

BRIGHT Learn

Building Responsive Interactions for Growth, Healing, and Therapeutic Learning

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Motivation

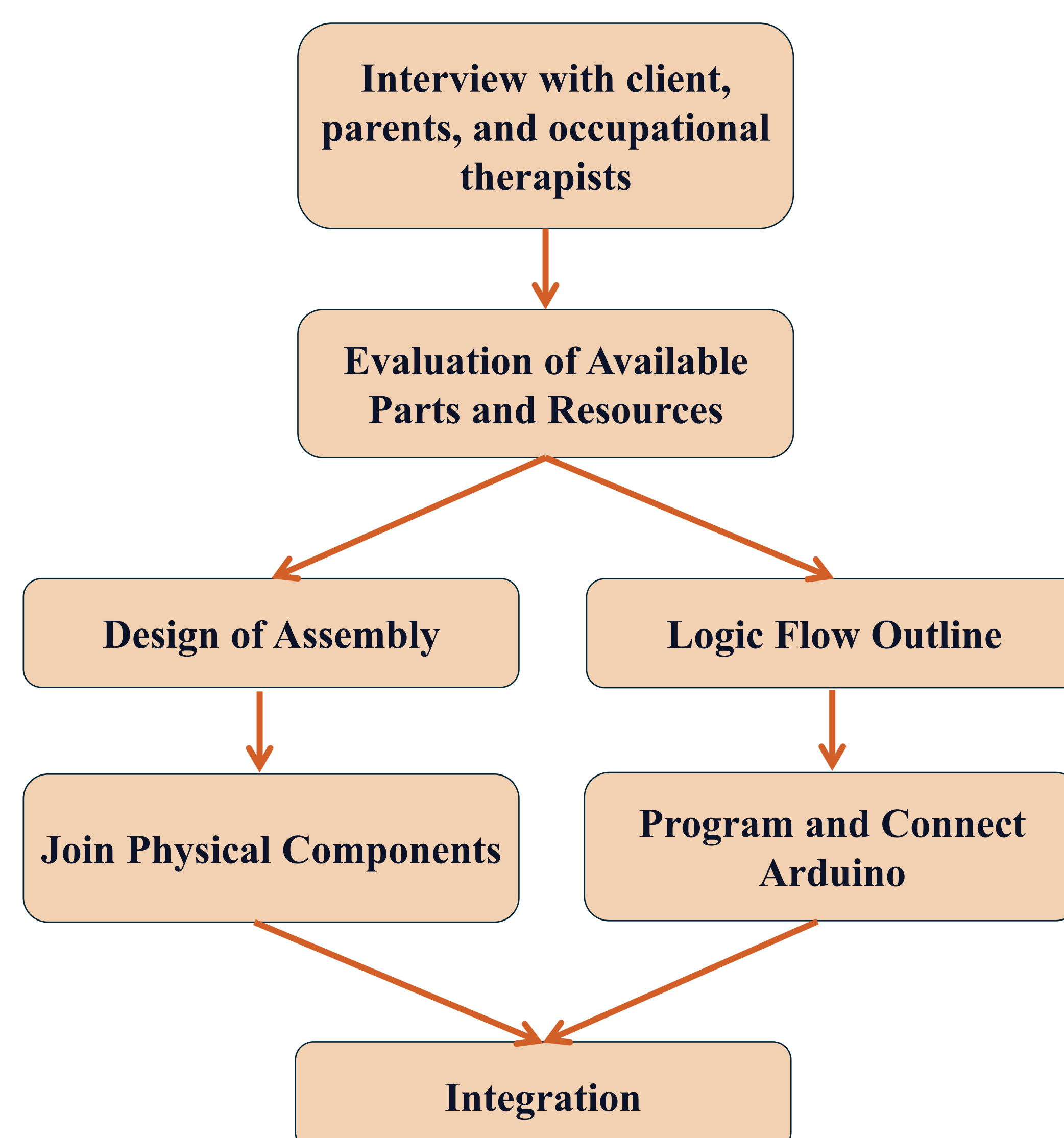
There are many benefits to using light, music, and color in stimulating children with developmental disabilities.

The client, Marin Merchant, is a 12-year-old child with special needs, who is learning the colors during occupational therapy. She has trouble with fine motor skills, including dexterity with her fingers and movement-to-target accuracy. This project aims to use a combination of music and lights to teach Marin the colors, while challenging her coordination.

One problem with existing methods of teaching Marin the colors is the lack of interaction. Thus, a feedback input and output system was prioritized in the design.

Marin's parents proposed the creation of a toy that integrates motor skills, decision-making, problem-solving, and color recognition. They expressed desire to make the toy robust against physical force, easy to turn on and off, and to not be battery-powered. They also suggested an element of familiarity be included.

