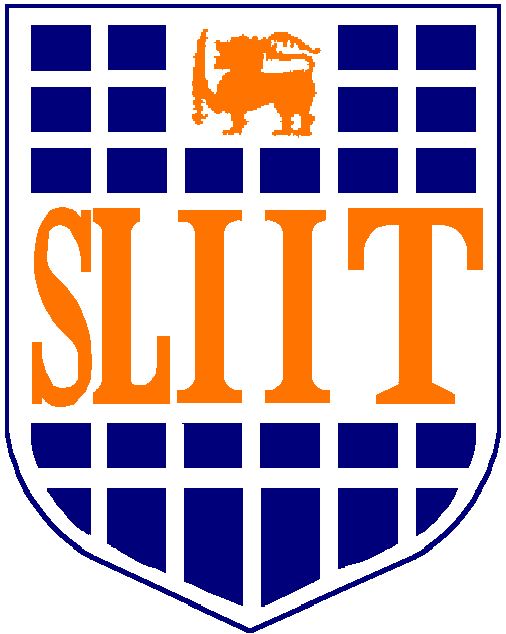
**Automated Examination Invigilator System**

(Project ID…………..)

**Project Proposal Report**



Bachelor of Science (Special Honours) in Information Technology

Sri Lanka Institute of Information Technology

28ndFebruary 2013

**Automated Examination Invigilator System**

**Project Proposal Report**

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| --- | --- | --- | --- |
|  | **Name** | **Student ID** | **Signature** |
| 1. | B.L.S. Deshan | IT 10 1602 44 |  |
| 2. | K.U.S. Madanayake | IT 10 1907 08 |  |
| 3. | R.M.G.S. Rathnayake | IT 10 1504 12 |  |
| 4. | T.L. Amaradasa | IT 10 0005 40 |  |

**Project Supervisor:** Mr. Chathuranga Manamendra

**Project Co- Supervisor:** Mr. Buddhika Hasantha Kasthuriarachchy

Bachelor of Science (Special Honours) in Information Technology

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**Abstract**

*Automated Examination Invigilator System (AEIS) is focused on automating the examination process and minimizing the difficulties faced by examination invigilators as well as candidates of the examination. The proposed system applies face, eye and motion detection techniques to automate some of the most important tasks in the examination process starting from registration of candidates till the marking of answer sheets.*

*Initially, candidates of the examination will be registered in the system along with their portrait images which will be used later on to validate the identity of each candidate. Before entering into the examination hall all the candidates are identified as valid or invalid candidates by using the face detection techniques. The main purpose of this facility is to avoid examination frauds. Throughout the examination, AEIS will observe the motion detections of all the candidates in the examination hall in a single view. The system has the capability to identify candidates separately as candidates who need some kind of help from the invigilator or candidates who are trying to do cheatings at the exam. As there are some limitations of the vision of human eye, and as the speed of detecting motions of several candidates immediately varies from one human to another one, the proposed AEIS will be more keen and productive in performing these tasks. Finally, AEIS is also capable of marking MCQ answer sheets automatically and auto generating the results sheet per each candidate. It will reduce the amount of time taken to mark the answer sheets so that the exam-marking process could be completed within a couple of days.*

*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.*

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# Introduction

## 1.1 Background

Automated Examination Invigilator System is focused on automating the examination process and minimizing the difficulties faced by examination invigilators as well as candidates of the examination. The proposed system applies face, eye and motion detection techniques to automate some of the most important tasks in the examination process starting from registration of candidates till the marking of answer sheets.

Initially, candidates of the examination will be registered in the system along with their images which are used later on to validate the identity of each candidate. This is the starting point of the examination process and here all the candidates’ details will be stored in the system. After completing the above step successfully the candidate can be known as a registered user for that particular examination. Capturing the images of the candidate is one of the most important tasks in order to identify the candidate later. Before entering into the examination hall all the candidates are identified as valid or invalid candidates through face detection techniques. For this step the images that were taken at the registration time will be used in order to verify candidate’s identity and then recognize the person as a valid or invalid candidate. The main purpose of this facility is to avoid examination frauds. The right candidate will be facing the right examination as a result of introducing this face recognition feature in the system. Throughout the examination time period the AEIS will observe the motion detections of all the candidates in the examination hall. The proposed system is capable of identifying them separately as candidates who need some kind of help or candidates who are trying to do cheatings at the examination. This is one of the important aspects of the proposed system as the candidates who really need help and candidates who are cheating can be identified separately using the system. This process is currently done by the invigilators manually and is not accurate as well. Finally, AEIS is also capable of marking MCQ answer sheets automatically and auto generating the results sheet per each candidate. This will reduce the time taken to mark the examination papers and results can be released earlier than using the manual marking method which is currently in practice. An Android application for invigilators will be also part of the proposed system. By introducing this new concept of mobile app for the invigilators the invigilation process will be easier for the examination invigilators as they need to move a lot during an examination. As mentioned above the system applies various techniques to perform the automation of the main tasks of the examination process which are currently done using the traditional manual methods. Basically image processing techniques will be heavily used in the system. The main goal of the proposed system is to make the examination process more secure and efficient.

In modern age, Information Technological advancement has minimized the whole world as places far away have come closer, thanks to technology. Advancement of technology provides the easy way for faster and secure communication, which also enhances the economy and the profit of different types of businesses. The impact of information technology can be seen everywhere in today’s world. With the use of advance technology, transaction became faster, accurate and more effective. As time passed by computers became more useful for every transaction being made.

