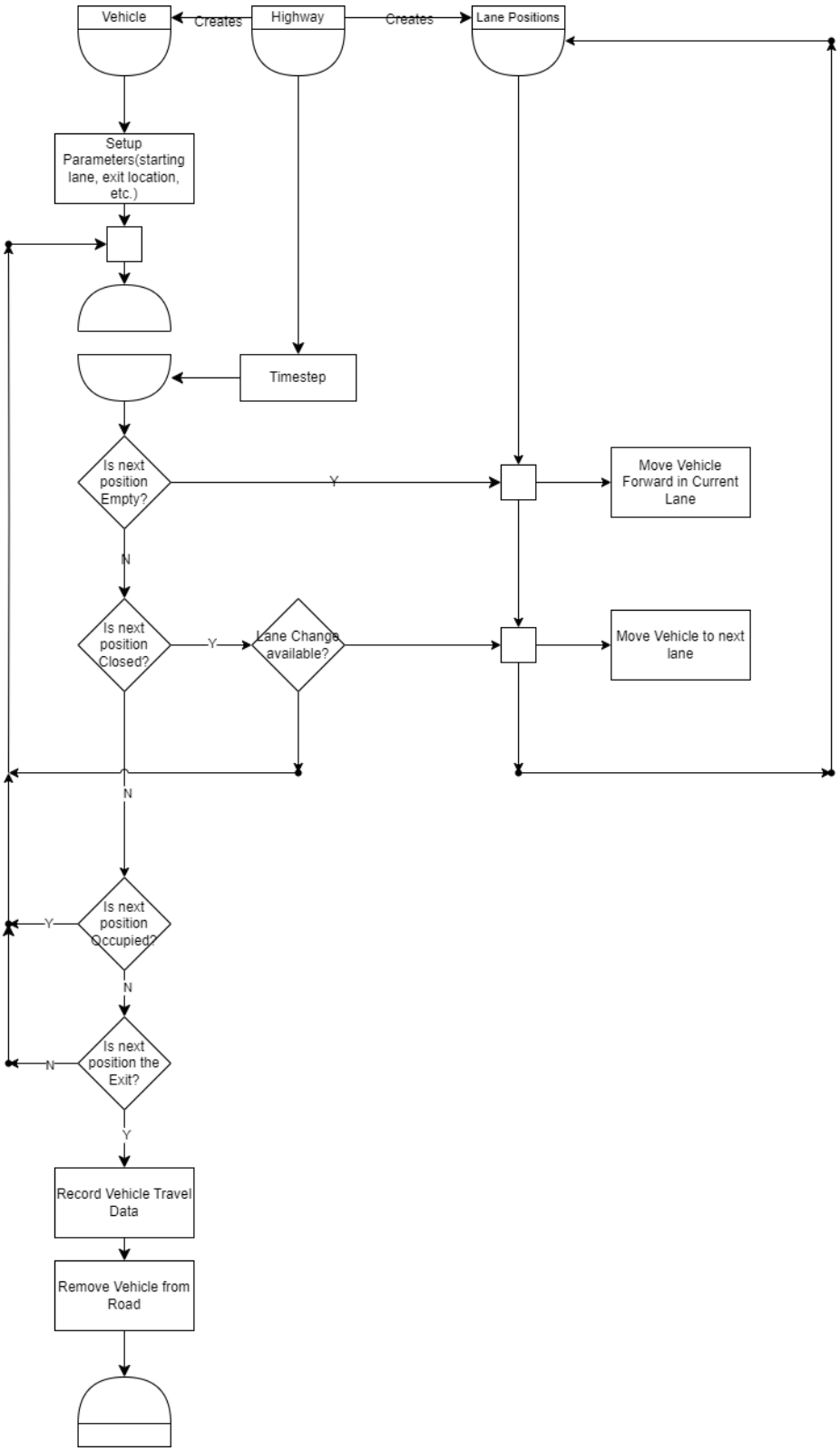
UML Diagram


Vehicle
Creates
Highway
Creates
Lane Positions
Setup Parameters(starting lane, exit location, etc.)
Timestep
Is next position Empty?
Y
Move Vehicle Forward in Current Lane
N
Is next position Closed?
Y
Lane Change available?
Move Vehicle to next lane
N
Is next position Occupied?
Y
N
Is next position the Exit?
N
Y
Record Vehicle Travel Data
Remove Vehicle from Road

Design Documentation

Vehicle

A vehicle is a data object that represents the resource being managed by the simulation. Each vehicle has several attributes, such as:

- Current X and Y: The current lane and position within the lane.
- Target Exit: The designated exit index for the vehicle.
- Steps Waiting: Counts the timesteps where the vehicle is prevented from moving; for example, another vehicle was in the spot it needs to change lanes into.

The vehicles run a method every time the simulation sends a timestep. For every timestep, the vehicles try to perform actions:

- Reach an Exit: Attempt to change lanes towards an exit once within a certain distance.
- Move Forward: Attempt to advance in the current lane, if the next LanePositon is empty then the vehicle progresses.
- Change Lanes: Evaluate the need to change lanes when approaching a lane closure or their designated exit. This involves checking adjacent lanes for other vehicles.

Vehicles send events to the rest of the simulation to communicate their position and behavior:

- Update Position Event: Received by the UI system to reflect movements in the array of lane positions managed by the Highway class. This array UI is a grid of squares representing the positions.
    - Red = Closed
    - Green = Occupied
    - Grey = Empty
- Exit Reached: Each vehicle sends this event when it reaches its exit, it sends data such as how many time steps it took to reach its destination. This data is logged to be analyzed.

Simulation

The Simulation class acts as the executive controller for the traffic system. It is responsible for:

- Initialization: Setting up the system by creating the Highway and populating it with vehicles. This includes assigning starting positions and target exits for each vehicle.
- Timestep Management: Handling the progression of time within the simulation. For each timestep, the Simulation class:
    - Sends events to vehicles, prompting them to check whether they can move forward or need to change lanes.

Highway

The Highway is a data class that represents the road network. It consists of:

- Lane Positions: A two-dimensional array that forms a grid representing the highway. Each element in the array corresponds to a specific position in a lane. This array is reflected in the UI (see vehicle events).
- CloseLane Method: A method to close a specific section of the Lane Position array. This marks the positions as closed, preventing vehicles from occupying these spaces.

Lane Position

A Lane Position is a data class that represents a specific spot on the highway. It has three possible states:

- Occupied: Indicates that a vehicle is currently occupying this position.
- Empty: Indicates that the position is available for a vehicle to move into.
- Closed: Indicates that the position is closed and cannot be occupied by any vehicle.

Lane Positions are updated by vehicles to reflect their current state, ensuring an accurate representation of traffic flow on the highway.