Design Plan



Physical Casing

- **Base of Toy:** modular design, for ease of 3D printing (Fig 1).
- **Lid:** laser-cut from wood, with acrylic “windows” press-fit into each section to display the LED strip lights inside.
- **Colored push-buttons:** mounted into holes in the lid, allowing external input to system.
- **Speaker:** Central column with a stand for the speaker to sit on. A hollow cylinder (not pictured) was fit over it to amplify the sound.

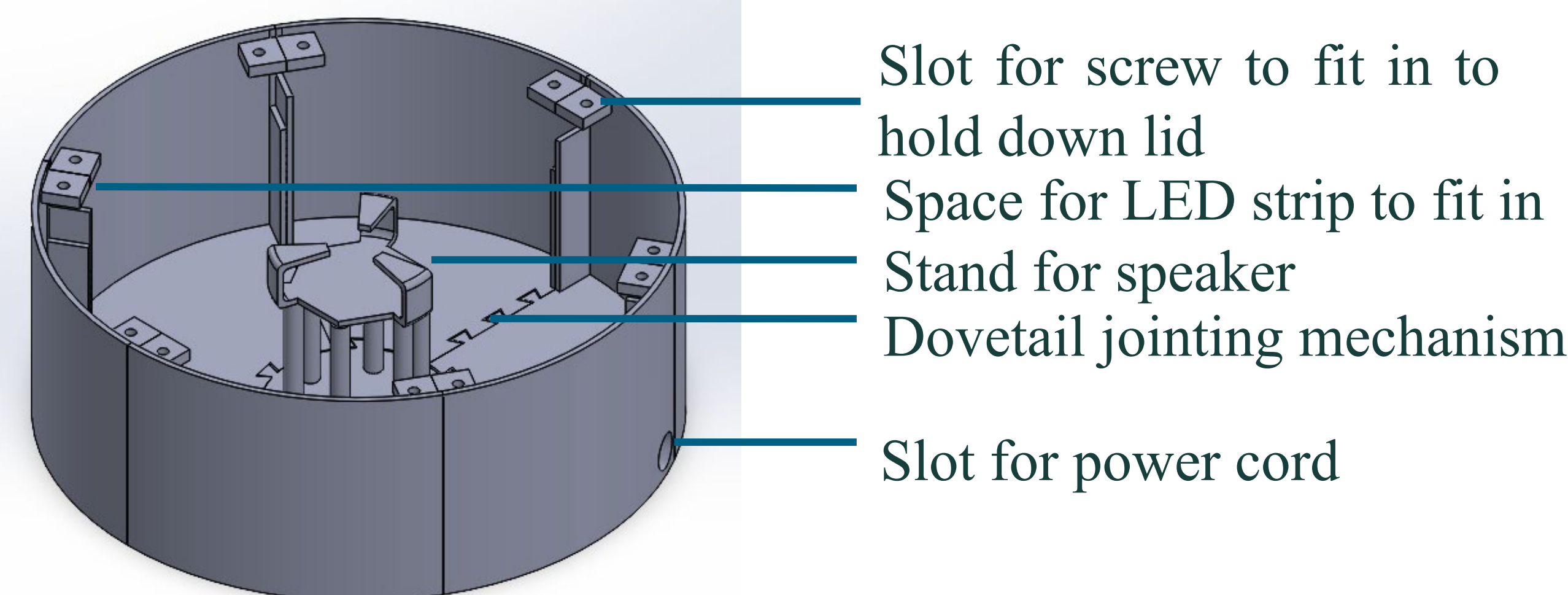


Figure 1: 3D Model assembly of components making the base of the part. Parts were individually 3D-printed, then press-fit together, then the cracks were sealed using a soldering iron.

Issues: tolerancing the edges and corners, modifying the design for new components as they were added, adjusting the height. Iterative design was essential to creating a viable final product.

Ease of use: Power on/off controlled by plugging in power cord, lid easily unscrewed for removal, Threaded inserts were heat-set into slots in each segment, so that bolts were not needed when screwing down the lid, facilitating removing and replacing the lid for maintenance as necessary.

Circuitry and Connectivity

- **Microcontroller:** Arduino Mega 2560 due to large number of pinouts for greater connectivity (Fig 2).
- **Pushbutton input:** signals Arduino to light up LEDs and trigger audio event corresponding to the color.
- **Audio:** produced via a TX/RX SD-card reader that communicates with the Arduino to select an .mp3 file and play it from speaker.
- Audio output is routed through LM386 amplifier to speaker for more robust sound.