Educational institutions are one of the organizations that should be equipped with advanced technology, because in these institutions many transactions are made frequently such as examinations, assessments and keeping track of records using manual ways which are not very efficient. New and rapidly improving technologies are in the process of transforming higher education. Therefore technology can also help to make education a much more interactive and collaborative process than the traditional process.

Examinations play a major role in the educational process. The traditional examination and assessment process faces lots of difficulties and problems due to the current systems which are being used. Both examination invigilators as well as candidates of the examination face these difficulties. Some of the problems are burdensome paperwork, the manual procedure used for conducting exam is time consuming process and error prone due to human limitations, and candidates have to wait for a long time to get the feedback because invigilators have to do the marking manually. But moving to an automated system will overcome all the above and many more limitations while providing more efficient and effective way of doing it.

An invigilator is the person who supervises students during an examination. There are lots of duties that have to be performed by an invigilator during the examination process. Nowadays most of this work is done manually by the invigilators themselves. It is less effective and lots of problems occur because of this traditional method of doing all these responsibilities by the invigilators.

The proposed Automated Examination Invigilator System (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.

According to our literature survey no research projects have been carried out specifically regarding the automation of examination invigilator process. But there were researches on other areas of examination such as examination scheduling problem. Automated Invigilator Assignment System [1] which was created as a solution for the examination scheduling problem is an example. This will be the maiden research and solution for the examination invigilator process which covers all the problem areas.

Nowadays lots of technologies have emerged in the area of image processing in order to solve various problems.

Following mentioned state-of-the-art methods and techniques are supposed to use during the project

* Optical mark recognition (also called optical mark reading and OMR) is the process of capturing human-marked data from document forms such as surveys and tests. [2]
* Human Face Recognition - Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images. It detects facial features and ignores anything else, such as buildings, trees and bodies. [3]
* Motion Detection (e.g. Eye Detection, Hand Gesture Recognition)
* Android Technologies – Wi-Fi Direct, Google Cloud Messaging

Following goals are expected to achieve through implementation of AEIS

1). Reduce the time taken for the overall examination from start till the end of the process

The current manual process of examination will be replaced by the AIES system and therefore the total time that will be spent on the examination process can be easily reduced as it will automate most of the steps in the examination process from starting till the end. This will save a lot of resources that were used for the current manual process.

2). Avoid impersonation of examination candidates

Impersonation of examination candidates can be avoided using the proposed system. It is difficult to avoid impersonation using the manual system.

3). Avoid examination malpractices

Examination malpractices take place in various forms during an examination and can be easily avoided using the proposed system as it can monitor each and every candidate’s behavior at the time of the examination. This will be more useful for the invigilators and it will assist them in identifying examination malpractices.

4). Increasing the user friendliness of the examination process

By the introduction of all time observation of the candidate’s behavior the requests for help by the candidates can be easily detected and responded. By this the user friendliness of the examination process can be increased.

5). Improve the accuracy in paper marking

Automating the MCQ paper marking will increase the accuracy of the marking process and increase the efficiency as well. Current manual process of paper marking is less accurate and the error rate can be very high. Therefore AEIS will increase the accuracy of paper marking.

## 1.2 Research Problems

### 1.2.1 Considerable amount of time taken to verify the identity of the candidates

In the process of invigilating the examinations, verifying the identity of the candidates is a mandatory task. Currently, at most of the government examinations National Identity Card (NIC) is the unique identifier used to verify the identity of the candidate. During the examination the invigilator has to collect NIC’s from all the candidates under his supervision and manually compare the details of the candidate with the NIC details, the details available in the candidate’s admission and the candidate details provided by the Department of the Examinations. This process consumes a considerable amount of time as it has to be done completely manually by the invigilator. Since the NIC’s and Admissions are collected from the candidates during the examination it will bring about disturbances to the candidates. Also while the invigilator is involved in this identity verification process, he may not be able to swiftly response to the candidates who are in need of additional materials or any instructions.

### 1.2.2 Impersonation

Impersonating is a situation where another person is trying to attend the examination instead of the real candidate [4]. This is also another major problem experienced at the examinations as the invigilator may not know the real candidate prior to the examination and maybe the very first time of seeing the candidate would be in real time at the examination. Therefore it is very difficult to avoid impersonation in the manual process.

### 1.2.3 Tracking attendance manually, consumes considerable amount of time

Tracking attendance of the candidates is also another problem which consumes a considerable amount of time. Currently the process of tracking attendance is done as a paper based work. The department of Examination will provide a list of names of the candidates assigned to a specific examination hall and their registration numbers to the invigilator. He has the responsibility of ensuring that all the candidates have put their signatures properly in the attendance sheet. At most of the time this process is also performed during the examination, so that the valuable time of candidates will be wasted uselessly. Further there is no efficient way of tracking the in and out times of the candidate when entering into the examination hall and when leaving the examination hall.

