FretFree

Play music FretFree

University of Colorado Boulder

Engineering for Social Innovation

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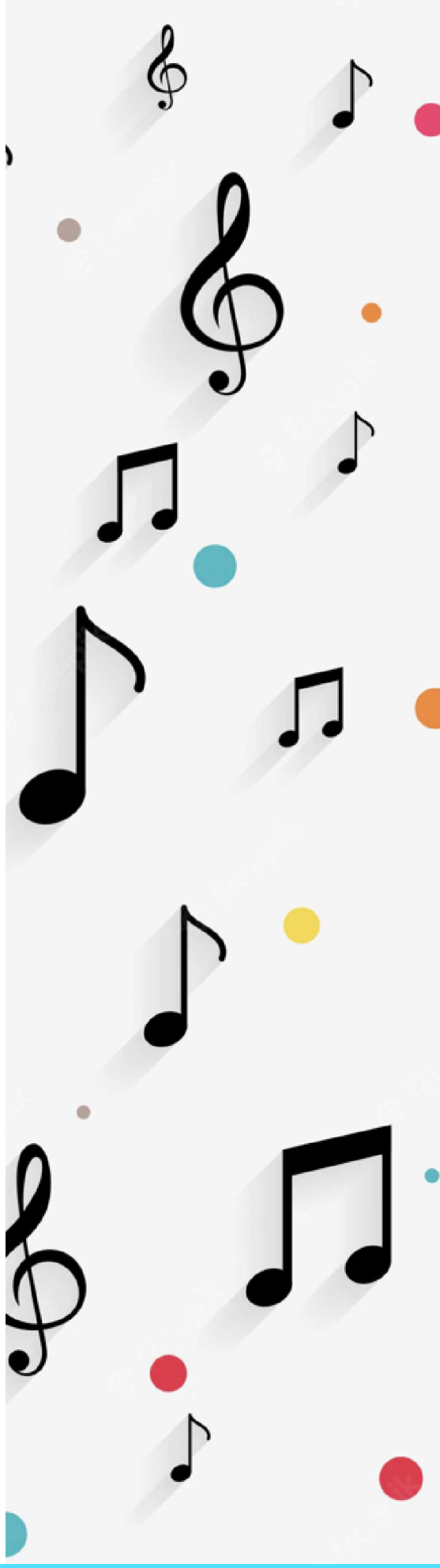
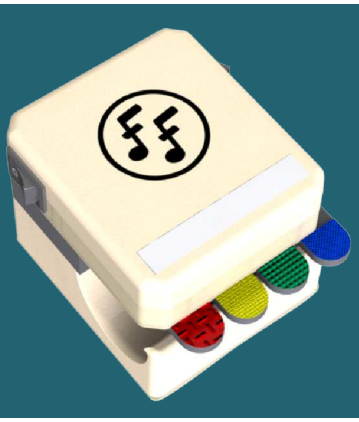


Background and Motivation



FretFree strives to make learning musical instruments simple and engaging for children with autism. Our product frets four of the most common chords on a ukulele with just the press of a key. It includes interactive lighting that allows the user to learn chords and songs quickly and keep them eager to continue with their music education.

THE PROBLEM

Children with autism struggle with communication and many aspects of everyday life such as social behaviors, self reliance, etc. When enrolled in music therapy, it is shown that 86% of these children begin to have improved social skills and are able to communicate more. However, these children can become discouraged due to the difficulty of learning an instrument and want to quit music therapy, not gaining any of the benefits from it.

EXPERT INTERVIEWS

After talking to over 30 music therapists and observing an adaptive learning class, it became clear there were a few challenges children with autism had when learning the ukulele. They included:

