# Software Requirements Specification

**for**

# Self Driving Car - Tesla Y

**Version 1.0 approved**

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**JAD**

**10/17/23**

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# Revision History

| Name | Date | Reason For Changes | Version |
|---|---|---|---|
| JJ Javier, Aaron Hamilton, Dheeraj Singavarapu | 10/17/23 | Initial Draft | 1.0 |

# 1. Introduction

## 1.1 Purpose

The purpose is to create a safe self driving mode application in pursuit of a safer driving environment. The application will allow unwavering decision making and communications between the environment and the vehicle. Drivers with difficulty in making these decisions while driving can rest assured as the self-driving vehicle will have efficient and accurate priority, reaction time, and security. As the target audience are those incapable of driving themselves, elderly folk, or people who have high interest in the technology that comes from the self-driving vehicle, the car's purpose is to allow driverless motion to get from one destination to another.

## 1.2 Document Conventions

This document follows IEEE formatting conventions. The document is written in Arial, double spaced, and font sizes for main headers are 18 pt, and subsection headers are 14pt and body sections are 12pt. Section headers and subsections are numbered and bolded. Every requirement statement has its own priority.

## 1.3 Intended Audience and Reading Suggestions

The intended audience of our proposal document are those incapable of driving themselves, the elderly who can no longer drive themselves, or those who have a high interest in the car and the technology that comes from it. The SRS will describe the vehicle's main and intended functions along with the non-functional requirements. Within this document you will find the product's design, user cases, hardware and software specifications, and many of its features that come with it.

## 1.4 Product Scope

The scope of this product and the purpose behind it is to create a safer driving environment. With the use of a highly advanced, self-driving car will be used to lower driving accident rates and prevent injury to passengers. With the car being able to use its sensors to communicate the environment to its software, it can react, responde, and properly take effective action based on its surroundings. Goals would include a lowering of driving accidents per year, reduce the congestion of traffic, and the ability to communicate from car to corporate about how they're doing and what more can be done to improve. This product aims to make the roads a safer place, not just for those who cannot drive, but those who may drive on the same roads as one.

## 1.5 References

"Model Y Owner's Manual." Tesla, www.tesla.com/ownersmanual/modely/en_us/.

# 2. Overall Description

## 2.1 Product Perspective

The origin of the Tesla Model Y can be traced to the product line known as Tesla. Co-founded most notably by Elon Musk, it is a new car added to the line of products and is very similar to its predecessors and other models of the same line such as: Model S, Model 3, and Model X. The Model Y is a cheaper version of the Model X in price and other aspects. Aspects like size, battery power, and functionality of the doors make the Model X much more expensive. Its system is within the shared ecosystem of other tesla models and uses both shared software and technology.

## 2.2 Product Functions

Functional requirements include the following, auto-direction with the steering wheel that keeps the car on the road, object detection around the vehicle that ensures no crashing, automatic gas usage so that the car remains on the speed limit without the driver having to push the gas pedal, automatic brake usage so that the vehicle will automatically begin to brake in accordance to a stop or traffic, and finally a system that detects roads, roadlines, and different terrain features so that the vehicle can stay on the road in its lane without failure.

## 2.3 User Classes and Characteristics

Some classes may include one for the steering, acceleration, braking, sensor input data, and the communication between sensor and software. Most, if not all product functions are used as the operator uses the vehicle and its system. The experience needed is for those who are capable of driving and passed the driver's license exam. One is not able to operate the vehicle without the acquisition of a driver's license. The most important classes are the main function of the car itself, the acceleration, braking and steering functions.

## 2.4 Operating Environment

The environment where the hardware platform operates is a computer system built into the Tesla Model Y by Tesla themselves. The software is mostly operating on a system Tesla continuously updates as time goes on. The latest update to the software was made around October 12, 2023 known as 2023.32.9. Other software components of the Tesla Model Y include, Autopilot and Full Self-Driving (FSD) Software, Touch screen infotainment system, as well as its Connectivity software. FSD is self explanatory as it is the system which allows self driving as a feature, the infotainment system comes with a touchscreen pad in the center of the car and is a hub for all tesla applications, finally the connectivity software is how tesla is able to receive digital updates or OTA(over the air) updates.

