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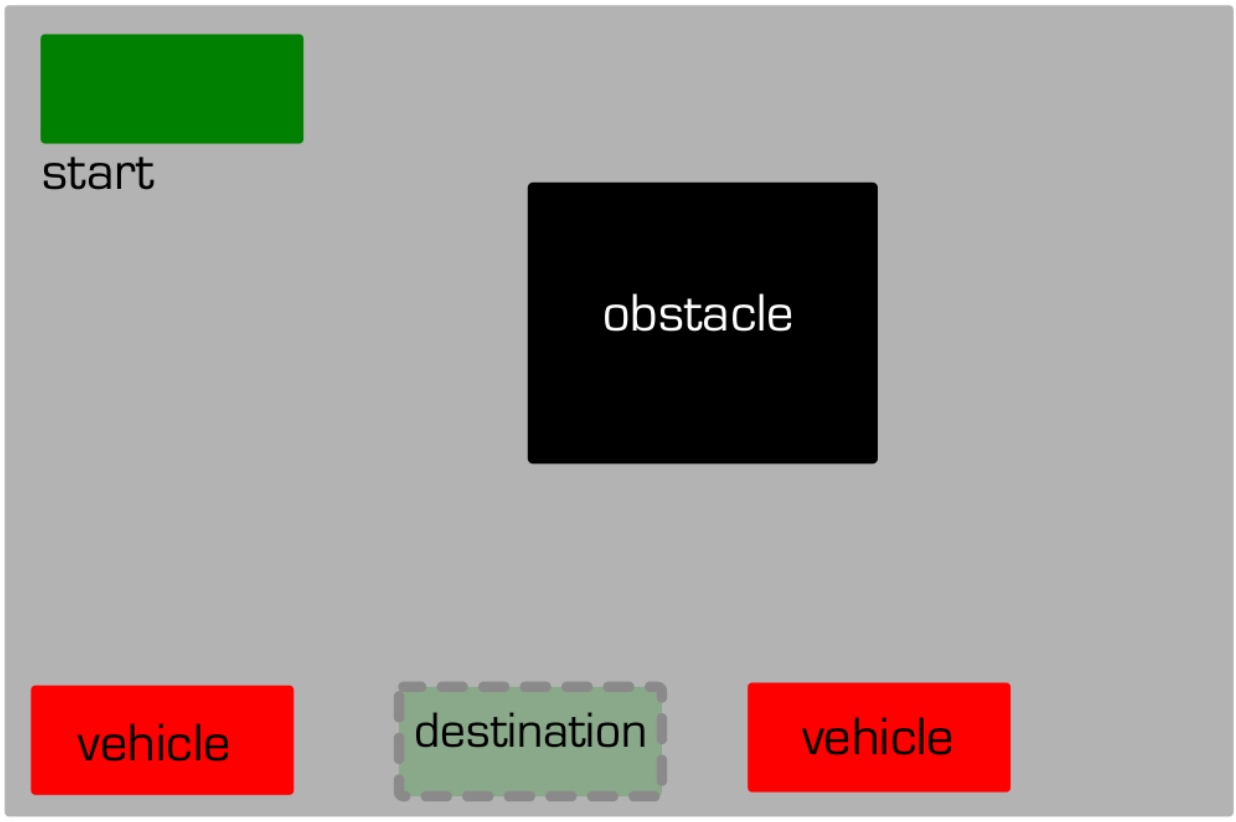
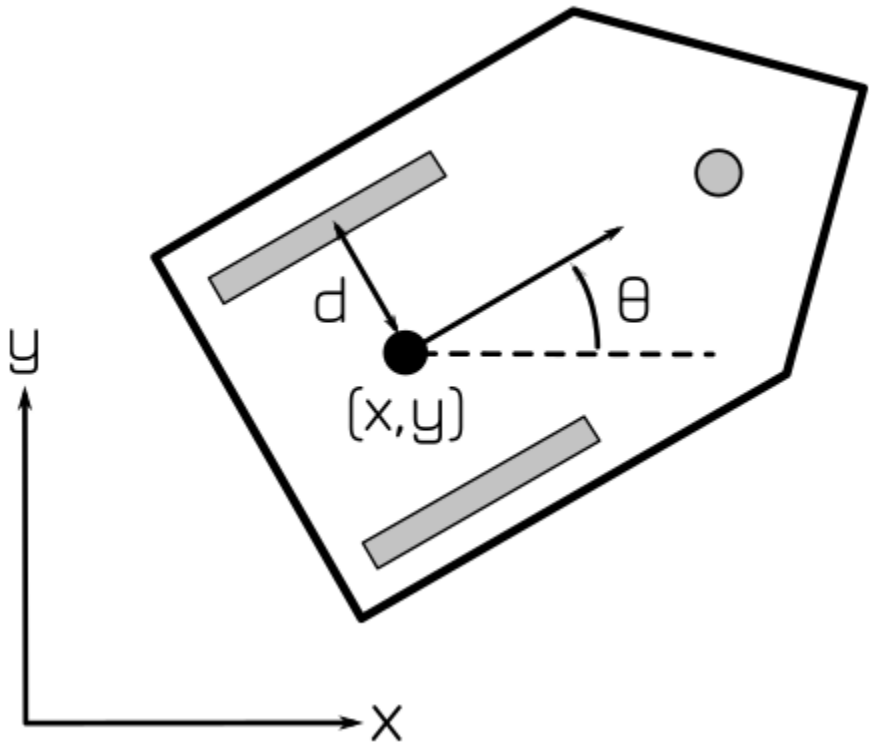
Report

