ENGINEERS GEOSCIENTISTS MANITOBA

2024 STUDENT ACHIEVEMENT AWARD

The Design and Implementation of Cubert: An Intelligent Rubik's Cube Solving Robot

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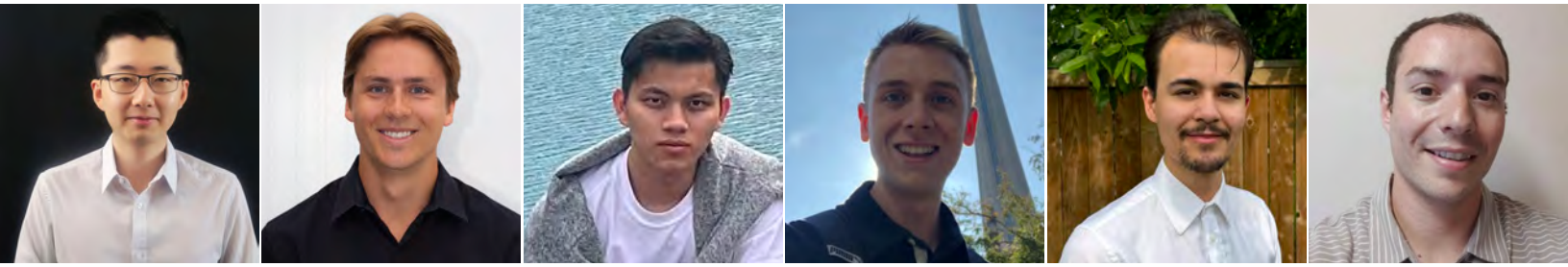

With the advent of artificial intelligence getting better every day, this project team wondered, "Can artificial intelligence solve a Rubik's Cube?"

Solving a Rubik's Cube requires skills such as spatial intelligence, pattern recognition, and fine motor dexterity, making it often deemed as a colloquial test of intelligence. These characteristics, when put together, create an interesting set of benchmarks to overcome. Thus, as a capstone project, the project team decided to create a robot that can physically solve 3x3 Rubik's Cubes, named Cubert.

Cubert is built upon three main modules: Sensing, responsible for the determination of the Rubik's Cube state (i.e., the cubelet colors on each face of the cube). Computation, responsible for determining the solution sequence using a machine learning model. Actuation, responsible for the physical manipulation of the Rubik's Cube.

Cubert solves a Rubik's Cube by first capturing the cube state with the Sensing Module, which uses pictures and image processing tools to determine the state of the Rubik's Cube (i.e., the colors and positions of those colors of each cubelet on each face of the cube). Then, the state information is encoded and passed to the Computation Module, which uses a trained reinforcement learning model to garner a solution sequence to solve the Rubik's Cube. Finally, this solution sequence is encoded to the motors of Cubert to begin manipulating the physical cube to the solved state.

Cubert can identify the cube state 100% of the time, garner a solution sequence within 2 minutes to solve the Rubik's Cube, and actuate moves to solve the physical cube within 1 to 2 minutes dependent on the severity of the initial scrambled state of the Rubik's Cube.

The future consideration for Cubert is to continue to improve the machine learning model so that it can solve Rubik's Cubes in more severely scrambled states. Moreover, the team hopes to refine the physical design to the point where it can be handled like a consumer product. That is, have Cubert be a plug and play device.