Face and Eye Blinking Detection System

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Declaration

This project has been done as the mini project for the third year second semester, Department of Computing and Information Systems, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. Project was supervised and guided by Ms. H.M. Rupasingha and our department head Dr. Senaka Amarakeerthi has given great support at progression of the project. All the work relating to this application including designing, programming and development has been done by O.D. Wedamulla(10/AS/CI/048), as an individual project and I was able to collect a vast knowledge about android app development with opencv. I did my best to get this program up to the expectations and the goals we elaborated in the project proposal. This document is the final report of this project which includes abstract, system requirements, planning, system analysis, design, development and testing.

....

Name of the Student Signature of the Student

Date:……

Certificate of Approval

We hereby declare that this project is from the student's own work and effort, and all other sources of information used have been acknowledged. This project has been submitted with our approval.

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Acknowledgement

I have taken many efforts in this project. However, it would not have been possible without the kind support and help of many individuals. I would like to extend my sincere gratitude to all of them. In the first place I would like to record my heartfelt gratitude to my supervisor Ms. H.M. Rupasingha Lecturer at Department of Computing and Information Systems for her exemplary guidance, monitoring and constant encouragement throughout the course of this project. I am highly indebted to her for his support in completing the project.

My heartfelt gratitude first goes to my parents and family members, and close relations and my friends who helped not only in resources but also in guidance and encouragement.

I take this valuable opportunity to express our sincere gratitude and appreciation to all those who supported me towards making this project a success. I offer my special thanks to Dr. Senaka Amarakeerthi, head of the department of computing and information systems and all staff members of Sabaragamuwa University who delivered us an invaluable support in both academic and nonacademic aspects. I also would like to thank all friends for extending their hand of friendship and providing moral support during preparation of interim report.

Finally we thank all those whose names were not mentioned for their help and encouragement in completing my project.

Abstract

In this project I intend to develop an android app that can detect human face and human eye blinking under certain specific condition. Here I am using image processing techniques to develop this application. Using the methods and patterns defined in image processing which relevant to detecting human face and human eye, I am planning to develop an android app. This android is consists of functions that can detect human face, left eye and right eye. In further I plan to develop this to detect human fatigue actions in human eye.

When it comes to recognize a human it is quite easy to understating the humans individually by processing human sensed images (ex:- finger prints and face recognition) from them face recognition is a method which not only gives a chance to recognize the face identically but also allow to recognize extra things like facial expressions and human fatigue. In this project my target is to make a face detection system from by accessing portable devices like web cam from a tablet or smart phone. In further developing I intend to integrate human eye fatigue detection to the same application.

I develop this project under Rapid Application Development methodology. According to that we collected all the necessary details regarding human face and eye fatigue detection then according to the gathered requirement we anticipate whole system requirement and then create a working prototype. After that we started to develop application using OpenCV library and eclipse IDE consists with android and OpenCV developing tools. Face detection and eye blinking detection is done by using haar_cascade library .This application is to be tested at different lighting conditions and different devices before submitting the final app.

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List of Abbreviations

APP	- APP is an abbreviation for application
OpenCV	- Open source computer vision library
IDE	- Integrated development environment
GUI	- Graphical User Interface
SDK	- Software Development Kit
AVD	- Android Virtual Device
NDK	- Native Development Kit
OS	- Operating System
API	- Application Programming Interface

Chapter 1

1. Introduction

1.1 Definition of the problem

Face detection and eye blinking detection of human has been a fundamental and challenging problem for computer vision. This project is proposing a good method to estimate eye blinking and detection of fatigue in human eye. This method is validated by detecting blinking eye condition within varies ways. In this project I represent a methodology for detection of eye in real time environment like driving a vehicle or examine a human eye. Actually drivers are main target of this project. Here we use OpenCV library developed by Intel to detect face and eye blinking. Using the methods that are describes in the OpenCV library we I intend to integrate those methods into an android app using necessary tools to build that app.

Eye blinking detection as a tool is now more accessible than ever, and is growing in popularity amongst developer from a whole host of different disciplines and have the potential to become an even more important component in future in the perspective of developing useful systems. This technology is used in cognitive science, psychology, human computer interaction, advertising, medical research, and other areas. Today, the human eye gaze, blinking and eye movement can be recorded with relatively high reliability by unobtrusive techniques. Though, there are relatively few techniques proposed for the active scene where the head and the camera move independently and the eye moves freely in all directions independently of the face. Though, care must be taken, that eye blinking tracking data is used in a sensible way.

There are many techniques and methodologies that this face detection and eye blinking detection system can implement. From all the other techniques I choose to develop this application to android phones. This app can be used in several area like medical, cognitive science, human computer interaction, advertising and etc. I intend to develop this app targeting drivers to detect their face and eye blinking. Even I am developing this app targeting people who drive vehicles I can extend this app towards area like medical, human computer interaction and advertising. There are lot of reason to choose android OS and mobile phones to implement this application using those two. Today mobile phones are using rapidly among them majority has smart phones so targeting mobile phones is a good competitive advantage for this app. Most of the smart phones are using Android as its operating system. So implementing this face detecting and eye blinking detection app will be a good marketing advantage.

1.2 Business Process

Since I am developing this application based on android devices and using OpenCV library as main library and some haar_cascade file and all things mentioned here are free tools and software. So have no initial cost when it's come to developing software and tools. But as person who developed an android app to detect human face and eye blinking I can make this app a commercial product because it has a commercial value as an android app. As I mentioned earlier android OS is used in many mobile devices so all that phones can have this app. As a developer I can release this app for a certain company or organization that is interested in buying this app for reasonable price tag. After releasing this app depending on the popularity I can to further developing on this app make the app a more convenient product. Finally a good profit can be achieved from this app, based on performance and usefulness of this in the perspective of users and depending on their feedback.

1.3 Need Analysis

When I research about the background of the face detection and eye blink detection of human, the first thing comes out is drivers and accidents that happen due to human fatigue problems. Second thing is about human's interaction with computers and eye blinking is connected to it. So we can decide driver's problem as most needed one. It will be a good solution on detect driver drowsiness depending on the eye blinking pattern or eye blinking rate. There some area that haven't addressed when it comes to solutions that has given to prevent accident due to driver drowsiness. I think it is a more practical and reliable solution to integrate face and eye blink detection system into an android application since majority of the people are using smart phones that are based on Android OS. So there is a need of an android application to detect drivers face and eye blink.

1.4 Aims and Objectives

- Getting familiarized with digital image processing techniques and android application development.
- Provide a free app to persons with a smart phones to detect driver drowsiness with only using their phones.
- Introduce a method to detect a person's face and eye blinking pattern or eye blinking rate when it comes to interaction with computer with human.
- Person can use this app at any time he/she want if he/she has android phone and the app is installed in it.
- Gather enough information about human to detect variation in eye blinking or pattern changing in eye blinking to predict a person's suitability to drive and not to drive or do any other assigned riskiness work.
- Integrating this detection system into mobile phone will improve portability and dependability.

1.5 Scope of the System

The purpose of this face and eye blinking detection android app is to detect a human face at first. Then it will detect the eye blinking and then based on eye blinking patterns that the camera capture the app will give some information when eye is blinking out of the ordinary pattern. This project can cover not only one area but several areas. For one this app can be used to detect drowsiness in drivers and also that blinking techniques can be very useful in some medical testing to detect anomalies in human eye. Another place we can use this app is when, integrated somehow to a device that runs android to detect human blinking pattern to identify human activities or human commands that specify early.

Chapter 2

2. System Analysis

2.1 High level diagram for existing system/process

In here we don't have any existing system to detect human face or human eye blinking details. This app will help to detect human eye fatigue at the relevant time and according to other condition this app will provide needed output according to the request. When we talk about current scenario currently the system does not have any way to identify the driver while on the road and no any way to recognize the fatigue of the driver. While driving on the road and it is a huge need to the system to track.

2.2 Software Requirement Specification

2.2.1 Requirement

Through several number of requirement gathering methods we have collected number of requirements which are users expecting from an eye blink detection app. Among those requirements we have selected some requirements which are in our scope.

- Detect the face and the eye blinking at any given circumstance. There should be no delay in detecting the mentioned details.
- App should be work on any given android phone apart from the version of android that available in the device.
- App should not crash suddenly when detecting the details if happened, a solution should be provided.
- The application should be easily downloaded from the app store directly and no third party should be involved in it.
- Since this is an android app it should be reasonably free of cost.

We have gone through these requirements and have considered things mentioned above and when developing needed requirements will be included.

Apart from the requirements mentioned above there are two types of requirement those are functional and non-functional requirements. Following are details about them.

Functional Requirement

Functional Requirements are the system requirements that should be there in order to perform the functions of the proposed system. There can be nice to have functionalities or should have functionalities. Nice to have functionalities are mentioned as - Should be able to... And should have… functionalities mentioned.

- Shall be able to recognize the face and eye blinking of a person.
- Shall be able to Alert when the person is not behave as usually.
- Shall be able to give record on one person's conditions.
- Shall be able to prevent faces by pass by images.
- Shall be able to use a portable Device.

Non Functional Requirement

Non Functional Requirements are the requirements that are supposed to have in the proposed system which needs to help the system functionalities work indirectly. These can be nice to have which are mentioned as Should be able to…I and should have requirements which mentioned.

- Tracking the images from an External Device.
- Track face and eye images taken from the camera.
- Track the face on Driving.
- Give outputs on face and eye condition.

2.3 Business System Option for Software

Through implementing this app we are trying to give good support to people who get various fatigue problems. Initially this application will avoid any drowsiness.

There are three possible platform that we can implement this app those are,

- iOS

  iOS is a mobile operating system developed and distributed by Apple Inc. Originally unveiled in 2007 for the iPhone, it has been extended to support other Apple devices such as the iPod Touch (September 2007), iPad (January 2010) and second-generation Apple TV (September 2010). Unlike Microsoft's Windows Phone and Google's Android, Apple does not license iOS for installation on non-Apple hardware. As of June 2013, Apple's App Store contained more than 900,000 iOS applications, 375,000 of which were optimized for iPad. These apps have collectively been downloaded more than 50 billion times. It had a 21% share of the smartphone mobile operating system units shipped in the fourth quarter of 2012, behind only Google's Android.

- Android OS

  Android is a Linux based operating system designed primarily for touchscreen mobile devices such as smartphones and tablet computers. Initially developed by Android, Inc., which Google backed financially and later bought in 2005, Android was unveiled in 2007 along with the founding of the Open Handset Alliance: a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. The first Android powered phone was sold in October 2008.