### 1.2.4 Ensuring that candidates are seated according to the set seating arrangements

Before commencing the examination, finding the correct seats allocated for all candidates in a particular examination hall and ensuring that the all are seated according to the arrangement is another major responsibility of the invigilator. At most of the time finding the correct seat allocated for a particular student is much confusing as there is no efficient solution used at the present. The invigilator has to refer to the list of candidates assigned to that particular examination hall to make sure the examination hall, to which the candidate is assigned and then discover the correct seat of the candidate by manually checking the available free seats. This may causes in commencing the examination at the desired time. Once each candidate is seated, the invigilator must check that each candidate is sitting in the correct desk, by checking each candidate’s name against his/her registration number. (Attendance Register) [6]

### 1.2.5 Avoiding examination malpractices

The incidence of examination malpractice is multi-dimensional in nature. Leakage of examination papers, Smuggling of prepared notes into examination hall, external assistance, copying, and smuggling of foreign materials substitution of script and improper assignment are some of the common ways used to cheat at examinations [5]. Most of the time examination malpractice is coupled with dishonesty. Pupils and students devise as a daily routine, new tricks to beat genuine supervisors and examiners. Currently this has become a growing concern since cheating is such a longstanding and global problem inherent by human beings [5]. Therefore there are so many difficulties in identifying and controlling cheating behaviors at the exams. The occurrence of examination malpractice at any level of educational possess the greatest threat to the validity and reliability of any examination and consequently to the authenticity and recognition of certificate issued [5].

### 1.2.6 Respond promptly to candidate requests

The invigilator has the responsibility to supervise candidates in a quiet and unobtrusive manner and respond to candidate’s queries promptly and distribute additional paper/equipment immediately as required. Several candidates may make requests at once, for exam-specific instructions, for a graph paper and any other additional materials, permission to use devices such as calculators. But a single invigilator cannot notice all candidates’ requests in a one sight and serve them all immediately. May be he has to go several times to collect required materials and thereby it may lead to generate delays in responding to candidate requests promptly [4].

### 1.2.7 Keeping constant watch on candidates throughout the examination

The invigilator is required to keep constant watch on candidates and walk around the room, sitting both at the front and the back of the room throughout the examination to avoid examination malpractices and to identify immediately the candidates who needs instructions or additional examination materials. Invigilators may not write, read or knit as usual invigilators are used to do at exams [6].

### 1.2.8 Maintaining efficient time keeping

A large wall clock and/or black board must be provided. If a clock is used, candidates must be verbally told as each half-hour passes. If a board is used, chalk will be required and the time must be marked off in half-hours and these crossed out as the time passes. Candidates must be verbally told as each hour passes and when they have 30 minutes left [6]. When there is only one invigilator assigned for the entire examination hall it may be very difficult to handle all the aspects of invigilating efficiently and effectively.

### 1.2.9 Inefficient and inaccurate marking of MCQ papers

It is very difficult to maintain consistency and accuracy in the marking of Multiple Choice Question (MCQ) answers with so many limitations. It consumes a lot of time to mark the papers manually and requires human resources significantly to perform the marking of papers. The cost engaged in this process is also very high. Degree of accuracy is very less and the error rate can be very high due to the illusion of human eye when following the same pattern of answers for a long period of time. This situation becomes even more complicated when the number of answer sheets to be corrected is a very large amount.

# 2.0 Objectives of the Project

## 2.1 Research Questions

* How to implement face authentication of the applicant accurately accommodating inter-class similarity, intra-class variability and different illumination conditions in real time through a live stream?
* How to train the system to recognize a raising hand using hand gesture recognition in the live stream and how to deal with multiple hands effectively at the same time?
* How to develop an algorithm to differentiate examination frauds and normal activities using motion detection and how to assign a severity level for suspected activity based on different criteria with different weights?
* How to transfer captured images from an android mobile client to server through Wi-Fi network?
* How to obtain a live stream video from an android mobile client through Wi-Fi network?
* How to develop and enhance the captured of exam answer sheets and normalize it before further processing?
* How to develop an effective algorithm for locating optical marks in a given image and process the image accurately?

# 3.0 Methodology

## 3.1 Methodologies for main modules of the project

### 3.1.1 Registration of candidates

Registration of candidates is the initial step of the Automated Examination Invigilator System (AEIS). To get registered for a particular examination with the use of AEIS, candidates are required to attend to the Registration of Examinations Unit. They are provided with a fresh registration form to provide their correct personal and academic details as below:

* Full Name of the candidate
* Name with the initials
* Title
* Gender
* Citizenship
* National Identity Card Number (NIC No.)
* Date of Birth
* Permanent address
* Contact Numbers
* Academic Course name
* Subjects
* Payment Details (if any)

Candidates are required to duly complete the above registration form and submit it to the Coordinator of the Examinations / Examinations Manager. The Coordinator / Manger will check all the details and if the applicant is eligible to sit for the exam the registration form will be approved or otherwise rejected. Then the Data Entry Operator at the Registration of Examinations Unit will check the approved registration form data and add them to the AEIS. The system will check whether that particular candidate has been registered with the AEIS before. If the applicant is already registered with system his/her new application for registering for the examination will be disregarded.

As a further development to this module the data can be automatically read and added to the AEIS using Optical Character Recognition (OCR) techniques. To serve this purpose a standard registration form should be designed so that the information filled by the applicant in handwriting can easily recognized by the OCR module. It is suggested to use an Image Scanner to obtain the scanned image of the registration form and transfer it to the AEIS. The Registration module of the AEIS will retrieve the data from the scanned image and automatically add them to the system. While the data insertion of the candidate is performed by the AEIS the candidate is referred to take portrait photographs in several predefined angles because the number of portraits of candidate is directly proportional with the accuracy rate of face recognition. These photographs will be added to the system and will be used in the Candidate Identity Verification module later on to verify the identity of the candidate before commencing an examination. All the data inserted into the Registration module will be validated at the time of insertion.

