**Task 2a: Motion Generation**

**Goal**: Generate a video feed of a green ball continuously tracing a lemniscate (infinity) curve.

**Implementation**: A ROS node publishes frames of a video where the green ball follows the lemniscate path. This video is published to the /image/ball\_animation topic.

**Result:** A green ball continuously tracing an infinity path.

**Task 2b: Ball Tracking**

**Goal**: Track the green ball's position in the video feed and publish its coordinates.

**Implementation**: A ROS node subscribes to the /image/ball\_animation topic, uses OpenCV to find the green ball in each frame, computes the (x, y) coordinates of the ball's center, maps these coordinates from the image to the turtlesim coordinate system, and publishes them as PoseStamped messages to the /turtle/move\_pose topic.

**Result:** Coordinates of the green ball are continuously published.

**Task 2c: Turtle Control**

**Goal**: Make the turtle in the turtlesim simulation follow the waypoints provided by the ball tracking node, thereby following a lemniscate path.

**Implementation**: A ROS node subscribes to the /turtle/move\_pose topic and sends velocity commands to the turtle based on the published coordinates to make the turtle follow the path.

**Result:** The output does not resemble the goal; some issue was there with the turtle sim and thus it was not able to follow the path.

**References:**

1. The equation oflemniscate is used form [Lemniscate -- from Wolfram MathWorld](https://mathworld.wolfram.com/Lemniscate.html).

2. This [blog](https://medium.com/swlh/part-3-create-your-first-ros-publisher-and-subscriber-nodes-2e833dea7598#:~:text=A%20ROS%20Node%20can%20be%20a%20Publisher%20or,whenever%20any%20message%20is%20published%20to%20the%20Topic.) was mainly helped.

3. This [tutorial](https://wiki.ros.org/turtlesim/Tutorials/Moving%20in%20a%20Straight%20Line) helped in developing some python scripts and ROS command.

4. For controlling the turtle sim this [tutorial](https://rosdriven-turtlesim.netlify.app/controlling-the-turtlesim/#move-the-turtle) helped.

5. For ROS official website has been used for some commands as well as writing some portion of code.