- Windows Phone OS

  Windows Phone is a series of proprietary mobile operating systems developed by Microsoft. It is the successor to Windows Mobile, although it is incompatible with the earlier platform. Unlike its predecessor, it is primarily aimed at the consumer market rather than the enterprise market. It was first launched in October 2010. The latest major release is Windows Phone 8, which was launched on October 29, 2012. With Windows Phone, Microsoft created a new user interface, featuring its Modern design language (which was formerly known as "Metro"). Additionally, the software is integrated with third-party and Microsoft services, and sets minimum requirements for the hardware on which it runs.

2.4 Business System Option for Hardware

Android based phone is always good option when considering device to build simple application to detect face and eye. Smart phones that included android has good quality in build camera so no other hardware resource are need to develop this app.

2.5 Cost Benefit Analysis

There are two types of costs in this project.

- Hardware Cost

  It is much difficult to check live camera feed on android emulator. Therefore to develop this application we need to have a smart phone that has android OS.

- Software Cost

  To develop this application we need advanced IDE's like Eclipse, android development tools etc.

When we considering about hardware cost in this project we can clearly see that using Apple iOS is somewhat expensive due to iPhone prices. But both Android and Windows Phone OS have smart phones for cheaper prices than iPhone. When we come to software cost, to develop Android applications we do not need to bother about software cost. Because Android is an open source project and software that need to code are all free. For Windows Phone we have to have licensed software such as Visual Studio. But still they offer free set of tools called Visual Studio Express. To develop

applications for iOS we have to have not only Mac (Apple) software but also computer which is running Mac OS and iPhone to check the application.

2.6 Selected BSO (Business System Option) and Justification

I have decided to develop this application using Android OS and smart phone that consist android OS. Following are some reasons for it,

- Android is free and it is easy to work with a product that does not need to pay money for using the OS and for the developers it is the same.
- All the developing tools are open source and they are cost free. Working with those tools are quite simple when we understood the pattern.
- Android OS popular among everybody who uses smart phones and majority of smart phone users have android phones so it is a good competitive advantage to develop an application for android devices.
- Android have introduce more enhance UI design call material design and it really attracts even more people. Using those UI techniques will improve the quality of the application.
- Android is the most stable operating system for mobiles devices that build by google.
- Android has wide range of apps and the capacity that google play store hold is the biggest app collection. So we can give this app to many customers.

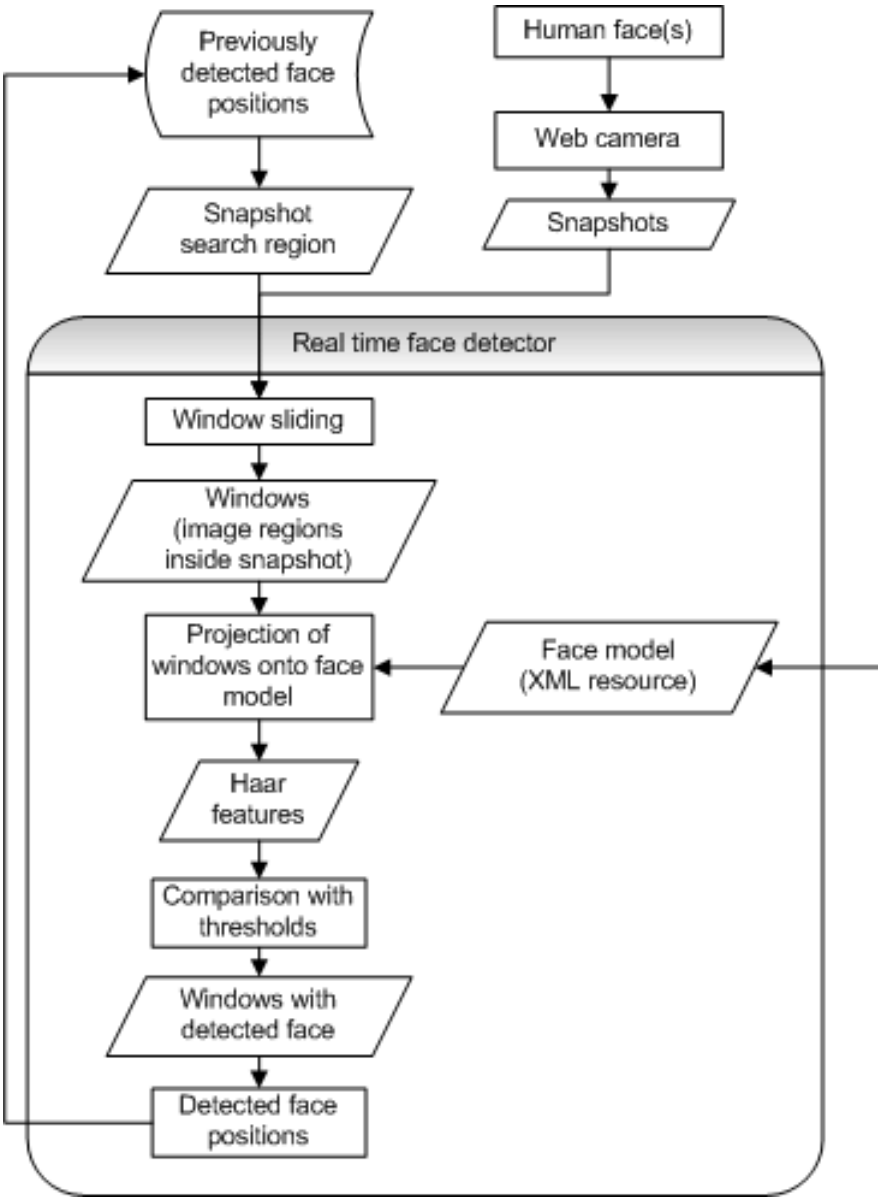
After developing the application it will be available in the google play store and it will be a free application for the users. And also developers does not need to pay money for publish their app on google play store unlike windows or iOS.

Chapter 3

3. System Design

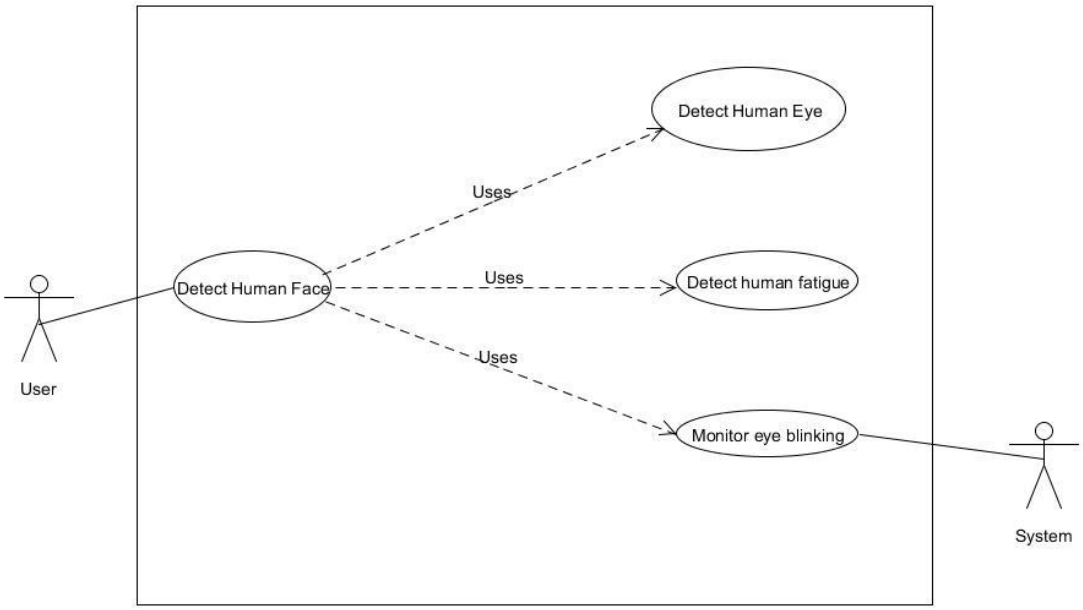
3.1 High Level Diagrams for proposed system

Figure 1



3.1.1 Use Case Diagram

Figure 2



Detecting human face use case description.

Table 1

Use Case:	Detecting face
Actors	Drives, Mobile phone users
Description:	A live feed is taken from the phone camera and send it to the app to detect procedure.
Per condition:	Face detection information should be added to the system.
Basic Course:	01. Give the defined parameters for face detection. 02. Send details to system to detect face.
Alternative Course:	Take the image if not detected.
Exceptional Course:	Internet is un available.
Post Condition:	Keep tracking the face until any defects.

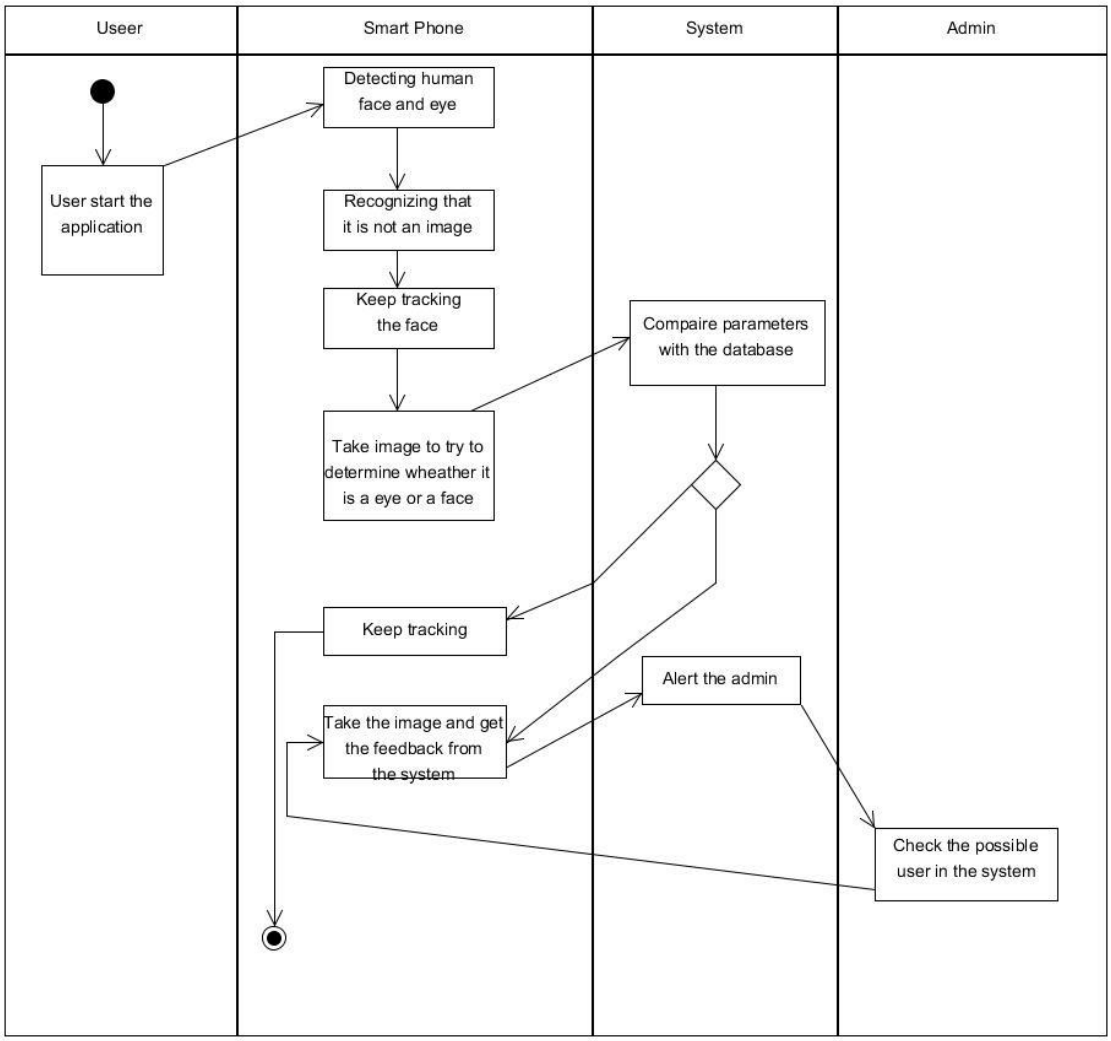
Detecting human eye blinking use case description.