After a successful data insertion, the Data Entry Operator will confirm the registering of the candidate. The system will auto generate an Examination Admission Number for each candidate record inserted to the module. Then the applicant is referred to perform a test with the Candidate Identity Verification module to check whether that the AEIS is capable of identifying the particular candidate and verify his/her identity. After completing all the above steps successfully finally an Admission Slip will be auto generated by the system in a printable format, including all the examination details such as Registration number, Examination date, venue, time and any other information regarding the examination.

### 3.1.2 Send SMS for examination candidates prior to each examination

After successfully registered for an exam candidate is given an Admission slip with all the details of the relevant examination. Other than that prior to each examination a text message containing details of the examination (Subject, Admission No, Date & Time, Venue, and Examination Hall No.) will be sent to each candidate’s mobile phone via Short Message Service (SMS). We have to integrate a GSM modem [16] with the desktop application and use that for automatically send SMS to the registered candidates prior to each exam. For that a suitable GSM modem should be chosen. Scheduling the SMS sending functionality is also required as candidates will be sent the SMS prior to each examination. Scheduled tasks will be used to implement this feature. All the examination details relevant for each candidate must be retrieved from the database. These details will be formatted in a well-structured way and the SMS content will be generated. Candidate’s mobile phone number will be also collected from the records. Then the content will be sent to the candidate’s mobile phone as a SMS.

### 3.1.3 Send Email to examination candidates prior to each examination

Other than the SMS reminder prior to each examination an email containing details of the examination (Subject, Admission No, Date & Time, Venue, and Examination Hall No.) will be sent to each candidate. A common email template should be created in order to use for all the emails. A HTML template will be suitable for this. All the examination details relevant for each candidate must be retrieved from the database. These details will be placed in the email template and the email content will be generated. Scheduling the email functionality will be done in order to send the email prior to each examination to the candidate. For that SMTP (Simple Mail Transfer Protocol) [17] will be used to implement the email functionality of the desktop application.

### 3.1.4 Candidate Identity Verification

The latter part of the candidate registration process is verifying the identity of the registered candidates using the data stored in the image database. In Automated Examination Invigilator System (AEIS), there are few events to handle to identifying the candidates. The First one is identifying the candidate using face recognition techniques. The proposed project consists with face recognition techniques of two types. Both methods are using simultaneously to enhance the accuracy of the face recognition process. Those techniques are “Face Recognition Using Eigen faces”[12] and “Face recognition using line edge map” [13]. First face recognition techniqueis based on the Karhunen-Loève transformation using eigenfaces [12] for recognition. Second face recognition techniqueapplies a new algorithm using line edge maps [13] to improve the previous methods such as the eigenfaces. Current face recognition techniques can be categorized in to two main categories.

1. Geometric approach
2. Feature-based characteristics. [14]

#### 3.1.4.1 Face recognition using eigenfaces [12]

The algorithm extracts the relevant information of an image which is captured by a high quality web camera and encodes it effectively. In this approach, a set of images of the same person, which stored in AEIS image database will be retrieved and then will be evaluated to identify the variation. Mathematically, using an algorithm calculates the eigenvectors of the covariance matrix of the set of face images [14]. Each image taken from the set will be forwarded to an eigenvector. These vectors characterize the variation between the given images. When we represent these eigenvectors, they are concerned as eigenfaces. Every human face can be represented as a linear combination of the eigenfaces. Also we can reduce the number of eigenfaces to the ones with greater values, and then we can do the recognition part in a high efficient manner.

The basic idea of the algorithm is to develop a system that can compare not images themselves, but the above mentioned feature weights. The above mentioned algorithm can be explained using few simple steps as follows,

1. Retrieve or extract the relevant images of faces from the AEIS image database
2. Continue with calculations of the eigenfaces.
3. Understand and determine the face space with all them. It will be great help for the further recognitions.
4. When a new image is arrived from the image source (web camera), calculate its set of weights.
5. Then determine that, the image is a face and can proceed with the algorithm. Then the face should be analyzed to check whether it is close enough to the face space.
6. Finally, it will be determined the relevant image is corresponded to a known face of the database or not.

#### 3.1.4.2 Face recognition using line edge map

This algorithm describes a new face recognition technique based on Line Edge Maps (LEM). Line edge maps technique uses physiologic features of human faces for the face recognition. It mainly uses mouth, nose and eyes as the most characteristic features since those features varies from person to person.

As the initial step of this face recognition technique, images are converted into gray-level (grayscale) images [15]. Then images are encoded into binary edge maps using Sobel edge detection algorithm. The main advantage of line edge maps is the low sensitiveness to illumination changes, because it is an intermediate-level image representation derived from low-level edge map representation [12]. The other major benefit is the low memory consumption since this line edge map algorithm keeps face features in a very simplified manner.

One of the most important parts of the algorithm is the Line Segment Hausdorff Distance (LHD). LHD is used to perform an accurate matching of face images. This method is not used to calculate exact lines form different images. The main goal of it is to find the characteristic flexibility of size, position and orientation. Furthermore this vector represents three difference distance measurements, orientation distance, parallel distance and perpendicular distance respectively. Measuring the parallel distance has the best priority because it has to choose the minimum distance between edges. It helps when line edge is strongly detected and the other one isn’t. It also avoids shifting feature points. The drawback of line edge maps is, it can confuse lines and not detect similarities that should be detected. To solve that drawback another measurement can be taken. So a new parameter to the Hausdorff distance, comparing the number of lines in the images is a good method to exclude images [12].

