The background is a dark blue color. It features several abstract, thin lines in gold and white. These lines form various geometric shapes, including triangles and polygons, some of which are partially cut off by the edges of the frame. The lines are scattered across the page, with a concentration around the central text box.

# Robot Grasping and Sorting Using User-Defined Categories

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# About the Project

## 1. ABOUT THE PROJECT

Robotic sorting is important for improving efficiency in several fields such as recycling and warehouse logistics. New types of objects or properties may require new areas for them to be sorted to. As such, we wanted to add flexibility in our sorting approach.

## 2. MAJOR REQUIREMENTS

The robot should be able to move to the object, pick it up, and navigate to the required sorting box for it to drop it off. It should repeat this process for every unsorted item

## 3. PROJECT GOALS

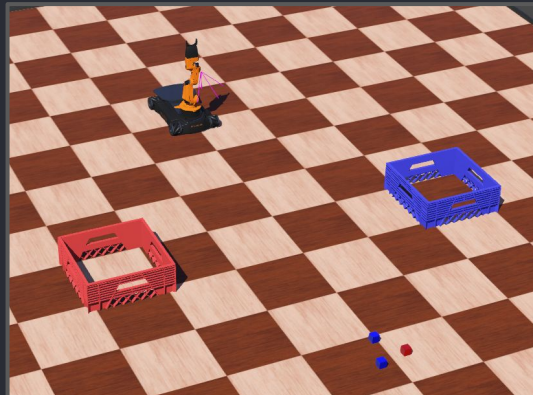
The main goal of the project is to let users define categories for the robot to sort by.

# Methodology

## 1.

### Robot

Our robot utilizes a 4 wheeled robotic arm named the YouBot by KUKA. We've also attached a Camera to it for object detection, along with a compass for helping compute its angle.



## 2.

### Environment

Our robot is situated in a unobstructed small bounded area filled with a pile of unsorted objects and baskets used as sorting zones.

## Movement Approach

For movement, the robot first attempts to angle itself towards the detected object. The robot uses a compass to help get the angle of where it's facing.

By comparing that to the angle between the robot and the desired position, the robot knows what angle to turn towards, and will successfully rotate towards the object.

Once Rotated, it'll move towards the object & stop to grasp it.

# Grasping Approach

For grasping, we used a very basic inverse kinematic solver to calculate the end-effector grasping orientation and position.

There might be some problems with certain orientations depending on the position of the cube that may require multiple attempts to grasp the items.

