# A Puzzling Project: Computerized Rubik's Cube Generator and Manipulator

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## 1 Abstract

My project will be to design a 3 dimensional Rubik's Cube that can be randomized by the computer and manipulated by the user. In addition, the program will be able to generate cubes of varying sizes, eg. 2x2, 3x3, 5x5, etc. Lastly, the program will have the ability to solve the Rubik's Cube by itself. I will use JavaScript to write my program in, so that users can manipulate it from any web browser without needing to download any special software.

## 2 Background

There are two main reasons why I chose to create a virtual Rubik's Cube for my project. First, I have always been interested in puzzles, and the Rubik's Cube is a very well known puzzle that is recognizable for almost anybody. Second, since I already had experience in coding, I was seeking a challenge, and I had noticed that other students in the past have attempted to create virtual Rubik's Cubes, and to my knowledge have been completed in JavaScript. In addition, none have been attempted in sizes other than the standard 3x3. Therefore, I can build off of the past Rubik's Cube projects while adapting them to JavaScript and adding the additional functionality of different sized cubes.

# 3    Cube Generation

The Rubik's Cube will be generated using three.js and WebGL. It will be comprised of a 3-dimensional matrix of "cublet" objects (the number of which will be determined by the size of the cube). The size of each cublet will be inversely related to the size of the whole cube, and all cublets of a specific sized cube will have the same size eg. a 4x4 cube will have smaller cublets than a 3x3 cube in order for the cube as a whole to be the same size while having more cublets. The location of the cublet within the matrix corresponds to its location in the Rubik's Cube. Lastly, all of the cublets will have all six colors, because if the program works correctly, the colors of the internal faces will never be seen, so they do not matter.

# 4    User Manipulation

There will be three different methods for the user to manipulate the cube. The first method will be manually rotating sections of the cube; this will be done by clicking and holding the desired section with the mouse and moving it in the desired direction. The second method will be an input terminal where the user can type in a size, and a new cube of that size will be generated. The final method will be two buttons the user can click on, labelled "Randomize" and "Auto-Solve", which will cause the program generate a new randomized cube and to solve the cube by itself, respectively.

# 5    Randomization and Solving

In order to randomize the cube, the program will first create a solved cube of the correct size. It will then conduct a series of random rotations to shuffle the cube. In order to "solve" the cube, the program will keep track of each rotation, done randomly or by the user. It will then conduct these same rotations in reverse order, and the result will be the correctly solved cube that it started with.

# 6    Timeline

I have made moderate progress on this project already. So far, I have created a 3x3 Rubik's Cube made up of individual cublets using JavaScript, OpenGL, and three.js. I am currently working on a mechanism to rotate specific faces of the cube, which I plan to have completed by Friday, Oct. 28 (FA). When that is complete, I will have a working 3x3 Rubik's Cube, and I will move on to the user manipulation. Only after I add the user manipulation will I work on modifying the cube for various sized Rubik's Cubes. The last portion I will work on is the automated solving of the cube. The tentative date I plan for the user manipulation to be complete is Friday, Nov. 4 (FB), my target for the different sized cubes is Friday, Nov. 11 (FC), which should set me on track to have the final project completed by Thanksgiving break.