2016

Smart Driver Assistant

Software Requirements Specifications

SEYMUR MAMMADLI
SHKELQIM MEMOLLA
NAIL IBRAHIMLI
MEHMET KURHAN

MIDDLE EAST TECHNICAL UNIVERSITY | Department Of Computer Engineering

Preface

This document contains the software design description for Smart Driver Assistant project. It is prepared in accordance with “ISO-IEC-IEEE 29148-2011 Systems and software engineering — Life cycle processes — Requirements engineering”

All the details which will be needed for building Smart Driver Assistant software project will be provided. Throughout this document use case models, class diagrams, sequence diagrams, object behavior models will be represented including other supporting design information.

During the first section, reader will be informed about the purpose and the scope of this project. Reader will be provided with perspective of this project.

In the second section a more detailed information will be given about the description of this project, the product perspective, product functions, user characteristics, constraints, dependencies and assumptions.

While in the third section, specific and concrete requirements will be shown including external interfaces, functional and non-functional requirements. Reader will be acknowledged with some definitions, abbreviations and acronyms which are used in this document.

Table of Contents

List of Tables and Figures

1. Introduction

This System Requirements Specification aims to mark out and show the design and architecture of Smart Driver Assistant from different aspects. It describes how the system is structured in order to supply the demands mentioned in this document. It is intended to give a hand to the reader to understand the implementation phase.

The main audience for this document is the design and the development team of the Smart Driver Assistant project which is called TETRIS team. Development, testing, and design are all done by the same team.

1.1 Scope

As the phone is used almost by everyone, but no one has a tendency to use it as a tool to save their own lives or the other's lives. So why not take more benefits from scope of features of the phones and extend it for our own welfare. Our project is aimed to be used by everyone who owns an Android phone. Furthermore our application will perform users' command requests, i.e texting or calling. In terms of advantages we can say that the driver will not need to buy anything in order to use this application.

The purpose of this project it to reduce the number of car accidents caused by drivers only because of their phone usage and the cases when they are sleeping. When the phone is used while driving, the driver's concentration is highly diminished, thus it creates a gap for making an error. In other cases when the driver has been driving for hours or is waked up early for job, it creates again a gap for making an error. This error could cause his/her death as well as other people who are driving or passing by. So we aim to take that phone and make it look like a special device which will serve as a guard of the driver and give the driver the opportunity to be fully focused and have a high probability of avoiding any accidents. Moreover crash detection algorithm will be implemented to make emergency calls in case of car accident. The only way of 'communication' between the driver and his/her phone will be his/her voice and the application's voice.

1.2 Overall Description

In this section of SRS document, general description of the factors which influences the system and its requirement is involved. It supplies with diagrams and models which gives a view of how the system is going to behave, respond and interact with the customer.

1.2.1 Product Perspective

This project is based on voice command feature and image recognition feature of Android operating system. That means it will be an Android application. The drivers mostly use their hands to call somebody or text them. Our application will set the drivers hands free. They will use only their voice to perform these operations i.e. call or text. Another very important feature will be that the phone itself might be placed near the corner of the window or in front of the driver in order to check whether if he/she might be sleeping. If it will be the case so, then the phone will interact with a driver, to wake him/her up. The type of interaction might be an alarm with vibration or a customized message set by the driver itself with maximum volume enabled.

In case of accident or crash detection our product will ask for feedback from driver in case of negative feedback or no feedback emergency call will be made by our product.

This application will execute the commands according to the user request. The following commands will be implemented:

- Call
- Send a message
- Read out a message
- Read out incoming notifications
- Activate safeguard mode

The application itself will interact with the driver for checking his/her conditions of sleeping. It will use the latest and most used messaging applications which are currently on the market, such as Facebook. But it will use also the GSM feature of mobile phones to perform the requests defined above. By GSM features we mean that the commands which are already mentioned, will make use of native call application and messenger application installed on the phone which uses SIM card features.

