AUTOMATED EXAMINATION INVIGILATION SYSTEM

(AEIS)

Software Requirements Specification Document

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Declaration

I hereby confirm that this is my original work and I have not copied anything from the previously completed projects without the author's consent.

(T. L. Amaradasa)

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1. Introduction

1.1 Purpose

The purpose of this document is to provide a complete description of the Automated Examination Invigilator System (AEIS). It will explain the purpose and features of the system, interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to external stimuli. This document is intended for both the stakeholders and the developers of the system. The SRS document includes a set of use cases that describe all the interactions the users will have with the software.

1.2 Scope

Automated Examination Invigilator System (AEIS) will automate the major examination invigilation operations. This document covers the requirements of Automated Examination Invigilator System for release 1.0 of June 2013. Mention will be made throughout this document of selected probable features of future releases. The purpose of this is to guide developers in selecting a design that will be able to accommodate the full-scale application.

There will be four major modules in the AIES system. The first module is a Candidate Identity Verification Module to verify the identities of candidates who enter the examination hall are valid candidates for the particular examination using face recognition techniques. The second module is the Examination Invigilation Module that automatically invigilates the examination hall using video surveillance techniques and motion detection techniques. The third module is Automated MCQ Paper Marking Module which will use optical mark recognition (OMR) techniques to mark the MCQ answer sheet with a high accuracy level. Note that AEIS system will mark MCQ results sheets only. Fourth module of AEIS system is Android based mobile application to invigilate the examination hall from mobile devices. These modules' functionality will be described in more detail in Overall Description.

The proposed AEIS is designed for use directly by Education professionals. Combining speed, precision and ease of use, AEIS enables to automate the process of invigilating the examination through this desktop application without any specific computing knowledge. Basically AEIS is the best solution to avoid the costly and time consuming process of producing, delivering, collecting and processing large amounts of data/paper work. Furthermore it will highly contribute in detecting and avoiding examination frauds and cheatings more efficiently.

1.3 Definitions, Acronyms, and Abbreviations

AEIS	Automated Examination Invigilation System.
SRS	System Requirements Specification
UML	Unified Modeling Language.
OS	Operating Systems.
AMAA	Android Mobile Assistance App.
HD	High Definition.
LAN	Local Area Network.
RAM	Random Access Memory.
LED	Light Emitting Diode.
SQL	Structured Query Language
GHz	Giga Harts
GB	Giga Bytes

Table 1: Definitions, Acronyms, and Abbreviations

1.4 Overview

The remainder of this document is two sections, the first providing a full description of the system for the users of the AEIS (Overall Descriptions). It gives an overview of the functionality performed by the product and describes the informal requirements. This is used to establish a context for the technical requirements specification in the next chapter.

The final section, Requirements Specification section, of this document is written primarily for the developers and describes in technical terms and the details of the functionality of the product. These two sections are cross-referenced by topic; to increase understanding by both groups involved. Both sections of the document describe the same software product in its entirety, but are intended for different audiences and thus use different language.

All the identified requirements were described in a homogenous structure. Also the requirements were modeled with Unified Modeling Language (UML) with suitable manner. Other than that formalization of requirements was enhanced in order to facilitate design and implementation of the platform.

2. Overall Descriptions

The rest of the SRS examines the specifications of the AEIS in detail. Section 2 of the SRS presents the general factors that affect the AEIS and its requirements, such as user characteristics and project constraints. This section does not state specific requirements. Instead it provides a background for those requirements, which are defined in section 3, and makes them easier to understand. Section 3 outlines the detailed, specific functional, performance, system and other related requirements of the AEIS. Supporting information about appendices is provided in Section 4.

2.1 Product perspective

Within the current state of art there is no similar Automated Examination Invigilator System is available. But there are automated computed based exams such as Moodle online exams, Lexis examination etc. There are also video surveillance systems used in different contexts used for many different invigilation purposes. Optical Paper Marking also can be applied for different software systems for different purposes.

Automated Examination Invigilator System (AEIS) is mainly consisted of two components which is the desktop application for the use of examination invigilator and an android based mobile application to facilitate the invigilator to invigilate examination hall while walking in the hall or from a remote destination as well.

