# ÇANKAYA UNIVERSITY
# FACULTY OF ENGINEERING
# COMPUTER ENGINEERING DEPARTMENT


# Test Plan, Test Design Specifications and Test Cases
### Version 1


# CENG 408
Innovative System Design and Development II


# Drowsy Driver Detection System

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# 1. INTRODUCTION

## 1.1 Version Control

| Version No | Description of Changes | Date |
|---|---|---|
| 1.0 | First Version | March 25, 2023 |

## 1.2 Overview

Drowsy Driver Detection System is a machine learning based application to detect drowsiness of driver. The use case of the system had been explained in the SRSdocument. The system will be tested according to these features in different environments.

## 1.3 Scope

This document includes the test plan of the use cases, test cases according to the test plan, and test design specifications. Therefore, the following sections will explain how we will implement test cases and what will be the test criteria.

## 1.4 Terminology

| Acronym | Definition |
|---|---|
| SRS | Software System Requirements |
| SDD | Software Design Document |
| GUI | Graphical User Interface |
| Web Application | A software which is coded by team members, and it includes different modes and features of the system. |

# 2.  FEATURES TO BE TESTED

In this section, we will explain our test plan and provide general information regarding the features to be tested. Additionally, for each feature, there will be a Test Design Specification given at the end of this document.

## 2.1  Detecting Face, Eyes and Mouth

Drowsy Driver Detection System has a camera which can detect face, eyes, mouth and send the real time video to our web application. Therefore, users are capable of observing external threats around that environment.

## 2.2  Classification with ML Model

Drowsy Driver Detection System can make classification via Machine Learning model. For that purpose, the system uses the outputs thatare received from its camera by being frame.

## 2.3  Alert System

Drowsy Driver Detection System can be operated via our web application. For that purpose, the system has a Bluetooth module to transmit videos to our app from camera.

## 2.4  Creating New Datasets with GANs

Drowsy Driver Detection System has a different module from another project. It creates new datasets not taken from articles, and they can be used to improve accuracy and similar metrics of ML model.

# 3.  FEATURES NOT TO BE TESTED

In this section, we described features which we will not be tested.

## 3.1  Performance on different environments

Our app can be used when the environmental factors are regular. Therefore, we will not test Drowsy Driver Detection System under such circumstances.

# 4.  ITEM PASS/FAIL CRITERIA

To be able to get success on this project, our app should detect drowsiness with high accuracy, and warn the user when drowsiness is detected. If any of the features are described in Section 2, we will consider the test as failed.

## 4.1  Exit Criteria

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

# 5.  REFERENCES

[1] CENG408_Group7_SRS,        March        25,        2022.        Available:
    https://github.com/CankayaUniversity/ceng-407-408-2022-2023-Drowsy-Driver-
    Detection-System/wiki/Software-Requirements-Specification

[2] CENG408_Group1_SDD,        March        25,        2022.        Available:
    https://github.com/CankayaUniversity/ceng-407-408-2022-2023-Drowsy-Driver-
    Detection-System/wiki/SDD

# 6. TEST DESIGN SPECIFICATIONS

## 6.1 Detecting Face, Eyes and Mouth (DFEM)

### 6.1.1 Sub features to be tested.

#### 6.1.1.1 Camera and Web Application Connection (DFEM.CWAC)

To be able to display detected face, eyes and mouth on the screen, the Camera and Web Application must be connected. After the connection is handled, we receive a real time video from camera on the screen. At this step, system is ready for detection procedure. In addition, to receive data from the camera, the user must first log into the system.

#### 6.1.1.2 Database Connection (DFEM.DC)

To use the application, the driver does not need to log in after turning on the system first. Therefore, it should be tested whether it has a connection with the database.

#### 6.1.1.3 Login Web Application (DFEM.LWA)

To use the application, the driver does not need to log in after turning on the system first. If it is not registered in the system, it must be registered in the system. Afterwards, the system will be directed to the camera system as the application screen.