### 3.1.5 Examination Invigilation Module

As the starting criteria of the examination invigilation module, the examination has to be scheduled and examination hall seat arrangement has to be defined. After examination scheduling and seat arrangement definition is completed, on the examination date at the examination hall entrance candidates has to authenticate themselves with the face authentication system. After the successful authentication of a candidate he/she will be recognized as a valid candidate for the particular examination and will be allowed to enter the examination hall. There will be an electronic display at the entrance of the examination hall for the purpose of displaying a virtual diagram of the seating arrangement for the particular examination in the particular examination hall. Along with the seating positions displayed on the electronic display, the name and the index number of the registered candidates for each and every seating position also will be displayed. As soon as the system authenticates the candidate with the face authenticating, system will validate the details and fetch the candidate details and the seating position for the particular authenticated candidate on the particular examination hall. The exact seating position of the authenticated candidate will be highlighted in the electronic display at the examination hall entrance. Therefore the candidate won’t need to bother to go through different seats to find the seat allocated for him/her.

There will be a High Quality Video Camera attached to each and every examination hall ceiling to obtain a HD live stream video of the invigilated examination hall. The proposed video camera for this process will provide a HD output with a resolution of 1440 x 1080 (Approx. 1.56 Megapixels). Video camera will be positioned in an angle which can clearly cover the complete examination hall. Focusing of the video camera will be fixed focus since there won’t be any changes of the position of the video camera after fixing it to the ceiling. Video stream will be transferred from the camera to the system through USB connectivity cable.

The proposed AEIS system will facilitate the invigilator to observe the live video stream of the examination hall through the digital monitor in front of him/her. A virtual grid overlay which separates the seating positions will be added on top of the live stream of the examination hall in order to easily identify candidates in a discrete manner. For painting the grid overlay on top of the live stream ControlPaint Class of the .NET Framework will be used [11]. The system will also facilitate the invigilator to observe more than single examination hall through the system real time. This will efficiently reduce the number of human resource which is needed for the examination invigilating purpose since a single invigilator is able to invigilate more than one examination hall at a time. For the purpose of displaying multiple streams as a combination Microsoft Directshow Technology will be used [23]. Furthermore invigilator will be able to switch between multiple observing options of live video stream. Examination invigilator can observe multiple video streams in a single window as separated frame layout, separate video streams in tab based layout etc. To simplify the use of invigilating stream and make the invigilating purpose more user-friendly there will be flexible options to control the video stream such as zoom in/ zoom out, navigate in zoomed view, switch between live streams etc. While invigilating the examination hall if the invigilator needs to know information about a particular candidate the invigilator will provided the option to view information of that particular candidate just by clicking on the candidate’s seating position on the live video stream. The AEIS system will locate the clicked position, identify the index number allocated for the particular location at the current examination and then query and display the information for the candidate who owns the selected index number. If the invigilator needs to know any special remark (bad reputation of examination cheatings, differently abled candidates etc.) on any of the candidate within the current candidate set invigilator will be able to get the necessary information through the system. AEIS system will identify the registered candidate set for the current examination and display if any candidate has any special remark.

AIES system will track the motions of the candidates in order to identify any suspected acts (examination frauds such as copying, passing chits between candidates) happening at the examination hall while the examination goes on. For the motion tracking of the candidates AIES system will use a suspected act detecting algorithm which will be based on main factors.

* Tracking the motion of the candidate’s head [7]

By analyzing the live stream AEIS will mathematically calculate the movements of each and every candidate’s heads in order to identify whether the candidate tries to cheat by copying from other candidates. Algorithm will be developed in order to detect only the considerable movements since some normal slight movements shouldn’t be considered as cheatings or frauds.

* Tracking the movement of candidate’s upper body [8]

After analyzing several simulations of examination frauds it can be decided that considerable movement of upper body can be taken as a hint of examination fraud in most cases. In the proposed AEIS upper body of candidate will be tracked in order to detect any abnormal movement.

* Tracking the movements of candidate’s eye pair [9]

Even though the position of eyes is the most accurate way of detecting examination frauds, in most cases candidate’s eyes are not clearly visible at most of time in the examination duration due to bowed heads of candidates, low sensitivity of video stream etc. But still eye pair tracking plays a considerable role in examination fraud detection since there are some occasions which eye tracking can still be used such as when the candidate tries to copy from the candidate just in front of him / her.

Using these three main factors and other related factors the algorithm for identifying suspected acts will be developed to successfully identify suspected acts up to 95% of accuracy. Furthermore this algorithm will be able to calculate the severity level of suspected act based on different criteria’s having different weights assigned. While the examination is on progress AEIS system will continue to analyze the video stream in order to identify any suspected acts happening at the currently invigilating examination halls. If any suspicious act happens an alert will be generated by the AEIS system to notify the invigilator on the suspicious act. For maximizing the usability of the AEIS system will use different color schemes to highlight the suspected candidates according to the suspected severity level which will be calculated by the algorithm. Furthermore the AEIS system will keep log records about the suspicious acts with the relevant details such as suspicious candidate, time which the act occurred, examination venue and seating position and the severity level. AIES system will also maintain a list of candidates who are identified as suspected for cheatings for each and every examination in case the invigilators need to pay special attention on their result sheets at the paper marking time.

