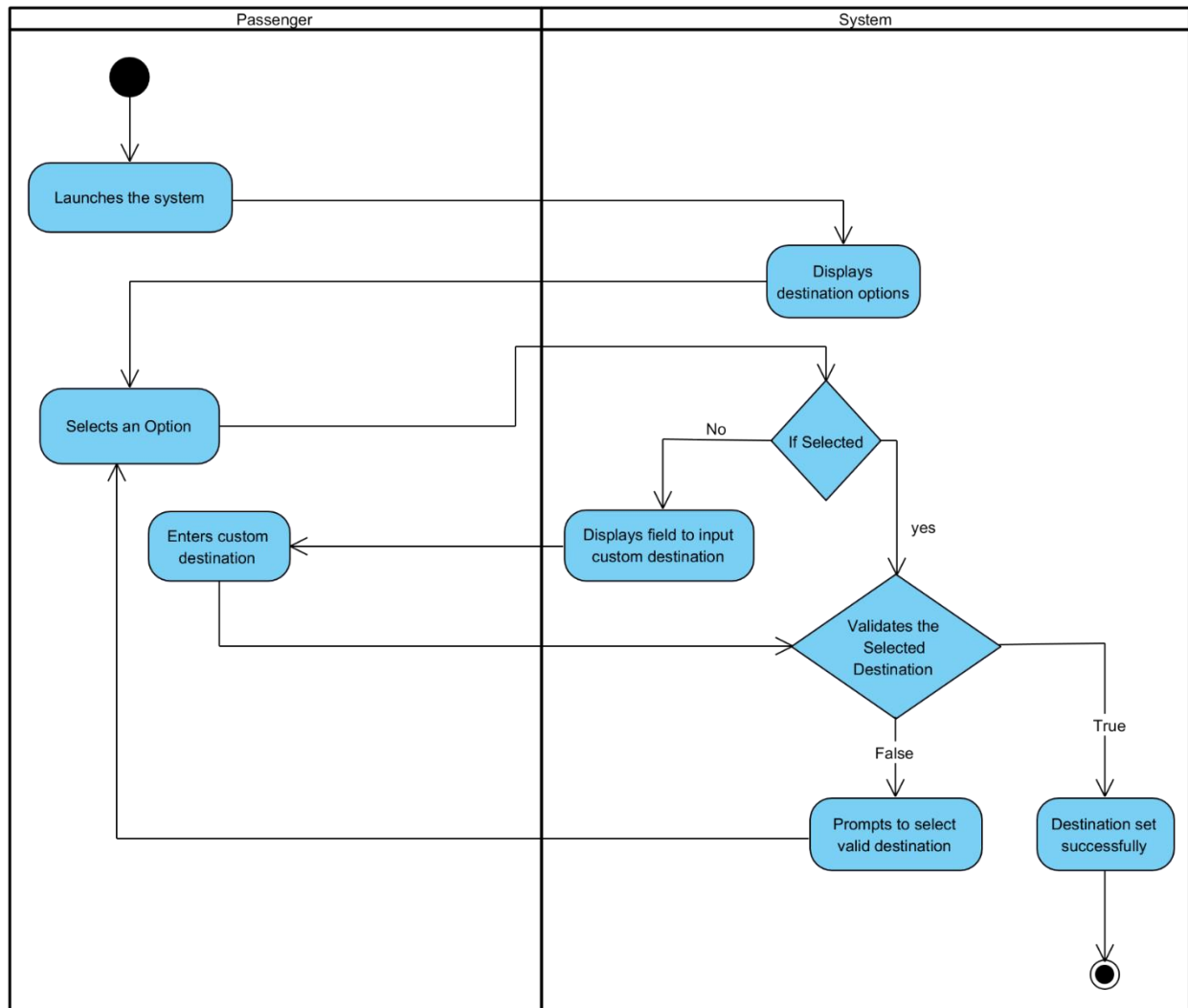


Detailed Use Cases

1. Set Destination

Use Case ID:	UC01
Use Case:	Set Destination
Actor:	Passenger
Precondition:	The Car is integrated with the system
Basic Flow:	<ol style="list-style-type: none">1. Passenger launches the autonomous vehicle system.2. Passenger selects a destination from the provided options.3. System validates the selected destination.4. System confirms the set destination to the passenger.
Alternative Flow:	<p>2a. If passenger does not want to select destination from the provided options, passenger can enter the coordinates of his/her choice.