



RUBIK'S CUBE SOLVER

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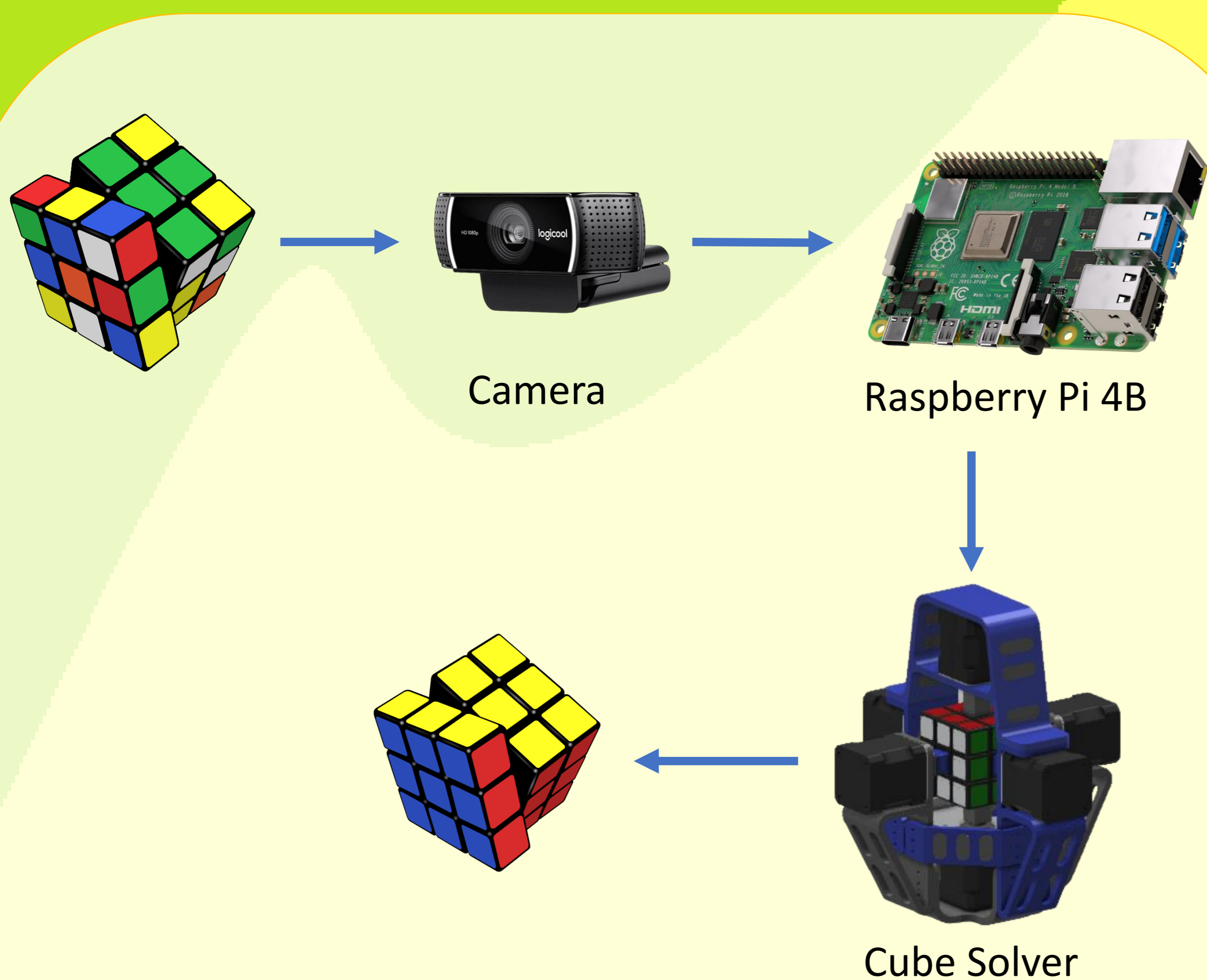


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INTRODUCTION

- ❖ The Rubik's Cube, a globally popular puzzle, fascinates millions with its complexity and challenge. This project explores the Rubik's cube color detection, solution process and designs a robot capable of solving the cube efficiently.
- ❖ The aim is to develop a system that not only solves the Rubik's Cube but also enhances skills in algorithm design, image processing, embedded systems, and software development for undergraduate students.

METHODOLOGY



- ❖ The images of the Rubik's cube taken through the webcam passes to the color detection algorithm which runs on Raspberry Pi 4B board as input. Color detection algorithm produces an output of colors which is formatted to suit to cube solving algorithm. The algorithm finds a solution that can solve the cube in the least number of moves in less than a second and transmits this solution to the motor control algorithm. The algorithm drives the stepper motors on the robot according to the solution and solves the cube.