#### 6.1.1.4 Capturing Real-time Video (DFEM.CRTV)

To receive the video, you must first login to the system. Afterwards, communication with the camera should be established and after this process, the web application will display the video on the screen.

#### 6.1.1.5 Capturing Frame and Detect Facial (DFEM.CFDF)

After the video is obtained, this video needs to be split into frames. It is necessary to detect the face, eyes, and mouth from the obtained frames.

## 6.1.2 Test Cases

In this section, we listed related test cases for feature Detecting Objects (DO).

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| DFEM.CWAC.01 | 3.2.1.2.2 | High | Connection with camera configuration is set. |
| DFEM.CWAC.02 | 3.2.1.2.2 | High | Camera is detected by bluetooth. |

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| DFEM.DC.01 | 3.2.1.2.1 | High | The database connection must be checked during the user's login or registration. |
| DFEM.DC.02 | 3.2.1.2.1 | High | If the connection is correct, the operations should be continued. |

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| DFEM.LWA.01 | 3.2.1.2.1 | High | Press "Login" or "Register" button on Web Application. |
| DFEM.LWA.02 | 3.2.1.2.1 | High | User will give information of their self and login the system. |

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| DFEM.CRTV.01 | 3.2.1.2.2 | High | Press "Start" button on Web Application. |
| DFEM.CRTV.02 | 3.2.1.2.2.2 | High | Receive real time video from camera. |

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| DFEM.CFDF.01 | 3.2.1.2.2.1 | High | Converting Real-time video as frames |
| DFEM.CFDF.02 | 3.2.1.2.2.(3-4-5) | High | Detecting Face, Eyes and Mouth from frames |

## 6.2   Classification with ML Model (CM)

### 6.2.1 Subfeatures to be tested

### 6.2.1.1   Training Machine Learning Model (CM.TMLM)

The model developed with the available datasets should be trained. Afterwards, accuracy and similar metrics should be checked by testing, and they should be trained again with a different model according to the results.

### 6.2.1.2   Detecting Status of Frames (CM.DSF)

The model obtained should be presented to the web application, and the application should detect the eye and mouth conditions of the driver in the frames obtained from the video obtained in real-time using this model.

### 6.2.2 Test Cases

In this section, we listed related test cases for feature Classification Module.

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| CM.TMLM.01 | 3.2.1.2.2.8 | High | The model should be developed and trained with the obtained datasets. The test results should be examined through different metrics in the developed model. A good model should be obtained by comparing the results. |

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| CM.DSF.01 | 3.2.1.2.2.8 | High | The resulting model should be applied separately for each frame. According to the results, the system should be redirected to the other system to calculate the results. |

## 6.3   Alert System (AS)

### 6.3.1      Subfeatures to be tested

### 6.3.1.1.      Calculation of Status of Driver via Detection Result (AS.CSDR)

If drowsiness is detected according to the results obtained after the model is applied, the alarm should be activated, and the user should be warned. For this, the amount of yawning and the time the eyes are closed are the basic metrics.

### 6.3.1.2.      Reporting Message and Display Alert (AS.RMDA)

When Drowsy Driver Detection System detects drowsiness while driving, it transmits a reporting

message to the screen of web application. This reporting message is displayed on the web application screen with error mesagge.

### 6.3.2 Test Cases

In this section, we listed related test cases for feature Alert System (AS).

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| AS.CSDR.01 | 3.2.1.2.2.8 | High | The model result should be transmitted to the system, the amount of stretching and the duration of the eyes closed should be calculated continuously. |
| AS.CSDR.02 | 3.2.1.2.2.8 | High | The alarm should be activated after the amount of yawning and the duration of the eyes closed exceed a certain threshold. The alarm should continue for a certain period of time and the user should be awakened. |

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| AS.RMDA.01 | 3.2.1.2.2.7 | High | A error message is sent to the web app. The web application displays warning messages and alert. |

## 6.4   Creating New Datasets with GANs (CND)

### 6.4.1 Subfeatures to be tested.

#### 6.4.1.1   Testing GANs Model (CND.TGANM)
After training the model, it should be tested with different data and whether it can easily produce the datasets required for the application.