</p> <p>4a. If the selected destination is not available or invalid, the system prompts the passenger to select another destination from the provided options or input a custom one.</p>
Post Condition:	The destination is successfully set in the system.

Activity diagram:



Equivalence Class Partitioning (ECP):

- **Valid Classes:**

- The destination is selected from the provided options.
- The destination is entered manually and is valid.

- **Invalid Classes:**

- The destination is selected but is not available (e.g., out of service area).
- The destination coordinates are entered manually but are invalid (e.g., incorrect format, non-existent location).

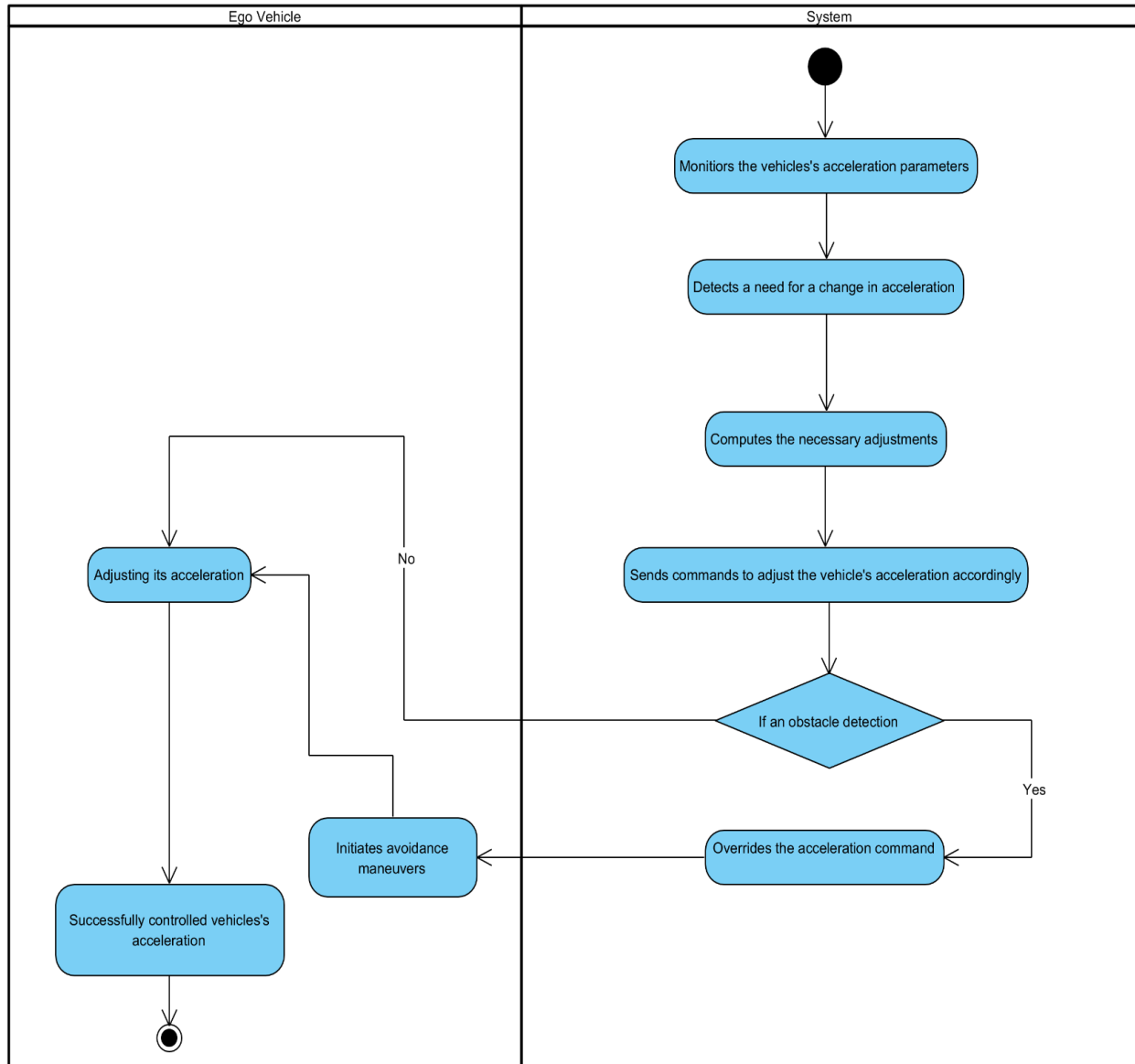
Scenarios and Test Case:

Scenario	Input Type	Input Value	ECP	Expected Output
Out of service area coordinates	Entered coordinates	"80.000000, -170.000000"	None	Error: Vehicle tries to go to the entered Coordinates, even if they are in any building

2. Control Acceleration

Use Case ID:	UC05
Use Case:	Control Acceleration
Actor:	Ego Vehicle
Precondition:	The vehicle is operational and in motion.
Basic Flow:	<ol style="list-style-type: none">1. System monitors the vehicle's velocity or acceleration parameters.2. A change in acceleration is required, the system computes the necessary adjustments based on navigation requirements, traffic conditions, and vehicle dynamics.3. System sends commands to adjust the vehicle's acceleration accordingly, using throttle control mechanisms.
Alternative Flow:	3a. If an unexpected obstacle is detected requiring sudden deceleration, the system overrides the acceleration command and initiates avoidance maneuver.
Post Condition:	The vehicle's acceleration is controlled as per navigation and operational requirements.

Activity Diagram:



Equivalence Class Partitioning (ECP):

- **Valid Classes:**
 - The vehicle's velocity and acceleration parameters are within normal operational ranges. i.e. <120 km/h
- **Invalid Classes:**
 - The vehicle's velocity or acceleration parameters are abnormal or invalid. i.e. = 120km/h

