A Design Proposal of Software to Support Operation of a Driverless Car

A self-driving, autonomous or driverless car performs every function of a car without human intervention (Yeong et al., 2021: 2). Many automakers, suppliers, and software and technology companies are committed to developing autonomous vehicles for society. Unfortunately, there are still many challenges to overcome until the population can drive worldwide without a driver. One of the reasons why the expectation for the driverless car is so vast is the car accidents reduction caused by humans (Fadaie, 2019: 5-7).

However, a brief description of how a self-driving car works is necessary to design software to support the operation of a driverless car. There are four essential functions:

1. Localization: Current position of the car
2. Perception: Perceiving its surrounding environment
3. Path planning: Route planning
4. Car control: Control speed, light, direction, brake etc.

In addition, the following picture shows which technologies are used in a driverless car to execute these functions (Reddy, 2019: 4-5).

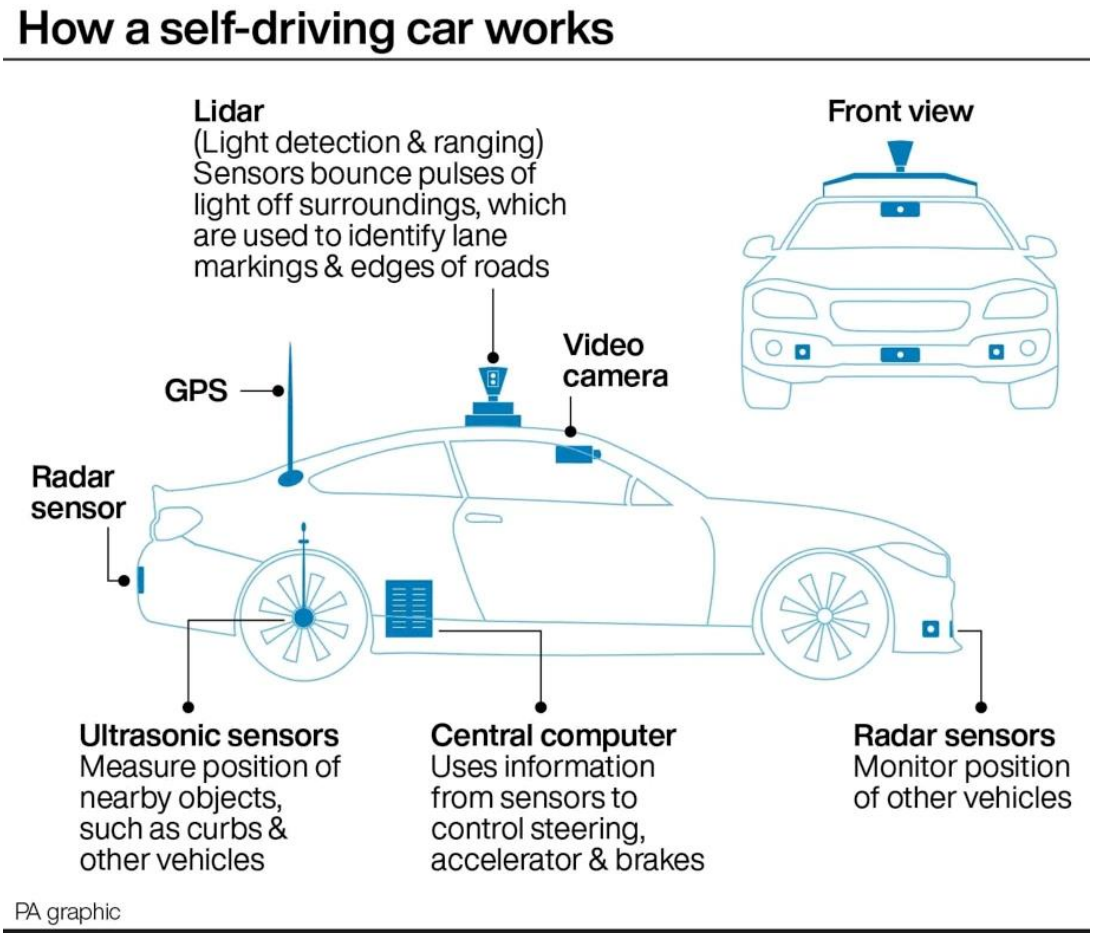

Figure 1: How a self-driving car works (Barrett, 2022)

The GPS is responsible for the function localization and path planning. Moreover, to fully use the ability of perception, numerous sensors are needed, such as Lidar, Radar sensor, Ultrasonic sensor, and especially cameras to detect obstacles, vehicles, traffic lights, pedestrians, etc. Finally, the central computer is responsible for controlling the car (Fadaie, 2019: 7).