- **Environment**

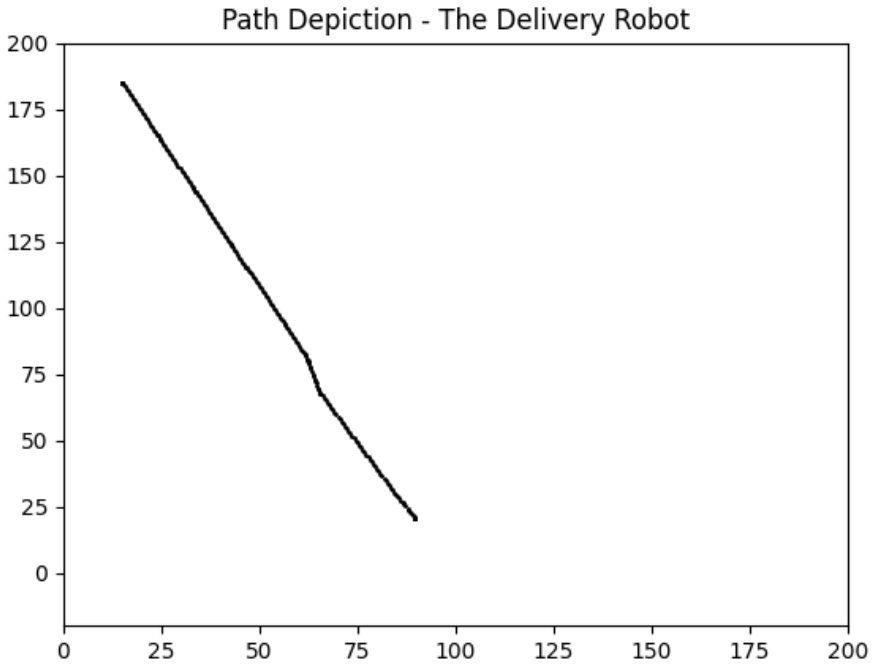


- **The Delivery Robot**
  - To create the kinematic model of constraints of the differential drive robot, the distance between two wheels (L) and the radius of the wheels(r) are required.
  - I started by discretizing the speed of left and right wheel, on which the orientation of the differential drive will be dependent.
  - The route planner algorithm calculates the optimal path from the start position to the goal position, while considering the kinematic equations of the differential drive.
  - The cost functions and kinematic equations are added in the planner algorithm document for the reference.
  - In order to check collision, the algorithm places the boundary of the robot dimensions on all the possible neighbors, and then it will check if the boundary intersects with any static obstacles present in the given environment.