### 6.4.2 Test Cases

In this section, we listed related test cases for feature Creating New Datasets with GANs (CND).

| TC ID | Requirements | Priority | Scenario Description |
|---|---|---|---|
| CND.TGANM.01 | 3.2.1.2.2 | High | After the model is trained, datasets must be generated and tested. These datasets should be used in the system according to their suitability. |

# 1. Detailed Test Cases

## 1.1 DFEM.CWAC.01

| TC_ID | DFEM.CWAC.01 |
|---|---|
| **Purpose** | Make Camera visible by for connection process. |
| **Requirements** | 3.2.1.2.2 |
| **Priority** | High. |
| **Estimated Time Needed** | 20 seconds |
| **Dependency** | There must be Internet connection. |
| **Setup** | A computer and web app must be provided. |
| **Procedure** | [A01] Connect computer to the Internet. |
| | [A02] Open Network settings from computer. |
| | [A03] Press Bluetooth section. |
| **Cleanup** | Close Internet connection. |

## 1.2 DFEM.CWAC.02

| TC_ID | DFEM.CWAC.02 |
|---|---|
| **Purpose** | Make Camera ready to stream. |
| **Requirements** | 3.2.1.2.2 |
| **Priority** | High. |
| **Estimated Time Needed** | 10 seconds |
| **Dependency** | DFEM.CWAC.01 needs to work correctly. |
| **Setup** | Computer must be working. |
| **Procedure** | [A01] Power up the Camera. |
| | [A02] Power on the Bluetooth with configured settings. |
| | [A03] Open devices connected section. |
| | [V01] Observe Camera in the device list. |
| **Cleanup** | Disconnect power of Camera. |

## 1.3 DFEM.DC.01

| TC_ID | DFEM.DC.01 |
|---|---|
| **Purpose** | Make Web application database ready for receiving driver data. |
| **Requirements** | 3.2.1.2.1 |
| **Priority** | High. |
| **Estimated Time Needed** | 20 seconds |
| **Dependency** | DFEM.CWAC.01-02 need to work correctly. |
| **Setup** | Web app must be provided. |
| **Procedure** | [A01] Connect to the web app. |
| | [A02] Open Register Page |
| | [A03] Give Information of Driver and Satisfied |
| | [A04] Go Login Page |
| | [V01] Observe Database is working properly or not. |
| **Cleanup** | Close the web application. |

## 1.4 DFEM.DC.02

| TC_ID | DFEM.DC.01 |
|---|---|
| **Purpose** | Make Web application database ready for logging. |
| **Requirements** | 3.2.1.2.1 |
| **Priority** | High. |
| **Estimated Time Needed** | 20 seconds |
| **Dependency** | DFEM.CWAC.01-02 and DFEM.DC.01 need to work correctly. |
| **Setup** | Web app must be provided. |
| **Procedure** | [A01] Connect to the web app. |
| | [A02] Go to MongoDB Page |
| | [A03] Give Information |
| | [A04] Control Information registered is in the database. |
| **Cleanup** | Close the database connection. |

## 1.5 DFEM.LWA.01

| TC_ID | DFEM.LWA.01 |
|---|---|
| **Purpose** | Make Driver register in the system. |
| **Requirements** | 3.2.1.2.1 |
| **Priority** | High. |
| **Estimated Time Needed** | 15 seconds |
| **Dependency** | DFEM.CWAC.01-02, and DFEM.DC.01-02 need to work correctly. |
| **Setup** | Web app must be provided. |
| **Procedure** | [A01] Connect to the web app. |
| | [A02] Open Register Page |
| | [A03] Give Information |
| | [A04] Go Login Page |
| **Cleanup** | Close the web application. |