## 2.5 Design and Implementation Constraints

Tesla's design allows the owner / user to have easy access and easy understanding of how the system operates. Users must follow all car use regulations and protocols in order to use the vehicle

on public roads. The car must be charged in order to run accompanied by the key card given in order to unlock and use the car with its features. The car itself has memory storage for the user's data and to keep their preferences. The car overall has everything it needs when acquired including different tools, accessabilities, and security. The operator must maintain the vehicle if in contact with any damages to the car itself or the system. Software updates will be available to the user at the given moments, the user must be able to navigate to the update settings in order to accomplish the software update altogether.

## 2.6 User Documentation

User manual and guide will be available within the system. Or the user may find the online manual located at www.tesla.com/ownersmanual/modely/en_us/.

## 2.7 Assumptions and Dependencies

First and foremost it is assumed that the Tesla Model Y will comply with basic regulatory standards and rules placed on electric vehicles that also include autonomous driving. It is also assumed that both vehicle and user data is highly protected from any sort of data leaks as well as cyber attacks. It is also assumed that there will be consistency in the manufacturing of the Tesla Model Y with little to no defects in released products as well as meet quality standards. Finally we assume that the OTA or over the air updating system will continue to put out updates for the Tesla Model Y. Now as far as dependencies go the Tesla Model Y depends a lot on the software updates provided by Tesla themselves. The Tesla Model Y also depends on the availability of charging stations around the world. Another thing the Model Y depends on is the mobile apps functionality and compatibility. It also depends on the changes that can happen to regulations as far as autonomous and electric vehicles go. Finally the Model Y is dependent on the access to the internet or a cellular network in order to update the car and other remote access features.

# 3. External Interface Requirements

## 3.1 User Interfaces

The user interface will be a tablet-like screen within the front center of the car in order to easily navigate between the many features including the self-driving application. When starting the car, the screen will turn on and show a homepage for the user to navigate. The screen will show the vehicle's battery status, location, exterior display, and multiple app icons. From there the user may go through the different tabs and change settings and customize the vehicle to their suitability. The tablet-like screen is a touch screen so the user should be able to easily go through the car's features and learn what the vehicle entails specifically for the self-driving application. Buttons used will be on the steering wheel of the vehicle. There are two buttons on the left and right side of the wheel that allow the user to press, open or turn features of the vehicle itself.

## 3.2 Hardware Interfaces

The Tesla Model Y uses a variety of sensors and cameras in order to get input to the software in communications in order to tell its environmental surroundings and relationship in distance. Hardware overall consists of the car and its components to function a car, the steering wheel for

additional navigation, its side, front, and back cameras, as well as sensors that communicate the environment with the software. Another huge hardware component is the built-in tablet-like screen used at the front of the car, right of the steering wheel. This component allows the user to navigate through the software features and help guide the user in operating the vehicle as a whole.

## 3.3 Software Interfaces

The software interfaces of the Tesla Y self-driving car facilitate critical communication and data exchange for the system's seamless operation. The vehicle's central processing unit (CPU) and embedded software work in tandem with the self-driving system, enabling real-time decision-making and control. Mapping and navigation databases provide essential location and route information, ensuring accurate route planning. The self-driving system also relies on Tesla's over-the-air (OTA) update system to continuously improve and update its software. In addition, third-party API integration allows the system to obtain real-time traffic data and road conditions. All these interfaces, supported by Tesla's proprietary operating system, contribute to the vehicle's safe and efficient autonomous operation on the road.

## 3.4 Communications Interfaces

Communication mainly comes from outside sensors of the vehicle to the software. The sensor to determine what object is around the car such as another vehicle, bike, pedestrian and other foreign objects. These sensors tell the software what the objects around them are and how far it is from the vehicle. With so, the car is able to determine how far it needs to be before deceleration or how far is far enough to begin accelerating. This also allows the vehicle to stay in lane and be aware of when to change lanes based on the sensory input of how far an object is within a lane to the right or left of the vehicle. The vehicle may also submit any crash reports or feedback from the user to the manufacturer. With customer service available at their given hours, users may get access to their data or get help in understanding how functions within the vehicle as a whole work entirely. All the communications from the user specifically come from the tablet screen as the users are able to navigate through to access communications.