Table 2

Use Case:	Detecting eye blinking.
Actors	Drives, Mobile phone users
Description:	Keep the human eye blinking tracked.
Per condition:	Eye detection information should be added to app interface.
Basic Course:	01. Give the defined parameters for eye detection.
Alternative Course:	If a one eye is not tracked.
Exceptional Course:	Camera is not working properly.
Post Condition:	Keep tracking the face for eye blinking.

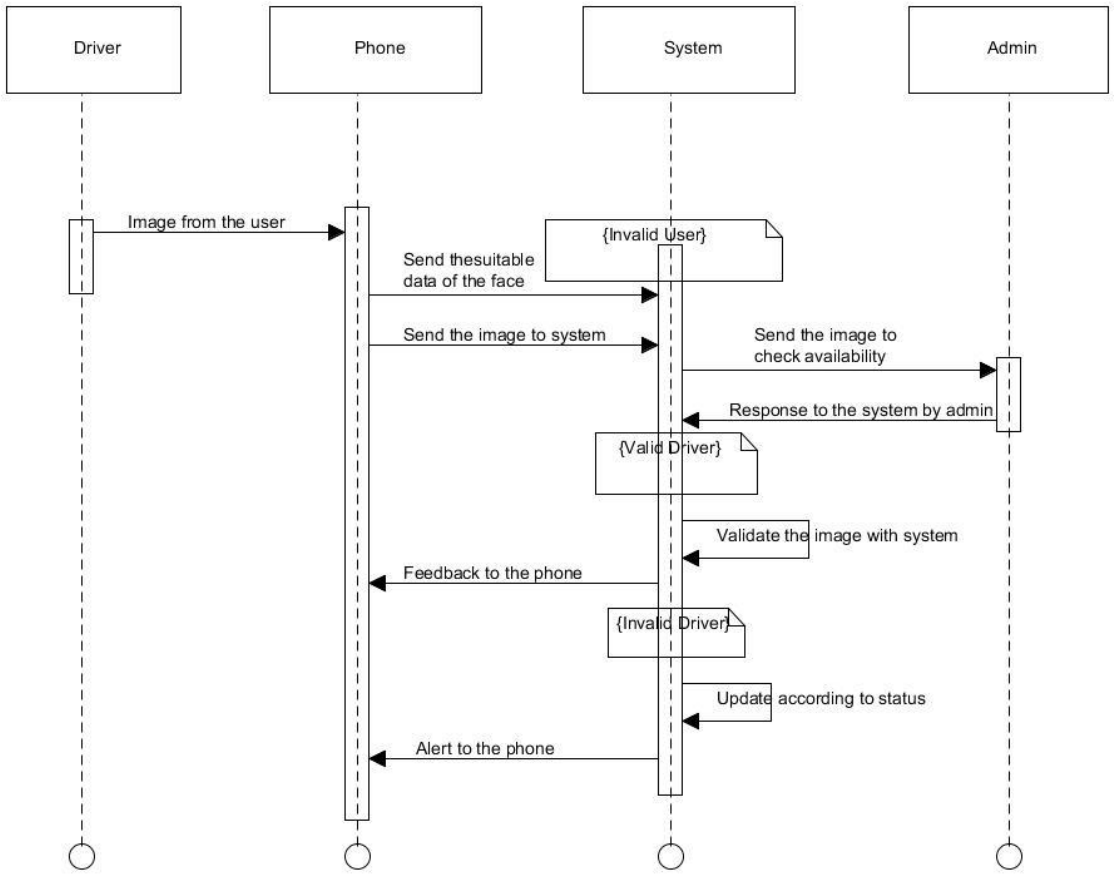
3.1.2 Activity diagram

Figure 3



3.1.3 Sequence diagram

Figure 4



3.2 Methodologies used for the system

A system development method is refers to some sort of framework can be used to develop, plan and control the process of system. A wide variety of such frameworks have evolved over the years, each with its own recognized strengths and weaknesses.

To implement this project I have choose Rapid Application development (RAD) method because it's basic principles are matching very well with our basic requirement. Following are some basics of RAD,

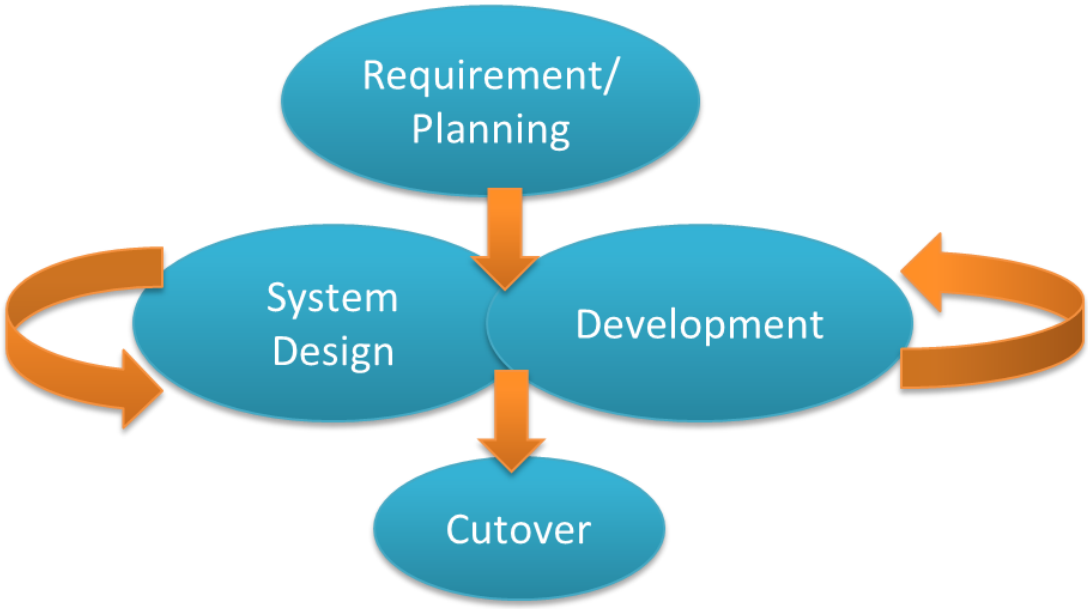
- Aims to produce high quality systems quickly, primarily through the use of iterative Prototyping (at different stage development) and computerized development tools. These tools may include Graphical User face (GUI) builders, Computer Aided Software Engineering (CASE) tools, Database Management System and object oriented techniques.
- Key objective is for fast development and delivery of a high quality system at a relatively low investment cost.
- Standard systems analysis and design techniques can be fitted into this framework.
- Users are seen as gaining more of a sense of ownership of a system, while developers are seen as gaining more satisfaction from producing successful systems quickly.
- Attempts to reduce inherent project risk by breaking a project into smaller segments and providing more ease of change during the development process.
- Project control involves prioritizing development and defining delivery deadlines or "time boxes". If the project starts to slip, emphasis is on reducing requirements to fit the time box, not in increasing the deadline.

There are many advantages of using Rapid Application Development over other system development methodologies such as:

- RAD can produce systems more quickly and to a business focus, this approach tends to produce systems at a lower cost.
- Ability to increases reusability of components.
- Reduced development time.
- The operational version of an application is available much earlier than with Waterfall, Incremental, or Spiral frameworks.
- Quick initial reviews occur.
- Encourages customer feedback.
- Integration from very beginning solves a lot of integration issues.
- Provides the ability to rapidly change system design as demanded by users.

Rapid Application Development (RAD) has four phases. Following is a diagram that describes them.

