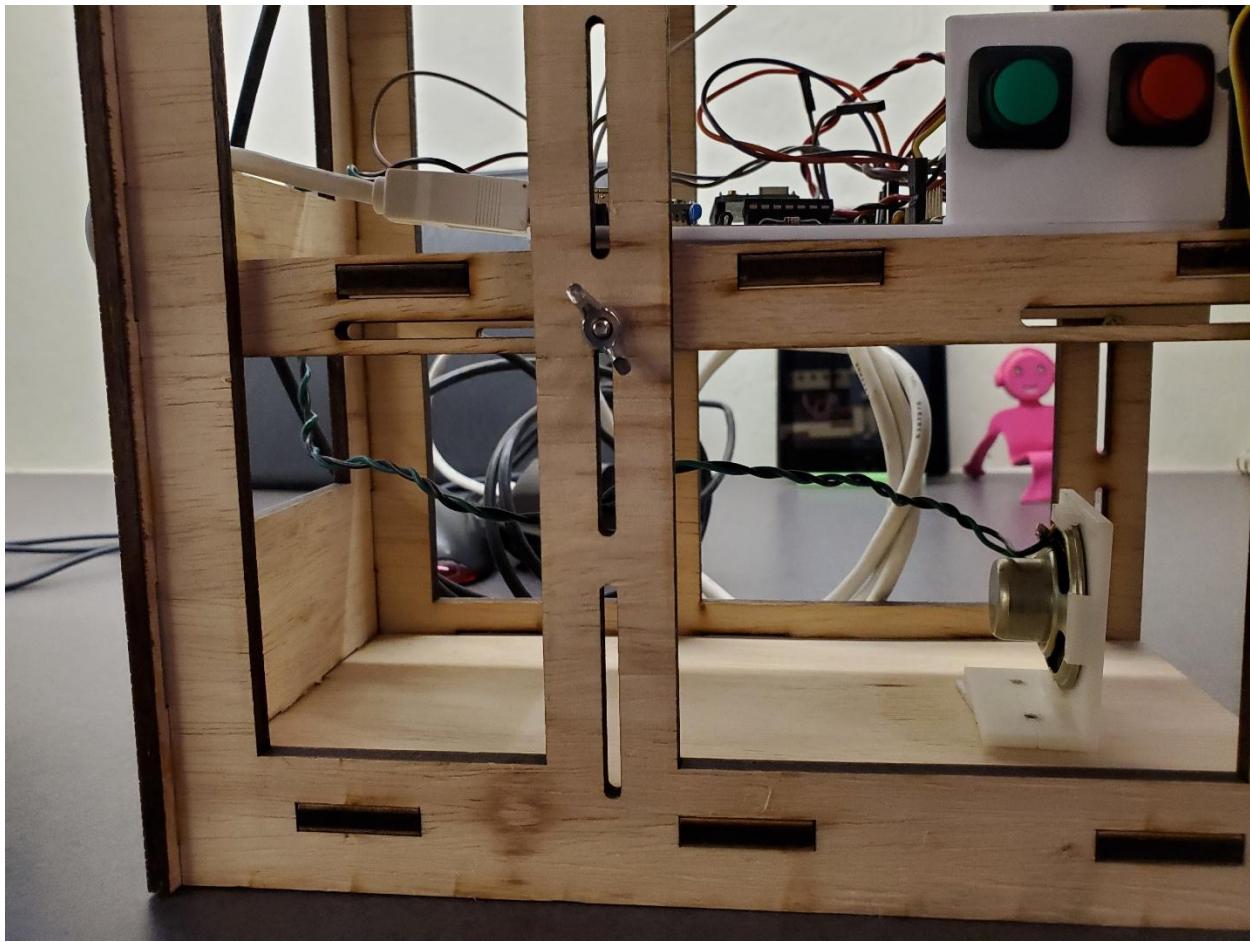


Figure 9. Loudspeaker Mounting.

3D CAD file for this bracket is in:

***** CAD FILE IS MISSING !!!! *****

This bracket is mounted to the base using double sided tape.