# 4. System Features

System features will include auto-steer, auto-brake, traffic light / stop sign check, location/route management, speed management, and auto-park

## 4.1 Auto-Steer

### 4.1.1 Description and Priority

Keeping the vehicle in proper road lanes while following speed limits
Priority: High
Benefit: 9
Cost: 5
Penalty: 5
Risk: 3

### 4.1.2 Stimulus/Response Sequences

User Action: User selects on the auto drive application
System Response: From the moment auto drive is selected, the vehicle will take over all steering actions taking in the environment information to determine what actions need to be taken.

#### 4.1.3 Functional Requirements

REQ-1: User should be the owner/operator of the vehicle having accessibility to the vehicle
REQ-2: User should navigate through the menu of the vehicle's tablet and select the auto pilot feature

## 4.2 Auto-Brake

#### 4.2.1 Description and Priority

Decelerating approaching the speed of 0 depending on the distance relationship from the front of the vehicle to the object in front of the vehicle
Priority: High
Benefit: 9
Cost: 3
Penalty: 4
Risk: 3

#### 4.2.2 Stimulus/Response Sequences

User Action: User selects on the auto drive application
System Response: From the moment auto drive is selected, the vehicle will take over all steering actions taking in the environment information to determine what actions need to be taken.

#### 4.2.3 Functional Requirements

REQ-1: User should be the owner/operator of the vehicle having accessibility to the vehicle
REQ-2: User should navigate through the menu of the vehicle's tablet and select the auto pilot feature

## 4.3 Traffic Light / Stop Sign Check

#### 4.3.1 Description and Priority

The communication between the environment checking from sensor input if a traffic light is red, yellow, or green or if approaching a stop sign. Based the check will auto-brake or maintain speed.
Priority: Medium
Benefit: 9
Cost: 5
Penalty: 7
Risk: 2

#### 4.3.2 Stimulus/Response Sequences

User Action: User must not interfere when car is checking for the traffic light / stop sign

System Response: The vehicle will determine based on the sensor indication if it's green to continue forward and maintain proper speed, if yellow to auto-brake and slow down, and if it's red or a stop sign and come to a complete stop and wait until either the light turns green or it's the vehicles turn to begin driving again.

#### 4.3.3 Functional Requirements

REQ-1: User should be the owner/operator of the vehicle having accessibility to the vehicle
REQ-2: User should navigate through the menu of the vehicle's tablet and select the auto pilot feature

## 4.4 Location / Route Management

#### 4.4.1 Description and Priority

Gives the vehicles location on a map in real time while giving the best routes when wanting to go from one location to another.
Priority: low
Benefit: 7
Cost: 2
Penalty: 1
Risk: 1

#### 4.4.2 Stimulus/Response Sequences

User Action: User selects turns on and begins using the vehicle
System Response: The vehicle will start and the system will be online

User Action: User selects the settings application from the built in screen tablet
System Response: The system will open up its settings where the location indicator will be displayed

User Action: User selects to turn on location at all times
System Response: The vehicle will use the information from the vehicle and display the current location in real-time.

#### 4.4.3 Functional Requirements

REQ-1: User should be the owner/operator of the vehicle having accessibility to the vehicle
REQ-2: User must go into the vehicle's settings and allow the vehicle's location to be shown in real-time.

## 4.5 Speed Management

#### 4.5.1 Description and Priority

The user may set a speed limit manually before engaging in auto pilot or the vehicle will be able to determine the speed limit based on location and type of area it's being driven in
Priority: High
Benefit: 9
Cost: 5
Penalty: 5
Risk: 5

#### 4.5.2 Stimulus/Response Sequences

User Action: User selects on the auto drive application
System Response: Based on the type of area road the vehicle is located at, the car should automatically base its speed off the speed limitations

User Action: User selects auto pilot speed management
System Response: User may set a maximum speed the car can go while in auto pilot mode

#### 4.5.3 Functional Requirements

REQ-1: User should be the owner/operator of the vehicle having accessibility to the vehicle
REQ-2: User should navigate through the menu of the vehicle's tablet and select the auto pilot feature
REQ-3: User should navigate through the auto pilot's features and be able to set a speed limit if necessary

### 4.6 Auto-Park

#### 4.6.1 Description and Priority

When arriving at the user's chosen destination, the vehicle will turn and align itself based on its surroundings given by the sensors to properly put itself in position to park.
Priority: Low
Benefit: 7
Cost: 3
Penalty: 2
Risk: 1

#### 4.6.2 Stimulus/Response Sequences

User Action: User selects on the auto drive application
System Response: Vehicle will take the sensor input data to determine the wheel adjustment, speed adjustment and position itself to park