AEIS system provides feature to track the candidates who are requesting for invigilator’s assistance such as requesting additional examination materials. The system will be able to identify a raised hand (using a palm detection algorithm) in the live stream using hand gesture recognition techniques [10]. When a raised hand or multiple hands are detected AEIS system will be able to identify it as a request for assistance and the requesting candidate will be highlighted at in the video stream with a blinking square. When the system detects that a candidate is requesting further assistance system will provide alerts to notify the invigilator on the request. With this feature examination invigilator won’t miss any request of assistance and will be able to cater the candidates as soon as possible. In some case there can be more than one request for assistance may occur at the same time. To cater this type of cases AEIS system will maintain a priority based request list which will make sure the requests are assisted in first request first serve basis. It will avoid the candidates to wait longer time periods for assistance.

AEIS system will also facilitate the invigilators to save the whole examination video for archival purposes in case that there will be a need to watch the video at a later time. The archiving location, video formats, video quality can be changed according to the need of the invigilator or the using organization. Further the AEIS system will provide the facility to search the achieved videos based on different search criteria such as examination date and time, examination date range, examination venue or even using the name or index number of any candidate who faced the examination. There will be an option to watch all the suspicious acts occurred in a particular examination at a later time.

### 3.1.6 Display examination hall/halls live video stream in the Android application

Wi-Fi enabled IP cameras will be used to provide the live video streaming of examination halls to the Android application. Users of the application can see one or more examination halls live video stream through the application. Android progressive download method can be used to implement video streaming of the examination halls. There will be various actions that the user can perform regarding the video stream. They can navigate through different hall views, each candidates view and different sections of the hall. Zooming in /out options will be also included to increase the clarity of the video according to the user’s preference. Android application users can specifically tag any candidates and add them to relevant groups based on any suspicious actions by the candidates. These details will be transmitted to the main desktop application for later review.

### 3.1.7 Transmitting images of MCQ Answer Sheets to the desktop application

Transferring images of MCQ Answer sheets to desktop application is needed for automating of the marking of the MCQ answer sheets. High resolution image of the MCQ answer sheet will be captured using the Android invigilator application and stored in a specific location in the phone memory / SD card. A secure Wi-Fi connection between Android application and the desktop application must be established in order to transmit the captured image to the desktop application. Android Wi-Fi Direct API will be used to establish Wi-Fi connection with the desktop application and then the high resolution image will be sent to the desktop application securely. As Wikipedia says “Wi-Fi Direct is a standard that allows Wi-Fi devices to connect to each other without the need for a wireless access point” [18] it is the most suitable technology to be used here. For this Wi-Fi must be enabled in the desktop PC where the AEIS is installed. This will be later used in automating the marking of MCQ answer sheets.

### 3.1.8 Marking of MCQ papers

It is very difficult to maintain consistency and accuracy in the marking of Multiple Choice Question (MCQ) answers with the limitations of the human resources. This becomes even more complicated when the number of answer sheets to be corrected is a very large amount. The proposed AEIS system will reduce the amount of time taken to mark the answer sheets so that the exam-marking process could be completed within a couple of days.

Initial step for automating the marking of MCQ answer sheets would be designing a standard answer sheet to be used by the candidates at the examination. Candidates indicate their answers by darkening circles marked on a pre-printed sheet and the scanned images of those answer sheets are used to mark and prepare the final result [20]. The technique used to detect the marked answers is Optical Mark Recognition (OMR).Therefore the answer sheet should be designed in such a way so that it can be used directly to capture data by the software which is used to read optical marks. These answer sheets are also called as optical answer sheet or "bubble sheet" that are special printouts containing circles or elliptical bubbles or boxes used as marking areas where the candidate marks using a blue/black pen or pencil [19,21]. There are many facts to be concerned when designing an answer sheet such as, demarcation of the ‘DO NOT WRITE’ areas, not making any stray marks on the answer sheet, not altering the size of the sheet format when printing and not altering the size of circles/checkboxes in the answer sheet, optimizing for computer scanning etc. so that ambiguity is reduced to the minimum possible [19-20]. The software used to read the answer sheets will read these specific locations and converts the information into data [19]. The most important fact is to ensure that all the candidates are using only the recommended answer sheets to mark their answers as the reader software will only read the answers in recommended sheets. Any external design containing bubbles cannot be called as a recommended answer sheet because it might not have correct parameters and dimensions as per the rules for the standard answer sheet [19]. Before developing the software to read the optical marks, setting up of rules for candidates to use the recommended answer sheet should be done by concerning the following facts [19].

* What type of pen/pencil can be used for marking the answers (E.g. Blue/Black Ball Pen or HB pencil)
* Using of Ink Pens.
* Avoiding partial filling or spilling out.
* Avoiding over-writing on answer sheet.
* Marking of multiple bubbles for single choice question the answer will be considered as being wrong.
* Mark the response only in the space provided for the purpose as response marked elsewhere will not be considered.

Before commencing the examination the candidates should be advices to carefully read the instructions given on the sheet before filling.

To develop the software dedicated for reading the filled answer sheets, an efficient algorithm should be developed. Generally OMR is distinguished from optical character recognition (OCR) by the fact that a complicated pattern recognition engine is not required. That is, the marks are constructed in such a way that there is little chance of not reading the marks correctly. This does require the image to have high contrast and an easily-recognizable or irrelevant shape [20].