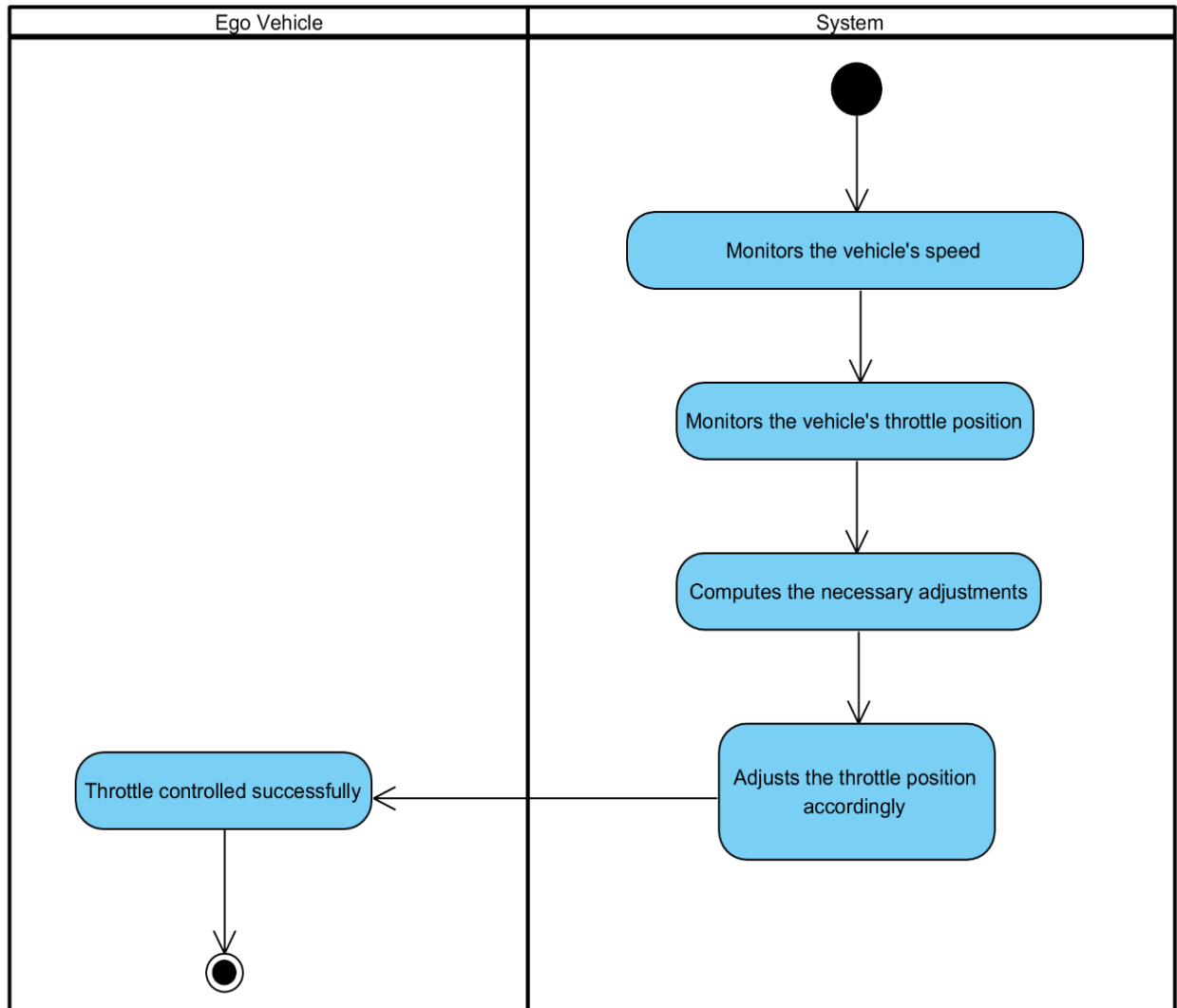
Scenarios and Test Cases:

Test Case	Input Value	ECP	Expected Output
Abnormal Velocity Parameters	Velocity = 200 km/h	None	Unexpected Error
Negative Velocity Parameters	Velocity = -20 km/h	None	Unexpected Error

3. Control Throttle

Use Case ID:	UC06
Use Case:	Control Throttle
Actor:	Ego Vehicle
Precondition:	The vehicle is operational and in motion.
Basic Flow:	<ol style="list-style-type: none">1. System monitors the vehicle's speed and throttle position.2. A change in throttle position is required, the system computes the necessary adjustments based on navigation requirements, traffic conditions, and vehicle dynamics.3. System adjusts the throttle position accordingly, regulating the engine's power output.
Alternative Flow:	None
Post Condition:	The vehicle's throttle position is controlled as per navigation and operational requirements.

Activity Diagram:



Equivalence Class Partitioning (ECP):

- **Valid Classes:**
 - The vehicle's speed is within the normal operational range (i.e. 0 km/h to maximum speed limit).
 - The throttle position is within the normal operational range (i.e. 0% to 100%).
- **Invalid Classes:**
 - The vehicle's speed parameters are abnormal or invalid (i.e. speed exceeding maximum permissible limit).
 - The throttle position is abnormal or invalid (i.e. throttle position exceeding 100%).

