IP'21 Apps Specs

3- Automatic Detection and Recognition of Children Toy Cubes

# Description

## Main Idea

Children cubes are one of the most common toys to teach numbers, letters and common words, as shown in Figure 1. Usually, parents are required to sit with their children many times to help them during the learning process. Automating this process will help children learn without continuous supervision from their parents, and will make parents happy ☺. It could also help people with general learning disability.



Figure 1: Children toy cube

This application aims to automatically detect and recognize the shape on one of the cube sides. As a start, assume that the camera is facing one of the cube surfaces with small tilting, and at different distances. The cube surface comes with different colors. It can be captured with any in-plane rotation angle on simple backgrounds. There are **10 initial shapes** under consideration. The application should be able to automatically detect and recognize any of the 10 shapes on one or more cubes from the given image.

### Selected 10 Shapes:

**A, B, T, Y, 1, 2, 3, 4, 5, 6**

|  |  |
| --- | --- |
| **Input** | **Output** |
| cubos-de-madera-baby.jpg | **B**  **A**  **B**  **Y** |

## Minimum Requirements

Detect and recognize a one-side shape from:

1. Images with one or more cube on simple background.
2. Images captured with small tilting of the cube surface.
3. Different distances between the camera and the cube surface.
4. Cube with different in-plane rotation angle.
5. Cube surface with different colors.

## Possible Add-ons (Bonuses)

* Detect and recognize a one-side shape from:

1. Picture taken from different camera perspectives.
2. Picture with complex background.
3. Picture of tightly adjacent cubes.

* Ability to learn new shapes.

# Suggested Search Tracks and Keywords

You may use some/all of the following keywords as a guide (not restricted to them):

1. Segmentation.
2. Hough transform.
3. Morphological operations.
4. Region properties.
5. Shape representation and description.

# Test Images for Minimum Requirements

Case1: Direct shot of one cube surface with different distances.

Case2: Direct shot of two or more cube surfaces.

Case3: Shot, with small tilting, of one cube surface with any rotation angle.

Case4: Shot, with small tilting, of two or more cube surfaces with any rotation angle.

# Test Images for Bonuses

Case5: Tilted versions of cases 1, 2, 3, 4.

Case6: Images captured on complex backgrounds.

Case7: Tightly adjacent cubes.

Case8: New shapes.

# References

1. Textbook Ch. 3: Intensity Transformations and Spatial Filtering
2. Textbook Ch. 9: Morphological Image Processing
3. Textbook Ch.10: Image Segmentation
4. Textbook Ch.11: Image Representation and Description

# Sample Input/Output

|  |  |
| --- | --- |
| **Input** | **Output** |
| cubos-de-madera-baby.jpg | **B**  **A**  **B**  **Y** |
| playing-cubes-numbers-blue-colored-over-set-ten-isolated-over-white-background-45812548.jpg | **1**  **2**  **3** |
| cubos-de-madera-con-los-nmeros-para-los-nios-23715089.jpg | **1**  **2**  **3** |