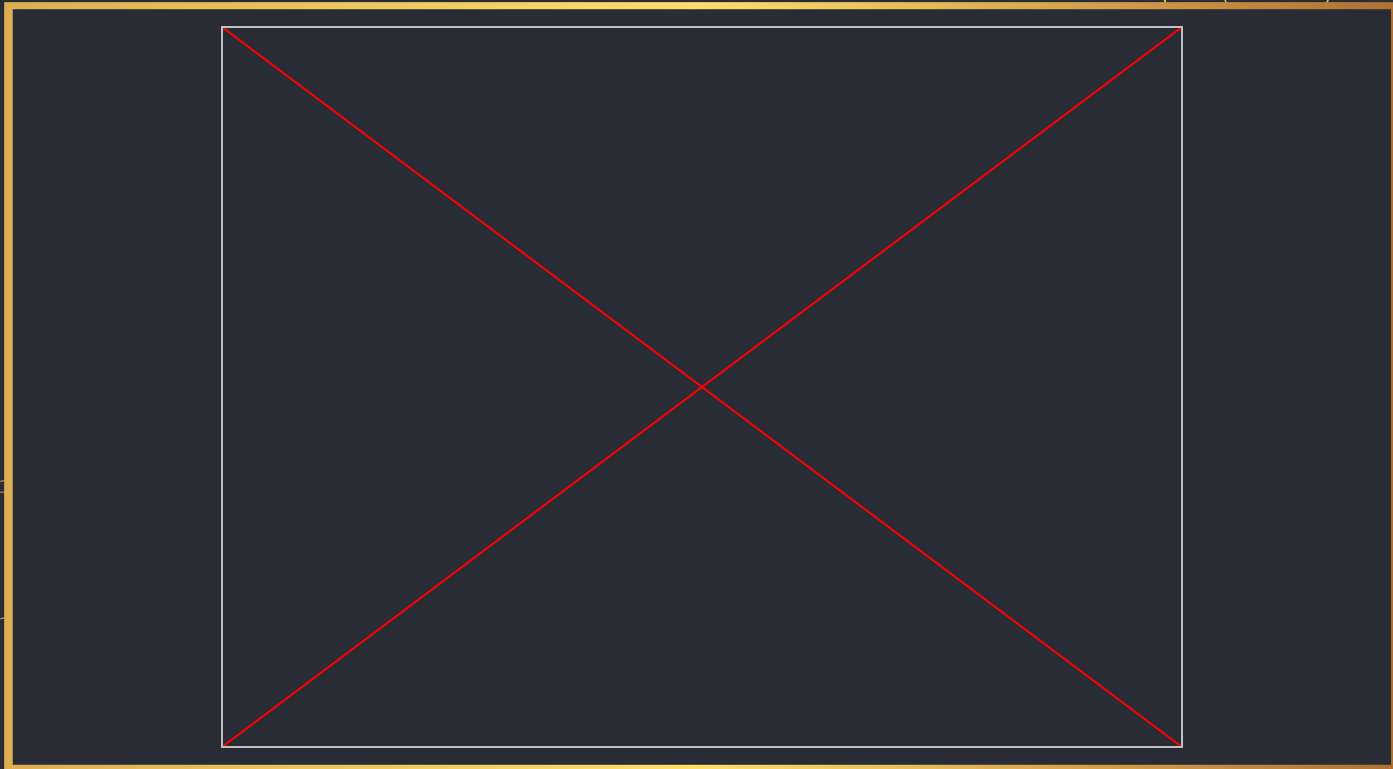
# Sorting Approach

We utilize the “description” field for Webots objects to add tags to it. The tags represent the user inputting whatever label they want onto the object.

After the program starts, it fetches each label, and asks the user which basket objects with that label should go.

```
Blue
Would you like to sort Blue objects in the blue box (1) or the red box (2)?
Type 1 or 2 for your selection
Red
Would you like to sort Red objects in the blue box (1) or the red box (2)?
Type 1 or 2 for your selection
Blue
[-1.54671, -0.48053, 0.024990190000009783]
Distance to Object: 3.4217874821835754
compass vals: [-0.0027710945335035343, -0.9999961594447221, -4.616158995532724e-05]
Angle to Target: 0.003018550929072994
[-1.54671, -0.48053, 0.024990190000009783]
Distance to Object: 3.411011219757245
compass vals: [-0.0027710072260127825, -0.9999961598071688, -4.347262033276488e-05]
Angle to Target: 0.003028134447760511
[-1.54671, -0.48053, 0.024990190000009783]
Distance to Object: 3.4000361371016856
compass vals: [-0.002770955021133878, -0.9999961598765691, -4.5170635988899456e-05]
Angle to Target: 0.003037961509447129
[-1.54671, -0.48053, 0.024990190000009783]
```

# Video Demo



# Future Scope

- Taking full advantage of KUKA youBot's omnidirectional mecanum wheels, current movement is a fraction of what it could be
- More accurate inverse kinematic solvers for better grasping
- Camera placing on youBot or giving it a predefined environment (Simulation currently has it floating in air)
- More user input sorting groups, more specifically defined groups, and autonomous sorting with predefined regions and groups
- Classic improvements on robots (i.e. obstacle avoidance, optimal path finding, etc)



Thank you!

The background is a dark blue color. In the top-left and bottom-right corners, there are several overlapping, thin, light-colored geometric shapes, primarily squares and rectangles, some of which are rotated. These shapes are arranged in a way that they appear to be floating or scattered across the corners of the page.