#### 4.6.3 Functional Requirements

REQ-1: User should be the owner/operator of the vehicle having accessibility to the vehicle
REQ-2: User should navigate through the menu of the vehicle's tablet and select the auto pilot feature

## 5. Other Nonfunctional Requirements

### 5.1 Performance Requirements

Rigorous testing, redundancy in critical systems, and continuous improvement of technology are essential to mitigate technical conflicts. The constant checking of the sensors within and outside

the car as well as its communications between the sensors to the car will elevate the experience and bring reassuring performance. Performances include lane management, traffic light change indicator, route management, acceleration control, speed maintenance, brake control, and pedestrian watch. The performance should be available and reliable 24/7 as the user inputs the use of the self driving application

| Non-Functional Req | Weight | Self Driving - Tesla Y | Manual |
|---|---|---|---|
| Response time to other cars & traffic lights | 0.10 | 0.20 | 0.30 |
| Route / Lane Management | 0.40 | 0.70 | 0.70 |
| Priority of vehicles Vehicles | 0.50 | 0.90 | 0.70 |
| Total | 1 | 0.75 | 0.66 |

## 5.2 Safety Requirements

Establishing clear liability frameworks and insurance policies to address these issues is essential. Government regulations and industry standards can play a role in shaping liability rules. Though the operator may not by physically driving the car, he or she is required to have a driver's license. Safeguards include emergency breakage at a certain distance between car and objects in front and multiple cameras from the front, back and both sides of the vehicle to ensure safety between the vehicle and the surrounding environment including cars, pedestrians, and buildings.

## 5.3 Security Requirements

Implementing robust cybersecurity measures and adhering to data protection laws are crucial for addressing privacy and security conflicts. The feature to report feedback or report or a crash in real time allows the vehicle to adjust while being protected against potential hackers.

## 5.4 Software Quality Attributes

With the use of software, the possibility of software updates to give users improved versions on a basis will allow an increase in the products adaptability, availability, correctness, flexibility and maintainability. With consistent checks between all products in use, there will be a constant inflow of new information from those who use the product. The vehicle will have a guide built in to show those who are operating the product how to use it and a list of contact information to further ask if needed.

5.4.1 Adaptability: Users will be able give feedback based on experience
5.4.2 Availability: The application will be available to users 24/7.
5.4.3 Correctness: The application should meet its functional requirements.

5.4.4 Flexibility: Changes and modifications will be tested and run over and used to improve the application

5.4.5 Interoperability: The software should be able to communicate with the manufacturer and developers of the product

5.4.6 Maintainability: The application should be easy to update and troubleshoot.

5.4.7 Portability: The application will be only accessible with the specific car type

5.4.8 Reliability: The application should not crash under normal operation and repeated inputs.

5.4.9 Reusability: Parts of the codebase should be reusable for future add-ons.

5.4.10 Robustness: The software should be able to handle unexpected inputs and errors without causing a crash or data loss in the system.

5.4.11 Testability: Testings will be run by use of the given feedback from multiple users

5.4.12 Usability: The software will be user friendly and easy to navigate.

## 5.5 Business Rules

Governments and industry stakeholders need to work together to establish clear, consistent, and adaptable regulatory frameworks that support the development and deployment of autonomous vehicles. Though passengers won't be driving the vehicle, it is required that the operator of the vehicle has a driver's license. Defining ethical guidelines for self-driving car behavior and engaging in public discussions to shape these guidelines can help address conflicts. Only the owner of the vehicle will be able to operate the car and its features including the self-driving application.