The overall architecture is shown in Figure 1:

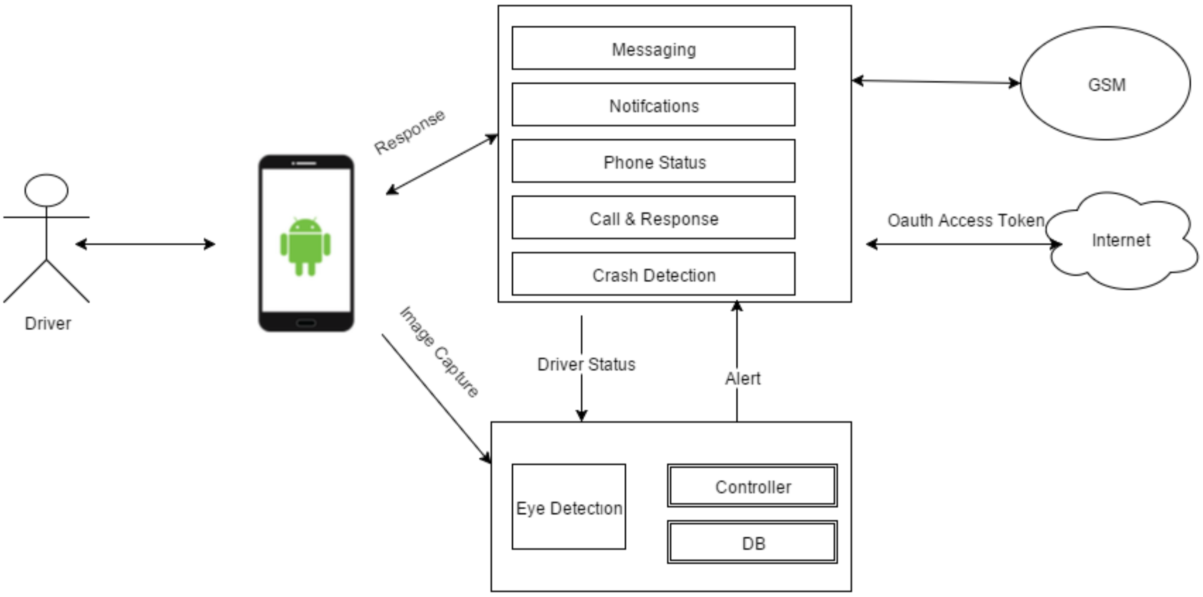


Figure 1: System Architecture Diagram

1.2.2 Product Functions

Drivers will be the main users and targets of Smart Driver Assistant project.

Driver will interact with phone using voice commands. Driver will be supplied with the following functionalities without any requirement for physical contact:

- Driver will be able to send the messages through GSM or Internet and will be able to ask to read received messages using Text-To-Speech.

- Driver must be informed about incoming notifications. This notification can be an incoming message from social media.

- Driver must be informed about Phone Status. Application must give information about current battery level and warn the driver to plug the phone to charge.

- Driver will be able to receive incoming call and perform an outgoing call.

- Driver must be alerted or warned when systems detect that he/she is sleeping using Eye Detection algorithm.

- Driver must be able to ask for emergency call when Car crash detected.

1.2.3 User Characteristics

Software team needs to provide a simple and user friendly interface that is easy to cope with.

A midlevel phone user must comprehend the system just with reading simple instruction manual about command list. Command list should not be very complex. An average user should easily understand and memorize commands. A user with small speaking flaws must be tolerated by the system.

1.2.4 Limitations

Since our product will be used lots of services like camera, Speech-To-Text and Text-To-Speech it will consume large amount of power. So in long distances phones must be kept plugged in.

Our product will not be able to perform well in very noisy places. Because of mixed sounds will be hard to process. But it will tolerate the car's own noise.

Performance of driver drowsiness detection will be highly diminished in complete dark places. So our product must not be used in complete dark environment for this purpose.

2. References

[1] ISO-IEC-IEEE 29148-2011, Systems and software engineering — Life cycle processes — Requirements engineering

[2] IEEE STD 830-1998, IEEE Recommended Practice for Software Requirements Specifications

3. Specific Requirements

3.1 Product Perspective Requirements

3.1.1 User Interfaces

There will be four user interfaces:

- Main user interface
- “How to” user interface
- Preferences screen
- “About us” screen

Main user interface: This will be main and most qualified interface. This interface provides user triggering voice commands, notification and eye detection. In other words, voice commands, notifications and eye detection can be turned on and off using this interface.
With the action bar control, user will be able to switch between other UI screens.