Figure 5

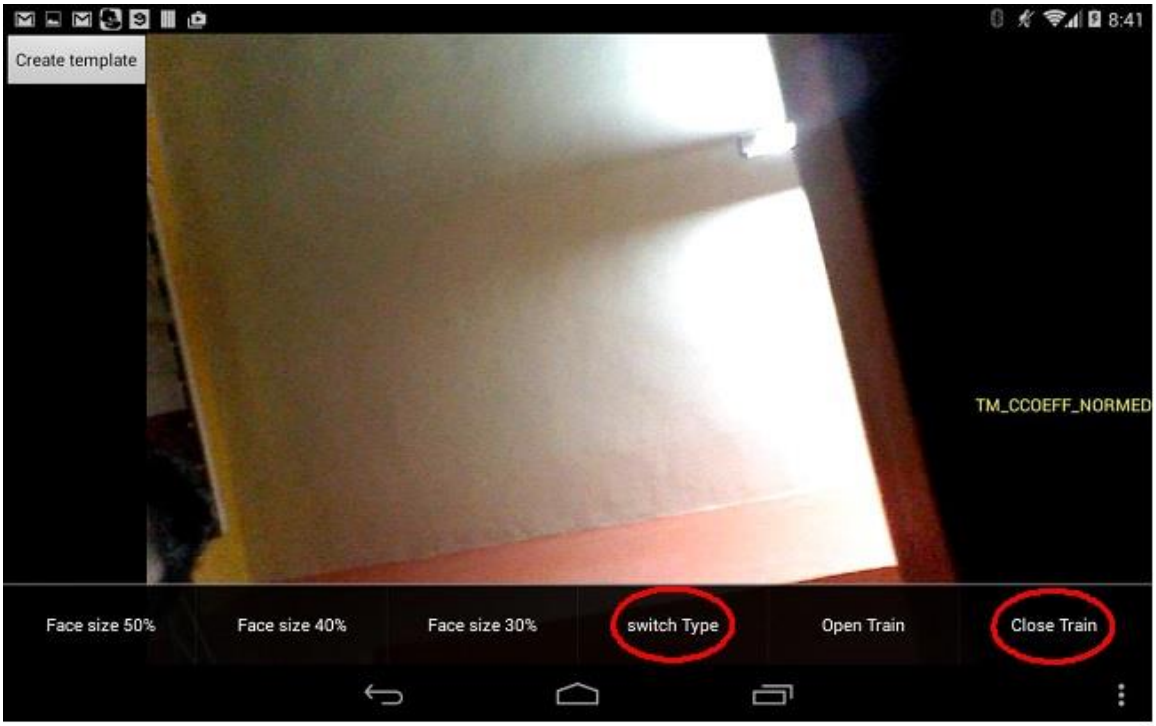


1. **Requirements planning phase**: -- Combines elements of the system planning and systems analysis phases of the Systems Development Life Cycle (SDLC). Users, managers, and IT staff members discuss and agree on business needs, project scope, constraints, and system requirements. It ends when the team agrees on the key issues and obtains management authorization to continue.
2. **User design phase**: -- During this phase, users interact with systems analysts and develop models and prototypes that represent all system processes, inputs, and outputs. User Design is a continuous interactive process that allows users to understand, modify, and eventually approve a working model of the system that meets their needs.
3. **Construction phase**: -- Focuses on program and application development task similar to the SDLC. In RAD, however, users continue to participate and can still suggest changes or improvements as actual screens or reports are developed. Its tasks are programming and application development, coding, unit-integration and system testing.
4. **Cutover phase**: -- Resembles the final tasks in the SDLC implementation phase, including data conversion, testing, changeover to the new system, and user training. Compared with traditional methods, the entire process is compressed. As a result, the new system is built, delivered, and placed in operation much sooner.

3.3 GUI Design

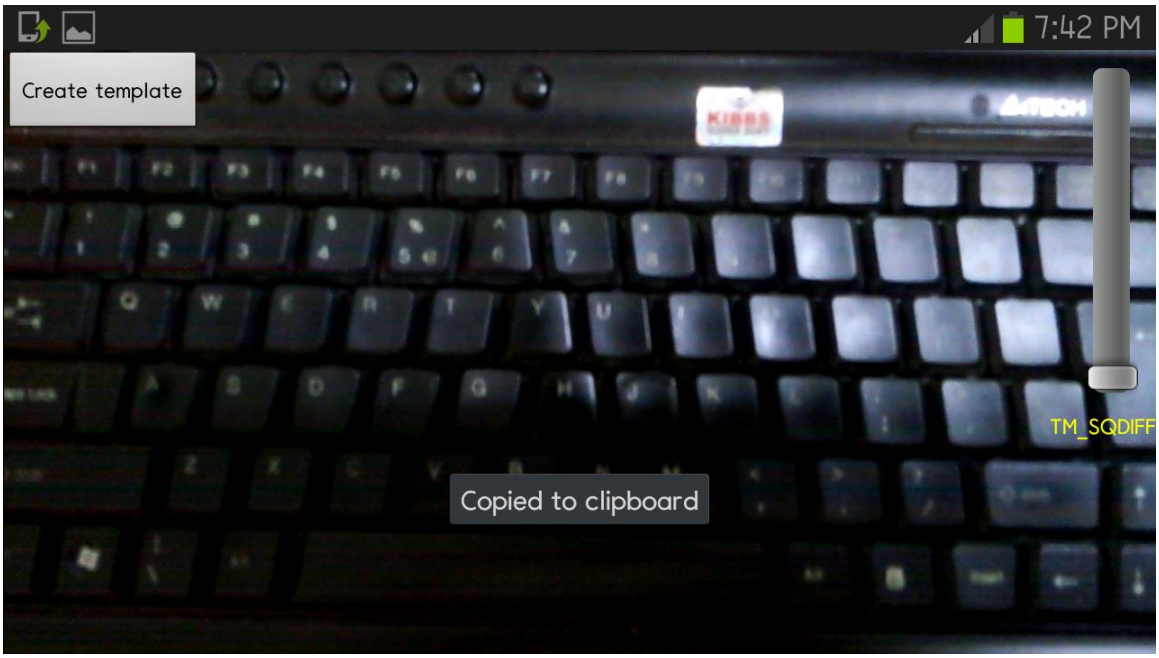
Here is the main interface of the application.

Figure 6



Here is the same interface on different device.

Figure 7



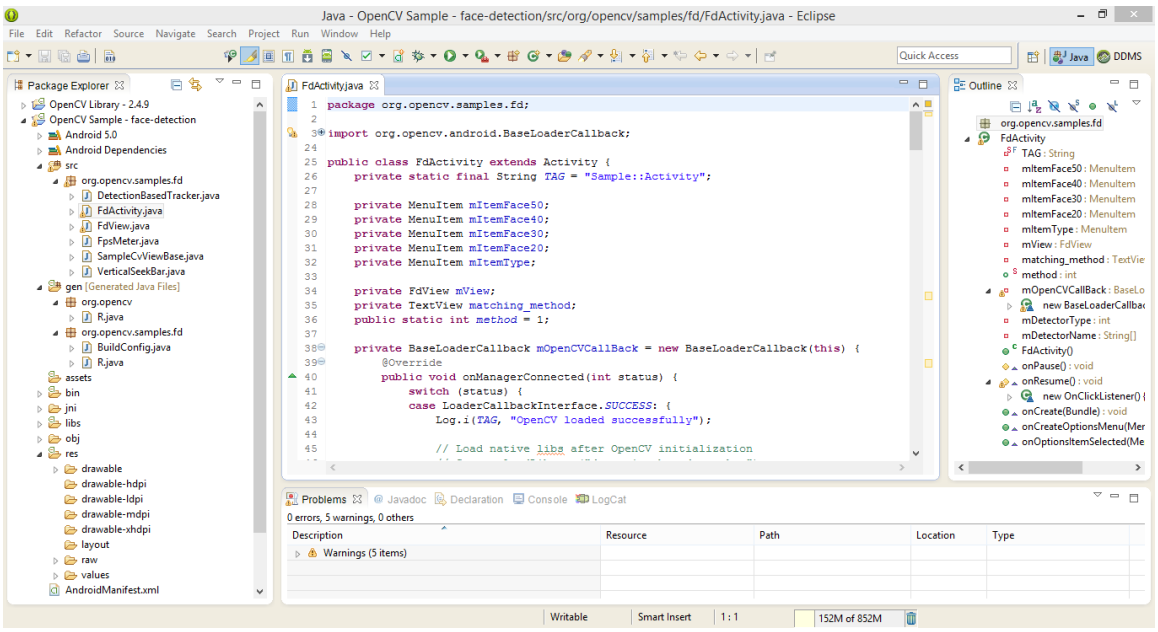
Chapter 4

4. System Development

4.1. Developing Environment Tools & Programming Language

Chapter discusses on the system development phase of the project and further elaborate the implementation architecture. Techniques that are used to implement the product will justified with other methods that are used in previous studies. Hidden algorithms, Feature extraction method, programming language and tools are discussed here.

Figure 8



Programming language and Development tools

When selecting the tools and technologies for the development of the Fatigue recognition System the main factors that have considered is the matching of the requirement with the hardware, software and human technological capabilities which are available in the context. Since the application is related to Image Processing, Choosing related tools and Platforms are very critical. Most part of the project done using the Java CV android SDK (OpenCV java Wrapper specifically developed for Android Development) which is a pattern recognition software developed by Intel Russia research center in Nizhny Novgorod, and now supported by Willow Garage and Itseez.

What is OpenCV.

OpenCV is an open source library of programming functions mainly aimed at real-time computer vision. It is a Programming Language Written in C/C++ languages and to use we need a Native C/C++ environment thus there is a way we can make an Application using the same Environment by using a Wrapping of an Expected Programming language. Currently OPENCV is providing a separate Library which build with the java wrapper and Android Standard development KIT (SDK).

Why Android and Why OpenCV

Android is the Operating System which is mostly used in the common and cheap devices.

Why OpenCV.

OpenCV is the most easy and possible image Processing library for Android (Except form face SDK android which does not have the ability to recognize characteristics of face). Form the Library we can not only recognize the attributes of a face and Process those existing methods and classes.

Development Tools

The First stage we need to find and recognize the data which is most suitable for recognizing faces and eyes. Image data is not only for training but also for testing and tracking. This helps. Also it is a must to use a suitable and easy configurable IDE to android and JavaCV. All the mobile application development is are chosen with the tools to develop are as given below.

Eclipse Android Development Tools

This is one of the Selected IDEs available (the available IDEs for android is Eclipse ADT / Eclipse installed ADT bundle to it and the IntelliJ Android Studio) but among them the most suitable one is Eclipse ADT Plugin. The whole reason is that there are more resources for doing developing in JavaCV.

What is eclipse

Eclipse is an integrated development environment (IDE). It contains a base workspace and an extensible plug-in system for customizing the environment. Written mostly in Java, Eclipse can be used to develop applications. By means of various plug-ins, Eclipse may also be used to develop applications in other languages: Ada, ABAP, C, C++, COBOL, Fortran, Haskell, JavaScript, Lasso, Natural, Perl, PHP, Prolog, Python, R, Ruby(including Ruby on Rails framework), Scala, Clojure, Groovy, Scheme, and Erlang. It can also be used to develop packages for the software Mathematica.

Development environments include the Eclipse Java development tools (JDT) for Java and Scala, Eclipse CDT for C/C++ and Eclipse PDT for PHP, among others.

This is used to develop the Application as a IDE and all the related Purposed like debugging, Emulating.

Android programming using java

Java is a general-purpose computer programming language that is concurrent, class based, object-oriented and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers “write once, run anywhere” (WORA), meaning that code that runs on one platform does not need to be recompiled to run on another. Java applications are typically compiled to byte code that can run on any Java virtual machine (JVM) regardless of computer architecture.