AEIS system will use several different types of hardware components to support different functionalities within the system. The main hardware devices using through the system are High Definition Video Camera, Web camera, Wi-Fi Router and Android based Mobile devices.

2.1.1 System interfaces

The applications main interface to the system is through the .Net Framework. AEIS application uses the functions provided in the .NET framework to manipulate system resources.

Android Mobile Assistant will receive push notifications using Google Cloud Messaging [2] API and it will use Wi-Fi Direct [3] API.

API used to connect with Wi-Fi camera.

2.1.2 User interfaces

User interfaces that are used in Android Mobile Assistant Application have been specified below.

- Main Screen
- Live Stream
- Alerts
- Help Request
- Cheating
- Capture Images
- Camera
- Quality Check
- Transmit Images
- Record Audio

2.1.3 Hardware interfaces

1. High Definition (HD) camera.(roof top attachment)

2. Web cameras. (face recognition purpose)

3. Extra LED flashing devise.(camera front)

4. PCs with Windows OS.

5. Wi-Fi adapters for PCs.

6. Android Mobiles with Wi-Fi supported.

7. 17' or higher LCD monitors. (for clear & large video streaming)

2.1.4 Software interfaces

- AIES system will only supports the windows operating systems (XP, Vista, Windows7).
- Automated Examination Invigilator System (AEIS) shall interface with SQL Server 2005 as its database component.
- AIES shall interface with Emgu CV Wrapper which essentially provides an interface between OpenCV and C#.
- AEIS Mobile Application will use Android mobile platform and will only be deployed to android based mobile devices.

2.1.5 Communication interfaces

SMS communication gates need to send alerts periodically for registered examination candidates prior to each examination.

Email alerts need to send periodically for registered examination candidates prior to each examination.

When the Android Mobile Assistant notifies the AEIS that the MCQ answer sheet images are ready to be downloaded it will download the images and store in a secure location using a GSM modem [1].

2.1.6 Memory constraints

1. 4 GB RAM is recommended.

2. 1 TB hard disk is recommended for medium size server.

3. 512MB Graphic cache.

2.1.7 Operations

1. Login to Android Mobile Assistant Application

2. Stream examination hall video through the app

3. Capture images of MCQ answer sheets

4. Transmit images of answer sheets to AEIS

5. Send/ receive alerts

6. Record audio of help requests

7. Transmit audio of help requests

2.1.8 Site adaptation requirements

In order to deploy Automated Examination Automation System (AEIS)

- The running computer should be connected to a Local Area Network (LAN)
- HD Video camera Devices should be placed in the correct positions and also should be connected to the (LAN)
- Examination Environment should meet the necessary lighting requirement to fetch a quality video stream through the cameras.
- Candidate Seating position Details and other Examination Data should be pre entered in order to automate the examination invigilation process.
- For the Candidate Identity Verification, candidate's portrait photographs should be provided to the system image database Face Recognition.
- Provided photographs should meet the necessary image quality in order to effectively verify the candidate's identity.
- For M.C.Q. Marking Module correct answer data should be provided prior to begin the automated paper marking process.
- Wi-Fi router should be configured to connect to the LAN and also android based mobile device which is used to deploy the AEIS mobile application must be compatible with connecting to a LAN via Wi-Fi

2.2 Product functions

This use case diagram describes all the functions of each component and this diagram shows the relationship among actors and the use cases. In here use case scenarios are included to describe the progression of the each use case.