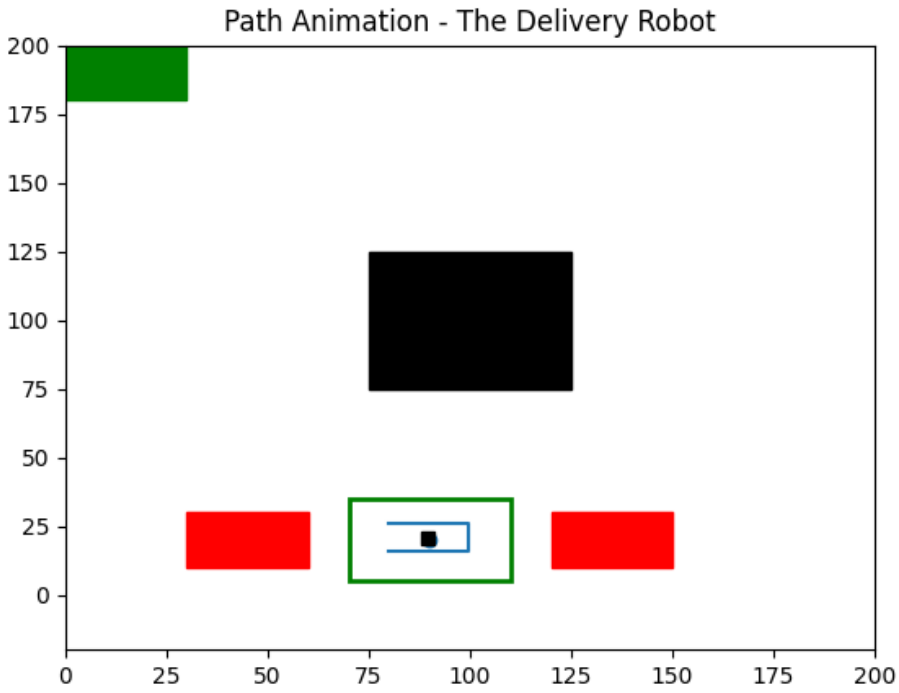


(Differential Drive Kinematics)

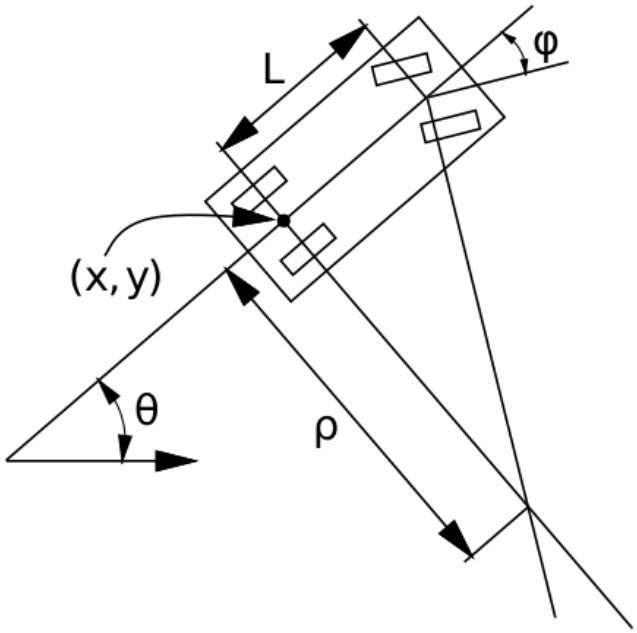
- Below is the path taken by the delivery robot to reach the goal position.



- Final position of the robot (Animation video uploaded separately)

