

CSE-5364 ROBOTICS

CSE-4360/5364
AUTONOMOUS ROBOTS

Drawing Robot

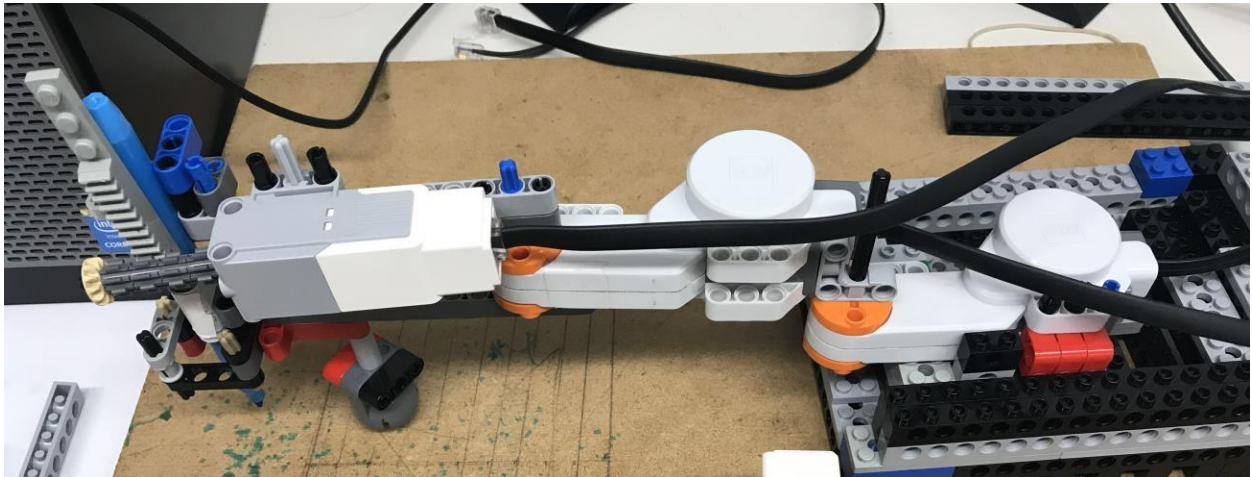
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OBJECTIVE: To build and program a robot arm that can draw polygons using a marker. Here you should build a robot arm that can move a marker mounted at its end across a piece of paper, the coordinates are given at compile time. Given that polygon, the robot moves the marker to the first corner (without drawing a line) and then trace the shape on the paper.

WORKSPACE: Drawing will be limited to a 15cm x 10cm area that can be located based on the kinematic characteristics of the robot constructed.

DESIGN: The Robotic arm used two revolute joints with mentioned linked lengths in kinematic solutions provided below which covers the drawing workspace (10 cm * 15 cm) and one prismatic joint to move the pen up and down.