## 1.6  DFEM.LWA.02

| TC_ID | DFEM.LWA.01 |
|---|---|
| **Purpose** | Make Driver login in the system. |
| **Requirements** | 3.2.1.2.1 |
| **Priority** | High. |
| **Estimated Time Needed** | 10 seconds |
| **Dependency** | DFEM.CWAC.01-02, and DFEM.DC.01-02 need to work correctly. |
| **Setup** | Web app must be provided. |
| **Procedure** | [A01] Connect to the web app. |
| | [A02] Go Login Page |
| | [A03] Give Information and Press Login Button |
| | [V01] Observe Camera System Page |
| **Cleanup** | Close the web application. |

## 1.7  DFEM.CRTV.01

| TC_ID | DFEM.CRTV.01 |
|---|---|
| **Purpose** | Going to web page for observing real time video stream from camera. |
| **Requirements** | 3.2.1.2.2 |
| **Priority** | High. |
| **Estimated Time Needed** | 10 seconds |
| **Dependency** | DFEM.CWAC.01-02, and DO.CAAC.02 need to work correctly. |
| **Setup** | Android app must be provided. |
| **Procedure** | [A01] Stream is receiving from camera. |
| | [A02] START button is pressed. |
| | [V01] Going to Real-time Video Screen |
| **Cleanup** | Close web app to block display of stream. |

## 1.8  DFEM.CRTV.02

| TC_ID | DFEM.CRTV.02 |
|---|---|
| **Purpose** | Make Web application ready for observing real time video stream from camera. |
| **Requirements** | 3.2.1.2.2.2 |
| **Priority** | High. |
| **Estimated Time Needed** | 10 seconds |
| **Dependency** | DFEM.CRTV.01 needs to work correctly. |
| **Setup** | All the set up in DFEM.DC and DFEM.LWA must be provided. |
| **Procedure** | [A01] Stream is receiving from camera in Real-time video screen. |
| | [V01] Observe the stream on the computer's screen. |
| **Cleanup** | Close the application. |

## 1.9  DFEM.CFDF.01

| TC_ID | DFEM.CFDF.01 |
|---|---|
| **Purpose** | Convert Real-time video stream to frames |
| **Requirements** | 3.2.1.2.1 |
| **Priority** | High. |
| **Estimated Time Needed** | Not estimated. |
| **Dependency** | DFEM.CRTV.01-02 need to work correctly. |
| **Setup** | All the set up in DFEM.DC and DFEM.LWA must be provided. |
| **Procedure** | [A01] Get Real-time video from DFEM-CRTV part. |
| | [A02] Apply Algorithms to get frames |
| | [A03] Store frames in system. |
| **Cleanup** | Close the real-time video page to return main page. |

## 1.10 DFEM.CFDF.02

| TC_ID | DFEM.CFDF.02 |
|---|---|
| **Purpose** | Detecting face, eyes, and mouth from frames |
| **Requirements** | 3.2.1.2.2.(3-4-5) |
| **Priority** | High. |
| **Estimated Time Needed** | Not estimated. |
| **Dependency** | DFEM.CRTV.01-02 and DFEM.CFDF.01 need to work correctly. |
| **Setup** | All the set up in DFEM.DC and DFEM.LWA must be provided. |
| **Procedure** | [A01] System starts to detect face, eyes and mouth from every frames. |
| | [A02] Get all frames one by one |
| | [A03] Detection algorithm is run for every frames |
| | [V01] Observe detected frames. |
| **Cleanup** | Close the real-time video page to return main page. |

## 1.11 CM.TMLM.01

| TC_ID | CM.TMLM.01 |
|---|---|
| **Purpose** | To test training of model in the system to detect drowsiness |
| **Requirements** | 3.2.1.2.2.8 |
| **Priority** | High. |
| **Estimated Time Needed** | 10-15 minutes |
| **Dependency** | - |
| **Setup** | - |
| **Procedure** | [A01] Datasets are taken. |
| | [A02] Apply ML model. |
| | [A03] Specify categories or labels |
| | [A03] Test the model via metrics |
| | [V01] Observe the detection machine learning model. |
| **Cleanup** | Press STOP button again to stop training. |