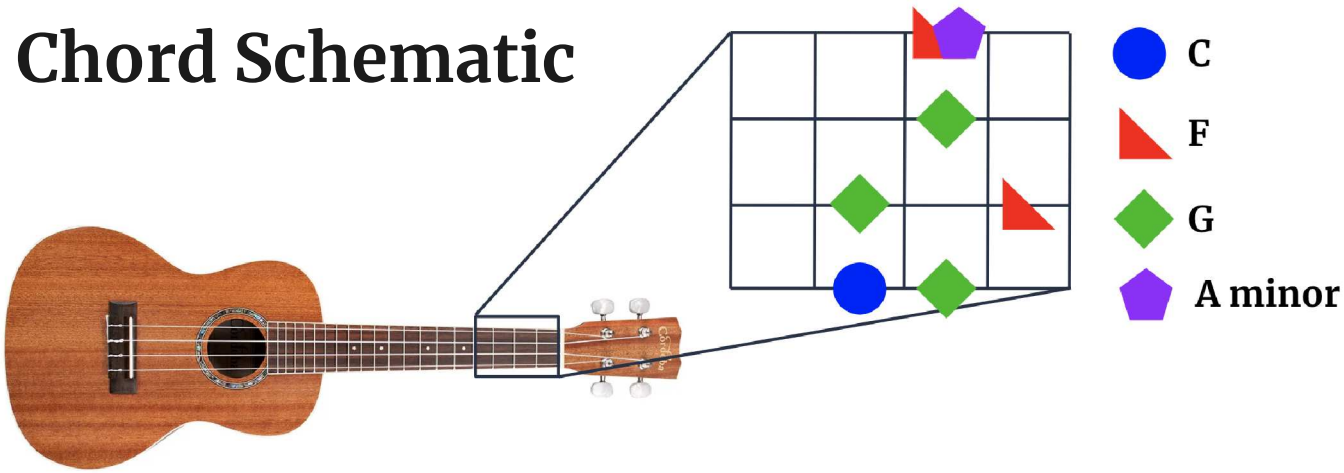
1. Having to apply too much force to press down the strings to make a chord (fret a chord)
2. Trouble transitioning from chord to chord when playing songs
3. Creating accurate sounding chords
4. Not having a comfortable grip while playing the ukulele

OUR SOLUTION

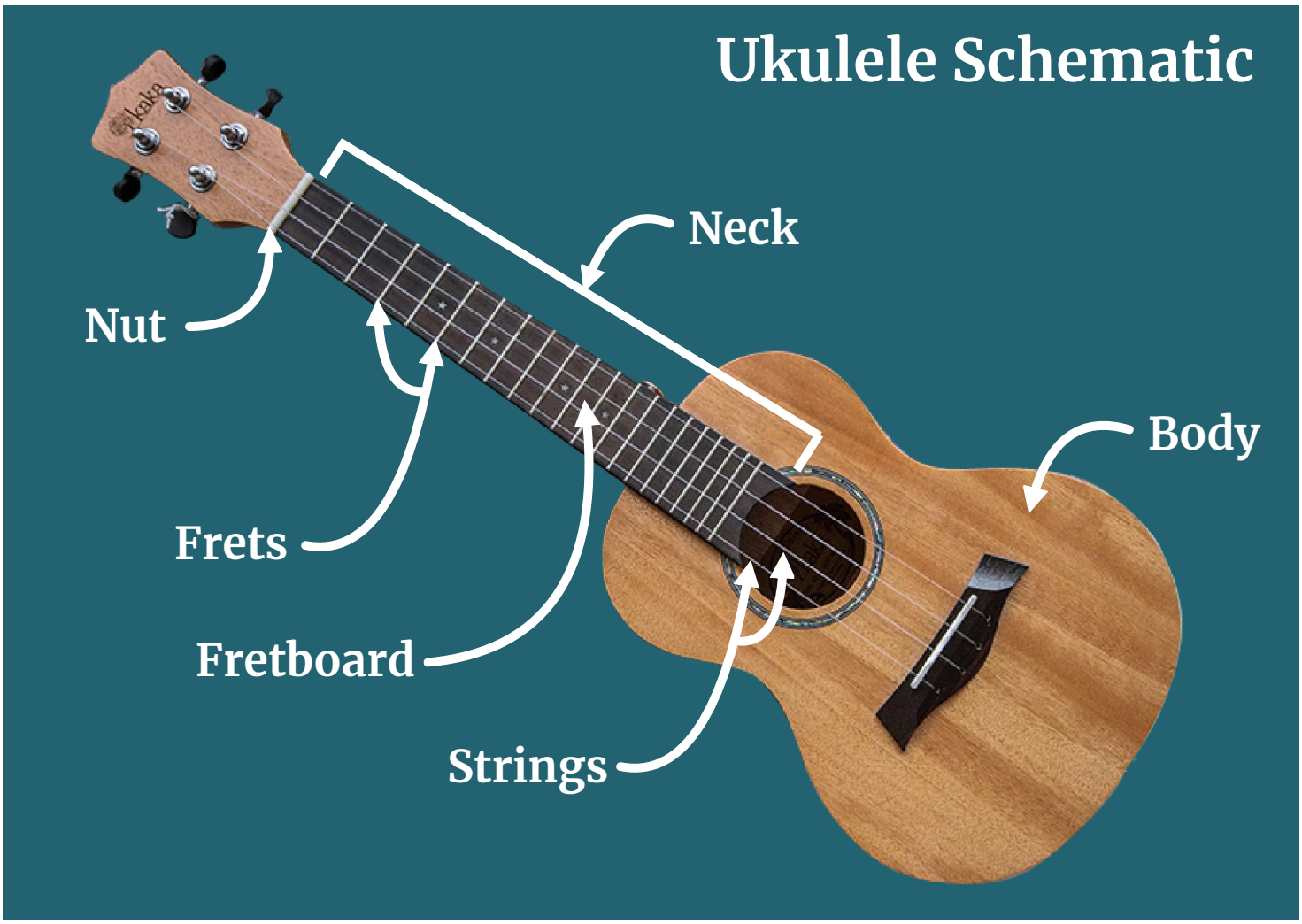
FretFree has created a device called the FretFree Ukulele which allows children to easily learn to play the ukulele. The user is able to play the F, C, A minor, and G chords with just the press of a key for each chord. These chords make up thousands of songs the user will instantly be able to play. The keys were ensured to be easily pressed with minimum force and will create the right chord 100% of the time. An interactive lighting system is also integrated into the device with two modes: one for positive feedback when learning chords and one for guided learning of songs that can be programmed into the device. It also has a comfortable thumb grip to make sure users do not become fatigued while playing.