Android Mobile Assistant Application

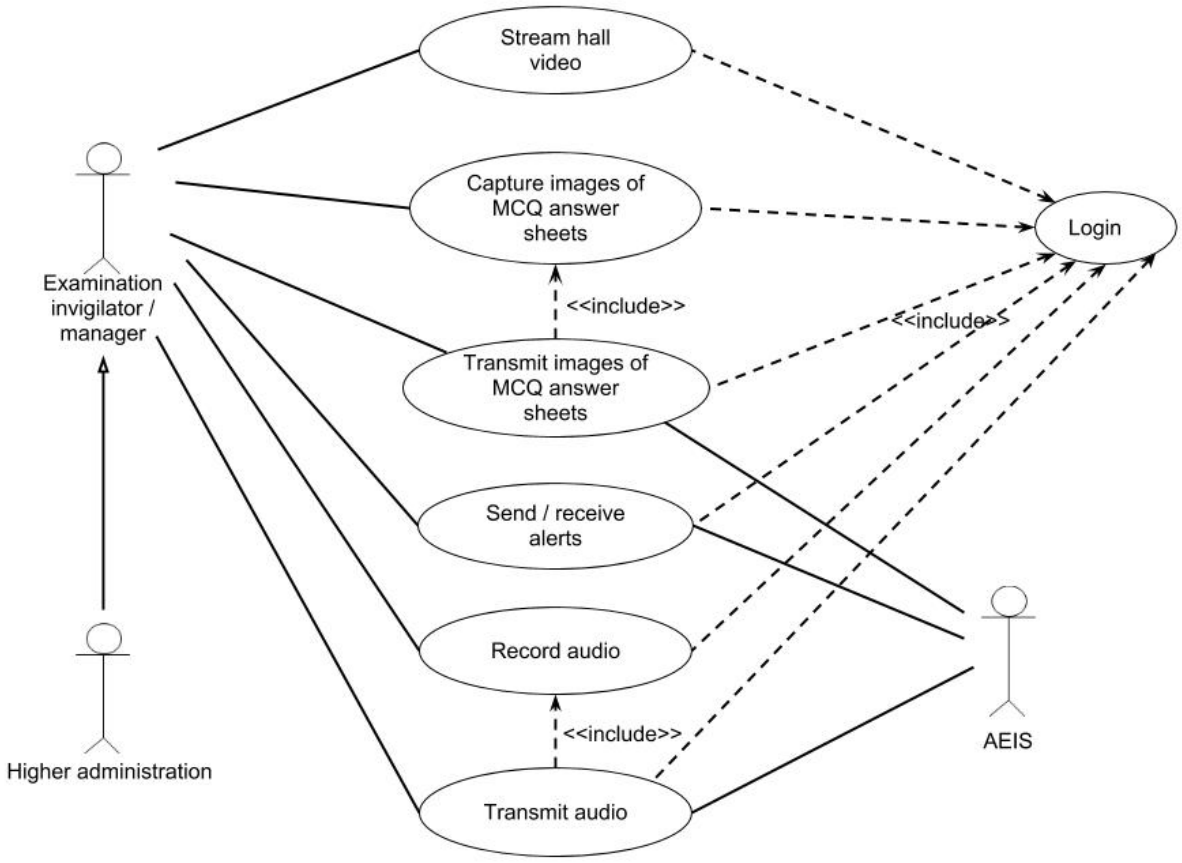

Figure 2.1 - Use Case diagram

Use case element	Description
Use case Name	Login
Primary Actor	Examination invigilator/ manager
Secondary Actor	-
Precondition	User should navigate to the login page of the app
Sequence	1.User type username and password and submit 2.Validate user 3.User is allowed to perform operations according to his priorities 4.Use case end
Post condition	User can successfully login to the app & perform operations
Extensions	1A Wrong username and password. User is prompted an error message and allowed to re-enter the pass word correctly.

Table 2.1: Use case - Login

Use case element	Description
Use case Name	Stream Hall Video
Primary Actor	Examination invigilator/ manager
Secondary Actor	-
Precondition	Login is success, User should successfully navigate to the correct page
Sequence	1. User selects to view stream 2. Access stream from the AEIS 3. Display stream 4. Use case end
Post condition	User successfully views the stream.
Extensions	1A Decline , exit

Table 2.2: Use case - Stream Hall Video

Use case element	Description
Use case Name	Capture images of MCQ answer sheets
Primary Actor	Examination invigilator/ manager
Secondary Actor	-
Precondition	Login is success, User should successfully navigate to the correct page
Sequence	1. User selects to capture images of MCQ answer sheets 2. Fill the exam information 3. Click start capture 4. Camera activity will be started 4. Use case end
Post condition	Images of MCQ answer sheets can be captured
Extensions	1A Decline , exit

Table 2.3: Use case - Capture images of MCQ answer sheets

Use case element	Description
Use case Name	Transmit images of MCQ answer sheets
Primary Actor	Examination invigilator/ manager
Secondary Actor	AEIS
Precondition	Login is success, User should successfully navigate to the correct page
Sequence	1. Transmit the images using the Wi-Fi connection to AEIS 2. Use case end
Post condition	Images of MCQ answer sheets will be sent to the AEIS
Extensions	1A Decline , exit

