Self-driving Car Model

System Functionality[1]

|  |  |  |
| --- | --- | --- |
| Sense | Ultrasonic | Sensing is the ability to accurately perceive the environment around the vehicle. |
| Lidar |
| Radar |
| Camera |
| Plan | On-board computer system | Planning, commonly referred to as driving policy, is where decisions are made about what strategic (i.e. change lanes) and tactical (i.e. overtake the blue car) decisions to take. |
| Act | Power system | Acting is the issuance of the decision (translated into mathematical trajectories and velocities) to the various actuators within the vehicle to perform the driving decision. |
| Breaking system |
| Steering system |
| … |

Sensing Coverage

|  |  |
| --- | --- |
| Sensing Coverage | Front |
| Rear |
| Left |
| Right |

Sensing range

|  |  |  |  |
| --- | --- | --- | --- |
| Sensor | Range | Under the influence of | coverage |
| Ultrasonic | <2m |  | Front, Rear |
| Lidar | <200m | Weather | Omni-directional |
| Radar | <50m (Short range) |  | Omni-directional |
|  | <250m (long range) |  | Front |
| Camera | TBD | Illuminance and weather | Omni-directional |

Actions of car

|  |  |
| --- | --- |
| Action of car | Start |
| Left steering |
| Right steering |
| Acceleration |
| Cruise |
| Breaking |
| Reversing |

Speed modes

|  |  |
| --- | --- |
| Stop | 0 |
| Slow | 1, 2 |
| Fast | 3, 4 |
| Limited | 1≤speed limit≤4 |

Traffic rules

|  |  |
| --- | --- |
| Traffic rules | Speed limit |
| No lane changing |
| No overtaking |
| … |

Other agents

|  |  |
| --- | --- |
| Other agents | Front car |
|  | Rear car |
|  | Left car |
|  | Right car |

Relationship between cars

|  |  |
| --- | --- |
| Invisible | Out of sensing range, or visibility of sensors is blocked by occlusion |
| Safe longitudinal/ lateral distance |  |
| Close longitudinal/ lateral distance |  |
| Dangerous longitudinal/ lateral distance |  |
| Collision |  |

**Scenario 1 Left Lane Cruise**

Traffic model:

Two lanes

|  |  |
| --- | --- |
| Left lane | Traffic lane |
| Right lane | Emergency lane |



Three car models:

|  |  |
| --- | --- |
| Front car |  |
| Target car |  |
| Rear car |  |

Distance control:

|  |  |
| --- | --- |
| Front | Enabled |
| Rear | Enabled |
| Left | Disabled (No left lane when cruise) |
| Right | Disabled (In this scenario there is no car on the right (emergency) lane when cruise) |

Initial parameters

Front car:

|  |  |
| --- | --- |
| Position | Left lane |
| Front |
| Speed mode | Slow |
| Enabled actions | Acceleration |
| Cruise |
| Breaking |
| Disabled actions | Start |
| Left steering |
| Right steering |
| Reversing |
| Enabled speed modes | Slow |
| Fast |
| Limited |
| Disabled speed mode | Stop |

Target car:

|  |  |
| --- | --- |
| Position | Left lane |
| Middle |
| Speed mode | Slow |
| Enabled actions | Acceleration |
| Cruise |
| Breaking |
| Right steering |
| Disabled actions | Start |
| Left steering |
| Reversing |
| Enabled speed modes | Stop |
| Slow |
| Fast |
| Limited |

Rear car:

|  |  |
| --- | --- |
| Position | Left lane |
| Rear |
| Speed mode | Slow |
| Enabled actions | Acceleration |
| Cruise |
| Breaking |
| Disabled actions | Start |
| Left steering |
| Reversing |
| Enabled speed modes | Slow |
| Fast |
| Limited |