Ukulele Basics

Chord Schematic



Ukulele Schematic



The Design: FretFree Ukulele

FretFree's unique design allows children with autism to easily learn to play the ukulele, creating a positive and inclusive experience.

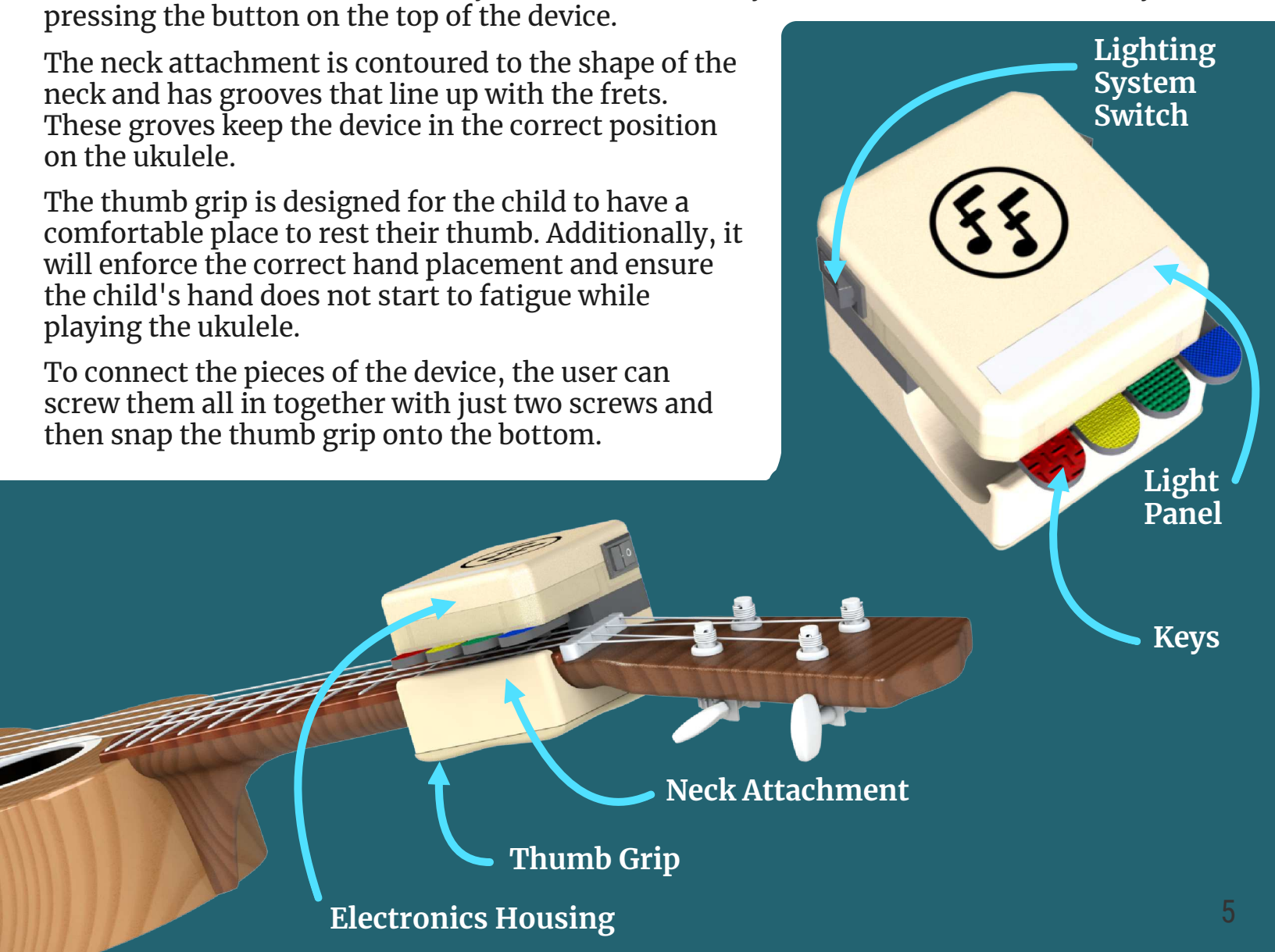
Children are able to play the F, C, A minor, and G chords with just the press of a key for each chord. The keys were tested thoroughly using finite element analysis software and testing of the physical model to ensure the child will not have to apply too much force to make an accurate sounding chord. Each key has tactile color pads on them so that the child can differentiate each chord by color and feeling. The "feet" on the keys are positioned to create each chord when the keys are pressed. Additionally, the feet have a plastic layer on the bottom of them to create precise sounding chords and ensure no damage is done to the instrument.