Table 2.4: Use case - Transmit images of MCQ answer sheets

Use case element	Description
Use case Name	Send / receive alerts
Primary Actor	Examination invigilator/ manager
Secondary Actor	AEIS
Precondition	Login is success, User should successfully navigate to the correct page
Sequence	1. Send / Receive alerts from AEIS 2. Use case end
Post condition	Users can send / receive alerts
Extensions	1A Decline , exit

Table 2.5: Use case - Send / receive alerts

Use case element	Description
Use case Name	Record audio
Primary Actor	Examination invigilator/ manager
Secondary Actor	-
Precondition	
Sequence	1. Record audio screen will be displayed 2. Use case end
Post condition	Users can record audio
Extensions	1A Decline , exit

Table 2.6: Use case - Record audio

Use case element	Description
Use case Name	Transmit audio
Primary Actor	Examination invigilator/ manager
Secondary Actor	-
Precondition	
Sequence	1.User type username and password and submit 2.Validate user 3.User is allowed to perform operations according to his priorities 4.Use case end
Post condition	User can successfully login to the app & perform operations
Extensions	1A Wrong username and password. User is prompted an error message and allowed to re-enter the pass word correctly.

Table 2.7: Use case - Transmit audio

2.3 User characteristics

High-Administrator:

Person who responsible for maintenance of the system and upgrading or change system domain information. The person must has the knowledge on,

1. Network Administration.

2. Database administration.

3. Software Architecture.

4. Camera & Hardware knowledge.

5. Better understanding on Examination process (Domain)

Ex: - Software Engineers, Network Engineers & System Architect

Administrator:

Person who can access all functionalities and is not allowed making changes on the system. The person must has the knowledge on,

1. Knowledge of using Windows based applications.

2. Database administration.

3. Better understanding on Examination process (Domain)

Ex: - Senior Lecturers

Staff:

Person who can access limited functionalities and is not allowed making changes on the system. The person must has the knowledge on,

1. Knowledge of using Windows based applications.

2. Better understanding on Examination process (Domain)

Ex: - Lecturers, Assistant Lecturers, Instructors and Reception.

Student:

Person who can access limited functionalities and is not allowed making changes on the system. The person must has the knowledge on,

1. Knowledge of using Windows based applications.

Ex: - Candidates

****Login facility should be done by the staff. Candidate never allowed using Login information. (User-name & Password)*

2.4 Constraints

AEIS shall operate on PCs running Windows XP or later windows operating system which the speed is higher than 2.4 GHz.

Wi-Fi range of the router will limit to only 100m and invigilator will not be able to use Android client application outer from this range.

AEIS System will need .NET framework to operate on invigilators system.

AEIS system will work only with Microsoft SQL server database management system as its database component.

HD video camera will generate video stream which is clear enough for the system operations within 15m range. Examination halls with a length more than 15m will not be invigilated meeting the expected accuracy.

Examination hall should be maximum 10m wide to be covered from a single HD video camera.

Network data transfer rate should be higher than HD video camera data transfer rate (40 Mbit/s)

Examination hall should not have any obstacles within the camera range. Otherwise faulty results will be generated.

For testing purposes sample videos will be used since using live streams of examinations for testing is not practical.

2.5 Assumptions and dependencies

AEIS will run only on a machine with Windows based operating system.

Assume that network connection is always in upstate, because –

- Live video stream must be streamed over to the AEIS.
- MCQ answer sheets transmitted by Android Mobile Assistant should be downloaded.
- Send emails to candidates.

2.6 Apportioning of requirements

It is possible in the future that a few additional features be implemented into this system.

1. Automatically read data from filled candidate registration forms and add them to the AEIS using Optical Character Recognition (OCR) techniques

2. Online registration of candidates

3. Setting up cameras for each candidate table to observe them individually.

3. Specific requirements

3.1 External interface requirements

3.1.1 User interfaces

The user interface of the application is kept simple and user-friendly as it is used in the examination invigilation process.

