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Test Plan, Test Design Specifications and Test Cases

Version 1

CENG 408

Innovative System Design and Development II

AutoCar

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1. INTRODUCTION

1.1 Version Control

Version No	Description of Changes	Date
1.0	First Version	Feb 23, 2020

1.2 Overview

AutoCar System is a Simulated Autonomous Car System.The use case of the system had been determined in SRS document will be tested on the simulation environment.

1.3 Scope

This document encapsulates the test plan of the use cases, test design specifications and the test cases correspond to test plan.

1.4 Terminology

Acronym	Definition
PID	The PID proportional-integral-derivative controller is a control loop method is a commonly used feedback controller method in industrial control systems.
Data Fusion	Data Fusion is the process of integrating multiple data sources to produce more consistent, accurate and useful information than any data source provides.
Emergency Vehicle	The emergency vehicle is any vehicle designed and authorized to respond to the emergency in a life-threatening situation.

2. FEATURES TO BE TESTED

This section lists and gives a brief description of all the major features to be tested. For each major feature there will be a Test Design Specification added at the end of this document.

2.1 Driving State

In the simulation the vehicle must follow the its lane, avoid collisions with the objects on the road and consider traffic rules.

2.2 Emergency Awareness

In this part vehicle need to detect emergency vehicle and change its lane to clear emergency vehicle's path.

2.3 Voice Assistant

In this part system need to take input from user for basic orders as changing lane, speed. It includes display to show system values to user.

3. FEATURES NOT TO BE TESTED

3.1 System accuracy on different cars

Simulation environment does not provide mass data of the car. So, we fixed in 300 kg. Velocity PID works with fixed mass. We won't test on different cars to check difference.

3.2 System accuracy according to weather

Simulation environment does not provide different types of weather (rainy, snowy...).

3.3 Traffic Lights and Path Planning

These parts have lower priority than other cases for us and we have very limited time for this project.

4. ITEM PASS/FAIL CRITERIA

To be able to success on this project our car needs to follow the lane, not hit objects on the road and let the emergency vehicle pass by changing lanes.

4.1 Exit Criteria

- 100% of the test cases are executed
- 99.9% of the test cases passed
- All High and Medium Priority test cases passed

5. REFERENCES

[1] https://github.com/CankayaUniversity/ceng-407-408-2019-2020-Autonomous-Car/wiki/SRS
[2] https://github.com/CankayaUniversity/ceng-407-408-2019-2020-Autonomous-Car/wiki/SDD

6. TEST DESIGN SPECIFICATIONS

6.1 Driving State (DS)

6.1.1 Sub features to be tested

6.1.1.1 Lane Detection and Management (DS.LDM)

System need to detect lane and manage to stay on the center of the lane. And find if there is a one left or one right lane exits.
With processing the image data from front camera.

6.1.1.2 Object Recognition and Tracking (DS.ORT)

System need to recognize objects in its environment and trigger PID system if there is a need.

6.1.1.3 Data Fusion and PID (DS.DFPID)

System need to make data fusion according to data from sensors. And take actions according to result or in voice order case with PID.

6.1.2 Test Cases

TC ID	Require ments	Priority	Scenario Description
DS.LDM.01	3.2.1.7.	H	Take image data from front camera. Process it to find lines.
DS.LDM.02	3.2.1.7.	H	Find center of the lane.
DS.LDM.03	3.2.1.7.	H	Decide line directions and find if next lanes on the sides are exists.

TC ID	Require ments	Priority	Scenario Description
DS.ORT.01	3.2.1.5.	H	Take image data from both front and back cameras. Process it to find objects and return relative positions of near objects to DS.DFPID.03.

TC ID	Require ments	Priority	Scenario Description
DS.DFPID.01	3.2.1.8.	H	Take current velocity data and update it according to result from DS.ORT.01 with PID control.
DS.DFPID.02	3.2.1.7.	H	Take GPS data and lane data from DS.LDM.02 to follow current lane.
DS.DFPID.03	3.2.1.6.	H	Take sensors data from (radar, lidar.. and DS.ORT.01) and side lane data from DS.LDM.03 to take necessarily actions (lane changing, increase brake intensity...)

6.1 Emergency Awareness (EA)

6.1.1 Sub features to be tested

6.1.1.1 Recognize Emergency Vehicle's Siren (EA.REVS)

System need to recognize emergency vehicle's siren and check position of the vehicle DS.ORT.01.
If vehicle's position is in the same lane with the car it needs to change lane.