An interactive lighting system is also integrated into the device with two modes. The first mode is a positive feedback system for learning the chords. When the child presses a key, the light bar will show a colored light that matches the color of the pressed key. This will enforce which chord is being played so the child can learn quickly. The second mode is for learning songs that can be programmed into the device. This is an engaging method for the child to learn songs fast. LEDs will light up to the a chord in the song and the child will press the corresponding key, triggering the next chord in the song to light up. These lights are color coordinated with the keys.The child can easily switch between the modes by pressing the button on the top of the device.

The neck attachment is contoured to the shape of the neck and has grooves that line up with the frets. These groves keep the device in the correct position on the ukulele.

The thumb grip is designed for the child to have a comfortable place to rest their thumb. Additionally, it will enforce the correct hand placement and ensure the child's hand does not start to fatigue while playing the ukulele.

To connect the pieces of the device, the user can screw them all in together with just two screws and then snap the thumb grip onto the bottom.



Manufacturing Considerations

Current Manufacturing Process

To create our first few prototypes, the team utilized the 3D printing resources available at the University of Colorado Boulder. The design was adjusted to ensure that it could be 3D printed. PLA was chosen chosen due to its strength and elastic properties and ease of being 3D printed. PLA was also chosen due to being compatible with the 3D printers used. The PCB for the lighting electronics system was manufactured using the campus PCB printer.

Future Manufacturing Process

To mass manufacture the device, the team plans to injection mold the product from ABS. Each component has been created with ribs, drafts, and fillets necessary for the injection molding process to create an easy transition from 3D printing to injection molding. This will drastically cut down the unit cost of the device and allow the team to provide more devices in a timely manner.

