Sight and Sound Latch

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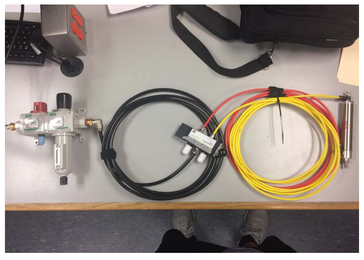
The Problem

Sight & Sound Theatre in Lancaster, Pennsylvania is a theatre company that performs well-known Biblical stories as plays. The company reached out to Messiah College and the Collaboratory with a problem. The theatre uses large set pieces in each play and, for these to be effective, they must be securely connected. Currently, the theatre uses hand-operated latches. This requires either stage hands or even actors to activate these latches, and results in unwanted stress upon the whole production team, especially the actors that need to focus on their primary responsibilities. Because of this, they desire a button-operated latch that can be controlled from elsewhere in the facility.

Goals

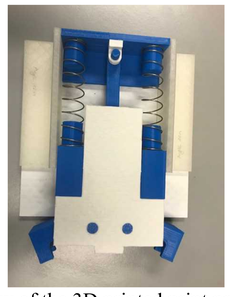
The overall mission of this team is to enhance the immersion of the performances done by Sight and Sound. The theatre company is fairly popular, usually filling a 2,000 seat auditorium for shows multiple times a week. Because of these numbers, it is safe to assume that the company draws in more than only Christian customers. If this is true, then the company is sharing the gospel in an incredible way. People may only come for the theatrical experience, but leave with a better understanding of who God is.



Pneumatic set up used for testing

Specifications

A successful solution to this problem would ideally be a strong latch that is hidden from the audience, along with being quiet and not too expensive. Initially, we will design the latch with a goal of handling 500 lbs of force. This would be an average amount the latch would need to hold, but the final design should be scalable so the force could range up or down depending on the type of set it is on. Our financial goal would be around $200 to $300 per latch. The latch would need to be no louder than a 40 dB SPL level during operation. It needs to be no larger than 18 inches high, 24 inches wide and 12 inches deep.



Top view of the 3D printed print prototype

Methodology

After considering various possible latching designs, we have chosen a design which is comprised of two components: the mechanical side and the pneumatic side. The pneumatic side includes a pressure-activated cylinder that extends towards the mechanical side. This cylinder will be button operated to make things as simple as possible. It pushes on the front of the latch which recesses into its walls. As the pneumatic cylinder pushes on the latch, posts in the base of the latch force the jaws to close around the cylinder. The latch includes a pin and track mechanism that allows the latch to operate similarly to that of a pen. Once the latch is pushed in completely, it locks into a closed position. The cylinder then retracts with the jaws of the latch closed around it, which pulls the respective set pieces together, allowing for actors or actresses to perform on them.

The track itself has multiple steps to guide the latch into the proper position. As the pneumatic cylinder pushes the latch back, with just enough force to overcome the force of a spring in the latch, the pin starts to move along the track. Once it gets to the top of the heart it drops down a step and the cylinder starts to pull back. The pin drops down one more step to get to the closed position of the latch at the dip of the heart. Here is where the pneumatic cylinder will be pulled back with its full force to bring the set pieces together. When ready to be released, the cylinder will be pushed forward again to drop down another step and be pulled back up the incline to rest at the open position. The steps serve to direct the pin in the right direction so that it is not allowed to backtrack.

To test and refine the design, we have created prototypes using a 3D printer. The insights from this process has lead to multiple improvements in the design of the latching mechanism.

At the same time, we have been working on the pneumatic cylinder side of the latch, sizing the needed components, and doing some initial testing of that design.

Pin and track mechanism

Detailed view of the track.

Conclusions

We have developed and refined a latch design which should meet the specifications. We are currently working on fabricating steel prototypes. We will begin assembling these latches and the pneumatic side of the latch as soon as possible and develop testing strategies to analyze the indexing capabilities of the latch as well as the probability of wear and tear over time.

Further Information

For more information, contact George Noble (gn1162@messiah.edu).

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Sight & Sound Theatres

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