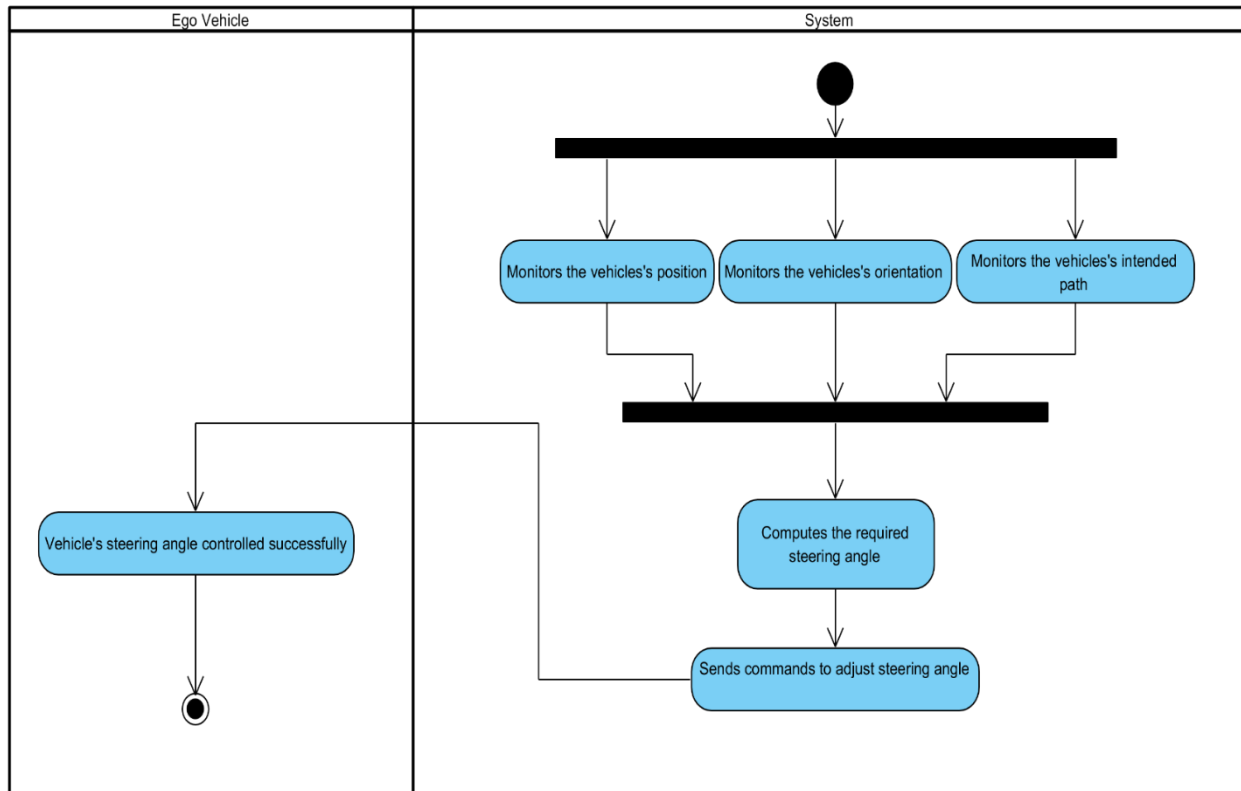
Scenarios and Test Cases:

Test Case	Input Value	ECP Classification	Expected Output
Negative Speed	Speed = -10 km/h	None	Unexpected Error
Negative Throttle Position	Throttle = -20%	None	Unexpected Error

4. Control Steering

Use Case ID:	UC07
Use Case:	Control Steering
Actor:	Ego Vehicle
Precondition:	The vehicle is operational and in motion.
Basic Flow:	<ol style="list-style-type: none">1. System continuously monitors the vehicle's position, orientation, and intended path.2. Based on navigation instructions and environmental factors, the system computes the required steering angle adjustments.3. System adjusts the steering angle accordingly.
Alternative Flow:	None
Post Condition:	The vehicle's steering angle is controlled as per navigation and operational requirements.