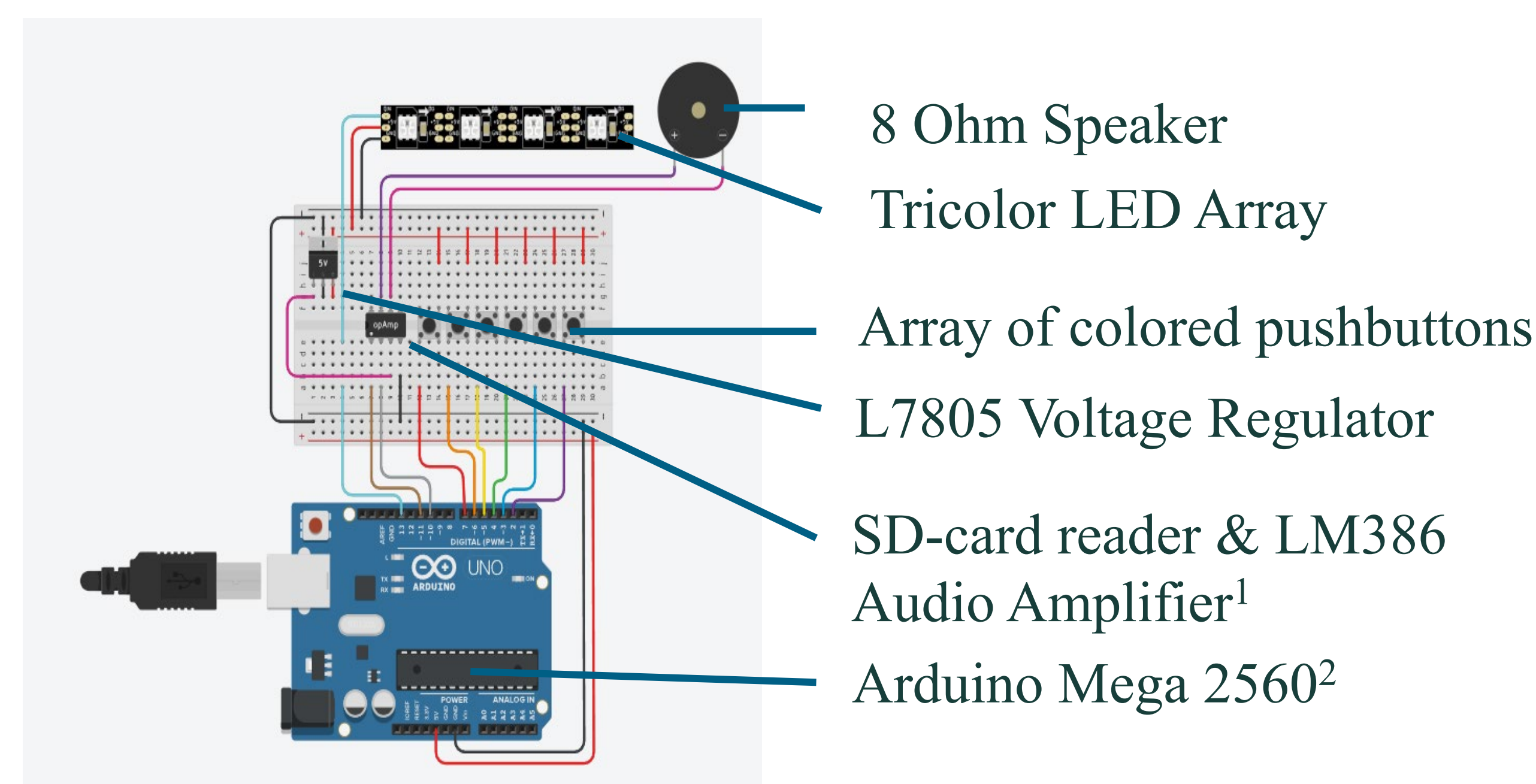


Figure 2: Block diagram of circuit components:

1. SD-card reader and LM386 Audio Amplifier are separate modules but grouped together here.
2. Arduino Mega 2560 was used in the project but an Arduino Uno is pictured here.