Rubik's Cube Solver

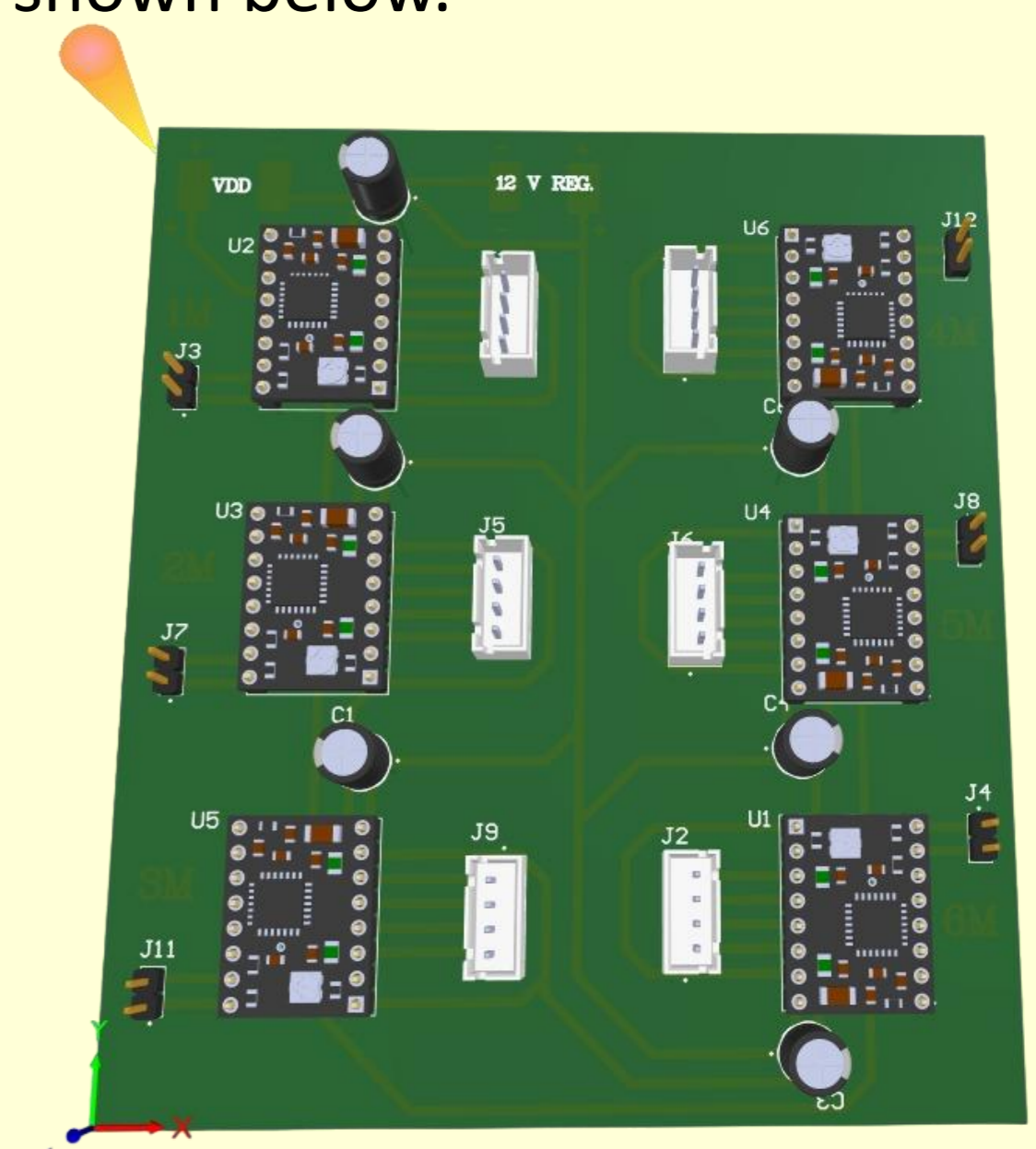
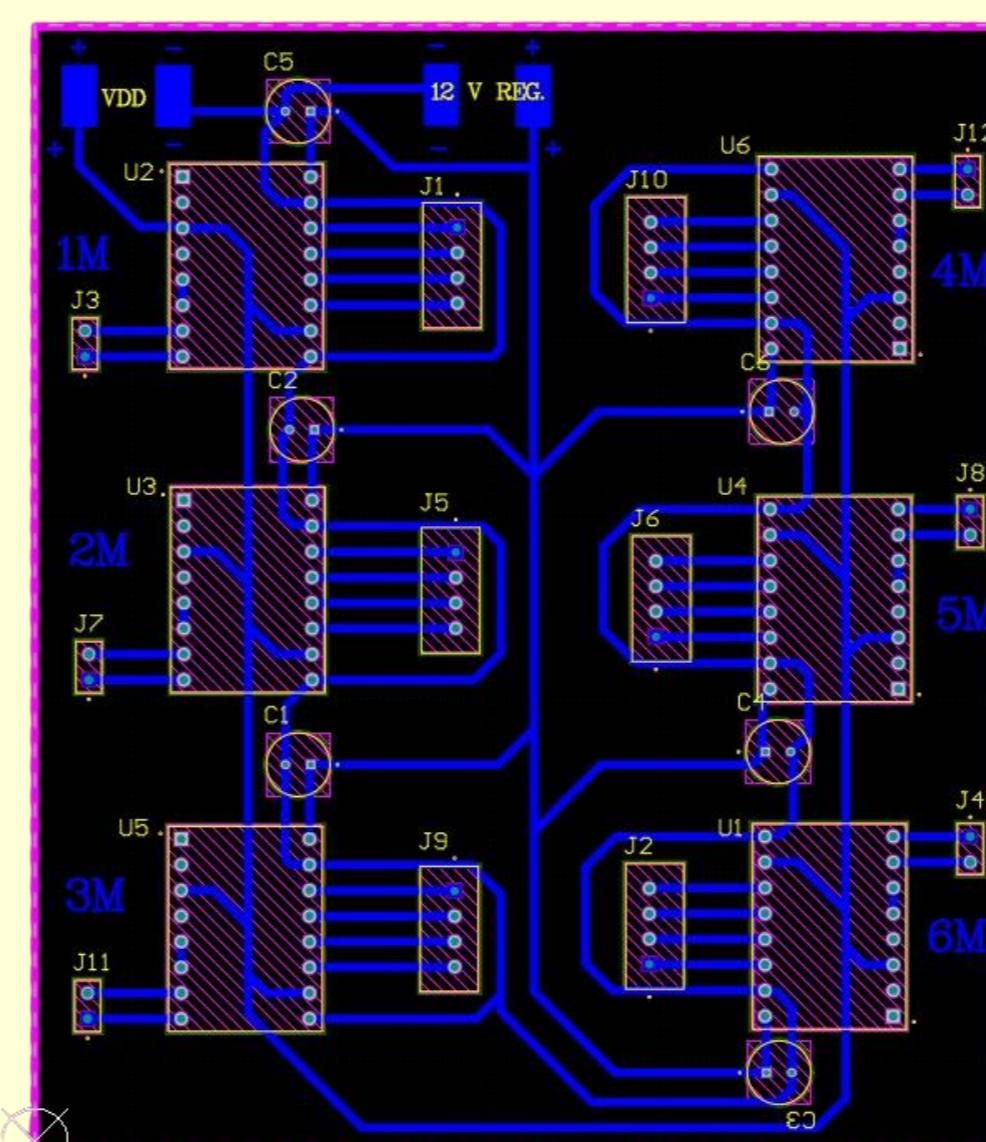
PROJECT DESIGN

- ❖ The robot utilize a camera to capture the cube's image, employing image processing techniques to identify the individual colored pieces of each faces and their arrangement using image processing techniques by OpenCV library. It is thought to take the advantages of using the HSV color model over RGB for this task, leveraging its elasticity to lighting variations. Then the detected colors are passed to the Rubik's cube solver algorithm as input.



Color Detection of White Face

- ❖ The project design focuses on creating a robot capable of solving a Rubik's Cube by fixing motors to the center of each face, ensuring efficient and precise control. This design is preferred because it reduces motor control complexity, allows the cube to be solved with fewer moves, and enables faster solving. Custom 3D-printed parts are utilized to securely attach the motors and accommodate the specific dimensions of the chosen Rubik's Cube. A Raspberry Pi 4B is used for its powerful microprocessor, which is suitable for handling the image processing tasks required to identify the cube's current state and control the step motors. A PCB is designed and printed for the six A4988 motor driver circuits to stabilize motor control, as shown below.



- ❖ It is utilized Kociemba's two-phase solver algorithm, renowned for its efficiency and ability to solve most random scrambles within an impressive 20 moves on average.

ACKNOWLEDGEMENTS

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