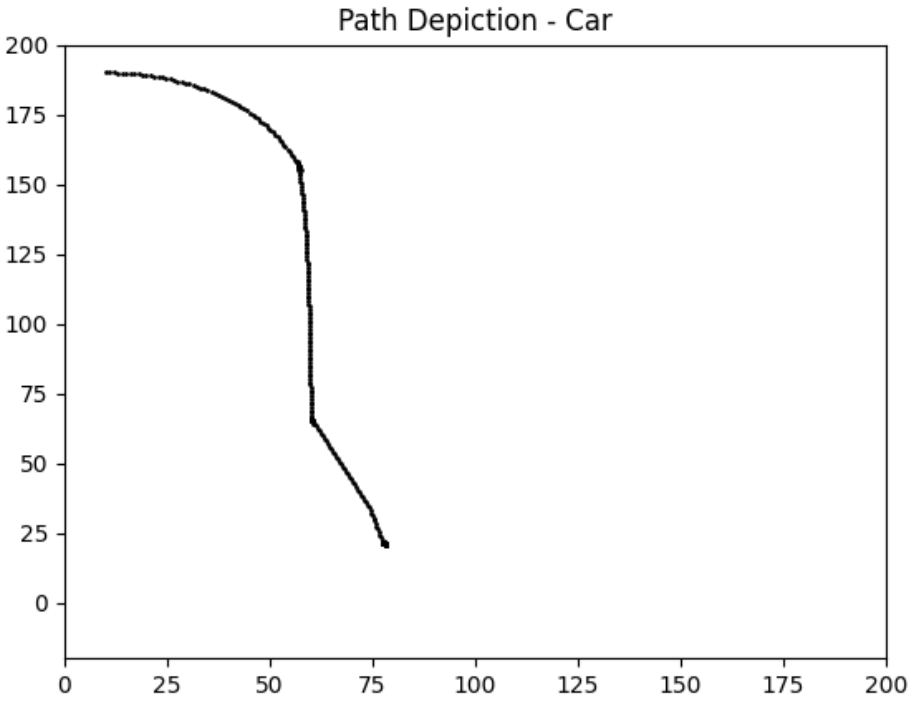


- **Car**
    - To create the kinematic model of constraints of the car, we need to consider steering angle and speed both. Here, the wheelbase of the car was given as 2.8m.
    - I started by discretizing the value of steering angle and speed and for the same, I used the kinematic equation of the Ackerman Geometry.
    - The route planner algorithm calculates the optimal path from the start position to the goal position, while considering the kinematic equations of the car.
    - The cost functions and kinematic equations are added in the planner algorithm document for the reference.
    - In order to check collision, the algorithm places the boundary of the car dimensions on all the possible neighbors, and then it will check if the boundary intersects with any static obstacles present in the given environment.

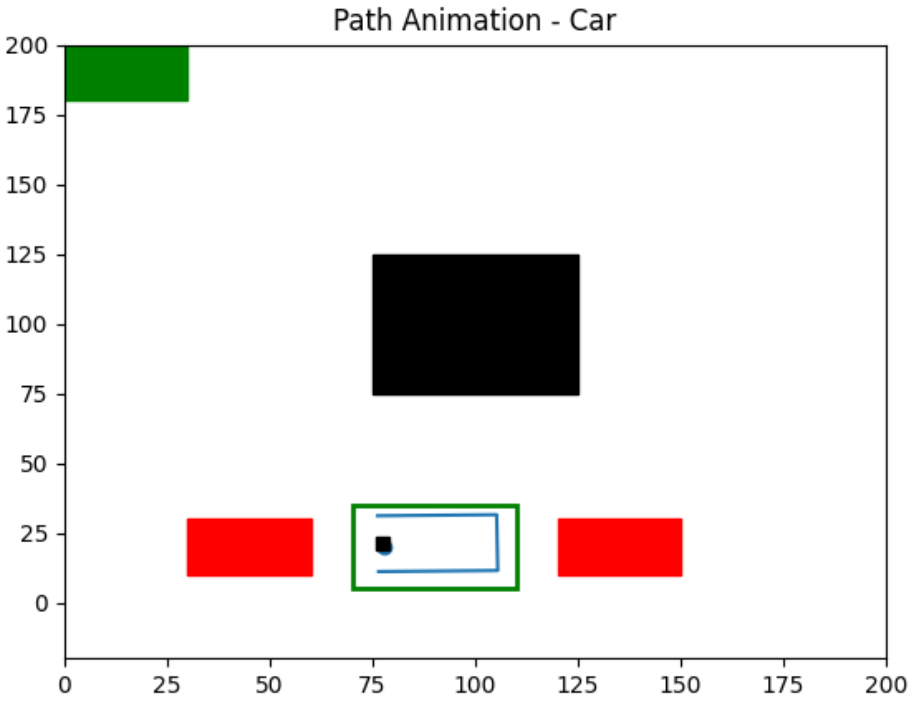


(Ackerman Steering Kinematics)

- Below is the path taken by the car to reach the goal position.

