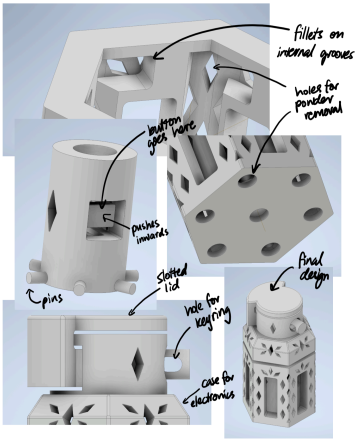
MECHENG755 Project 1 Report **Sophia Schulz (ssch923)**

Overall Keychain Design and Inspiration

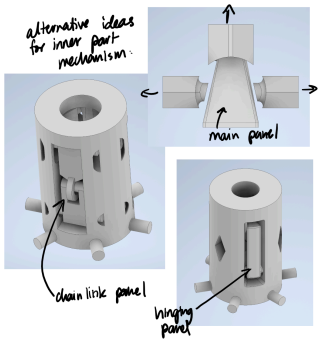
My goal for this project was to create a functional keychain with a “commercial” look and feel. As a mechatronics student, I love combining the different disciplines that I study in some way, such as electronics and mechanical design. I decided to create a lantern keychain with embedded electronics to make the design light up somehow. Inspired by images of ornate lanterns online, I chose a hexagonal outer frame with rectangular windows. I wanted the main moving mechanism to lift up and “open” these windows, so I created an inner cylindrical part that could be pulled up to expand the lantern through the use of pins sliding in grooves. I also made a “twist and lock” mechanism at the top of the part, allowing the lantern to stay in its expanded position. In order to hold the electronics, I made the inside of this cylindrical part hollow and created a compartment at the top of the lantern for the electronics. While designing, I kept in mind how a person might use my keychain intuitively, so I added a lid that could slot into the top casing for easy replacement of the batteries/electronics. To keep this lid in place, I added a hole at the end of it for the keyring which, when attached, would prevent the lid from sliding back out.

Features and Improvements Made



As I developed the keychain design and test-printed along the way, I made iterations and improvements to smaller features and to the overall design. For example, I added the grooves that the pins would slide up within on the interior of the outer frame. This allowed them to be invisible from the outside, protecting them from damage and contributing to the polished, “commercial” look I was aiming for. Another improvement I made was adding fillets on these internal grooves, not only to reduce stress concentrations but also to allow for a smoother and more secure “twist and lock” mechanism. I also took into consideration both desktop FDM printing and SLS powder-based printing, especially with the diamond hole pattern I added to the outer frame for easy powder removal from the internal grooves. The diamond pattern was chosen for its aesthetics, its ability to print without supports due to its internal angles, and because it didn’t compromise the structural integrity of the outer frame. The diamond pattern also had the benefit of letting light through in a unique way, once again similar to the ornate lanterns they were inspired by. I also added circular holes at the bottom of the design for powder removal.

For the inner cylindrical part, I wanted to add another moving mechanism to incorporate further complexity. However, I was extremely limited by the dimensions I had chosen for the overall structure and the need for the inner portion to be hollow for the light/electronics. I experimented with adding moving parts within the walls of the inner cylinder, such as a chain-link panel design and panels folding out on hinges, but found these to either look out of place or to print poorly such that the mechanisms didn’t move well or broke off. I settled on an idea that also gave me space to add the button for the LED: a diamond panel that would push outwards as the button was pressed. I explored adding two more panels that would push to the sides as the central panel was pushed by using angled edges rubbing



against each other, but the parts were too small to move well, so I stuck with just one main central panel. I added “guide rails” to ensure the button stayed in place and added a backing part for the button that also prevented the diamond panel from falling out of the keychain.

Post-Processing and Overall Learnings

For post-processing, I first added the electronics consisting of a 5mm LED, resistor, button and two hearing aid batteries. Unfortunately, I didn’t account for the large beads of solder on my wires, so I was unable to fit the batteries tightly in the casing and close it with the lid. The electronics worked well though and the lantern lit up quite nicely! The nylon material was also translucent and glowed well, so I painted most of the keychain white to preserve this look. As for what I learned, one of my biggest takeaways from this project was learning support optimisation in Prusa Slicer. I had never designed anything with more complex parts that required supports before, so I quickly learned how to use Prusa’s paint-on supports feature to selectively add supports and minimise post-processing time. My other biggest learning was designing for different manufacturing methods (FDM vs SLS), such as with the diamond pattern explained earlier. Additionally, I challenged myself to design a more “commercial” looking/functioning product that would be intuitive for anyone to use, such as by protecting the pins from external damage, adding casings/slots for the electronics, and using the keyring hole as a locking mechanism for the lid. Finally, I learned about the limitations of choosing a tall, narrow and hollow structure when it comes to adding complex moving parts. The push-panel was the best solution given the limited space I had and the need for 0.5mm clearances, but if I were to repeat this project, I would explore other dimensions that could give me more freedom with adding moving parts. Overall though, I’m generally happy with what I was able to accomplish given the limited space and the structure I chose, and I’m especially happy with the polished look of the keychain and its functionality as a lantern!

Setup time in Prusa Slicer	5 minutes
Printing time on desktop FDM printer	2 hours 18 minutes
Post-processing time (support removal)	20 minutes
Total cost of SLS part	$12.24 (from Shapeways using PA12 nylon)