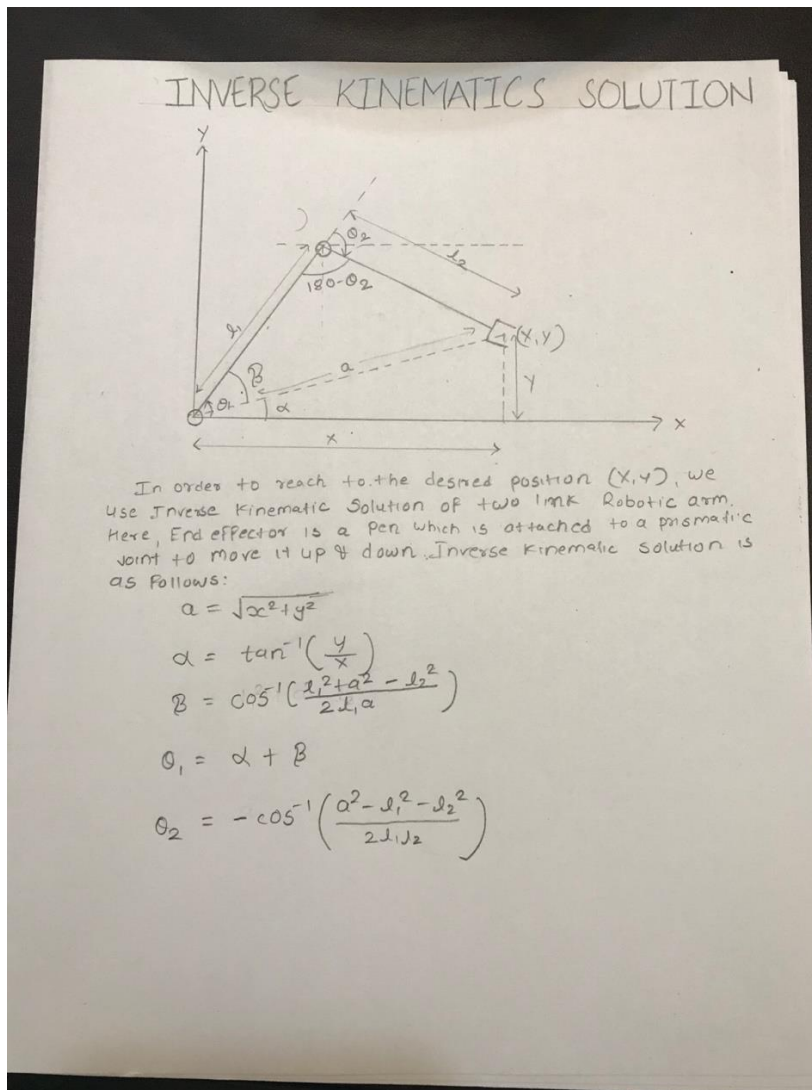


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Drawing strategy –

Inverse kinematic solution for the drawing robot solved below gives us the coordinates to where the robot pulls the pen using motors (revolute joints) over the paper and start drawing based on the coordinates sequentially provided in input.

To draw straight lines between the two end points **Bresenham's line algorithm** was implemented which gives set of points (step size = 0.1 CM) which are nearest to the line defined by the two end point coordinates of the segment. However, only the midpoint of the segment was used while drawing a straight line in order to minimize deviation from the line. To draw straight line between these two points speeds given to both joint motors were proportional to the respective desired joint angles, Theta 1 & Theta 2.

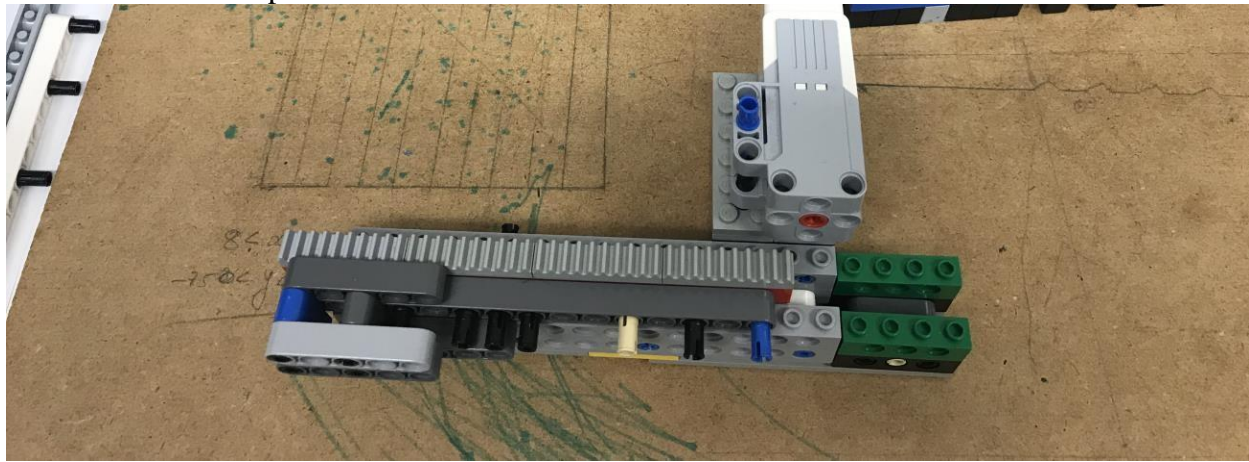


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Project Challenges:

Primary challenge of this project was to draw straight lines. Initially I constructed a robotic arm with 3 revolute joints to get three degree of freedom as well as a prismatic joint to draw straight line with a marker attached to the slider which slides over a definite distance. However, weight & size of the slider made it difficult to physically move the marker precisely to the desired position in the workspace because of which I switched to a 2 DOF robotic arm design without any slider. The resolution of the internal encoders of Lego EV3 motors is 1 encoder count per degree i.e. 1:1 ratio which limits control accuracy of the motor angular movements.

Slider which was implemented earlier.



Source code is attached with report.