After collecting the filled answer sheets an Android client application will be used to capture the images of the sheets and transmit the captured image directly to the desktop application via a Wi-Fi connection. Then the system will mark the answers with perfect accuracy by using high-resolution images. The system will conserves the image of each marked exam, thereby eliminating any cause for doubt. These images are archived and accessible at any time for reviewing. Results from the marked scored will be available as soon as the scanning is complete. Users can adjust both the individual weightings of questions and answers and the grading scale of the exam. Finally the system will assembles and generates a statistical report. This report can be both printed and exported directly to the database, making the official recording of candidates’ marks instantaneous while eradicating reporting errors resulting from the manual keying in of this data.

### 3.1.9 Provide alerts to the Android Application

Android application will be getting alerts about the candidates who cheat in the examination and then invigilator can take actions regarding those candidates. Alerting will be done by the Android push notifications using Google Cloud Messaging (GCM) for Android technology which is a service that allows you to send data from your server to your users' Android-powered device [22]. A server must be implemented to pass notifications to the Android application. Also alerts will be sent to Android application regarding requests of assistance by candidates. Extra needs of the candidates can be recorded by the Android phone as audio and then transmitted to the main invigilator through the Android application using Wi-Fi. Then the main invigilator can take any decision regarding those needs.

## 3.2 Task and Sub-Task List

### 3.2.1 Member 1: Task and Sub-Task List

**Member Name:** B. L. S. Deshan **DIT No.:** IT 10 1602 44

#### Task 1: Provide the seating position information to candidate at the entrance

* *Sub-Task 1:* Show Virtual grid of exam hall.
* *Sub-Task 2:* Show names and exam index number at grid
* *Sub-Task 3:* Highlight the seating position for particular candidate.

#### Task 2: Show examination hall/halls live video stream to the invigilator

* *Sub-Task 1:* Provide facility to watch one or more examination halls live video stream at invigilator’s

computer.

* *Sub-Task 2:* Ability to switch between different types of viewing options
* *Sub-Task 3:* Options to zoom in / out , navigate in video stream
* *Sub-Task 4:* Ability to view candidate information
* *Sub-Task 5:* Ability to check special remarks of current candidate group

#### Task 3: Highlight suspected activities of candidates

* *Sub-Task 1:*Highlight any suspected act using motion detection
* *Sub-Task 2:*Provide alerts to the invigilator on suspicious acts
* *Sub-Task 3:*Maintain suspicious candidates log
* *Sub-Task 4:*Different color codes for suspicious level

#### Task 4: Highlight students who are requesting for assistance

* *Sub-Task 1:*Highlight candidate/s who are requesting for assistance
* *Sub-Task 2:*Provide alerts for invigilator on requests of assistance
* *Sub-Task 3:*Maintain priority list based on the time of request

#### Task 5: Enable to analyze examination video at a later time.

* *Sub-Task 1:*Ability to watch videos of examinations at a later time
* *Sub-Task 2:*Ability to search for videos on different criteria
* *Sub-Task 3:*Ability to watch suspicious acts occurred at a particular examination

### 3.2.2 Member 2: Task and Sub-Task List

**Member Name:** K. U. S. Madanayake **DIT No.:** IT 10 1907 08

#### Task 1: Registration of candidates

* *Sub-Task 1:* Designing of the student registration form
* *Sub-Task 2:* Insertion of Candidate details to the registration module
* *Sub-Task 3:* Insertion of Candidate portrait photographs to the registration module
* *Sub-Task 4:* Updating and Deletion of candidate records
* *Sub-Task 5:* Preview of candidate details
* *Sub-Task 6:* Generate the Admission Slip in a printable format

#### Task 2: Marking of MCQ papers

* *Sub-Task 1:* Designing of a standard MCQ answer sheet which is optimized for computer scanning
* *Sub-Task 2:* Setting up the rules to be followed by the candidates when marking the answers in the

MCQ Answer Sheet

* *Sub-Task 3:* Accept transmitted images of the captured images via a Wi-Fi connection
* *Sub-Task 4:* Store the transmitted images of the MCQ answer sheets
* *Sub-Task 5:* Develop an algorithm to detect the marks in the images of the answer sheets
* *Sub-Task 6:* Store the data detected from the images
* *Sub-Task 7:* Develop a module to mark an answer sheet
* *Sub-Task 8:* Produce and store the results
* *Sub-Task 9:* Generate a results sheet in a printable format
* *Sub-Task 10:* Conserving the images of each marked exam
* *Sub-Task 11:* Retrieving the conserved images for preview

### 3.2.3 Member 3: Task and Sub-Task List

**Member Name:** R. M. G. S. Rathnayake **DIT No.:** IT 10 1504 12

#### Task 1: Setup windows components for face detection

* *Sub-Task 1:* Create the user interfaces which suitable and comfortable with face recognition function.
* *Sub-Task 2:* Configuration of the web camera & setting up the connectivity between the user interfaces.

#### Task 2: Configuring the hardware components & interaction with the system

* *Sub-Task 1:* Develop the algorithm to convert camera input images & video stream into standard

quality. (Brightness and contrast)

* *Sub-Task 2:* Develop the model to store web camera images and convert in to gray scale formatted with

required quality for face recognition.

* *Sub-Task 3:* Build-up the connection between the database and the user interface to exchange images

between them.

#### Task 3: Implementation of face recognition techniques

* *Sub-Task 1:* Develop the model to face recognition using eignface technique.
* *Sub-Task 2:* Build-up the algorithm to optimize the face recognition using line edge map.