6.1.2 Test Cases

TC ID	Requirements	Priority	Scenario Description
EA.REVS.01	3.2.1.9.	H	Recognize emergency siren.
EA.REVS.02	3.2.1.9.	H	Take data from DS.ORT.01 to check position of the emergency vehicle and if vehicle's position is in the same lane with the car trigger DS.DFPID.03 to change lane.

6.2 Voice Assistant

6.2.1 Sub features to be tested

6.2.1.1 Activate Voice Assistant (AVA)

After the system starts, the voice assistant is starts with the system. With the trigger sentence, user activates the voice assistant.

6.2.1.2 Speech Recognition and Respond (SRR)

The desired command will be received by voice and will be convert into text with API. After this command is confirmed, the process starts. System values vary according to this process on the screen.

6.2.2 Test Cases

TC ID	Requirements	Priority	Scenario Description
VA.AVA. 01	3.1	H	Actuate the voice assistant starting with the system with the trigger phrase(“Hi car”ex.).
VA.AVA. 02	3.1	H	System values will continue to appear even if the user does not command.

TC ID	Requirements	Priority	Scenario Description
VA.SRR. 01	3.2.1	H	It translates the "Change lane to right" or "Change lane to left" command, which the user says verbally, into text and makes the system understand.
VA.SRR. 02	3.2.2	M	It translates the “Increase vehicle speed" command, which the user says verbally, into text and makes the system understand.
VA.SRR.03	3.2.3	M	It translates the “Decrease vehicle speed" command, which the user says verbally, into text and makes the system understand.

7. Detailed Test Cases

7.1 DS.LDM.01

TC_ID	DS.LDM.01
Purpose	Process image data from front camera to find lines.
Requirements	3.2.1.7
Priority	High.
Estimated Time Needed	1 sec
Dependency	Simulation should be started. Camera device must be exist on the car.
Setup	Camera must be working.
Procedure	[A01] Get image data from camera device.
	[A02] Process data to find lines
	[A03] Reduce lines.
	[V01] Observe that lines founded successfully
Cleanup	New image data input

7.2 DS.LDM.02

TC_ID	DS.LDM.02
Purpose	Find center of the lane.
Requirements	3.2.1.7
Priority	High.
Estimated Time Needed	1 sec
Dependency	DS.LDM.01 need to work correctly.
Setup	Simulation should be started. Camera device must be exist on the car.
Procedure	[A01] Get line data from DS.LDM.01.
	[A03] Find center of the lane.
	[A04] Draw lines on display screen.
	[V01] Observe that lines displayed on the screen correctly.
Cleanup	New lane data input

7.3 DS.LDM.03

TC_ID	DS.LDM.03
Purpose	Decide line directions and find if next lanes on the sides are exists.
Requirements	3.2.1.7
Priority	High.
Estimated Time Needed	1 sec
Dependency	DS.LDM.01 need to work correctly.
Setup	Simulation should be started. Camera device must be exist on the car.
Procedure	[A01] Get line data from DS.LDM.01.
	[A02] Decide line directions
	[A03] Find if side lane exists.
	[V01] Observe that existed side lanes has been found successfully.
Cleanup	New lane data input

7.4 DS.ORT.01

TC_ID	DS.ORT.01
Purpose	Process image data to find objects and return relative positions of near objects to DS.DFPID.03.
Requirements	3.2.1.5.
Priority	High.
Estimated Time Needed	1 sec
Dependency	Camera device must be exist on the car.
Setup	Camera must be working.
Procedure	[A01] Get image data from the cameras.
	[A02] Find objects.
	[A03] Set flag if emergency vehicle exists on the road
	[V01] Observe that relative positions of near objects to returned to DS.DFPID.03 and flag has been set on the existence of emergency car.
Cleanup	New image data input

7.5 DS.DFPID.01

TC_ID	DS.DFPID.01
Purpose	PID control for velocity.
Requirements	3.2.1.8.
Priority	High.
Estimated Time Needed	1 sec
Dependency	Necessarily devices must be exists on the car.
Setup	Simulation should be started.
Procedure	[A01] Get current velocity of the car.
	[A02] Apply PID on the velocity data.
	[V01] Observe that the updated velocity has been successfully set.
Cleanup	New velocity data input