Java is the Language mainly based on Android Platform and this all the computations and algorithms can be seen in here

OpenCV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real time computer vision, developed by Intel Russia research center in Nizhny Novgorod, and now supported by Willow Garage and Itseez. It is free for use under theopen BSD license. The library is cross-platform. It focuses mainly on real-time image processing. If the library finds Intel's Integrated Performance Primitives on the system, it will use these proprietary optimized routines to accelerate itself.

This is the Library used to track the face and recognize the eyes from each frame which leads to recognitions.

JavaCV/OpenCV for android configuration

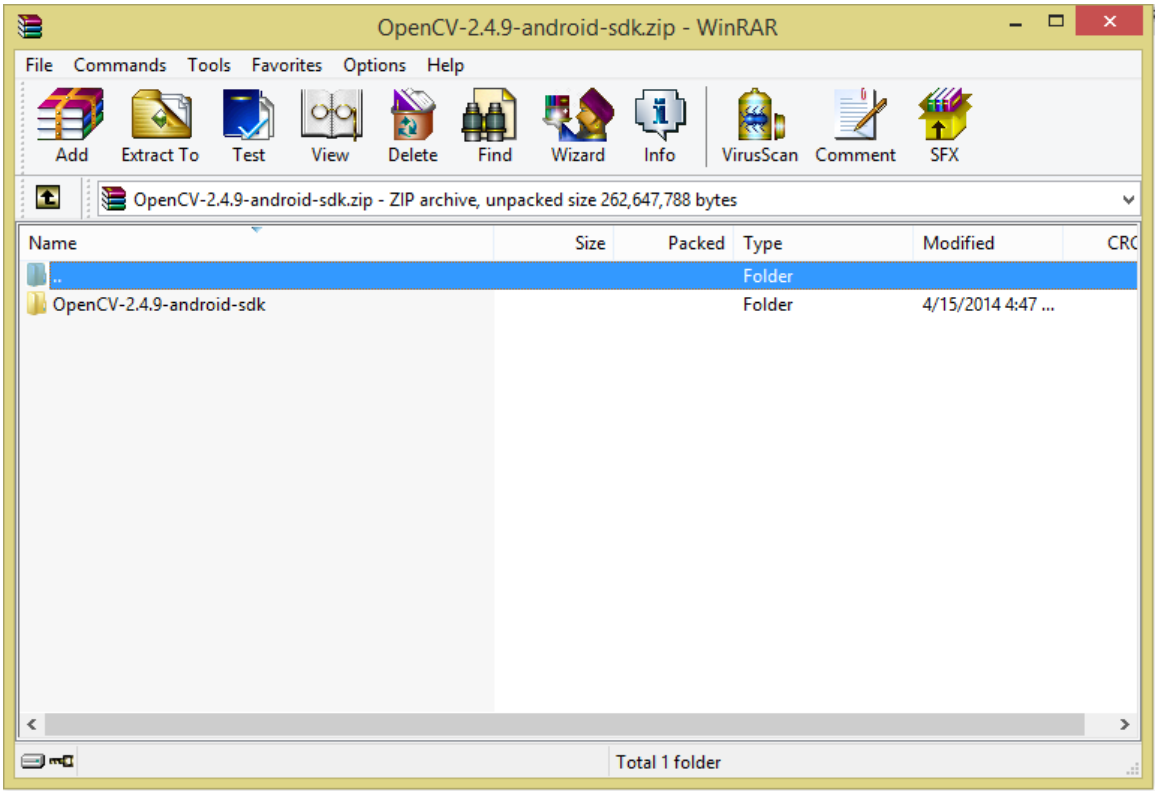
In android development the first thing we need to do is get the IDE configured and here are the steps to the configuration of the Android ADT bundle to OpenCV / JavaCV. If the IDE does not have an ADT plugin it needs to be installed.

Then C++ Development tool for Eclipse also Known as the CDT Plugin is also need to Installed. Then Go to the OpenCV download page on SourceForge and download the latest available version. Currently it's "OpenCV-2.4.9-android-sdk.zip" Create a new folder for Android with OpenCV development. For this tutorial we have unpacked OpenCV SDK to the C:\Work\OpenCV4Android\ directory.

Note: Better to use a path without spaces in it. Otherwise you may have problems with ndk-build.

Unpack the SDK archive into the chosen directory.

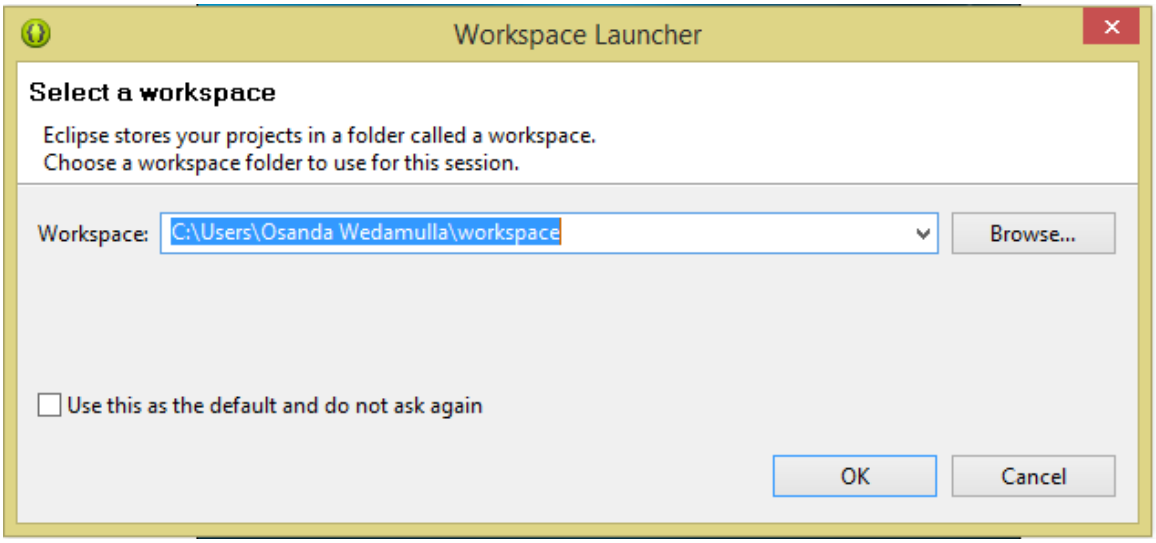
Figure 9



Then Import the Open CV Library and the Sample (samples to check if the SDK is working properly) using the following Steps. Start Eclipse and choose your workspace location.

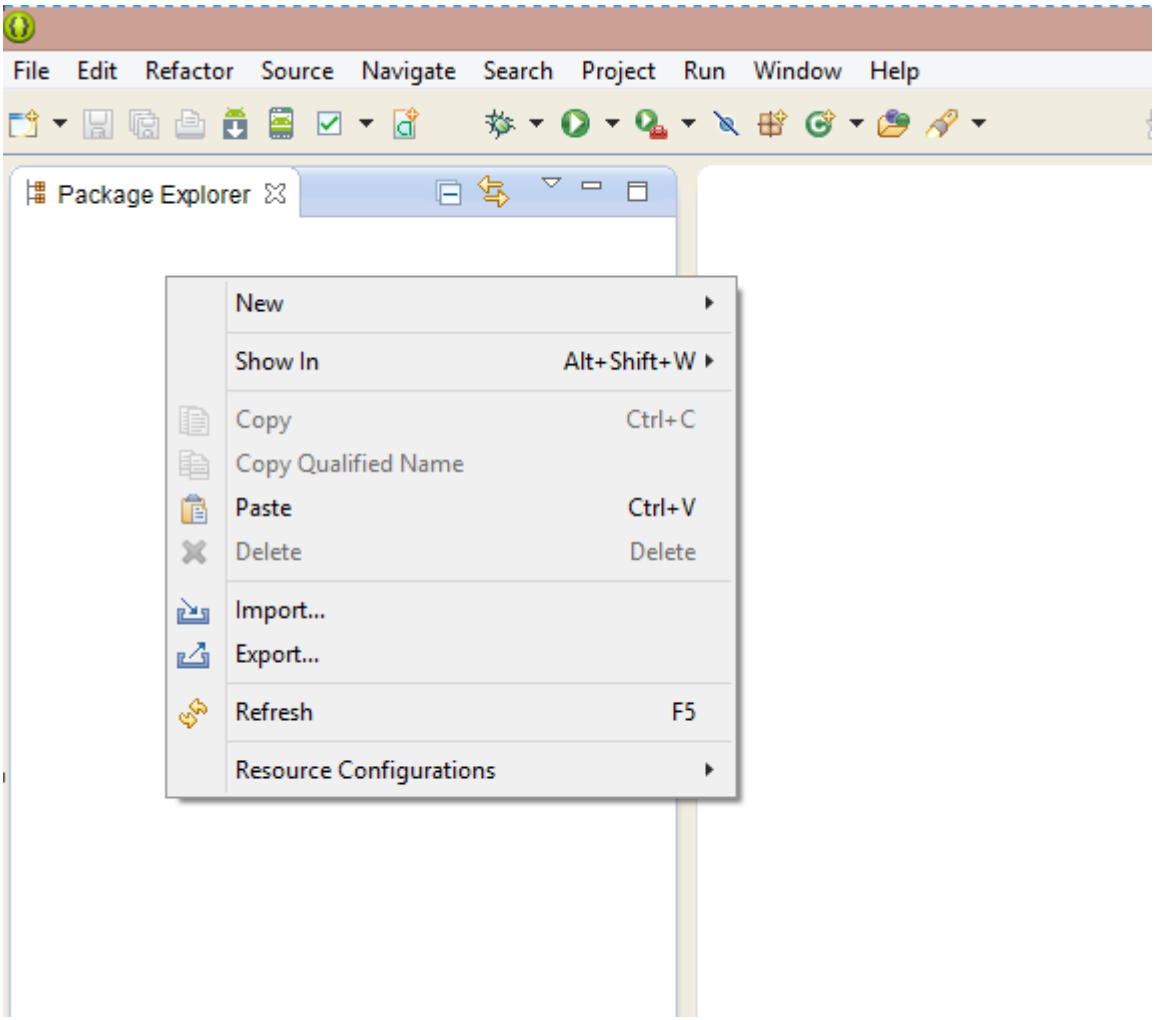
Recommend to start working with OpenCV for Android from a new clean workspace. A new Eclipse workspace can for example be created in the folder where you have unpacked OpenCV4Android SDK package.