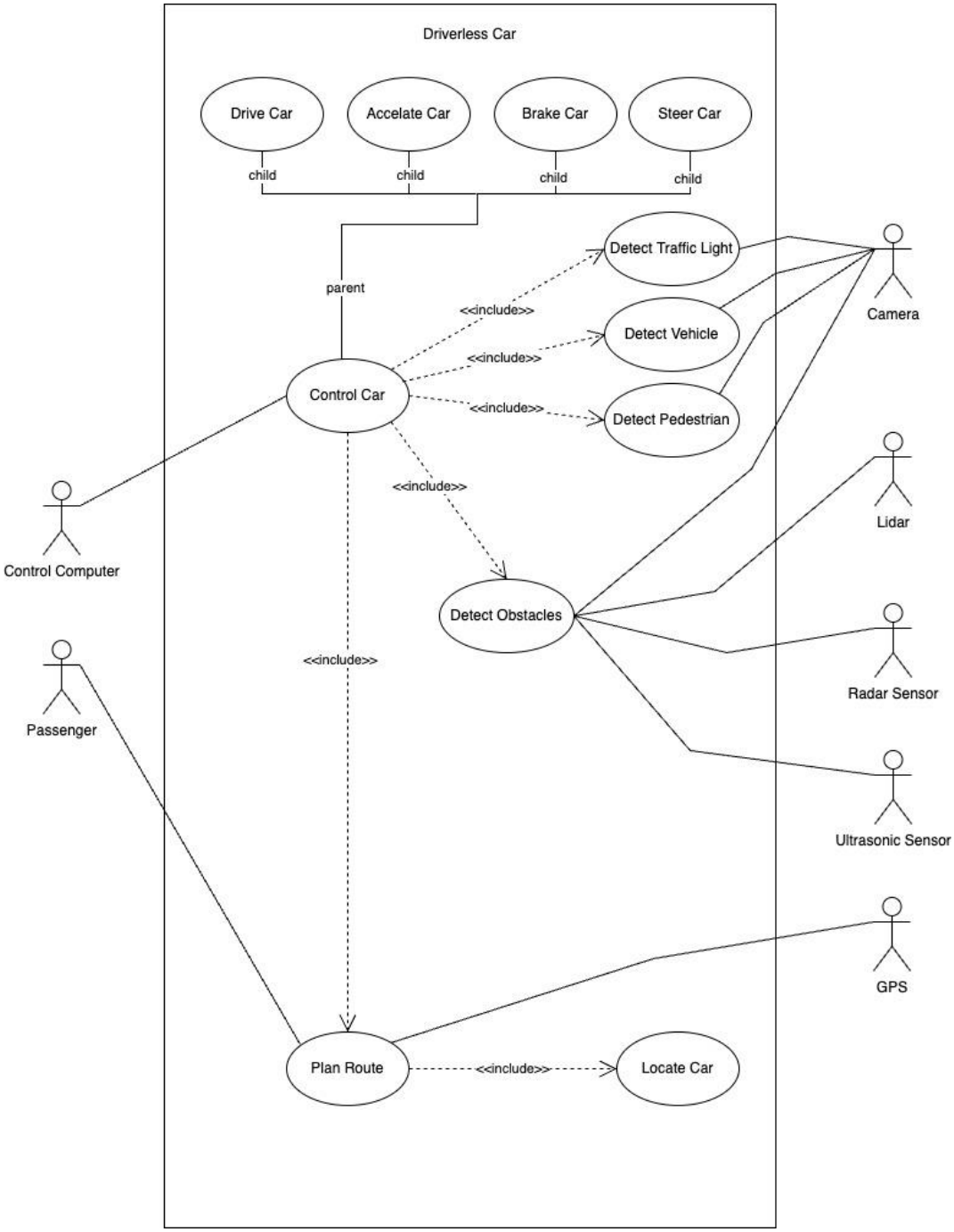

Figure 2: Use Case Diagram for a driverless car (own representation)

Figure 2 shows a use case diagram for a driverless car. It shows the interaction between the user and the software and which functions are required for the software. (Visual-Paradigm, 2022). In the case of a driverless car, the vehicle control computer and the

passenger are the primary actors in initiating the use of the system, and the technologies are the secondary actor. For instance, the central computer uses all the information of the sensors and camera to control the car and, lastly, to drive or brake the car (Barrett, 2022).