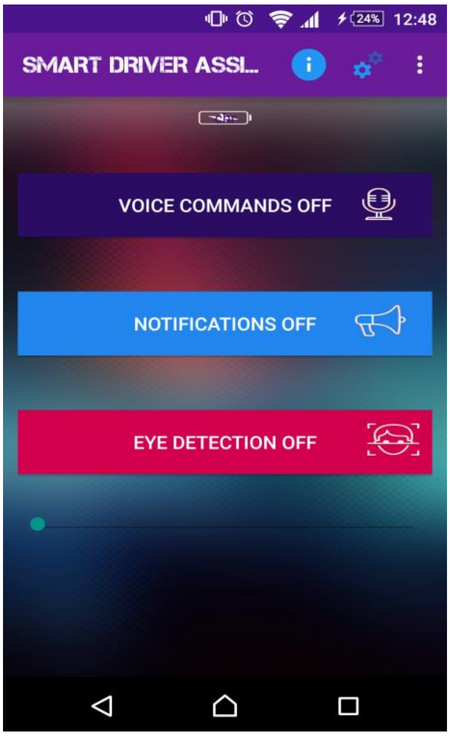
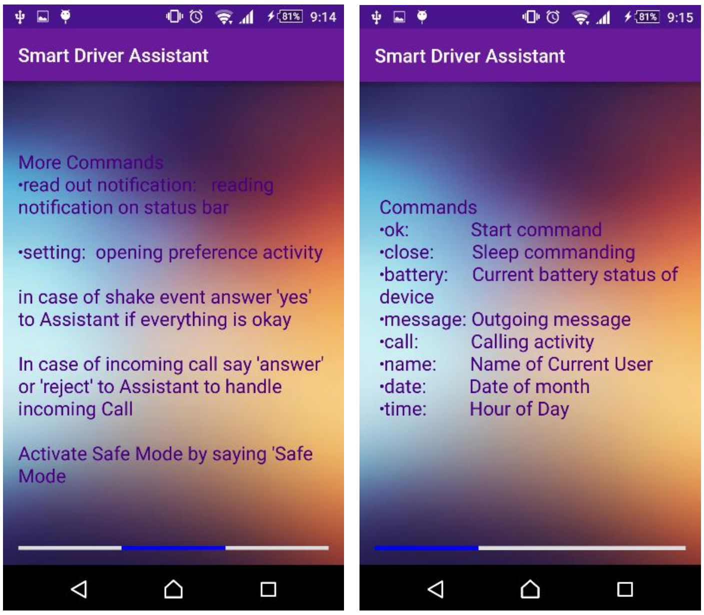


Figure 2: Main User Interface

How to User Interface: This interface will provide the user with the information about how to use the application. It includes performable commands that will be processed by voice control.



Smart Driver Assistant

More Commands
•read out notification: reading notification on status bar

•setting: opening preference activity

in case of shake event answer 'yes' to Assistant if everything is okay

In case of incoming call say 'answer' or 'reject' to Assistant to handle incoming Call

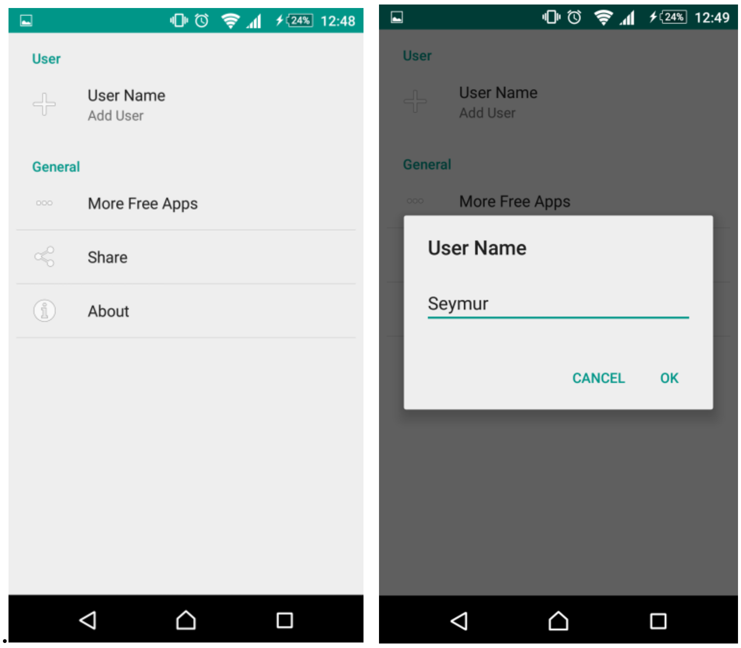
Activate Safe Mode by saying 'Safe Mode

Smart Driver Assistant

Commands
•ok: Start command
•close: Sleep commanding
•battery: Current battery status of device
•message: Outgoing message
•call: Calling activity
•name: Name of Current User
•date: Date of month
•time: Hour of Day

Figure 3: “How to” screen

Preferences screen: In preferences screen, user can enter some private and personal information about him/herself like user name, emergency call number etc.



