A SYSTEM FOR SOLVING JIGSAW PUZZLE USING MULTIPLE ROBOTS

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1. OBJECTIVE

The objective of the project is to build an autonomous multi robot based system to solve a Jigsaw puzzle.

Description: In an arena there will be puzzle blocks scattered in different orientations. So the system should be able to detect those blocks, pick them,rotate them in proper orientation and place those blocks at their respective destination to form the final image.

2. COMMUNICATION

For communication Xbee modules are used. Data like target position, PID gains, robot position, error angle, stop command, mode bits etc are sent in a packet, which is then parsed in the robot once received.

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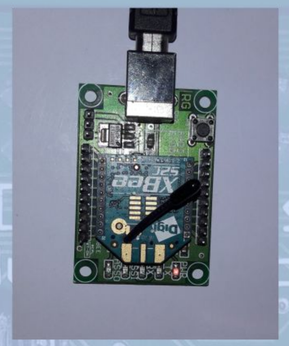
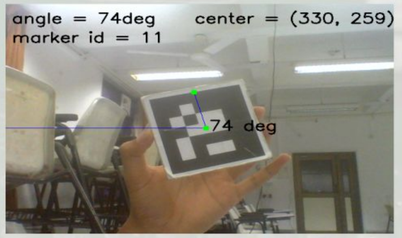
```

sample data packet

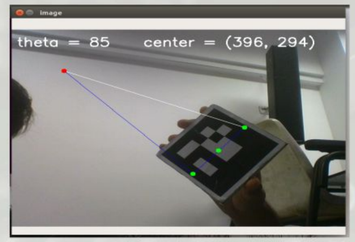


3. ArUco DETECTION & ORIENTATION

For localisation we are using ArUco markers. So the first thing is to properly detect the position and orientation of the ArUco markers.



ArUco orientation and position (Clockwise manner)



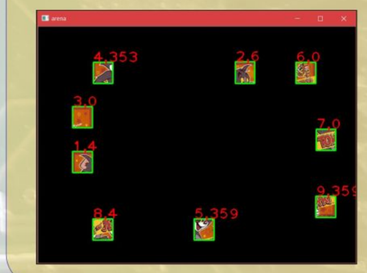
ArUco orientation and position with respect to a point

4. GO-TO-GOAL CONTROLLER

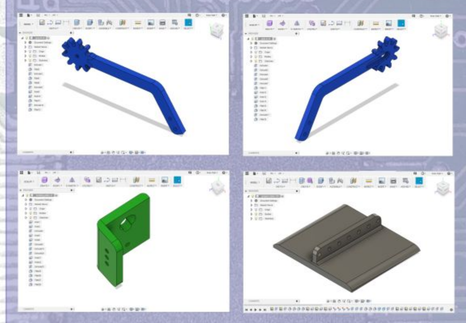
Given a target location the robot travels to that destination using a PID controller.

5. TEMPLATE MATCHING

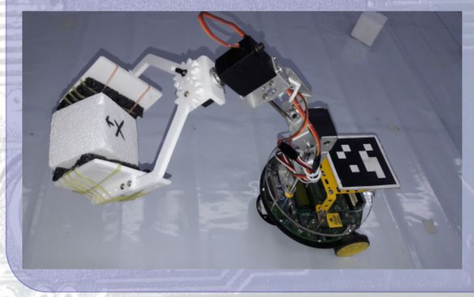
The system has to detect the puzzle blocks placed in the arena by its number and orientation.

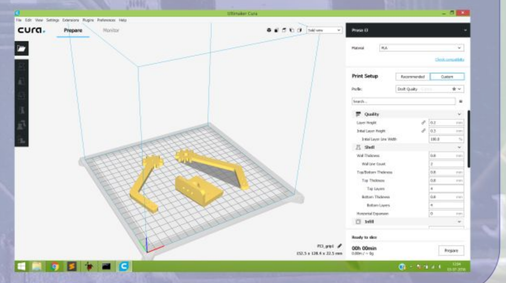


6. Gripper Mechanism



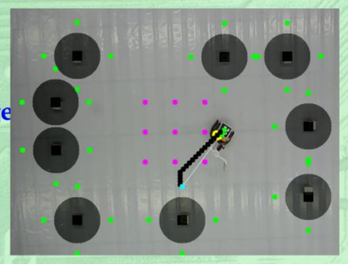
The gripper mechanism is designed to grab cubes of dimenssion 12x12x12 cm. The gripper consists of two gears, one of which is mounted on to the rotor of the servo. The gripper parts are designed on Fusion360 and then sliced on ultimaker cura so as to get the parts 3D printed.





7. PATH PLANNING AND OBSTACLE AVOIDANCE

The robot has to travel to its destination in en environment where the other robot and the puzzle blocks except the targe block are obstacles. A* algorithm is used for path planning on a much lower scale than the actual frame size for faster operation, then the path is rescaled to the actual frame size.



8. FINAL IMPLEMENTATION

The system takes a digital replica of the arena and detects the puzzle blocks and their position and orientation and stores the data in a dictionary.Then according to the position of the robot the path is determined and the robot goes to the desired block, picks it, rotates it & then travels to the blocks destination positi--on. After placing the block in proper orientation it then goes to the next nearest block.

After all the blocks have been placed the task is completed.