## 1.12 CM.DSF.01

| TC_ID | CM.DSF.01 |
|---|---|
| Purpose | To apply ML model to detect drowsiness of driver |
| Requirements | 3.2.1.2.2.8 |
| Priority | High. |
| Estimated Time Needed | 10 seconds |
| Dependency | DFEM.CFDF.01-02 and CM.TMLM.01 need to work correctly. |
| Setup | All the set up in CM.TMLM.01 must be provided. |
| Procedure | [A01] Get frames from system. |
|  | [A02] Apply ML model. |
|  | [A03] Detect the status of driver. |
|  | [A04] Direct system to calculate time of closing eye and yawning number. |
|  | [V01] Observe status of frames. |
| Cleanup | Disconnect camera system of Bluetooth module or close the application. |

## 1.13 AS.CSDR.01

| TC_ID | AS.CSDR.01 |
|---|---|
| Purpose | To apply ML model to detect eyes are open or not and yawn, no yawn |
| Requirements | 3.2.1.2.2.8 |
| Priority | High. |
| Estimated Time Needed | 10 seconds |
| Dependency | DFEM.CFDF.01-02 and CM.TMLM.01 need to work correctly. |
| Setup | All the set up in CM.TMLM.01 must be provided. |
| Procedure | [A01] Get frames from system |
|  | [A02] Apply ML model |
|  | [A03] Detect the status of driver |
|  | [A04] Direct results to the detection system to decide status of driver. |
|  | [V01] Observe status of eyes, mouth |
| Cleanup | Disconnect camera system of Bluetooth module or close the application. |

## 1.14 AS.CSDR.02

| TC_ID | AS.CSDR.02 |
|---|---|
| Purpose | To clarify driver is drowsy or not, while calculating eyes closing time and number of yawning |
| Requirements | 3.2.1.2.2.8 |
| Priority | High. |
| Estimated Time Needed | 10 seconds |
| Dependency | DFEM.CFDF.01-02 and CM.TMLM.01 need to work correctly. |
| Setup | All the set up in AS.CSDR.01 must be provided. |

| Procedure | [A01] Get categories of frames from AS.CADR.01 module |
|-----------|-------------------------------------------------------|
|           | [A02] Calculate time of eyes closing |
|           | [A03] Calculate number of yawning |
|           | [A04] If drowsiness, direct decision system to alert system |
|           | [V01] Observe status of driver (drowsy or not) |
| Cleanup | Disconnect camera system of Bluetooth module or close the application. |

## 1.15 AS.RMDA.01

| TC_ID | AS.RM.01 |
|-------|----------|
| Purpose | To create error message and alert according to status of driver |
| Requirements | 3.2.1.2.2.7 |
| Priority | High. |
| Estimated Time Needed | 10 seconds |
| Dependency | AS.CSDR.01 needs to work correctly. |
| Setup | All the set up in AS.CSDR.02 must be provided. |
| Procedure | [A01] After observing status of driver, create error message. |
|           | [A02] Create alert and display error message. |
|           | [A03] Put text on web app's screen. |
|           | [V01] Observe alert and error mesagge |
| Cleanup | Disconnect the camera supply or close the application. |

## 1.16 AD.TGANM.01

| TC_ID | AD.TGANM.01 |
|-------|-------------|
| Purpose | To test GANs model to create new datasets and improve accuracy and metrics. |
| Requirements | 3.2.1.2.2 |
| Priority | High. |
| Estimated Time Needed | 20 minutes |
| Dependency | - |
| Setup | GANs model is created. |
| Procedure | [A01] Get GANs model and apply to datasets |
|           | [A02] Test result to get higher accuracy and frames for app. |
|           | [V01] Observe new datasets, including frames (based on eyes, mouth) |
| Cleanup | Stop the testing GANs model. |

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# 1. Test Results

Test implementations are not yet complete.