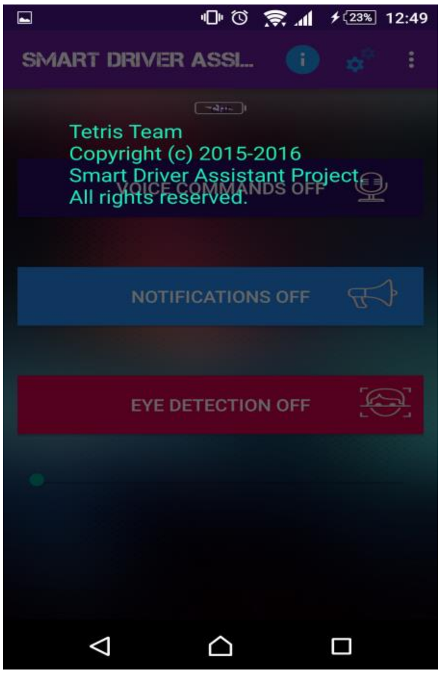
User
User Name
Add User
General
More Free Apps
Share
About

User
User Name
Add User
General
More Free Apps

User Name
Seymur
CANCEL OK

Figure 4: Preferences screen

“About us” screen: This screen gives brief information about the product and the developer team.



Tetris Team
Copyright (c) 2015-2016
Smart Driver Assistant Project
All rights reserved.

Figure 5:“About us” screen

3.1.2 Software Interfaces

The System will provide interface for Facebook, and Android API’s intertwined. TinyDB is used because no large database is required. Android API’s will be used for Text-To-Speech, Speech-To-Text, messaging, notification handling receiving and sending calls and for crash detection. OpenCV library will be used for Driver Drowsiness Detection. More detailed specification will be demonstrated in Software Design Description (SDD) document.

3.1.3 Hardware Interfaces

No extra hardware is required except Android phone.

3.1.4 Communication Interfaces

All kind of communication will be established on GSM or Internet which includes: messaging, calling and notification handling.

3.1.5 Memory Constraints

Application should need small memory for storing the data. Since it is a mobile application, it will process the data just using small amount of memory. For example, driver drowsiness detection algorithm will be implemented in a way where it satisfies with at most 10 pictures to process.

3.1.6 Site adaptation requirements

If the product is going to be used in an extreme way/road condition crash detection algorithm should be still working no matter the road surface.

3.2 Function Requirements

The system will perform the following functional requirements

- User can enable and disable voice commands
- User can perform a phone call
- User can handle an incoming phone call
- User can send a message
- User can handle an incoming message
- User can acquire device status
- User can set the shake level
- User can set his/her name and emergency phone number
- User can enable and disable notifications
- User can filter notifications
- User can learn how the application works
- User can get general information about the application
- User can enable and disable Eye Detection System
- User can interact with Eye Detection System