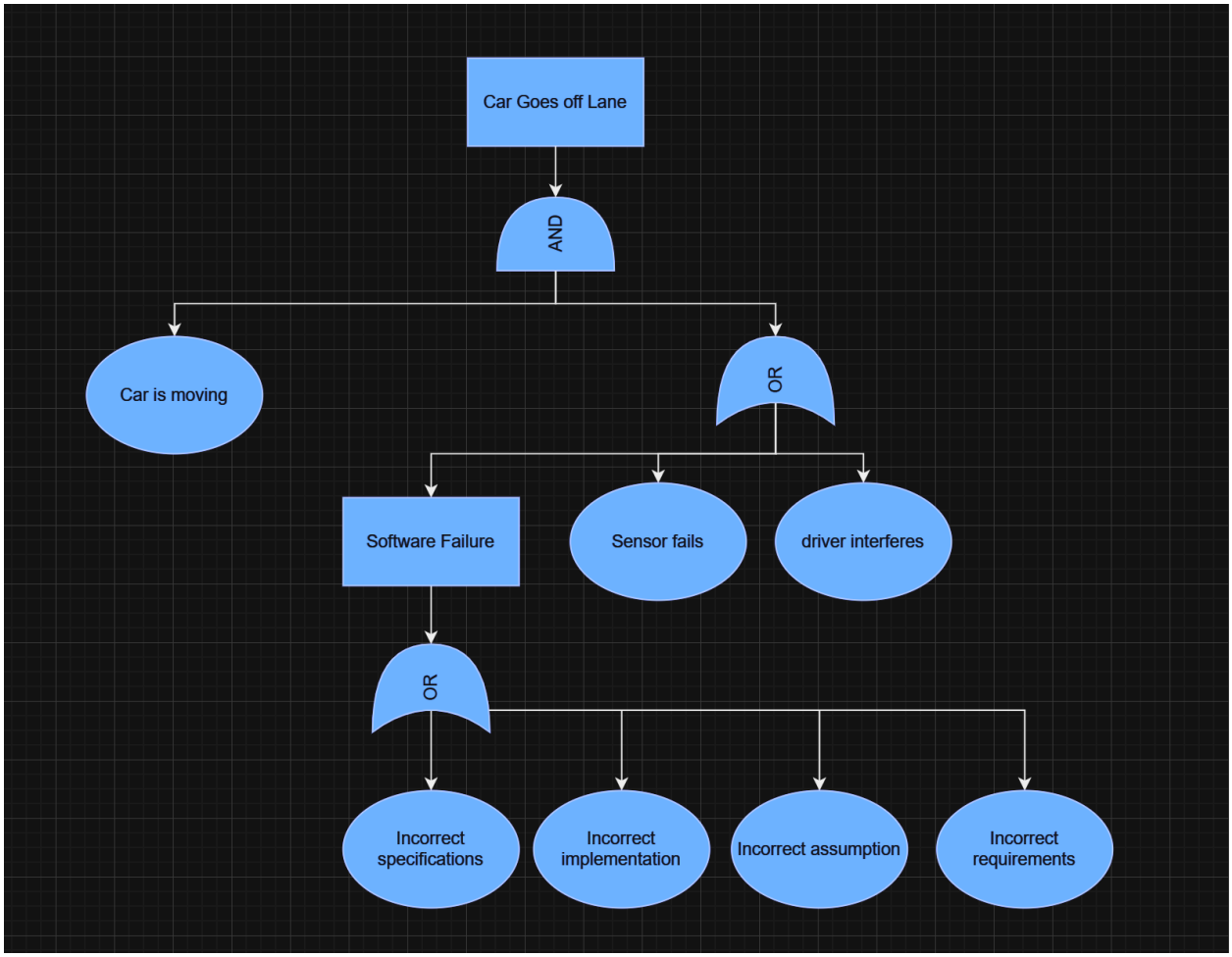
# 6. Other Requirements

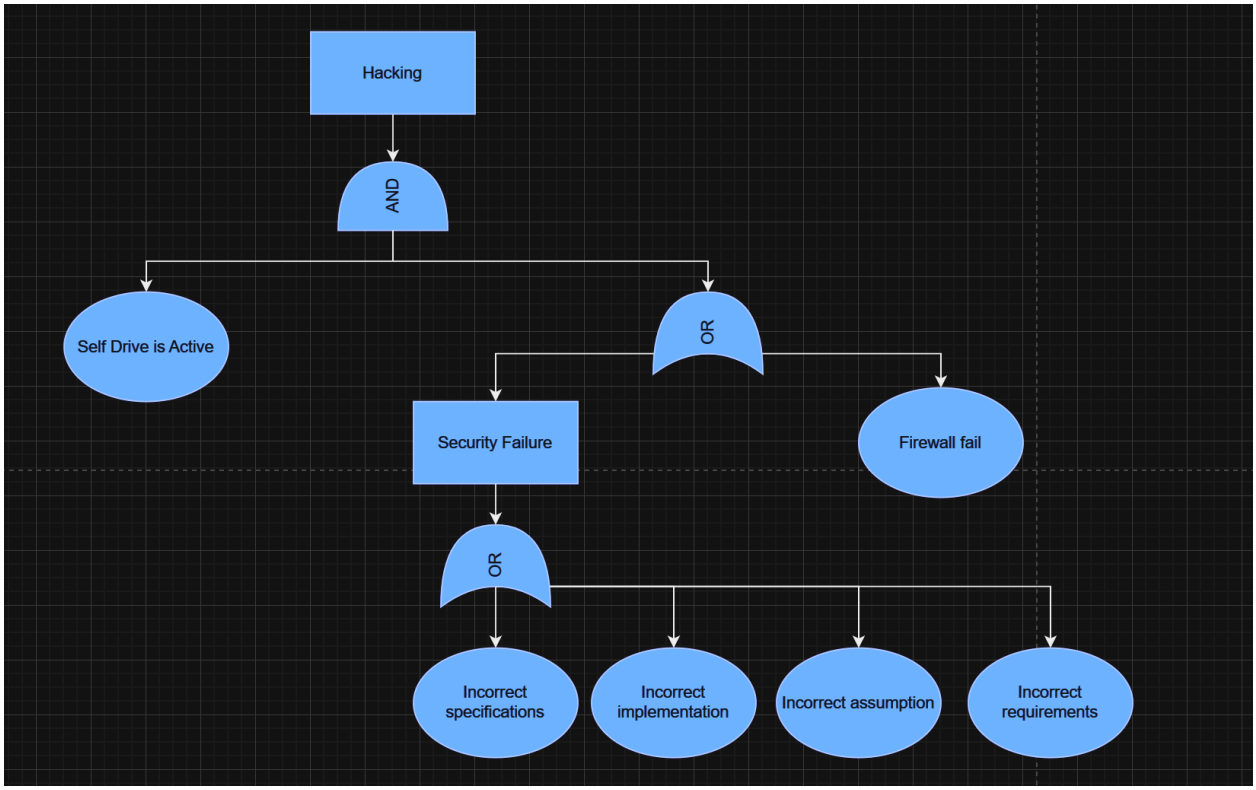