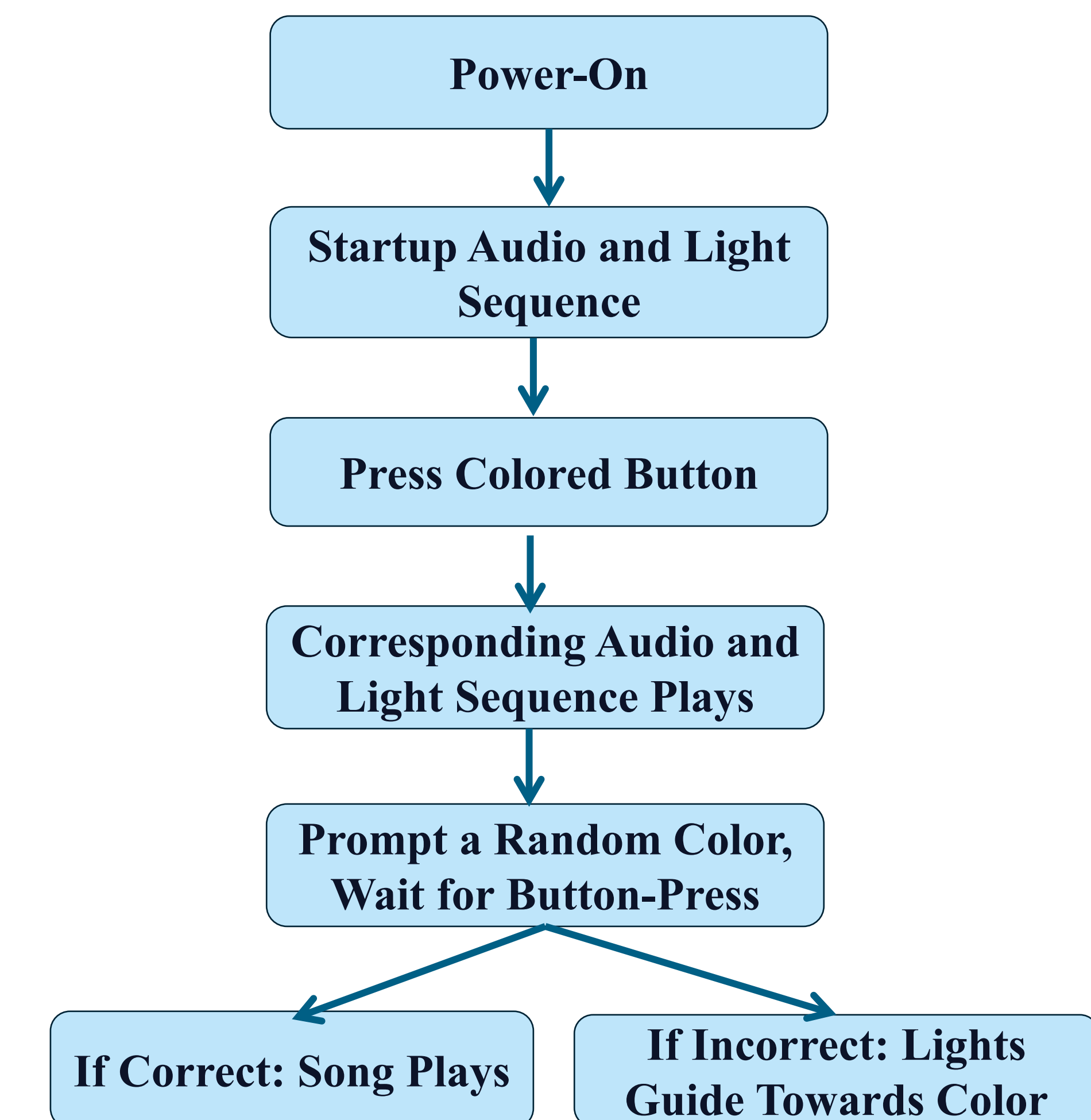
Power consumption: LED strip was noted to draw up to 2A of current, which exceeds the Arduino pinout capability.

- Thus, an L7805 voltage regulator was introduced to provide an additional power source independent of the Arduino.

Code used to program the Arduino is available at <https://github.com/mayarim/BRIGHT-Learn>

- Includes code from Arduino libraries FastLED and SerialMP3Player

Play-Flow



Future Directions

Additional considerations for future iterations of this project:

- Waterproofing design with a sealant
- Alternate versions of the arcade-style buttons would be used that have LEDs
- A volume knob, possibly realized using a potentiometer, could be implemented for comfort of the client's parents.
- On-off switch to power device off without unplugging

References

<https://docs.arduino.cc/hardware/mega-2560/>
<https://github.com/FastLED/FastLED/>
<https://github.com/salvadorrueda/SerialMP3Player>
<https://www.ti.com/lit/ds/symlink/lm386.pdf>
<https://www.st.com/resource/en/datasheet/178.pdf>

Acknowledgements

Marin Merchant for motivation and encouragement.
Sarika and Birju Merchant for proposing the idea.
Mohamed Ismail for advice with CAD tools and brainstorming.
Christopher Bingham for support with equipment.
Prof. John Board for technical advice and guidance.