Rubik’s Cube Personal CAD Design Project

INTRODUCTION

For my personal CAD project, I decided to pursue the design of a Rubik’s Cube. For many years now I’ve been a huge fan of solving cubes, and so I felt that this would be a project I would greatly enjoy. While a Rubik’s cube may seem quite simple upon first glance, the inside of a Rubik’s cube is actually quite complex, and is something that has always fascinated me.

PARTS DESIGN

I began the design by creating the center axles of the cube, known as the yoke. Attached to the yoke are the six main center pieces of the cube. These center pieces are particularly important in a Rubik’s cube, as they never change their physical location; they only rotate around the yoke. The remaining pieces of the Rubik’s cube snap into the structure, and are held in by the center pieces attached to the Yoke.
The pieces that fill the remainder of the cube can be classified into two different parts: the corner pieces, and the middle pieces. The pieces have small protruding portions designed to lock it into the cube, and preventing the piece from falling out, but without impeding the movement of the cube. These two pieces are pictured below, with the corner piece on the left, and middle piece on the right.

Additionally I created “color plates” to be placed on each cube so that the individual sides could be different colors. While designing this, I discovered a new feature of drafting an extrusion, which allows the extrusion to taper. I thought that this provided a neat, unique look to the plate, and decided to go with that, rather than a simple, flat square.
ASSEMBLY AND MATING

Once all of the parts were designed, I began the most time consuming part of the project, which was the assembly. I began by mating the center pieces to the yoke, while maintaining their ability to rotate upon the axes. After that, I mated each of the remaining pieces, one at a time, into the cube until it was completely assembled. In the end, putting all of the parts together (the yoke, each cube, and the color plates on each side of the cube) required a total of 450 mates. The fully composed cube can be viewed below, next to the sectional view.
The wire frame view on SolidWorks allows us to see the internal components of the cube once it’s assembled.

**ROTATING FACE**

The most difficult part of the project was achieving a rotating side of the Rubik’s cube. After extensive research, I determined that limitations in SolidWorks software renders it impossible to have all faces of the cube capable of simultaneously rotating (as this would create conflicts in the mating). However, I was able to have one rotating face of the cube. Once I had successfully created an immobile cube assembly, I went back and began removing certain mates, and adding new ones, to allow for the face to move freely. However, it quickly became clear that sorting through the hundreds upon hundreds of mates to pick the right ones to delete would be a daunting task. After several hours of work, I eventually succeeded in achieving a freely rotating side, while maintaining the functionality of the remaining mates.
CONCLUSION

Overall, I found this project to be quite enjoyable; something I think was made possible by selecting something that matched my interests. The design process allowed me to learn a lot about both the Rubik’s cube, and the Solidworks software. I feel far more comfortable with modeling than I did previously, particularly with the mating (which I felt to be my weakness prior to this). In the end, this personal CAD project allowed me to grow and learn as a CAD designer.

The titled face depicted here is capable of fully rotating around its axle.