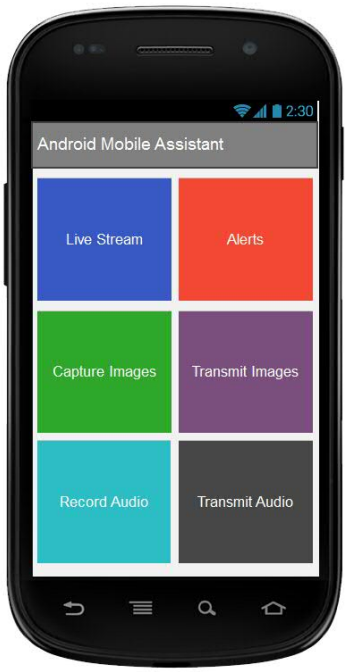

Figure 3.1 - Main Screen

This is the main screen of the Android mobile application. Users can access all the functions through main screen. Live stream, Alerts, Capture images, Transmit images, Record audio and Transmit audio are the main functionality of the app.

Figure 3.2 - Live Stream

Live stream of the AEIS examination hall video will be displayed here in a player with all the relevant details of the examination such as Exam no, Hall no, No of Participants. Users can change the video settings as required. Video can be displayed in full screen mode also. Users can detect any suspicious or help request activities using this interface.

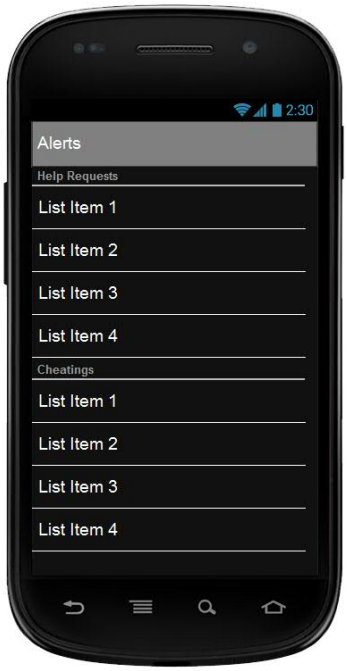

Figure 3.3 - Alerts

Alerts those were received from the AEIS desktop application can be listed down here. The list is divided in to two sections called Help requests and Cheatings. Help requests section contains all the help requests of the candidates and cheatings section contains all the suspicious activities of the candidates. By clicking any of the list item users will be taken to relevant alert details view.

Figure 3.4 - Help Request

Help request details will be displayed in this view such as alert id, alert type and the respective candidate ID.

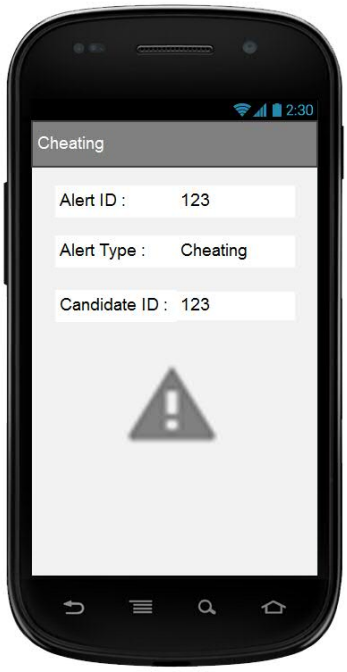

Figure 3.5 - Cheating

Cheating details will be displayed in this view such as alert id, alert type and the respective candidate ID.

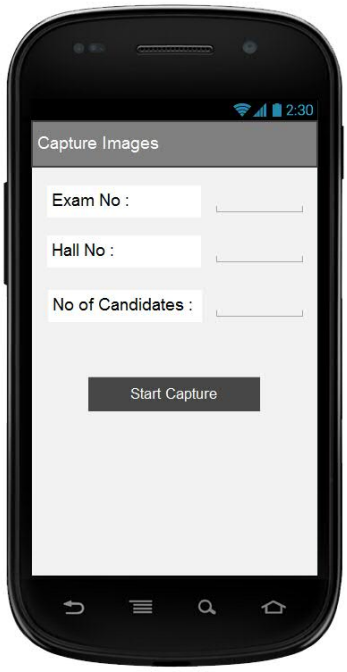

Figure 3.6 - Capture Images

MCQ answer sheet images can be captured using this interface. Before starting the capturing process some details must be filled out such as exam no, hall no and no of candidates. According to these details a unique directory will be created in the sdcard. This folder will be used to store the captured images for that particular examination. After clicking on Start Capture button user will be taken to Camera interface.