Figure 10



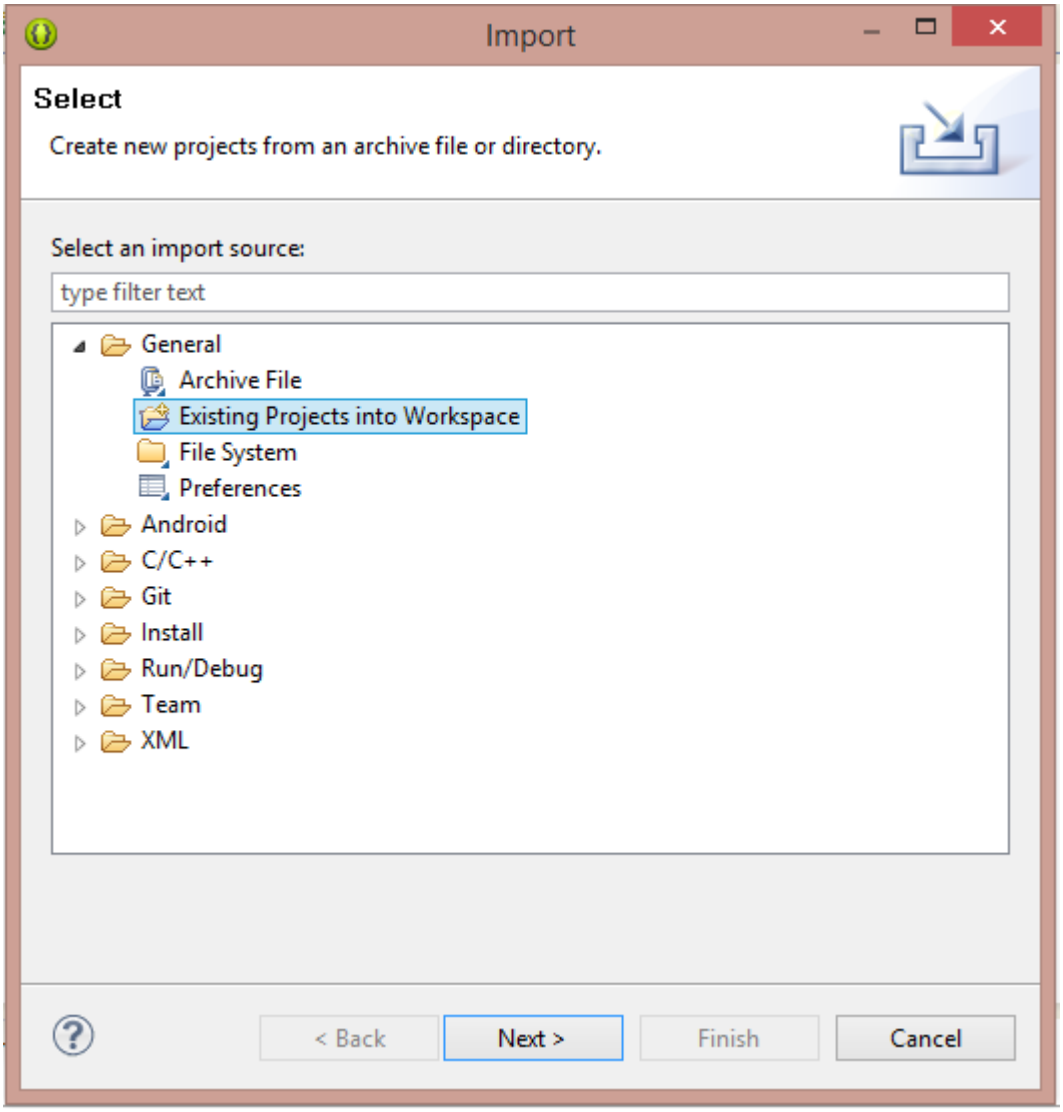
Import OpenCV library and samples into workspace. OpenCV library is packed as a ready-for-use “Android Library Project”. You can simply reference it in your projects right click on the Package Explorer window and choose Import option from the context menu.

Figure 11



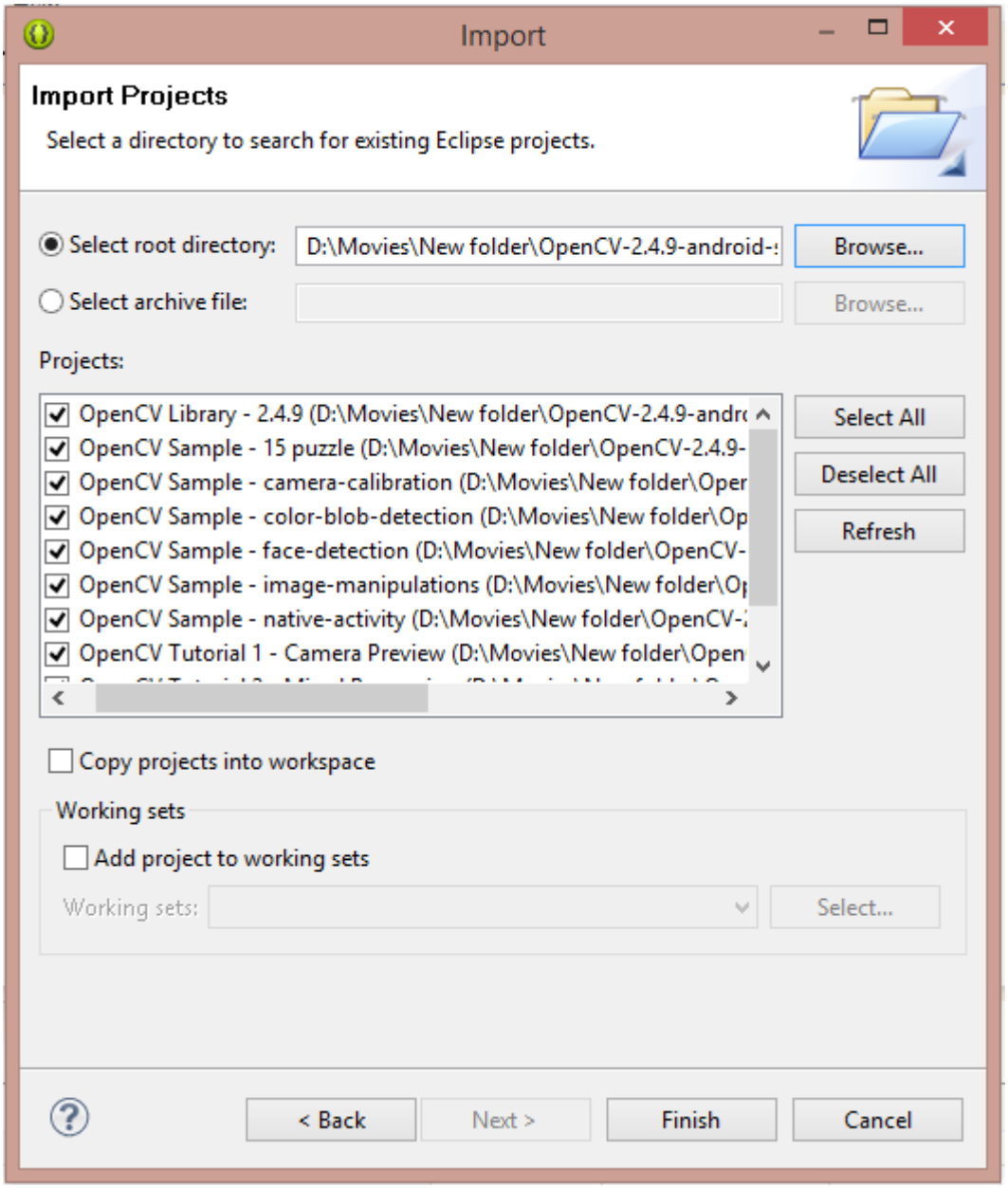
In the main panel select General Existing Projects into Workspace and press Next button.

Figure 12



After doing the above mentioned steps you will get a window like in figure 13. Then you have to browse the OpenCV SDK extracted folder and select it. Then it will show you list of libraries and sample code that you can you to develop computer vison project.

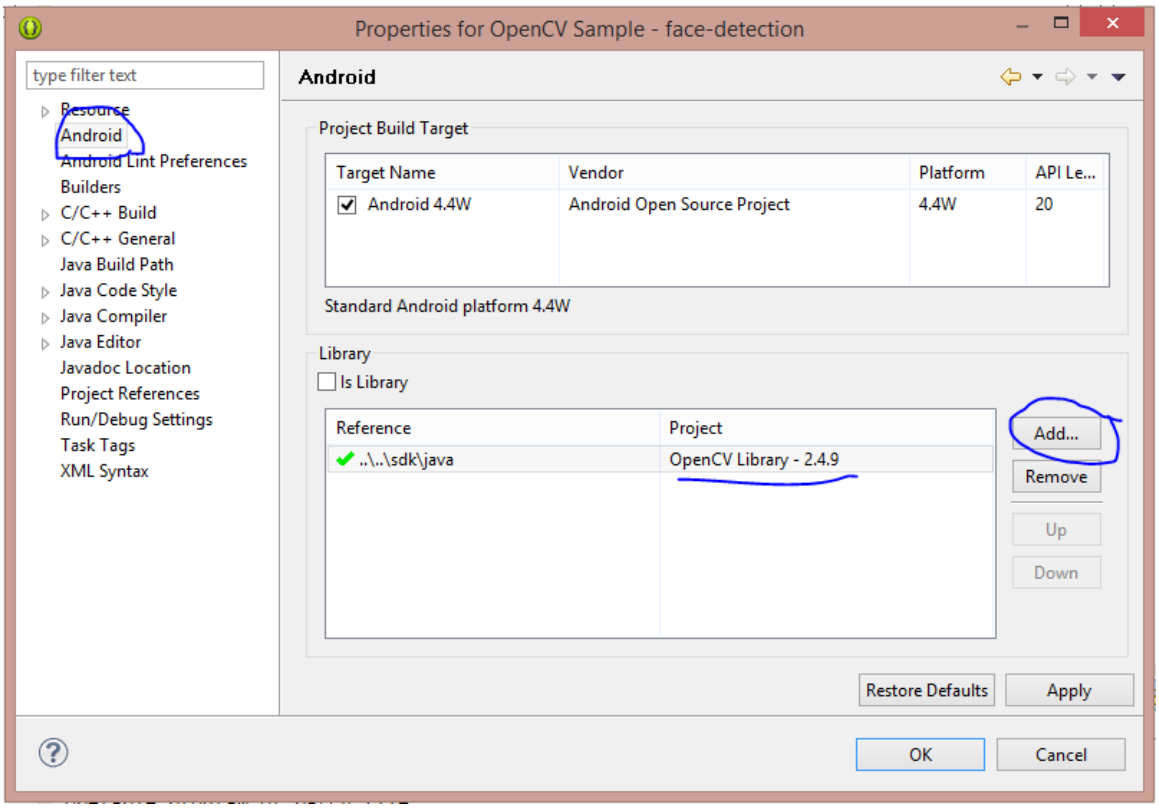
Figure 13



Select Just the OpenCV Library and Press Finish. If the OpenCV is configured OK then the library will not give any errors. If there are errors that means there are errors in the application Configurations.