FACE COMPONENTS.

The face consists of four 3D printed components, see figure 10:

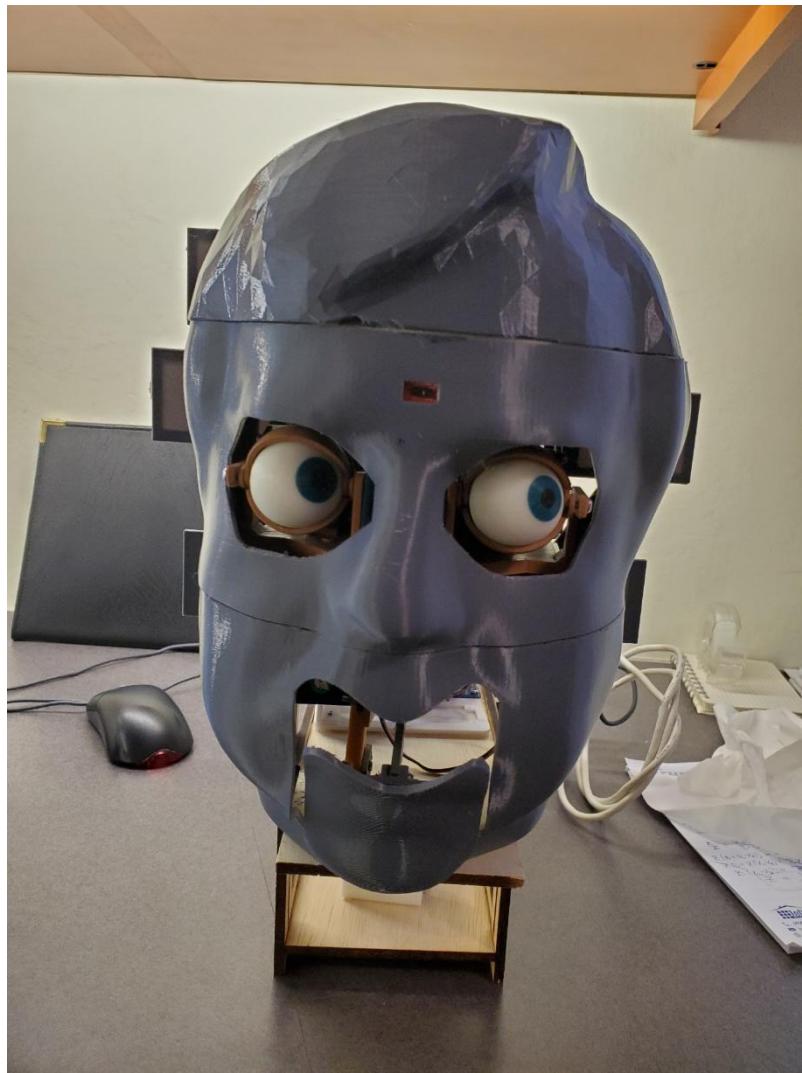


Figure 10. Face.

The CAD files for these components are:

- [The Crown](#). See:

***** CAD FILE IS MISSING !!!! *****

- [The Eyes](#). See:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/Heads%20Front.3mf>

- [The Mouth](#). See:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/Head/Mouth%20Front.3mf>

- The Jaw. See:

<https://github.com/TeamPracticalProjects/Animatronics/blob/main/Mechanical/Head/mouth.3mf>

These 3D printed components are attached to the frame using magnets. 3D printed “ears” are attached to the *frame* using screws and wingnuts; see figure 110, below.



Figure 11. Face Mounting Magnet Ears.

Magnets are glued to these ears in the proper position to hold the face components to the *frame*. These magnetic “ears” provide fine adjustment of the face components on the frame to precisely align with the shelves on which the mechanical eyes and mouth assemblies are located. 3D CAD files for these mounting ‘ears’ are in:

<https://github.com/TeamPracticalProjects/Animatronics/tree/main/Mechanical/Head>