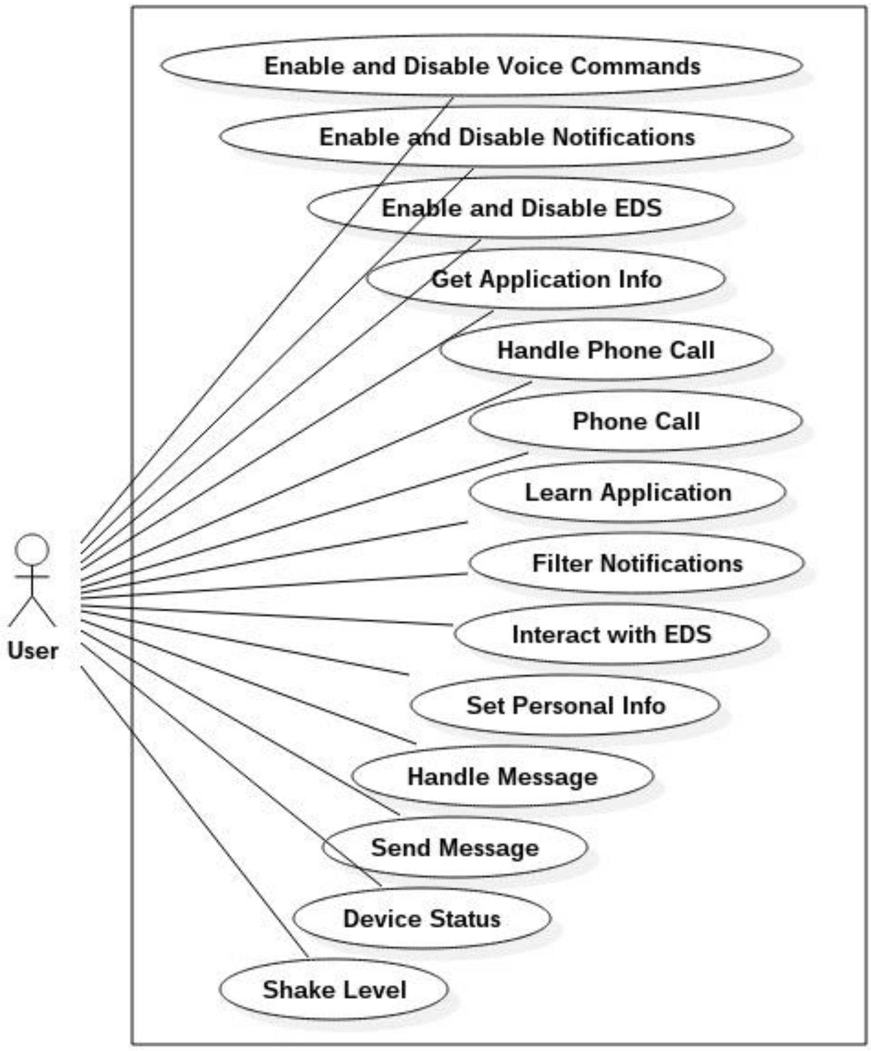


Figure 6: Use case diagram of SDA

Use Case Name	Enable and Disable Voice Commands	
Use Case ID	SDA-UC01	
Actor	Driver	
Description	This use case describes the event of enabling and disabling the feature of using voice commands	
Precondition	Device's microphone should be working	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks “VOICE COMMANDS” button in the main screen	Step 2: System checks state of the button
Alternative Scenario	**Step 2:** If the button is OFF system checks whether device's microphone is available. If no problem detected while checking microphone system will set the language to user's local language and turn on Voice Command feature by starting its service. Button state is changed to ON **Step 2:** If the button is ON, its state is changed to OFF. Then system will deactivate its running service.	
Postcondition	Voice Command service is either started or terminated	

Table 1: Use case for Enable and Disable Voice Commands

Use Case Name	Enable and Disable Notifications	
Use Case ID	SDA-UC02	
Actor	Driver	
Description	This use case describes the event of enabling and disabling the incoming notifications	
Precondition	Device's API should be greater or equal to 21	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks “NOTIFICATION” button in the main screen	Step 2: System checks device API value
Alternative Scenario	**Step 2:** If the button is OFF system checks whether device's API is greater or equal to 21. • If the result is successful then the system will open	

	Notification Listener Settings. Then the user will be able to mark and give the SDA permissions to read incoming notifications. The notification service will start to run in background. The button state will be changed to ON • If the result is unsuccessful then the message “This device does not support notification reading” will appear at the bottom of the screen. **Step 2:** If the button is ON the system will again open Notification Listener Settings and enable the user to remove SDA from reading the notifications. The button state will be changed to OFF and notification service is deactivated.
Postcondition	Notification service is either started or terminated

Table 2: Use case for Enable and Disable Notifications

Use Case Name	Enable and Disable EDS	
Use Case ID	SDA-UC03	
Actor	Driver	
Description	This use case describes the event of enabling and disabling the Eye Detection System	
Precondition	Device's camera should be working	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks “EYE DETECTION” button in the main screen	Step 2: System checks state of the button
Alternative Scenario	**Step 2:** If the button is OFF system checks whether device's camera is available. • If no problem detected while checking camera system will open the camera and start EDS activity. The button state will be changed to ON • If camera is not available then the message “This device camera is unavailable for EDS” will appear at the bottom of the screen. **Step 2:** If the button is ON, its state is changed to OFF. Then system will release the camera and close EDS activity.	
Postcondition	EDS is either started or terminated	

Table 3: Use case for Enable and Disable EDS

Use Case Name	Get Application Info	
Use Case ID	SDA-UC04	
Actor	Driver	
Description	This use case describes the event of introducing the driver with the general information of the application	
Precondition	None	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks “About” in the task bar of the main screen	
		Step 2: System opens the information dialog
Alternative Scenario	None	
Postcondition	User is presented with the information dialog	

Table 4: Use case for Get Application Info

Use Case Name	Handle Phone Call	
Use Case ID	SDA-UC05	
Actor	Driver	
Description	This use case describes the event of handling an incoming phone call	
Precondition	Voice Commands service should be working	
Primary Scenario	**Actor Action**	**System Response**
		Step 1: System reads out the name and surname of the caller Step 2: System starts Speech-To-Text and waits for the user response
	Step 3: User gives the command	
Alternative Scenario	**Step 3:** If the command is “Accept” system opens the phone call **Step 3:** If the command is “Reject” system closes the phone call immediately	
Postcondition	User either accepts or rejects the phone call	

