Assignment-2

Monica Gattupalli

National ID: 19991130-T308

1.Forward collision avoidance system:

The system's main goal is to prevent accidents and promote safety when drivers are distracted. When the motorist does not respond to the warning signal, this mechanism is engaged. There are two main functions in this system.

1. Detection: The sensors on the vehicle that can detect any obstacle in front of it.

2. Auto breaks: When drivers disregard the warning, the system automatically activates the auto breaks after a specified length of time to avoid collisions or accidents.

Forward collision avoidance systems make use of sensors, cameras, and radar, among other technologies.

Control Structure Diagram:

Collision controllers, brake controllers, and engine torque controllers are the three types of controllers found throughout the system.

Collision controller: This controller serves as a warning indicator and is linked to the vehicle sensor. It determines the collision rate and sends the warning signal to the vehicle based on the collision probability estimator and the vehicles and object status.

Brake controller: This brake controller operates and regulates the braking pressure and warns the brake system based on the severity of the accident rate.

Engine torque controller operates in conjunction with the braking controller and collision controller. This performs two functions: it works on the engine ignition system or it works on the transmission.

Controlled processes:

The Forward Collision Avoidance System is made up of three separate types of controllers that work together to detect and react to collisions. The collision controller assists in detecting the collision rate based on the front vehicles and sending a warning signal to the vehicles about it, as well as sending information to the brake controller, which calculates the brake pressure based on the data sent by the collision controller and sets the brake system if the driver does not respond to the warning signal. The brake controller calculates the amount of force that must be delivered to the brake in order to avoid an accident and any crashes. When the driver is in a situation like this, responds to the warning signal then engine torque controller reduces the torque. All the algorithms and the sensors and set to initial state when the vehicle is stopped or avoid the collision.

Control Action:

1. The collision controller uses an algorithm to predict the collision rate and delivers a signal to the cars.

2. The collision controller has access to the radars and cameras and monitors the front vehicles.

3. It has access to the sensor, which connects to the regulated mechanism via communication.

4. The engine torque controller is linked to both controllers and interacts with them in order to accelerate the vehicle

5.The engine ignition system and the transmission are linked to engine torque.

6. In a collision situation, the controller calculates brake pressure and sends the result to the actuator, who activates the brake if the driver does not reply.

7. In the event of a system failure, the driver is notified with the collision occurrence.

Feedback:

1. If the driver does not react to the warning signal, the system will automatically react to the collision and apply the brakes to avoid a collision.

2. If the driver responds to the warning signal by braking, all calculations and collision algorithms are reset to their default settings.

Assumptions:

1. Failure indication: we assume that the failure indicator informs the driver about the state of the forward collision avoidance system and also alerts the driver if the system has failed, allowing the driver to restart it to avoid the failure.

2. If the brakes are applied automatically, data is collected to determine the vehicle's ultimate location.

2.Security problems

The vehicle's sensors assist in detecting front-end collisions, sending an indicator to the driver if the driver does not respond to the warning signal, and automatically engaging the brake by estimating the brake pressure when applied, thereby lessening the severity of the accident.

Loss:

There will be two losses.

1. When an accident occurs, a person's life is lost.

2. There will be a significant loss of property, such as cars and other vehicles, as well as damage to the road.

Hazards:

1. If the sensors are not functioning properly, the sensor may collect incorrect data.

2. If the code makes a calculation error, it will automatically calculate the incorrect braking pressure, which could result in a major breakdown.

3. If the warning indication isn't working properly, the driver may or may not receive a warning signal.

4. Due to security concerns, only administrators should have access to vehicle data.

Constraints:

1. Every day / at regular intervals, all sensors should be examined.

2. The data should be collected correctly and consistently by the warning indication.

3. The object detection algorithm must function flawlessly in order to deliver data about the front vehicles to the collision collector.

3.Hazardous Control Actions:

Secure control actions	Not provided	Provided incorrectly	Provided too early /provided too late	Stopped too soon
Tampering of collision probability algorithm signal	Catastrophic: which ultimately results in collision.	Catastrophic: Due to tampering the result may incorrect	Catastrophic: late sense of signal leads to collapse	NA
Fabricated Sensor signal	Catastrophic: Failure in object detection algorithm	Catastrophic: Failure in object detection algorithm	Catastrophic: delays in the functionality	NA
Bogus Information	Negligible	Catastrophic: incorrect data process leads to incorrect decision.	NA	NA

4.Scenarios

<u>Tampering of collision probability algorithm signal:</u>

Tampering has the sense of altering or changing values in response to the environment. The signal's variable is manipulated in this method as a result of changes in the ambient variables. When the collision signal is tampered with, the values are changed, causing the controller to make incorrect judgments, which are then passed on to the brake controller,

which calculates the incorrect brake pressure, resulting in accidents if the driver does not respond to the signal.

When transmitting the signal to the collision controller, the forward collision avoidance system must be cautious about signal tampering. To avoid tampering, firewalls and protocols should cross-check the incoming communication signal. To identify the signal change, FCAS should compare the signal to the existing security algorithmic codes.

Fabrication Sensors signals:

The Forward Collision Avoidance system uses a larger number of sensors to capture precise information from the front vehicles; however, if the information/feedback from the sensors is manipulated, it can result in incorrect or modified signals, which can lead to system failure; this is technical manipulation. Due to environmental changes such as rain, mist on the cameras, fog, and obstruction due to a severe change in climate, the sensors can be modified manually, resulting in sensor failure.

Due to traffic in sensor signals, delaying in signal transmission can occur, resulting in an accident situation. Because of the lag in signal transmission, calculations and warnings may be delayed which causes accidents/crash of the vehicles.

The shortest path must be proposed to the signal to reduce transmission latency, and a time-to-time and point-to-point check must be performed on it to ensure that the signal is not altered or faked. The test must be carried out in such a way that the sensors system is carefully run.

Bogus information:

The term "bogus" refers to something that is not Incorrect information is the leading cause of failure and accidents. When erroneous information is provided to the controller, the algorithms calculate the false data, resulting in accidents and crash situations.
The information saved in the system should only be accessible to the system's administrators.

The security codes and firewalls should be powerful enough to combat foreign viruses and intruder attacks, and the system should be able to survive them.

Data kept in the system should be very secure, and it should be reviewed at regular intervals. Data should be filtered and cross-checked before being submitted to the database. The data should be free of tampering and should not be influenced by any external sources.

5. Personal reflection on STPA-SEC:

The STPA SEC is a security system that may be utilized as a measure of the STPA analysis as an add-on. The fundamental goal of STPA-SEC is to integrate security into every system using a top-down approach, which is one of the most efficient methods.

I think the concept of a forward collision avoidance system is a good one because it minimizes the number of collisions and accidents. However, I discovered some of the intricacy in the systems.

1. There will be a loss of life and property if the sensors do not function properly.

2. If there is a code error in the algorithm, it will do incorrect calculations, resulting in accidents.

3. Some technical issues may make it easier for intruders to take data.

4. The system contains some of the system's risky control behaviors.

In recent years, a forward collision avoidance system has emerged on the market, with a larger potential for growth. The system's concept will benefit a large number of individuals while also reducing accidents. Furthermore, as a crucial safety feature, this system secures the data collected by the numerous sensors. Finally, in today's society, the forward collision avoidance system is extremely beneficial, and offering security may expand the system's use in every car.