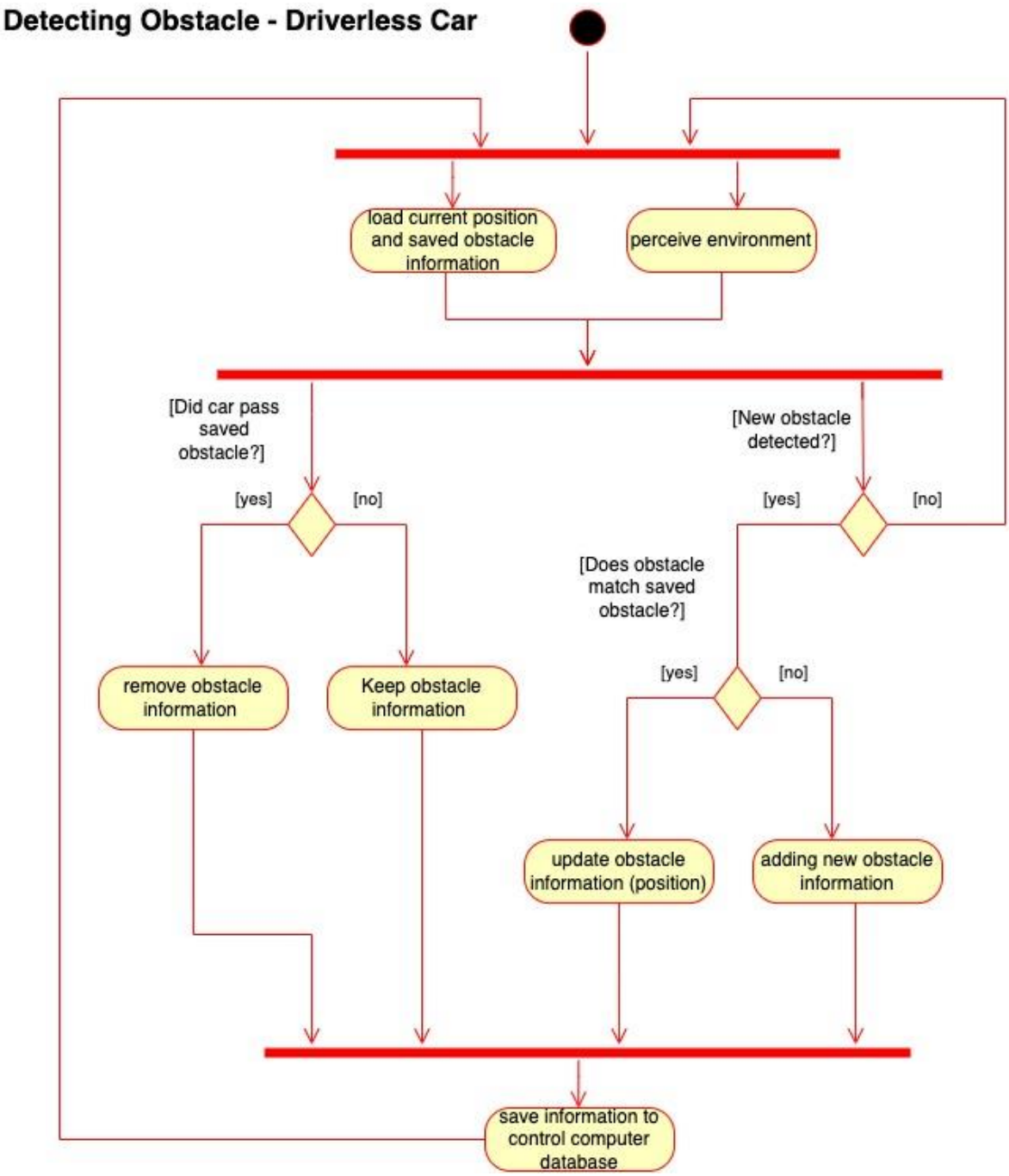

Figure 3: Activity Diagram for a driverless car during object detection (own representation based on (Furda & Vlacic, 2010: 1057)

Figure 3 represents an activity diagram (a behavioural diagram) which demonstrates an obstacle detection scenario of an autonomous car. In addition, the activity diagram shows how data structure can be used. In this case, data can be added, updated and removed through, for example, a dictionary or a list (Muzumdar, 2022).