Table 5: Use case for Handle Phone Call

Use Case Name	Phone Call	
Use Case ID	SDA-UC06	
Actor	Driver	
Description	This use case describes the actions taken for performing a phone call	
Precondition	Voice Commands service should be working	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User starts the call method by saying loudly "call"	
		Step 2: System asks the user about the callee
	Step 3: User provides the information	
		Step 4: System processes the information
		Step 5: System performs the phone call
Alternative Scenario	**Step 4:** If the information contains a name, system checks that name in phone contacts. • If the name is unique system moves to *Step 5* • If there multiple names, system reads out all of them including their phone's number last 3 digit and ask the user which of them to call. User mention only last 3 digits. If the system correctly receives it, moves to *Step 5* otherwise repeats from *Step 2* **Step 4:** If the information contains only numbers, system does string processing for errors. • If no error found, system moves to *Step 5* • If error found, system repeats from *Step 2*	
Postcondition	System performs the call with the provided information	

Table 6: Use case for Phone Call

Use Case Name	Learn Application
Use Case ID	SDA-UC07
Actor	Driver
Description	This use case describes the event of introducing the driver with the components, functionalities and usage of the application

Precondition	None	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks menu button in the main screen	
		Step 2: System opens the menu items
	Step 3: User clicks “How To” menu item	
		Step 4: System opens “How To” activity
Alternative Scenario	None	
Postcondition	User is directed to “How To” activity	

Table 7: Use case for Learn Application

Use Case Name	Filter Notification	
Use Case ID	SDA-UC08	
Actor	Driver	
Description	This use case describes the event of choosing the desired applications for reading out the incoming notifications	
Precondition	Device's API must be greater or equal to 21	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks “Settings” button in task bar of the main screen	
		Step 2: System opens the settings activity
	Step 3: User marks the desired applications	
		Step 4: System saves and use this information for filtering out incoming notifications
Alternative Scenario	None	
Postcondition	Notification Listener list is updated accordingly	

Table 8: Use case for Filter Notification

Use Case Name	Interacting with EDS	
Use Case ID	SDA-UC09	
Actor	Driver	
Description	This use case describes the actions taken by the system when interacting with user using EDS	
Precondition	EDS service must be working	
Primary Scenario	**Actor Action**	**System Response**
		Step 1: System detects the face and says loudly “Face detected, ready for watching” and waits for user's response
	Step 2: User when being ready gives the command by saying loudly “ready”	
		Step 3: System starts monitoring driver's eye
Alternative Scenario	**Step 3:** System detects the eyes are closed and asks the question “username?” • If no answer received or the answer does not contain “yes” keyword, then the alarm will ring • If the answer is “yes”, no action will be taken	
Postcondition	None	

Table 9: Use case for Interacting with EDS

Use Case Name	Set Personal Info	
Use Case ID	SDA-UC10	
Actor	Driver	
Description	This use case describes the event of setting user's personal information	
Precondition	None	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User clicks “Settings” button in task bar of the main screen	
		Step 2: System opens the settings activity
	Step 3: User enter personal	

	information in the related fields	Step 4: System saves the data and use the information when necessary.
Alternative Scenario	None	
Postcondition	User's personal information is updated	

Table 10: Use case for Set Personal Info

Use Case Name	Handle Message	
Use Case ID	SDA-UC11	
Actor	Driver	
Description	This use case describes the event of handling an incoming message	
Precondition	Voice Commands service should be working	
Primary Scenario	**Actor Action**	**System Response**
	Step 3: User gives the command	Step 1: System reads out the name and surname of the sender Step 2: System starts Speech-To-Text and waits for the user response
Alternative Scenario	**Step 3:** If the command is “Read” system find the message and reads it loudly **Step 3:** If the command is “Ignore” system takes not actions	
Postcondition	User either reads or ignore the message	

Table 11: Use case for Handle Message

Use Case Name	Send Message	
Use Case ID	SDA-UC12	
Actor	Driver	
Description	This use case describes the actions taken for sending a message	
Precondition	Voice Commands service should be working	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User starts the message method by saying loudly	