Activity diagram:



Equivalence Class Partitioning (ECP):

- **Valid Classes:**

Normal Steering: Steering angle within operational range

- -90° to 90° latitude, -180° to 180° longitude

- **Invalid Classes:**

Abnormal Steering: Steering angle outside operational range ($< -30^{\circ}$ or $> +30^{\circ}$)

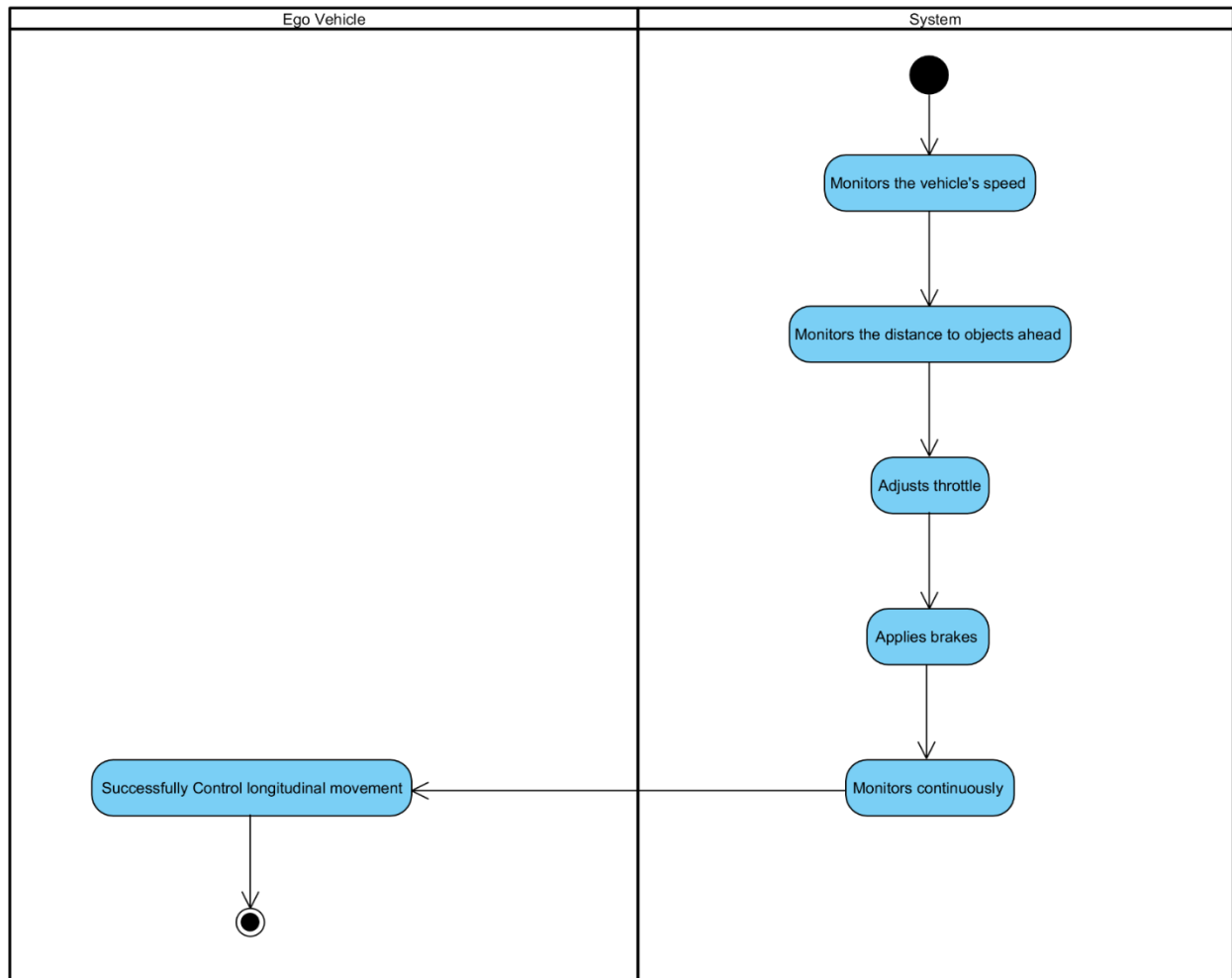
Scenarios and Test Cases:

Test Case	Input Value	ECP Classification	Expected Output
Abnormal Orientation	roll of -220° , pitch of 120°	None	Unexpected Error
Position out of bounds	-100° , 120°	None	Unexpected Error
Abnormal Steering Angle	-45° , 40°	None	Unexpected Error

5. Control Longitudinal Movement

Use Case ID:	UC09
Use Case:	Control Longitudinal Movement
Actor:	Ego Vehicle
Precondition	Vehicle is in motion
Basic Flow	<ol style="list-style-type: none">1. System monitors the vehicle's speed.2. System monitors the distance to vehicles and objects ahead.3. System adjusts throttle to maintain desired speed.4. System applies brakes to maintain safe following distance.5. System continuously monitors and adjusts as needed.
Alternative Flow	None
Post Condition	Vehicle maintains desired speed and safe distance from other objects.

Activity Diagram:



Equivalence Class Partitioning (ECP):

- **Valid Classes:**
 - Speed: $0 \text{ km/h} \leq \text{Speed} \leq 120 \text{ km/h}$
 - Distance: $2 \text{ meters} \leq \text{Distance} \leq 100 \text{ meters}$
 - Throttle Adjustment: $0 \% \leq \text{Throttle} \leq 80 \%$
 - Brake Application: $0 \% \leq \text{Braking Force} \leq 100 \%$
- **Invalid Classes:**
 - Speed: $> 120 \text{ km/h}$
 - Distance: $\text{Distance} > 100 \text{ meters}$
 - Throttle Adjustment: $< 0 \% \text{ or } \text{Throttle} > 80 \%$
 - Brake Application: $< 0 \% \text{ or } \text{Braking Force} > 100 \%$