# Appendix A: Glossary

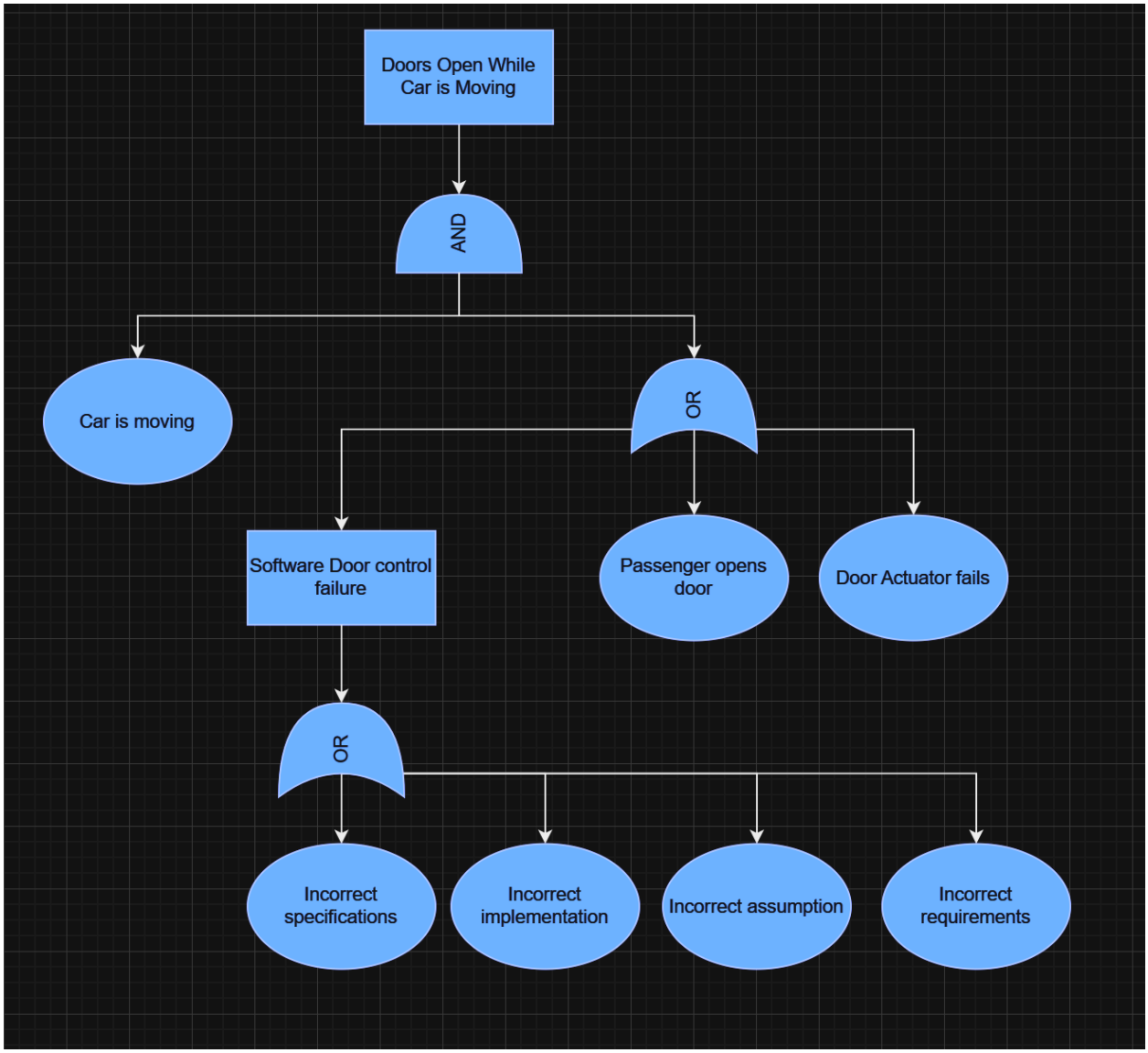
**Real time**: The actual time in which something takes place