If so you can import all the other applications form the above extracted folder. But there may be some errors of the applications in the sample applications and that means the Configuration is not finished.

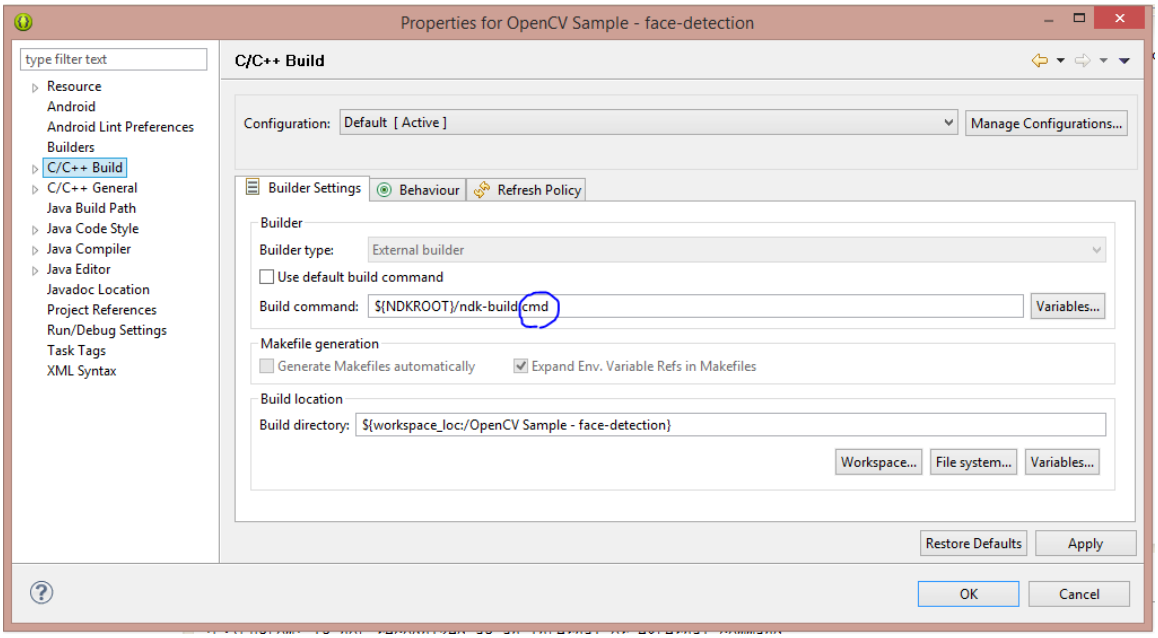
Figure 14



If there is still errors then Right Click and go to Properties of the Specific Folder and the Select the Add Button as shown in above window and add the Location of the Library. Then go to Properties and select and change the NDKROOT Directory to the Place Which the File is available. But it may still give errors for some since the some of the Versions Since some of the Libraries does not having any “ndk-build.cmd” file available If so you can find it in this link .

http://visualgdb.com/KB/?ProblemID=ndkbuild and copy it on to the Eclipse Plugins folder after that run every time the eclipse as administrator.

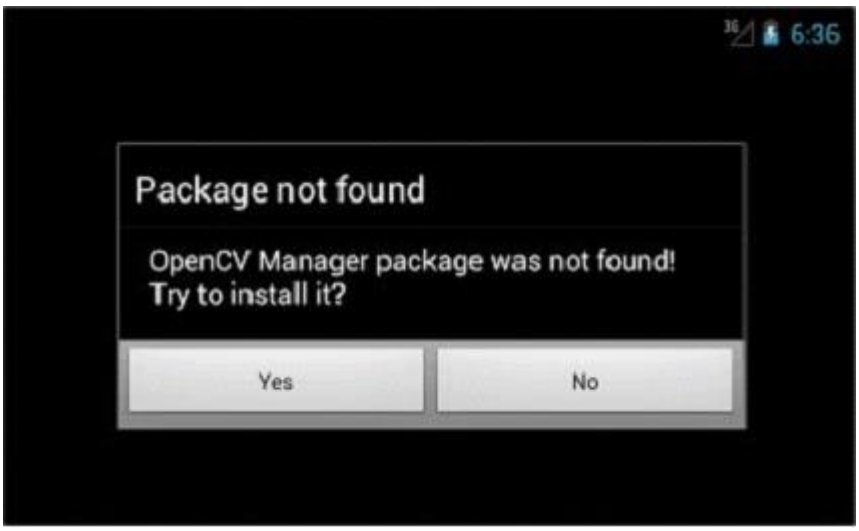
Figure 15



If you import a project successfully then you can Install the application to a device through installing it from developer mode.
For that we need to install another application in called OpenCV Manager which is also available in the android Play store as well as the Library file too.

If not after installing the app an error will give as follows.

Figure 16



When creating an app we need the permission of the camera for the application and we can gain it from adding the rights from android-manifest file

Android manifest file: Every application must have an AndroidManifest.xml file (with precisely that name) in its root directory. The manifest file presents essential information about your app to the Android system, information the system must have before it can run any of the app's code.

```
<uses-permission android:name="android.permission.CAMERA"/>
```

This will gain the permission to the camera / cameras of the devices for running in the applications in the application

```
<uses-feature android:name="android.hardware.camera" />
```

This will access the camera of the `device`

```
<uses-feature android:name="android.hardware.camera.autofocus" />
```

This will keep the camera focused at all time.

These three Permissions are compulsory for all the applications which built with camera related processing (image Processing) in an Android applications.

Apart from that the image the haar_cascade image detection files are also very useful for doing this application. These files have different versions of them available in the internet and we need to find the most suitable files and among those the suitable ones names are

Haarcascade_fronface.xml
Haarcascade_eyes.xml
Haarcascade_lefteye_mcs.xml
Haarcascade_rignteye_mcs.xml

These files become once a training material and also once a recognition device to the applications and these files are the XML files which are done under some research just to find faces and elements easily from videos and pictures. But there are more than one file available in the internet to use for image processing and the most suitable file need to use is needs to be selected from them. With the study the most accurate files which possible to use for real time face recognition is these set of files.

As seen in the AndroidMenifest.xml file this applications first executed application is the FdActivity.java file. From this file all the buttons and the video interface is made but all the processing is done in the other files.

In coding all the object oriented programming concepts are used like Use objects every time.

All the OpenCV applications are can be seen from the interface of the available OpenCV library.
Methods override and over load is done.(Polymorphism)

4.2. Exception Handling

When developing it is a good practice to handle exceptions and especially in a mobile application of image processing there is a high possibility of application crashing from in special situations like camera is not loading camera data is not tracked and even when the specific external XML file is not possible to load to the application all the exceptions are handled as given in following.

When “lbbpascade_frontface.xml” is loading for exception if it is not loaded as given in the following an exception is passed.

```
try {
            InputStream is =
context.getResources().openRawResource(R.raw.lbpcascade_frontalface
);
            File cascadeDir = context.getDir("cascade",
Context.MODE_PRIVATE);
            mCascadeFile = new File(cascadeDir,
"lbpcascade_frontalface.xml");
            FileOutputStream os = new
FileOutputStream(mCascadeFile);

            byte[] buffer = new
byte[4096];             int bytesRead;
            while ((bytesRead = is.read(buffer)) != -1) {
os.write(buffer, 0, bytesRead);
            }
is.close();
os.close();



        } catch (IOException e) {
            e.printStackTrace();
            Log.e(TAG, "Failed to load cascade. Exception thrown: " +
e);

}
```

Like that all the code the exceptions are handled.

Chapter 5

5. System Testing

5.1. Testing Methodology

Software testing aspects of the face detection and eye blinking detection application was discussed under this chapter. Accuracy of the face and eyes that are detected by the system is mainly tested in here.

Testing is carried out to ensure the system is aligned with the user expectation. Functionalities of the system were tested to improve the product quality, accuracy, usability, dependability and acceptability.

Here the main concern was to test the system with different faces. Methodology was simple. The performance of the system is tested against camera independent parameter by using two types of cameras: one who are involved in training and other who are not involved in training phase. The second parameter for checking system performance is different faces. The system was tested in an environment which has only one face and many faces as Possible. For the testing even videos and even images can be taken.