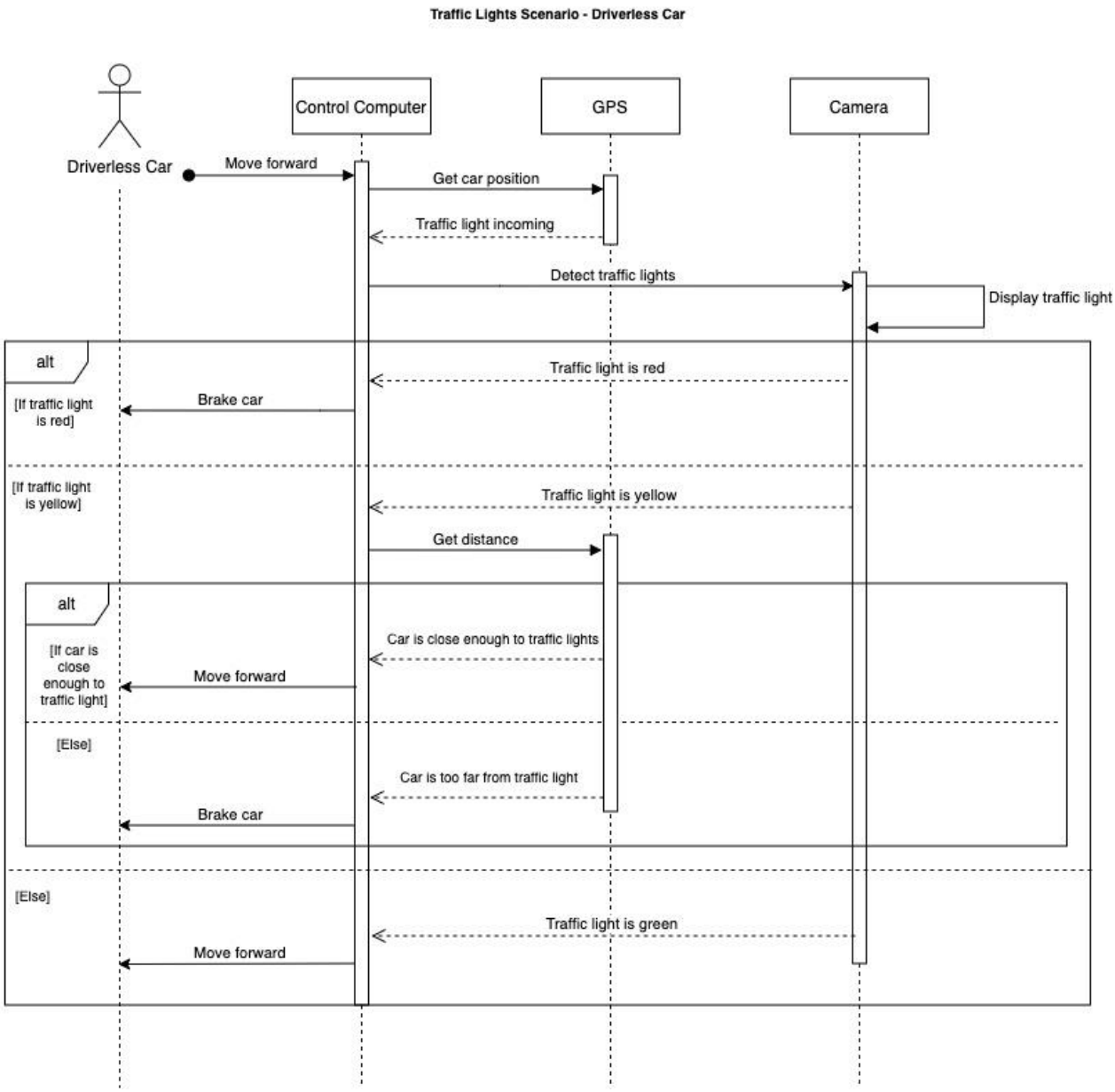

Figure 4: Sequence Diagram for a driverless car in a traffic light scenario (own representation based on (Golabhavi & Harish, 2020)

The behaviour of the driverless car in a traffic light scenario shows in figure 4 through a sequence diagram. It is clear to see how the system components interact at each traffic light state - red, yellow and green (Golabhavi & Harish, 2020).