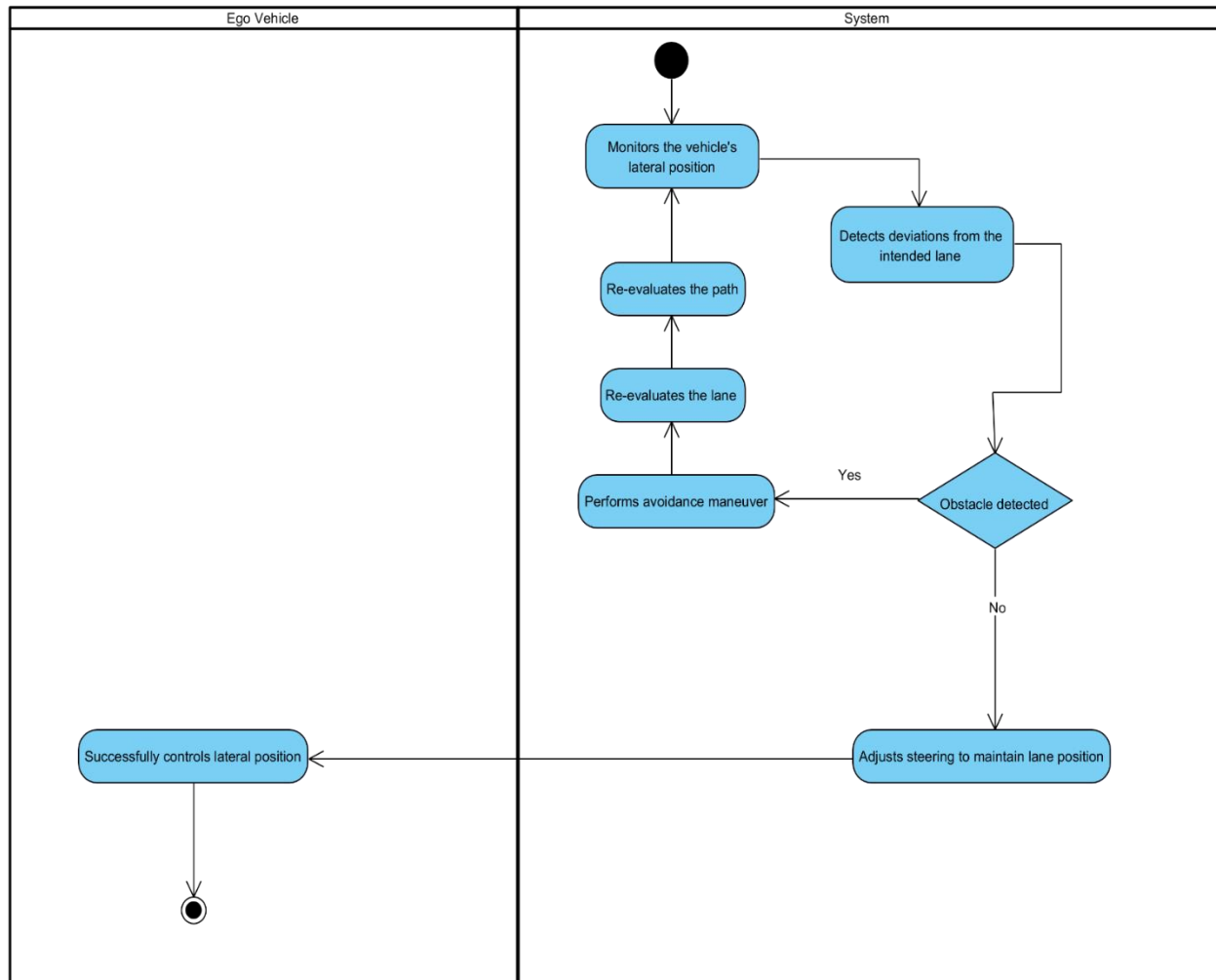
Scenarios and Test Cases:

Test Case	Input Value	ECP Classification	Expected Output
Abnormal Steering Angle	-45°, 40°	None	Unexpected Error
Unsafe distance	0	None	Unexpected Error
Braking force	152%	None	Unexpected Error
Abnormal Speed	-15.2	None	Unexpected Error

6. Control Lateral Movement

Use Case ID:	UC10
Use Case:	Control Lateral Movement
Actor:	Ego Vehicle
Precondition	Vehicle is in motion; path or lane is defined.
Basic Flow	<ol style="list-style-type: none">1. System monitors the vehicle's lateral position.2. System detects deviations from the intended lane.3. System adjusts steering to maintain lane position.4. System continuously monitors and adjusts as needed.
Alternative Flow	<ol style="list-style-type: none">2. If an obstacle detected while deviating or changing lane position:<ol style="list-style-type: none">2.1. System performs avoidance maneuver.2.2. System re-evaluates the lane and path.2.3. System resumes lateral control once clear.
Post Condition	Vehicle maintains correct lateral position within its lane.

Activity Diagram:



Equivalence Class Partitioning (ECP):

- **Valid Classes:**
 - Lateral Position: $-1.0 \text{ meters} \leq \text{Lateral Position} \leq 1.0 \text{ meters}$
 - Steering Adjustment: $-30^\circ \leq \text{Steering Angle} \leq 30^\circ$
- **Invalid Classes:**
 - Lateral Position: $\text{Lateral Position} > 1.0 \text{ meters}$
 - Steering Adjustment: $\text{Steering Angle} > 30^\circ$

Scenarios and Test Cases:

Test Case	Input Value	ECP Classification	Expected Output
Abnormal Lateral Position	-2.0 meters	None	Unexpected Error
Excessive Steering Adjustment	-45.23°	None	Unexpected Error