CSEE W4840 Project Proposal: Rubik's Cube Solver   Team Name: RCS

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Design Overview

The aim of this project is to develop a Rubik's Cube Solver using the Thistlethwaite's algorithm. In this project, we intend to solve the Rubik's Cube in the shortest possible time taking advantage of the FPGA's speed. We intend to use pure software to test the time it takes to get a Rubik's Cube solution and compare the execution time with software/hardware hybrid approach. This will help us determine the efficiency of using the FPGA to solve the Rubik's Cube.

Input

This project will obtain input from the user via the PS2 Keyboard's number pad and arrow keys. The arrow keys will be used to move between the six sides of the cube. The numbers 1-9 on the number pad will be used to change the color of each box on each face/side of the cube starting from the bottom left box.

Sensor Data

PS2 Keyboard Buttons

Output

When the execution of the program ends, the steps to solve the Rubik's Cube will be printed out on the VGA Screen. An image of the 3D Rubik's Cube corresponding to the step will also be displayed. The time it took to solve the Rubik's Cube will also be displayed on the VGA Screen.

Algorithm

This project makes use of the Thistlethwaite's algorithm that solves the Rubik's Cube in 5 Groups, in which the last Group is a solved cube. The algorithm works by restricting the positions of the cubes into Groups of cube positions that can be solved using a certain set of moves. Following this procedure solves the cube.

We intend to use hardware to accelerate the part of Thistlethwaite's algorithm that will take about 75-80% of the execution time to compute. This part is composed of holding and modifying the current state of the cube, which could take place about a few million times. The software indicates to the hardware how to modify the current state and controls the UI as well as the demonstration of the final solution.