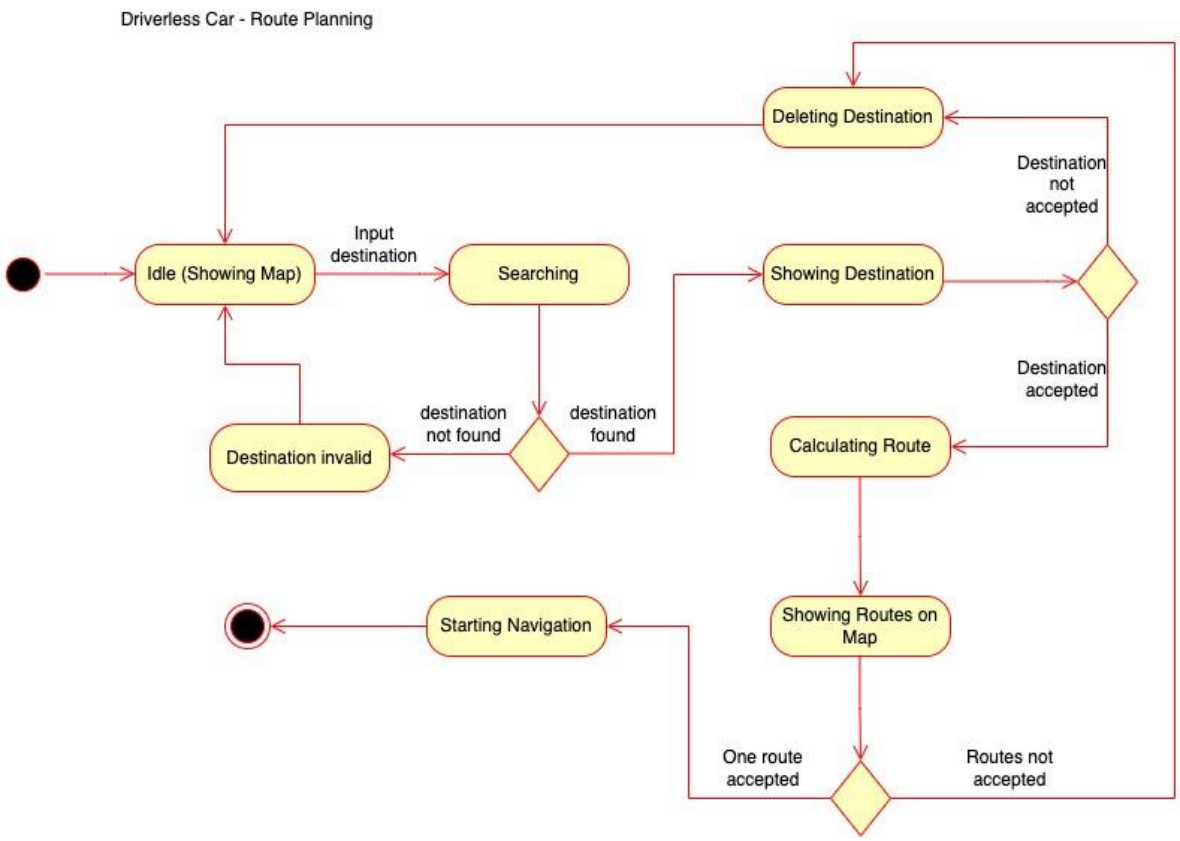

Figure 5: State Transition Diagram for a driverless car in a route planning operation (own representation)

The State transition diagram in figure 5 represents a route planning scenario where the focus lies on the interaction between the passenger and the driverless car. The destinations can be stored in a stack data structure principle. This means that the last data searched for can also be deleted first if the passenger decides on a different destination (last in, first out). The saved destinations can be viewed under the last searched destinations. A queue that follows the order first in and first out is not the proper storage principle (Muzumdar, 2022).