Figure 17

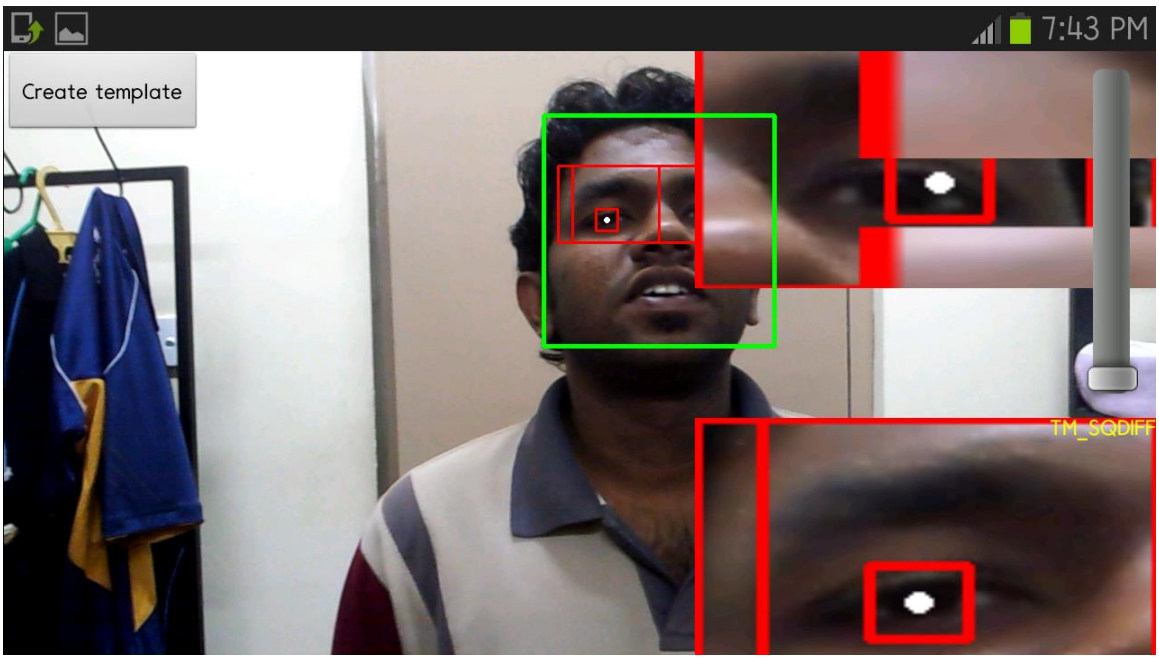
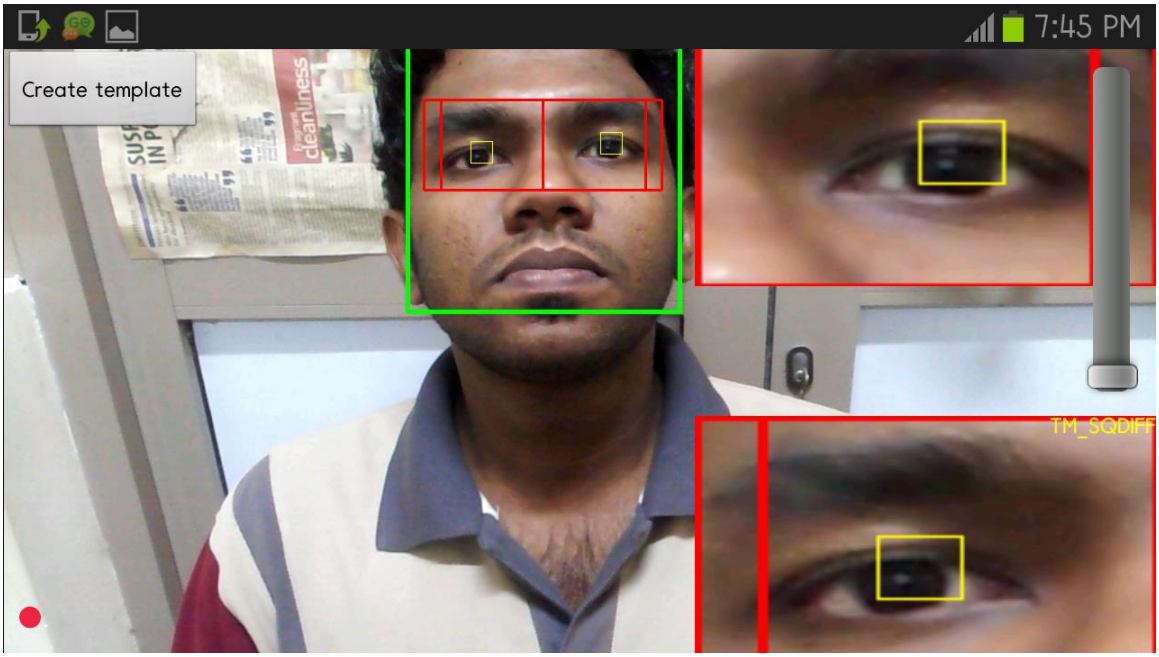


Figure 18



5.2. Test Cases and Test Results

Case 1: Detection of eyes in different devices.

Table 3

Device	Operating System	Number of Faces	Result
Samsung Note 1	Android 4.4.2	1	Good
Samsung galaxy SII	Android 4.0.1	2	Average
LG nexus 5	Android 4.4.4	1	Good

Case 2: Detection in different cameras of device

Table 4

Camera	Device	Number of Faces	Result
8MP	Samsung Note 1	1	Good
5MP	Samsung galaxy 2	2	Average
13MP	LG nexus 5	1	Good

Chapter 6

6. System Implementation

6.1. Implementation Requirements

There are two types of implementation requirement for an application.

1. Software requirement.

We can split this in to further as developer required software to implement and user required software.

From the developers perspective we need eclipse IDE to make changes in the application. By connecting an android mobile phone we can implement the app. If not we can use the android virtual device to check the application. That emulator is bundle with android SDK and we can use it freely.

Before installing the app we mad we need to download and install app called OpenCV manager after installing that we can install our app without any trouble.

2. Hardware requirement.

There is only one hardware requirement when implementing this application. That is a smart phone that has android as operating system. But there are some minimum that required to be fulfilled. Following are those,

Table 5

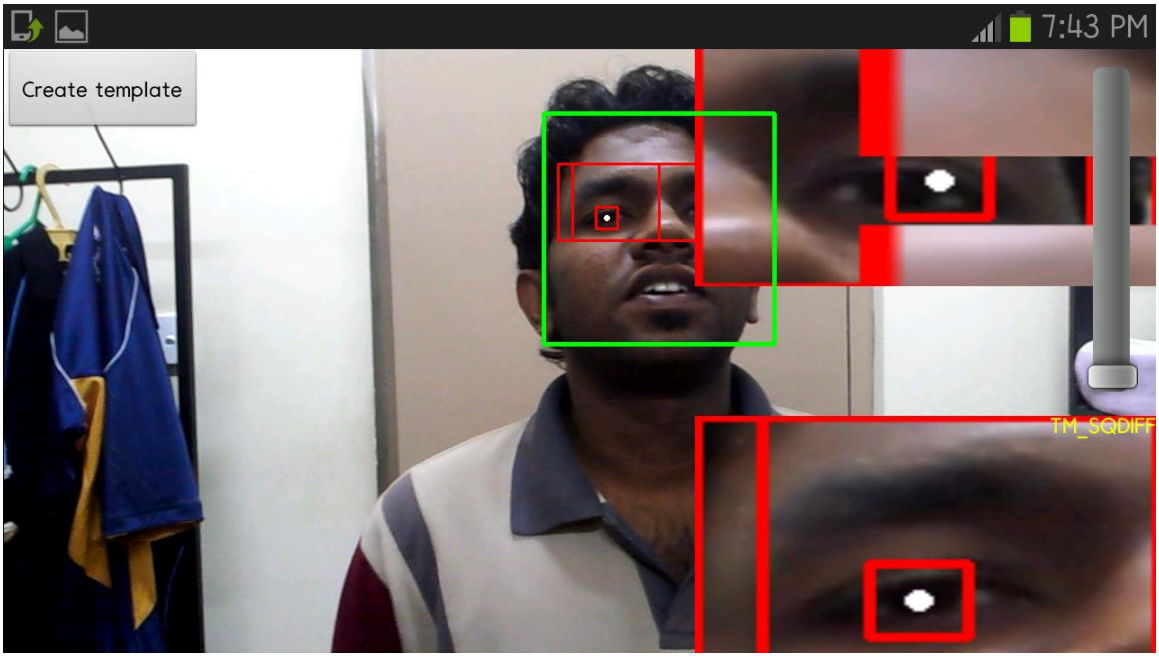
Processor(Minimum)	1GHz
RAM(Minimum)	512MB
Disk Space(Minimum)	
32bit	40MB
Camera	5MP or better

6.2. User Guide

Face and Eye detection is an Android Mobile application where you can Capture the eye blinking of the Driver or any other needed user of a Specific task on the go. In this application we can see it contain two options of capturing eye blinking on open eyes and the closing pattern of closed eyes.

In this section functionalities of the software and user commands are discussed. On Opening the application directly go to the camera view. From that the camera first detects while track a face first. Then as soon as the camera track a face it starts to recognize the eyes and takes the first template for open eye blinking tracking and detection. It will indicate the yellow rectangles with white dots. After tracking it becomes green and start tracking fatigue.

Figure 19



The captured most suitable face will start to track. If you need to change the option to closed face tracking you can go to the three dots button ( ) which is at the down right corner. Then you can go to the available options of the function and choose them as your need.

Chapter 7

7. Discussion and Conclusion

7.1. Discussion & Conclusion

This is an android app that can be used to detect face and eye blinking pattern of a human and it can be used to fulfill the expected requirement. Mainly driver fatigue can be track using eye blinking of eye pattern. In addition to that this can be used to just to detect human face. There are special circumstance that this application can be useful in occasions like examine patient with eye problem. Here eye blinking time or variations of it can be recognize by this app id this app is developed further.

7.2. The Degree of Objectives Met

Main objective of this project was to develop an application which is embedded with the capability of human Face detection and eye blinking recognition. Final product capable of tracking the human fatigue to some extend and there is a potential of developing the application to better application and more usage.

In order to fulfill this objective, compared to System requirement specification, most of the functional requirements are fulfilled. But some of them have not covered the full degree of functionality. There are some nonfunctional requirements were partially completed like connecting to the see and communicate the status to the server on the fatigue conditions of the Driver. Descriptions about those requirements are described below.

This application can track and determine the level of fatigue of the human in an efficient way in very with a less time. But there are some scenarios that the face will not recognize the eyes.

- Provide useful app that can be used or access by any smart phone that has android as the operating system.
- Issue and some kind of message when the eye blinking pattern or any deviation of human fatigue.
- Human face and eye can be detected separately without any overlap of one over another.
- Give a high accuracy when recognizing eye blinking.

7.3. Limitations and Drawbacks

Since there are no available haar_cascade.xml or image library suitable for eye detection (if use the image detection using library is making more time if we go to). Since there is a limitation of going to a high computing capable mobile device. But it makes the device more expensive and more.

Also can get rid of the above issue by building a haarcascade.xml also I suggest it as a research to do.

- Since we have wide range of mobile devices that run on android operating system we get different types of compatibility issues because each and every device run android on various custom roms except google nexus phone series.
- It is difficult to build the app to working on every phone that has android.
- Some android phones may not detect face and eyes since they have wide range of cameras and those not quality cameras.
- The app may crash suddenly when the developed API level is not compatible with the API level of the available phone. Most of the phones have older API level.

7.4. Further Modification, Enhancement and Extensions

In the further development of this android app I plan to make the app more advance by adding more support and additional functions to the system.

- This application can be developed to communicate with the servers as well as identify the faces of the users can be included to the applications. Also by adding the application as API application for mobile applications which makes the developers to make the application of human face related image processing application development.
- This application can be developed to work with an external digital camera. Instead of using the native camera on the phone we can make an option to add an external portable camera that work with the micro USB port in the phone. So we can detect the things we want from that external camera it is easy when driving.
- When the output is producing is make and warning tone or different set of images to indicate the results that expecting from the application.
- Implement this app with Wi-Fi option so that digital camera of any other necessary external device can be connected without any trouble.

8. References

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