Latch release Mechanism using the shape memory material nitinol

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Aim of the Project

The Aim of the Project was to design and build a nitinol operated latch release system to be mounted onto the group project that was a small-scale satellite launching system that ejected 6 micro satellites while also complying with space regulations and passing rigorous tests including vibration, acoustic, shock, pressure, electromagnet and temperature

Objectives

- Create concept designs and pick the best one or combination of multiple
- Create a working assembly and drawings
- Test nitinol spring for force and operating temperature
- Manufacture the latching system on the milling machine and lathe.
- Wire up the nitinol to actuate it
- Assemble the latching system and test

Background

In launching micro satellites into space strict regulations must be abided by in doing so it was decided that the best way to release the latch was to use nitinol. Nitinol is comprised of nickel and titanium at room temperature it is malleable but can be heat treated by heating above 500^{o}C to return to a trained shape with great force by then heating to 100^{o}C it is extremely durable and can withstand extreme movement while always returning to its trained shape

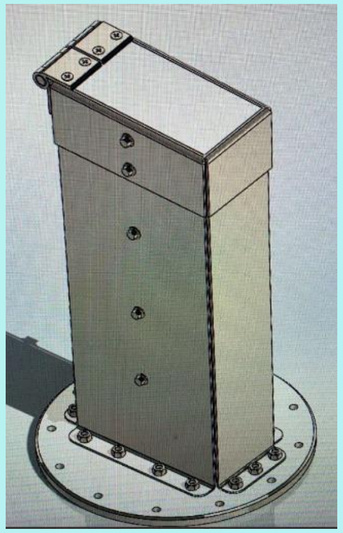

Figure 1 shows the outer shell of our group project from last semester in which my latch release mechanism will be mounted to keep the door shut until an electrical current is received, retracting the pin and releasing the doors

Figure 1 group project model which the latching system is to be mounted

Concept Designs

Design number	Simplicity	Manufacturability	Functionality	Total Score
1	4	5	4	13
2	2	2	3	7
3	3	4	2	9
4	5	3	1	9
5	1	1	5	7

Figure 2 Concept design selection chart

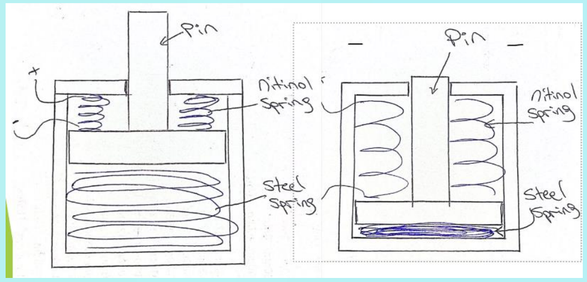

Figure 3 the winning concept design, design 1

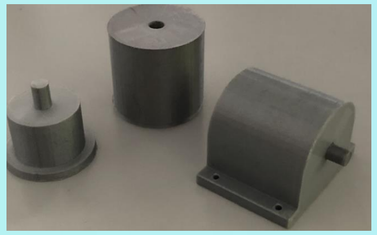

Figure 4 prototype 3d printed parts

3D printed prototype models were created to gain an understanding of the size and scale of the latching system

Final Design

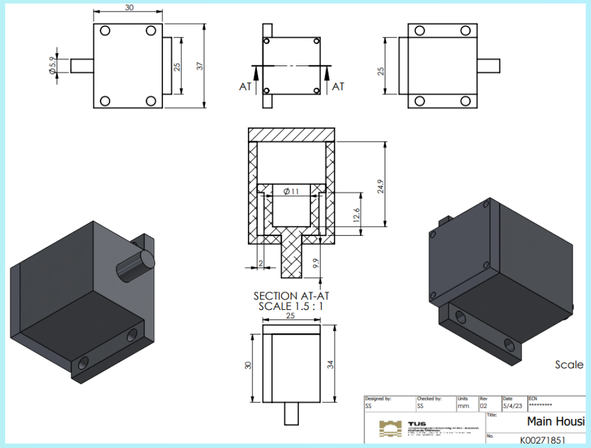

Figure 5 final design assembly

After improving on my best concept design my final design was created with simplicity manufacturability and functionality in mind

Manufacturing

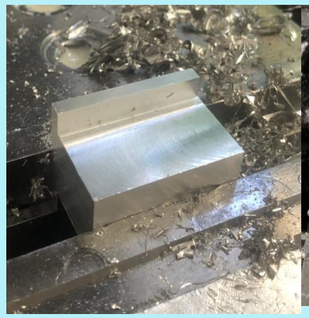

Figure 3 housing being machined to shape on milling machine

Figure 4 hole for pin being bored out

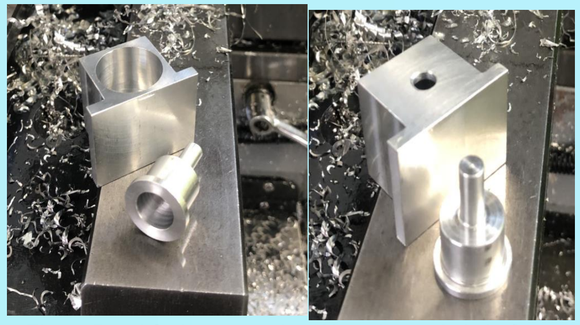

Figure 5 and 6 show completed housing and pin before holes were bored for assembly

Conclusion

As seen in figure 5 the final design assembly consist of 3 simple and easily manufactured parts the pin which is mounted inside the shell is kept in place by a stainless steel spring and once a electrical current is received from the space ship into the nitinol metal causing the nitinol spring to adapt its trained extended position this causes the pin to retract therefore opening the doors of the satellite launcher allowing the micro satellites to be released due to the properties of nitinol once it has cooled down the stainless steel spring will extend the pin again allowing the process to be repeated

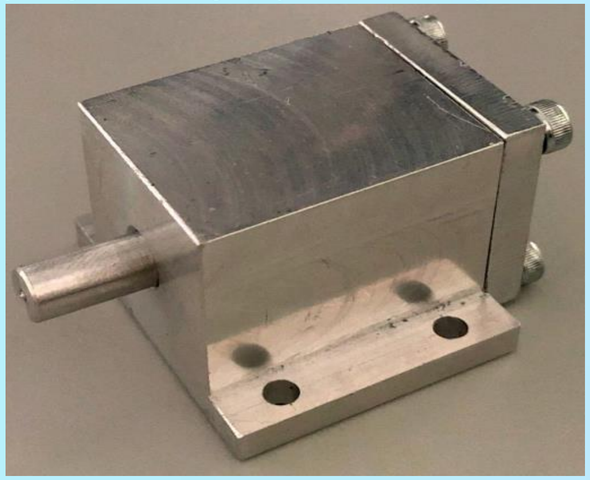

Figure7 Final manufactured assembly

Acknowledgements

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