Magic Cube Recognition and Restoration

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Introduction

People love playing magic cube but sometimes they may have difficulties restoring it. Although there are plenty of tutorials on the internet, most of these simply give abstract formula of which are often hard for beginners to read and understand. Thus our team wants to solve this problem to assist people having trouble restoring their cube with our knowledge in computer vision and programming. Our program will scan the current status of the magic cube in real-time and display the optimal restoration procedures step by step.

Approach

First of all we would use the video capture function offered by openCV to scan the six faces of a magic cube. Conventionally, the cells on a magic Cube have six colors -- red, orange, green, blue, white and yellow. To simplify the reconstruction process, we require the order of scanning as red->orange->green->blue->white-> yellow, and we would display the color of center cell of the face to be scanned as a reminder. By analyzing the value of RGB channels and normalized YUV channels we are able to classify the color of each cell and obtain a 3*3*6 matrix recording colors of cells in six faces. Since the light and shading condition could affect the spectrum detected, to ensure the correctness of color recognition, we would train our classifier if time allowed. After that we would run magic cube restoration algorithm to find a process to restore the disordered magic cube to its original state. There will always be a solution while the steps needed for restoration may vary. We would modify the algorithm to obtain a solution that uses as few step as possible. For better vision, we expect to display the restoration process step by step as an animation, thus people could follow it and restore their cube easily.

Expected Outcome

We would expect to detect and identify the colors of the six faces of the magic cube with high precise rate of 90% or above and display the color recognition results in real-time. Then we are going to reconstruct the magic cube in 3D animation. With our restoration algorithm, the number of the restoration steps is expected to be less than 100 for any disordered magic cube and the restoration process will be displayed using 3D animation in a human-readable manner.

The first risky part of this plan is the use of openCV for real-time detection and display. Since none of us has experience with the software, we would need to spend some time learning it. If we fail in accomplishing our goal with openCV, we would switch to MATLAB and implement the detection and restore process in MATLAB. The other risky part is the display of restore process with 3D animation. If we are stuck on this part, we would display the guide of moves to users with verbal descriptions and the state of the cube after each transition with simple visualization.

References

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