Figure 3.7 - Camera

Images will be captured using the camera interface.

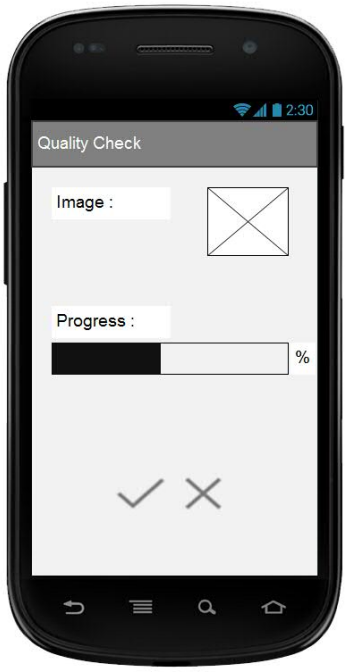

Figure 3.8 - Quality Check

The quality of the captured image will be checked using an algorithm and only if the image is in expected quality the next capturing will take place, otherwise user will be informed to recapture the previous image.

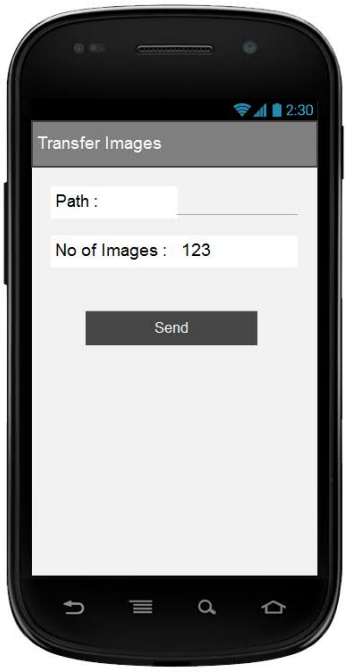

Figure 3.7 - Transmit Images

All images that were captured from the MCQ answer sheets of a particular exam will be transmitted to the AEIS desktop system through this interface. User has to specify the particular path to be sent and the number of images will be populated dynamically. When press the send button the images will be sent to the AEIS.

Figure 3.8 - Record Audio

Special help requests of candidates can be recorded as audio and sent to the higher administration through this interface. Start button will start the recording and stop button will stop the recording and when user press the send button that audio will be sent to the higher administration.

3.1.2 Hardware interfaces

1. High Definition (HD) camera. (roof top attachment)

2. Web cameras. (face recognition purpose)

3. Extra LED flashing device. (camera front)

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When the Android Mobile Assistant notifies the AEIS that the MCQ answer sheet images are ready to be downloaded it will download the images and store in a secure location using the Wi-Fi connection.

3.2 Classes/Objects

The class diagram below represents the important classes implemented for the Android Mobile Assistant Application with their operations. The diagram also shows how each class is associated with other classes in the system. Each activity is represented as a class and the functions associated with the class are represented within.