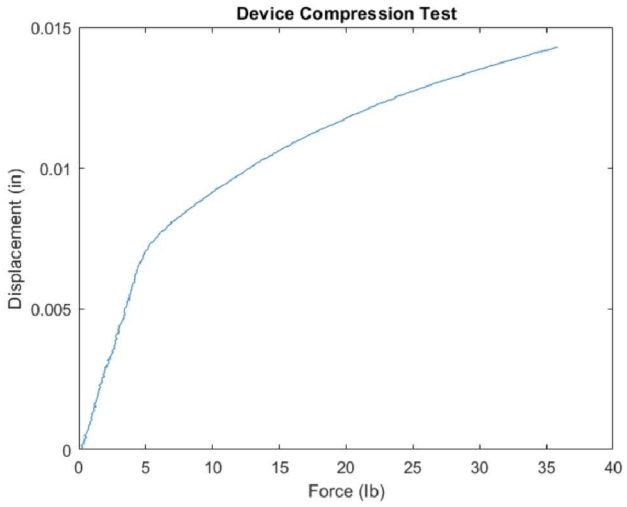
Testing and Results

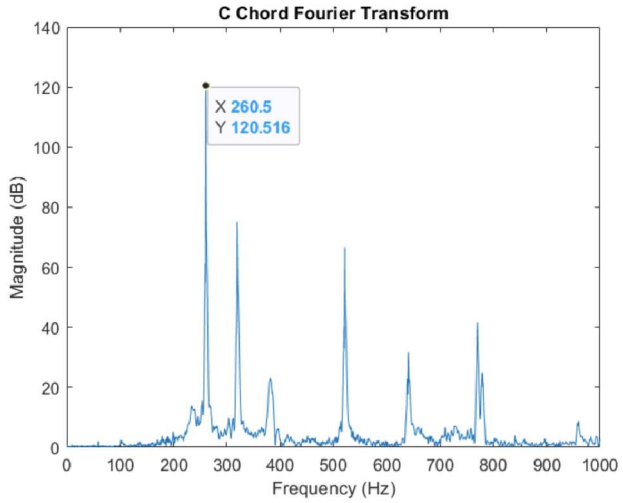
Verification Testing

FretFree has created a device that is compliant with ASTM F968-17 standards for consumer and child safety.

Tests

1. Compression and cycle tests performed on the Universal Testing Machine (Results seen on the left)
2. Audio recording tests verifying the chord accuracy within 0.5% (As shown on the right, the C chord should have a frequency of 261 Hz and ours was tested to be 260.5 Hz)





User Testing

The team has allowed the device to be used by 20+ children with autism enrolled in music therapy through private practices and schools.

Results

- Larger keys were necessary to make it easier to play
- Colors paired with chords helped with recognition of each chord
- Playing the device with the ukulele flat on the ground helped the children press a key and strum at the same time

Business Considerations

ADDRESSABLE MARKET

The target addressable market is 49.5 million 6-17 year olds in the United States. The serviceable available market makes up 23.6 million children that are enrolled in a music education program. The serviceable obtainable market the team strives to reach are the 536,400 children with autism in a music program in the United States.

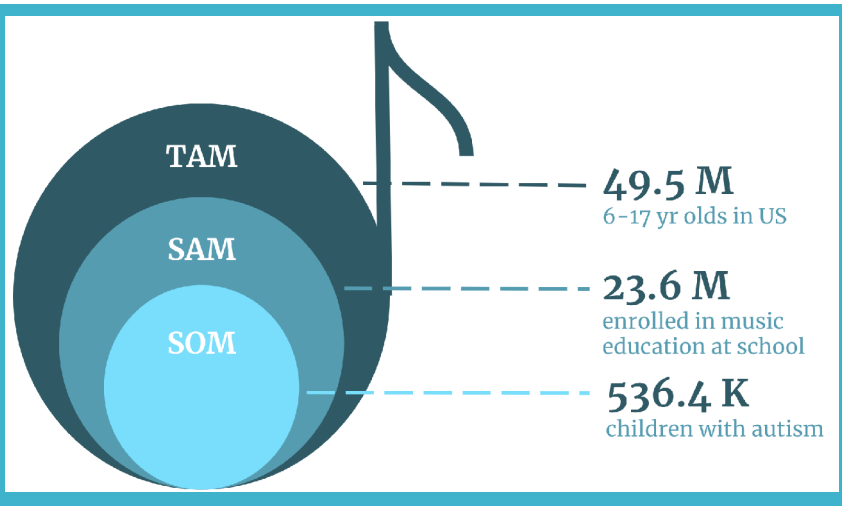
COMPETITIVE ADVANTAGE

From research conducted, the team learned about problems students currently have with existing products, such as not producing precise sounding chords or having to apply too much force onto these devices to make them work. To address this, FretFree has created levers that are designed to create accurate-sounding chords 100% of the time and require minimum force to press. FretFree has also added an electronic lighting system that none of our competitors have. This makes the device unique among all other products currently on the market and will give it the edge in quality of user experience.

BUSINESS PLAN

FretFree's initial launch will be in 9 months. The team plans to initially target local music therapists and schools around the Boulder-Denver area. In one year, FretFree will expand to all of Colorado and the surrounding states as well as launch a companion app allowing the user to upload songs of their choice and play along with music learning tutorials. The team will also start fundraising to be able to expand the company's products and services. After two years, FretFree will expand to music therapists, parents, and schools throughout the entire United States. The team will also begin to launch similar products for different string instruments that customers may be interested in learning. In three years, FretFree plans on continuing selling products across the United States as well as continuing to expand the product line. FretFree plans to sell the current product for $50.00 and have the app be a subscription model of $2/month. By 2027 it is predicted the net profit will be $3.46 million.

MARKET ANALYSIS



Our Team

As a team of five, we founded FretFree at the University of Colorado Boulder's mechanical engineering senior design class. We shared a passion for music and wanted to make a product that would allow children with autism to learn to play the ukulele without the frustrations that come with learning a new instrument, and to encourage their future musical endeavors!

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