7.6 DS.DFPID.02

TC_ID	DS.DFPID.02
Purpose	PID control for position.
Requirements	3.2.1.7.
Priority	High.
Estimated Time Needed	1 sec
Dependency	Necessarily devices must be exists on the car.
Setup	Simulation should be started.
Procedure	[A01] Get current position of the car from GPS.
	[A02] Apply PID on the position data.
	[V01] Observe that the updated steering angle has been successfully set.
Cleanup	New position data input

7.7 DS.DFPID.03

TC_ID	DS.DFPID.03
Purpose	Data Fusion.
Requirements	3.2.1.6.
Priority	High.
Estimated Time Needed	1 sec
Dependency	Necessarily devices must be exists on the car.
Setup	Simulation should be started.
Procedure	[A01] Get sensor data.
	[A02] Process data.
	[V01] Observe that data processed successfully and PID controllers triggered in the necessarily situations.
Cleanup	New data input

7.8 EA.REVS.01

TC_ID	EA.REVS.01
Purpose	Recognize emergency siren.
Requirements	3.2.1.9.
Priority	High.
Estimated Time Needed	1 sec
Dependency	Sound sensor device must be exist on the car.
Setup	Simulation should be started.
Procedure	[A01] Get sound data from environment with sensor.
	[A02] Process it.
	[V01] Observe that emergency siren has been successful recognized.
Cleanup	New sound data input

7.9 EA.REVS.02

TC_ID	EA.REVS.02
Purpose	Trigger DS.DFPID.03 to change lane.
Requirements	3.2.1.9.
Priority	High.
Estimated Time Needed	1 sec
Dependency	EA.REVS.01 recognizes siren.
Setup	Simulation should be started.
Procedure	[A01] Check positions of the cars.
	[V01] Observe that system trigger DS.DFPID.03 to change lane.
Cleanup	New sound data input

7.10 VA.AVA.01

TC_ID	VA.AVA.01
Purpose	To activate the voice assistant with the trigger sentence.
Requirements	3.1
Priority	High.
Estimated Time Needed	5 sec
Dependency	Necessarily devices must be exists on the car.
Setup	Simulation should be started.
Procedure	[A01] Say the trigger sentence.
	[V02] Voice Assistant will be displayed on the screen.
Cleanup	-

7.1 VA.AVA.02

TC_ID	VA.AVA.02
Purpose	Voice assistant waits for a command.
Requirements	3.1
Priority	High.
Estimated Time Needed	-
Dependency	Necessarily devices must be exists on the car.
Setup	Simulation should be started.
Procedure	[A01] Say the trigger sentence.
	[V02] Observe the voice assistant.
Cleanup	New command input

7.2 VA.SRR.01

TC_ID	VA.SRR.01
Purpose	Change the lane of the vehicle.
Requirements	3.2.1
Priority	High
Estimated Time Needed	5 sec
Dependency	VA.AVA.01 and VA.AVA.02 must work successfully
Setup	The system should find the algorithm of the desired command.
Procedure	[A01] Say the trigger sentence. (“hi car”)
	[V01] Observe the voice assistant.
	[A02] Say the “Go to the right lane” or “Go to the left lane”
	[V02] The assistant takes the verbal command and translates it into writing with API.
	[V03] Trigger necessary functions in the system.
Cleanup	-

7.3 VA.SRR.02

TC_ID	VA.SRR.02
Purpose	Change the speed of the vehicle.
Requirements	3.2.2
Priority	Medium
Estimated Time Needed	5 sec
Dependency	VA.AVA.01 and VA.AVA.02 must work successfully
Setup	The system should find the algorithm of the desired command.
Procedure	[A01] Say the trigger sentence. (“hi car”)
	[V01] Observe the voice assistant.
	[A02] Say the “Increase vehicle’s speed”
	[V02] The assistant takes the verbal command and translates it into writing with API.
	[V03] Trigger necessary functions in the system.
Cleanup	-

7.4 VA.SRR.03

TC_ID	VA.SRR.03
Purpose	Change the speed of the vehicle.
Requirements	3.2.3
Priority	Medium
Estimated Time Needed	5 sec
Dependency	User must pass Speech to Text test scenarios.
Setup	The system should find the algorithm of the desired command.
Procedure	[A01] Say the trigger sentence. (“hi car”)
	[V01] Observe the voice assistant.
	[A02] Say the “Decrease vehicle’s speed”
	[V02] The assistant takes the verbal command and translates it into writing with API.
	[V03] Trigger necessary functions in the system.
Cleanup	-