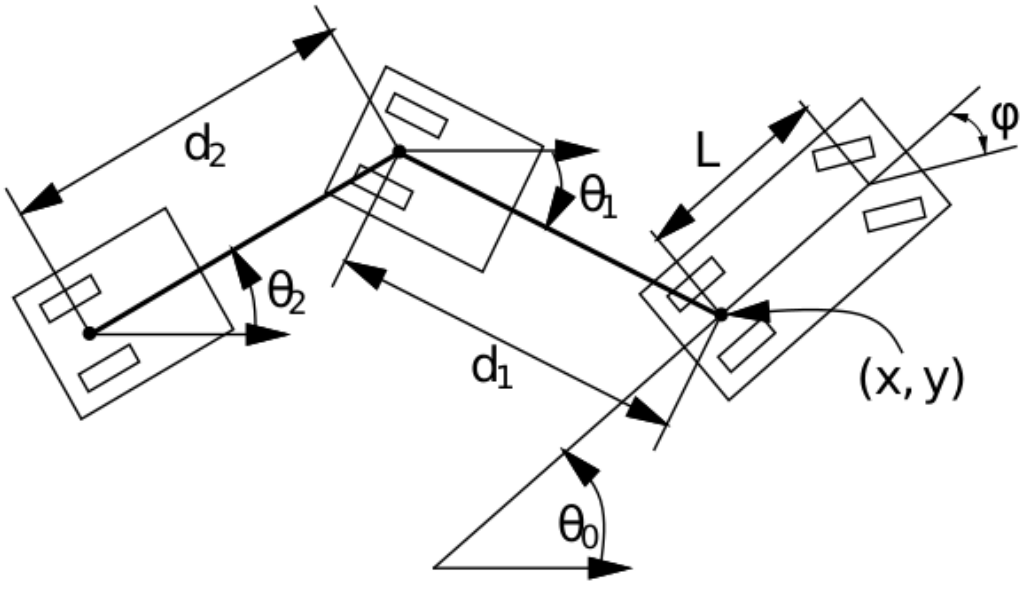


- Final position of the car (Animation video uploaded separately)



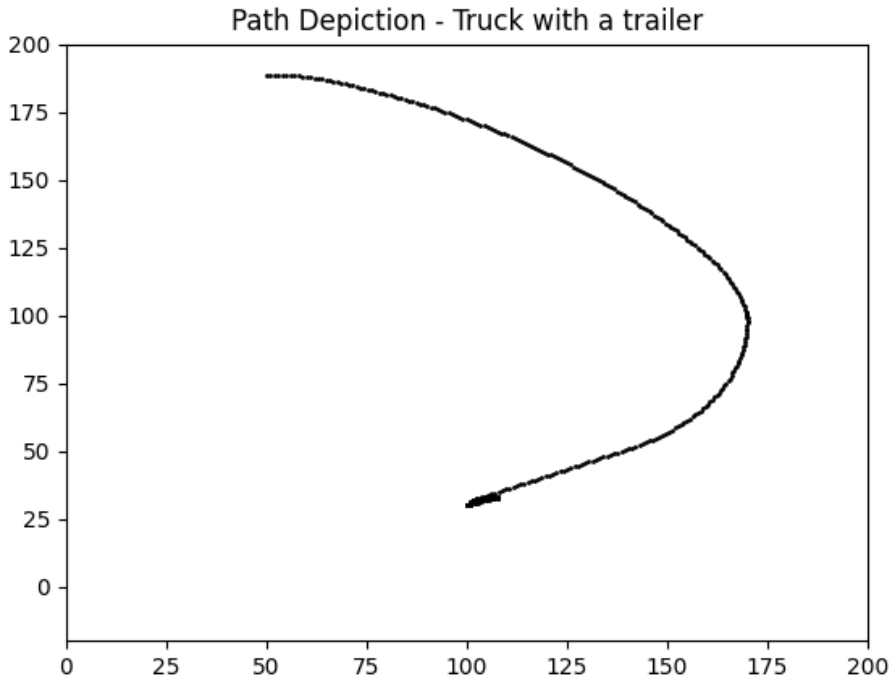
- **Truck with a trailer**

  - To create the kinematic model of constraints of the truck, we need to consider the same kinematics we considered for a car along with the kinematics of the attached trailer(s). For this assignment, I have considered a single trailer attached with a truck.
  - Given, Axle width = 1.75m, Wheelbase = 3m, the distance between the rear axle of the truck and the axle center of the trailer = 5 m
  - I started by discretizing the value of steering angle and speed of the truck, and for the same, I used the kinematic equation of the Ackerman Geometry.
  - Alongside, the orientation of the attached trailer is also being calculated.
  - The route planner algorithm calculates the optimal path from the start position to the goal position, while considering the kinematic equations of the truck and the trailer both.
  - The cost functions and kinematic equations are added in the planner algorithm document for the reference.
  - In order to check collision, the algorithm places the boundaries of both, the truck and the trailer, on all the possible neighbors, and then it will check if the calculated boundaries intersect with any static obstacles present in the given environment.



(Trailer Kinematics)

- Below is the path taken by the truck with a trailer to reach the goal position.



- Final position of the truck with a trailer (Animation video uploaded separately)