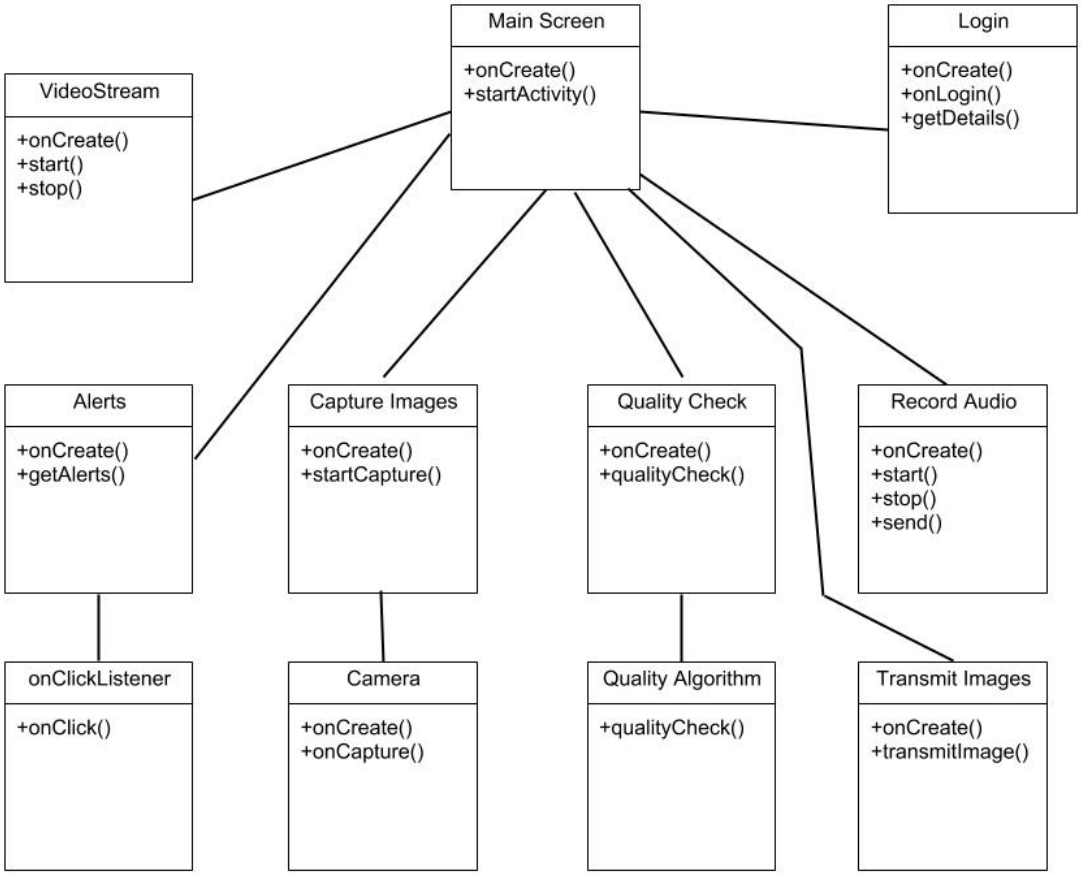

Figure 3.9 - Class Diagram

3.3 Performance requirements

A performance requirement is the extent to which a function must be executed, and is generally measured in terms of quality, quantity, coverage, timeliness or readiness. The performance of the application will be measured using speed, capacity and scalability.

AEIS is based on image processing. In Candidate Identity Verification process the captured images of the candidate should be processed in high speed as the user is going to see the processed results within very short time.

Since the invigilation is based on the examination hall video stream it must be real time, it might have a minimum delay as possible.

The system should have enough capacity to store MCQ answer sheets.

3.4 Design constraints

The examination hall video stream needs to be in high quality as it is used in the invigilation process to identify candidates. The examination hall light condition should be moderated.

The system needs several images of the candidate to be used in Candidate Identity Verification process. These images need to be captured using high quality camera which is a high cost.

In that case the total cost for the project would be increased.

3.5 Software system attributes

3.5.1 Reliability

All data storage for user variables will be committed to the database at the time of entry.

3.5.2 Availability

The system shall be available during normal hotel operating hours. All cached data will be rebuilt during every startup. There is no recovery of user data if it is lost. Default values of system data will be assigned when necessary.

3.5.3 Security

The PC on which the AEIS resides will have its own security. Only the invigilator will have physical access to the machine at the time of the examination.

Data Entry Operators will be able to log in to the Candidate Registration Module. Examinations Invigilators and Managers will have access to the Examination Invigilation Module, Android Mobile Assistant and Automated MCQ Marking Module. Higher Administration will have access to the all the subsystems. Access to the various subsystems will be protected by a user log in screen that requires a user name and password.

3.5.4 Maintainability

Object oriented programming is followed to develop the AEIS and shall be easy to maintain.

3.6 Other requirements

Simplicity

All the activities of AEIS system should be designed in a simple and in a way of anyone can easily understand to operate or to work with.

References

[1] What is a GSM Modem?, Nowsms [online] http://www.nowsms.com/faq/what-is-a-gsm-modem ,(Accessed : 10 February 2013)

[2] Google Cloud Messaging for Android, Android Developers [online] http://developer.android.com/google/gcm/index.html,(Accessed : 18 February 2013)

[3] Wi-Fi Direct, Wikipedia [online] http://en.wikipedia.org/wiki/Wi-Fi_Direct, (Accessed: 16 February 2013)