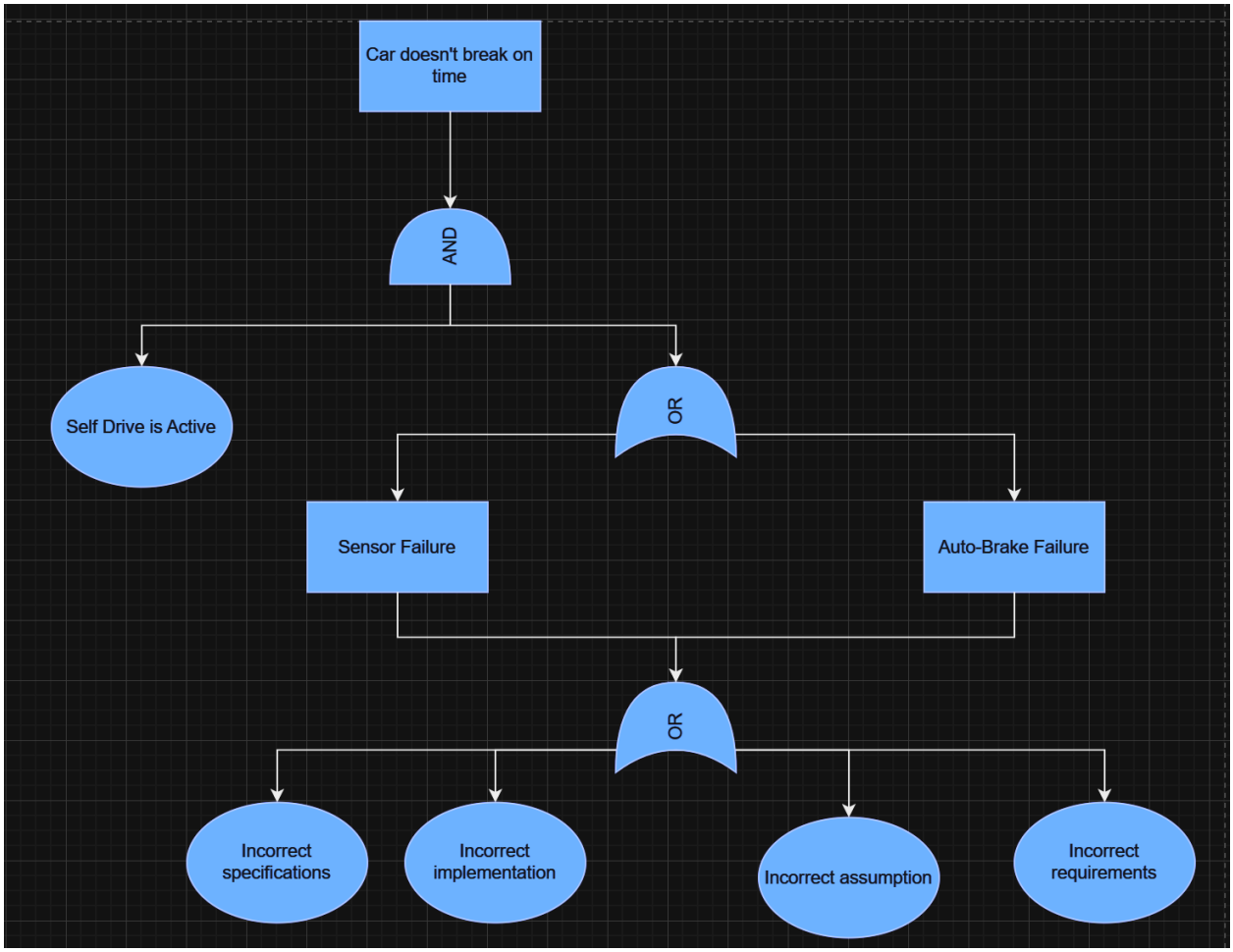
# Appendix B: Analysis Models

**Risk Trees:**

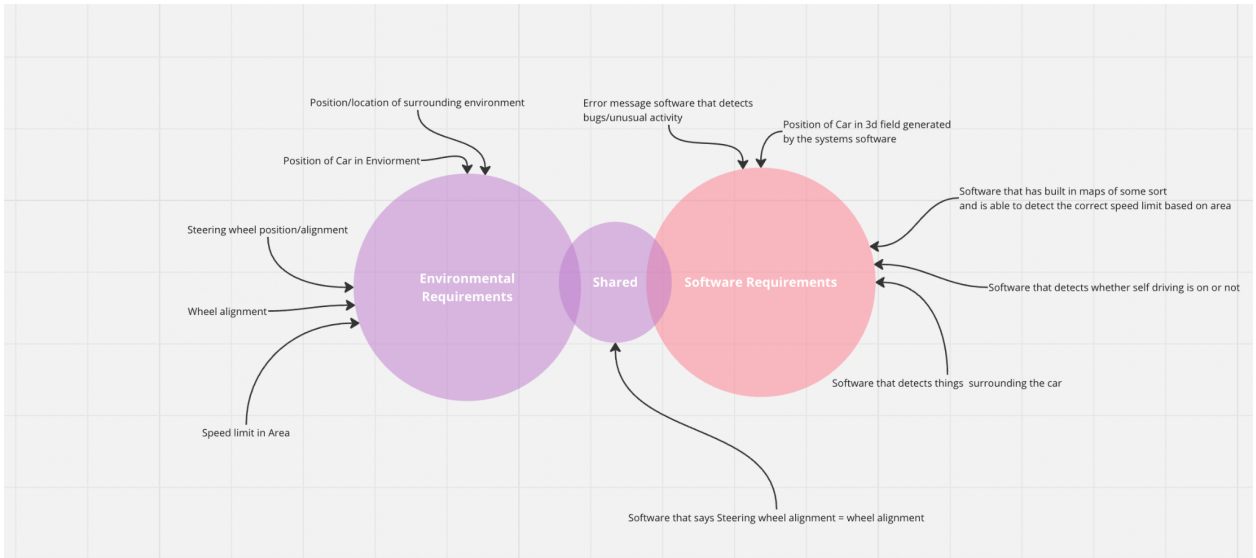

Car Goes off Lane
AND
Car is moving
OR
Software Failure
Sensor fails
driver interferes
OR
Incorrect specifications
Incorrect implementation
Incorrect assumption
Incorrect requirements


Hacking
AND
Self Drive is Active
OR
Security Failure
Firewall fail
OR
Incorrect specifications
Incorrect implementation
Incorrect assumption
Incorrect requirements


Doors Open While Car is Moving
AND
Car is moving
OR
Software Door control failure
Passenger opens door
Door Actuator fails
OR
Incorrect specifications
Incorrect implementation
Incorrect assumption
Incorrect requirements




## Software-Environment Diagram



# Appendix C: To Be Determined List

*<Collect a numbered list of the TBD (to be determined) references that remain in the SRS so they can be tracked to closure.>*