	“message”	
		Step 2: System asks the user about the receiver
	Step 3: User provides the information	
		Step 4: System processes the information Step 5: System asks user about the message content
	Step 6: User composes the content.	
		Step 7: System reads out loudly the content and ask user for confirmation
	Step 8: User gives response	
		Step 8: System processes the response
Alternative Scenario	**Step 8:** System will decides on response • If the response is “send”, system will send the message • If the response is “revise”, system will repeat from *Step 5* • If the response is “discard”, system will terminate the command	
Postcondition	System either sends or discards the message	

Table 12: Use case for Send Message

Use Case Name	Device Status	
Use Case ID	SDA-UC13	
Actor	Driver	
Description	This use case describes the event of requiring device's status	
Precondition	Voice Commands service should be working	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User starts the command by saying out loudly “battery”	Step 2: System acquires the battery status and says it loudly
Alternative Scenario	None	

Postcondition	User is informed about the device's status

Table 13: Use case for Device Status

Use Case Name	Shake Level	
Use Case ID	SDA-UC14	
Actor	Driver	
Description	This use case describes the event of setting shake level sensor's value	
Precondition	None	
Primary Scenario	**Actor Action**	**System Response**
	Step 1: User swipes the seek bar from left to right or from right to left	Step 2: System saves the information and notifies shake service
Alternative Scenario	None	
Postcondition	Shake level in the shake service is updated	

Table 14: Use case for Shake Level

3.3 Usability requirements

The usability requirements of Smart Driver Assistant are the following:

- The system must provide a simple and user friendly GUI
- System must be robust to extreme road conditions.
- System must be robust to user accent.
- The number of physical interactions should be minimum

3.4 Performance requirements

The performance requirements of Smart Driver Assistant are the following:

- It should process voice command in less than 2 seconds.
- It should process the Eye Detection algorithm less than 0.3 second

3.5 Design Constraints

The design constraints of the Smart Driver Assistant are listed as below:

- The program will be implemented using Android studio.
- Database side will be implemented using TinyDB
- Minimum Android API level must be higher than 15.
- User private data and actions must be kept private.

3.6 Standard Compliance

The system will wait for input voice command after being triggered by the keyword “Tetris”.

3.7 Software System Attributes

The software system attributes of Smart Driver Assistant can be listed below:

3.7.1 Reliability

- Smart Driver Assistant shall be run properly at every time needed
- Failure intensity should not be acceptable

3.7.2 Availability

- Smart Driver Assistant shall be implemented so that application crashes will be minimum
- Recovery of the whole system should take minimum time

3.7.3 Security

- User also need to activate notification access permission on device manually
- User's personal info shall not be accessed or reached by anyone except that person who can learn user location in case of emergency.

3.7.4 Maintainability

- System shall responds to the real time and physical interactions
- System shall responds to user commands properly
- Codes shall be supported by some techniques like related implementation comments, naming conventions and coding standards for increasing readability for future developments

3.7.5 Portability

- The Application shall be accessed also by different electronic devices using Android Operation System
- The Application shall be working properly on different versions of Android Operation System

3.8 Supporting Information

3.8.1 Configuration Management Tool

- The source code developed for this system shall be maintained in CMT

4. Data Model and Description

4.1 Data Description

4.1.1 Data Objects

Class diagram of Smart Driver Assistant is shown below:

