

Ruaidhri Cook

University of Wales Trinity St. David
(UNITED KINGDOM)
Rcook.148970@student.uwtsd.ac.uk

LEGO RUBIK'S CUBE SOLVING ROBOT



Abstract

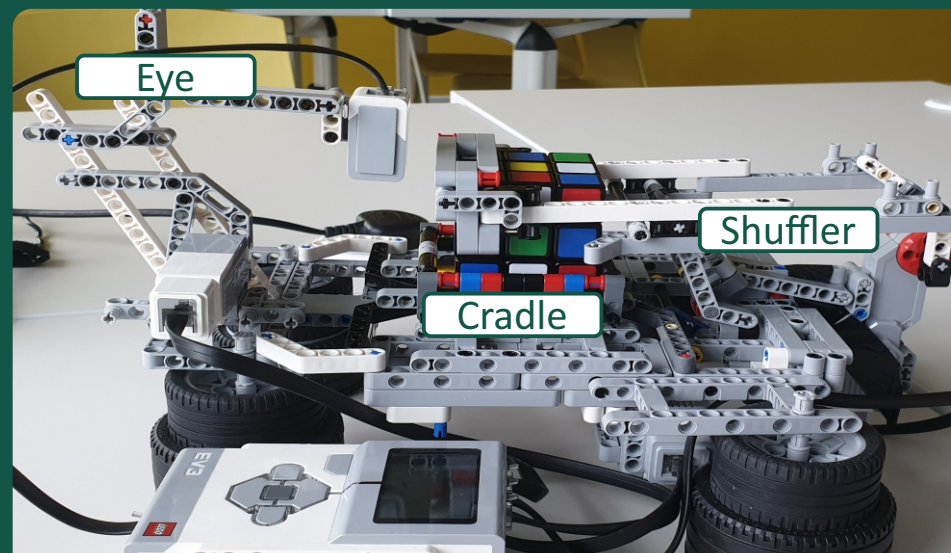
- Rubik's cubes are impossible to solve by chance
- They are solved by performing rotation algorithms on the cube
- This can be done by a Human being or a robot
- The EV3 LEGO MINDSTORMS set was used to create the robot to solve the cube
- It has a central processing brick, colour sensor, motor and connecting pieces
- The brick was programmed using Python to write a script that was executed on 3rd party firmware
- Functions were created to control the physical parts of the robot that performed moves
- An algorithm was created to decide which moves should be performed to solve the cube
- The project was difficult because of the vast amount of different cube combinations

The Rubik's Cube

- Created in 1974 by Erno Rubik[1]
- Originally called Buvos Kocka which is Hungarian for Magic cube
- Won Toy of the Year in both 1980 and 1981 [2]
- It is currently the best-selling toy of all time
- It has over 43 Quintillion different configurations
- Only requires a maximum of 20 moves to solve[3]
- Fastest human solve time is 4.22 seconds [4]
- Fastest robot solve time is 0.38 seconds

How to solve the Cube

- Most popular solve method is CFOP method
- Stands for: White Cross, First two layers, Orient last layer, Permute last layer
- Solves cube in stages using notation for moves
- Notation uses letters and symbols to represent rotations of each of the six faces
- The robot uses algorithm to solve the white cross created by translating notation into code
- The robot has a function that uses 'Eye' sensor input to identify & store the configuration of the cube in an array and a function to change the configuration in the array after each move
- The white cross solve algorithm uses the array storing the configuration of the cube and the function that changes the array after a move



Robot with Shuffler locked over the cube to allow Cradle to rotate the cube

Methodology

- Feature Driven Development methodology
- Form of agile development
- It was chosen because of the modular nature of both the hardware and software
- Tasks could be broken into chunks
- Deliverable at each stage of development that could be compared with project requirements

Results

- Only the white cross was able to be solved when cube configuration was entered manually
- The project was delayed by 7 weeks
- At first the firmware would not install properly
- The colour sensor used on the robot was temperamental - required optimal lighting conditions to identify cube configuration
- The project deliverables serve as a proof of concept - it could be completed with more time
- The project could have been more successful if precise Non-Lego components were used instead

References

- [1] Ruwix.com, "Important Dates in Rubik's Cube History." Available: <https://ruwix.com/the-rubiks-cube/history-rubiks-cube/important-dates-timeline/>
- [2] Rubik's, "Our heritage." Available: <https://uk.rubiks.com/about>
- [3] P. O. Fitzpatrick, "The history of Rubik's Cube." Available: <https://www.lexology.com/library/detail.aspx?g=dbcfd1ba-19c0-4c70-942b-38e95a4f5ba7>
- [4] Ruwix.com, "The History of the Rubik's Cube World Records." Available: <https://ruwix.com/the-rubiks-cube/history-of-the-world-record-evolution/>