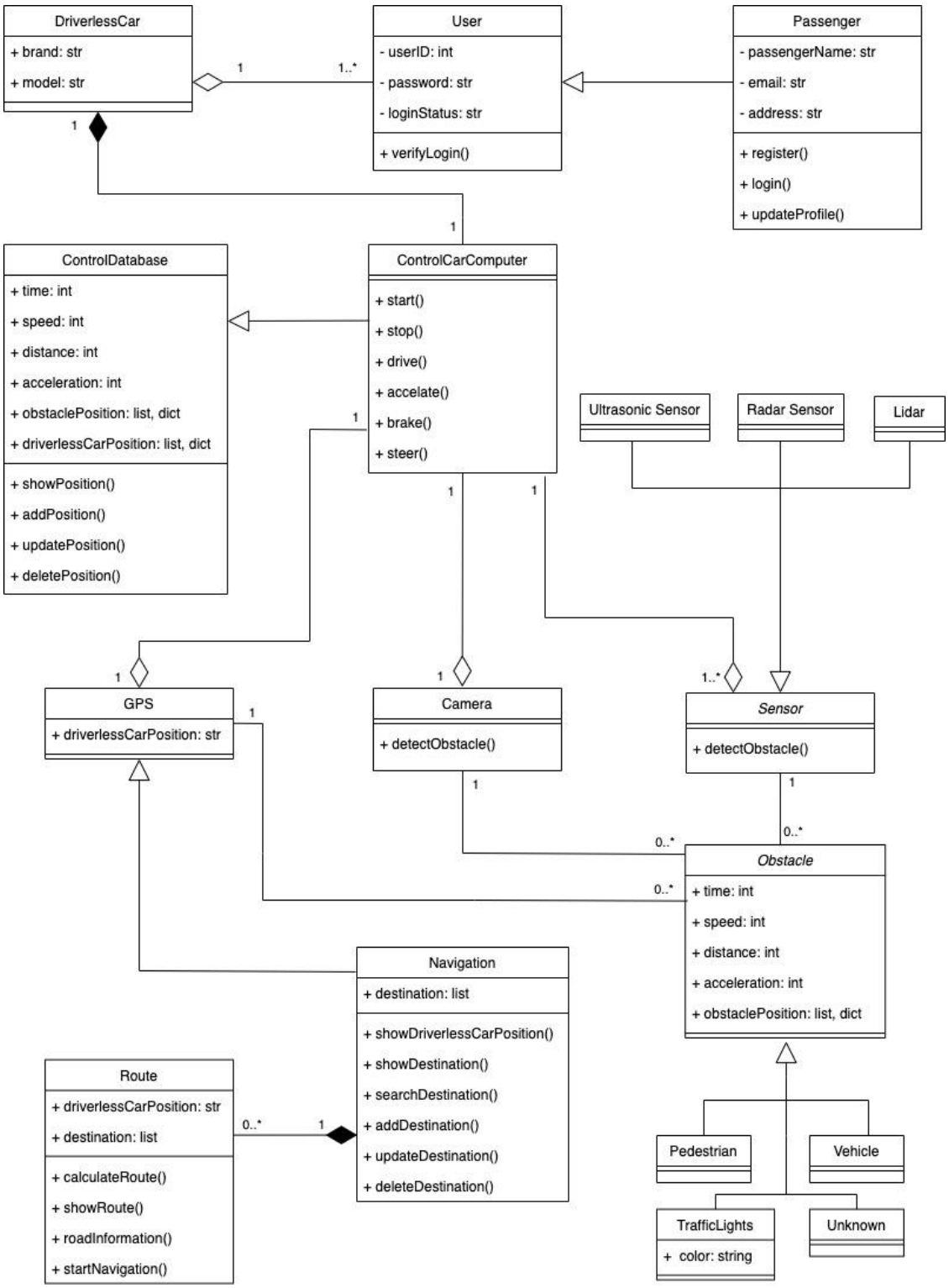

Figure 6: Class Diagram for a Driverless Car (own representation)

Finally, figure 6 represents a class diagram with the required classes, subclasses and associations for implementing the software of a driverless car with the respective operations.

References:

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