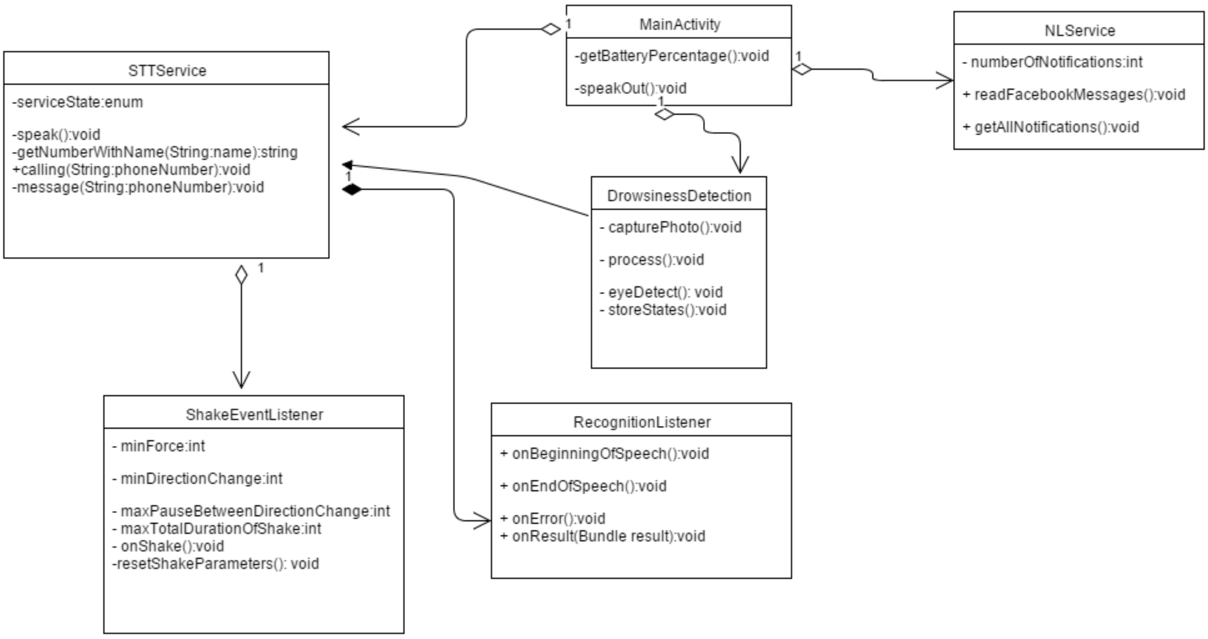

MainActivity
-getBatteryPercentage():void
-speakOut():void
1
1
1
NLService
- numberOfNotifications:int
+ readFacebookMessages():void
+ getAllNotifications():void
STTService
-serviceState:enum
-speak():void
-getNumberWithName(String:name):string
+calling(String:phoneNumber):void
-message(String:phoneNumber):void
1
DrowsinessDetection
- capturePhoto():void
- process():void
- eyeDetect(): void
- storeStates():void
1
ShakeEventListener
- minForce:int
- minDirectionChange:int
- maxPauseBetweenDirectionChange:int
- maxTotalDurationOfShake:int
- onShake():void
-resetShakeParameters(): void
RecognitionListener
+ onBeginningOfSpeech():void
+ onEndOfSpeech():void
+ onError():void
+ onResult(Bundle result):void

Figure 7: Class Diagram of SDA

4.1.2 Data Dictionary

Main Activity	This class is the starting point of our project. It starts all the services.

	Methods *getBatteryPercentage()*: Gets the percentage of battery level. *SpeakOut():* Triggers Text-To-Speech
STTService	This class is responsible for Speech-To-Text. It is supposed to work at background all the time and receive voice commands. ***Attributes*** *serviceState:* Stores the current state of service`: WAITING, LISTENING, PROCESSING ***Methods*** *getNumberWithName(String name):* Gets the phone number of according to the name from contacts. *calling(String phoneNumber):*Calls the number. *speak():* Triggers Text-To-Speech *message(String phoneNumber):* Sends message.
ShakeEventListener	This class implemented for detecting car crashes. ***Attributes*** *minForce :* Minimum force amount for detecting crash. *minDirectionChange:* Minimum direction change… *maxPauseBetweenDirectionChange:* Maximum pause *maxTotalDurationOfShake:* Duration of shake ***Methods*** *onShake():* Callback function for shake event. *resetShakeParameters():*Resetting the parameters for shake.
RecognitionListener	This class implemented for speech recognition as background.

	Methods *onBeginningOfSpeech():*Callback function for beginning of speech. *onEndOfSpeech():*Callback function for end of speech. *onError():*Callback function for errors. *onResult(Bundle result):* Callback function for result
NLService	This class implemented for notification handling. ***Attributes*** *numberOfNotifications:* Number of notifications that waits. ***Methods*** *readFacebookMessages():* Reads incoming facebook messages. *getAllNotifications():* Getting all notifications.
DrowsinessDetection	This class implements driver drowsiness detection ***Methods*** *capturePhoto():*Taking photos of driver. *process():* Process states and make a decision. *eyeDetect():*Detecting the state of eyes. *storeStates():*Stores the states

Table 15: Data Dictionary

5. Appendices

5.1 Constraints, Assumptions and Dependencies

- It is assumed that there will be no broken bicycles which might be inappropriately shown in the User Interface.
- There must be at least one maintainer during the working time in each station.
- There must be a clone copy saved in case of System and Database crash.

5.2 Definitions, Acronyms and Abbreviations

The definitions of the terms, which are used in this SRS document, are shown below:

TERMS	DEFINITIONS
TTS	Text To Speech
STT	Speech To Text
API	Application Program Interface
UI	User Interface
UML	Unified Modeling Language
SDA	Smart Driver Assistant
EDS	Eye Detection System
CMT	Configuration Management Tool

Table 16: List of Definitions, Acronyms and Abbreviations