#### Task 4: Optimization and Integration of face recognition modules

* Sub-Task 1: Integration of “eignface technique” and “line edge map technique” for better face

recognition.

* *Sub-Task 2:* Finalize the main model to face recognition which supported for take images from the

camera and compare with the images stored in the database. And give the recognition

results to candidate.

### 3.2.4 Member 4: Task and Sub-Task List

**Member Name:** T. L. Amaradasa **DIT No.:** IT 10 0005 40

#### Task 1: Send SMS for examination candidates prior to each examination

* *Sub-Task 1:* Integrate a SMS gateway with the system
* *Sub-Task 2:* Schedule the SMS sending functionality before each examination
* *Sub-Task 3:* Send SMS to the relevant candidates including the examination details

#### Task 2: Send Email to examination candidates prior to each examination

* *Sub-Task 1:* Create a common email template to be used to send to the candidates
* *Sub-Task 2:* Schedule the email sending functionality before each examination
* *Sub-Task 3:* Send email to the relevant candidates including the examination details

#### Task 3: Transmitting images of MCQ Answer Sheets to the desktop application

* *Sub-Task 1:* Store the captured high resolution image of the MCQ Answer sheet in the phone SDcard.
* *Sub-Task 2:* Setup a secure Wi-Fi connection between Android client app and the desktop application.
* *Sub-Task 3:* Transmit the stored image to the desktop application via the Wi-Fi connection.

#### Task 4: Show examination hall/halls live video stream in the Android application

* *Sub-Task 1:* Provide facility to watch one or more examination halls live video stream at Android

Application

* *Sub-Task 2:* Options to zoom in / out , navigate in video stream
* *Sub-Task 3:* Ability to tag candidates based on the video stream

#### Task 5: Provide alerts to the Android Application

* *Sub-Task 1:* Provide alerts to the Android app on suspicious acts
* *Sub-Task 2:* Provide alerts to the Android app on requests of assistance
* *Sub-Task 3:* Extra needs of the candidates can be recorded as audio and transmitted to the department

head via Android application

## 3.3 Project Gantt Chart

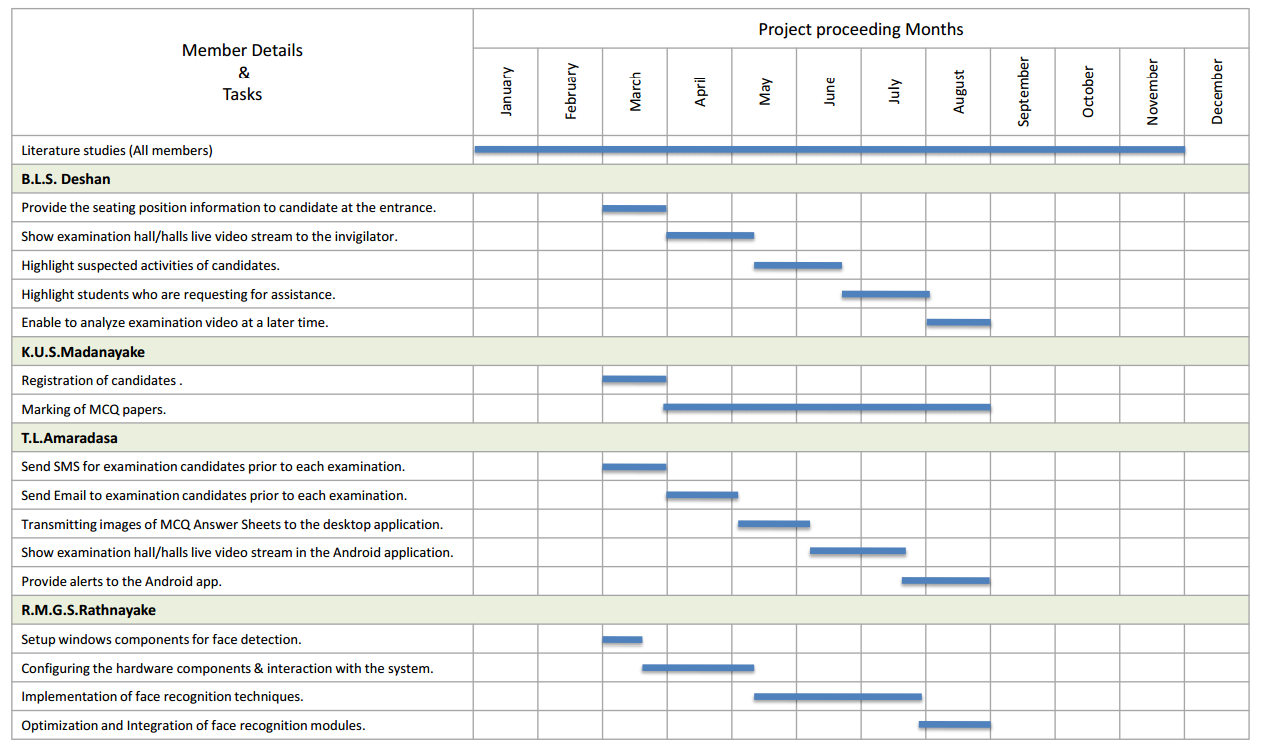


Figure 1.0

# 4.0 Description of Personal and Facilities

|  |  |  |
| --- | --- | --- |
| **Group Members** | **Roles** | **Resources** |
| IT 10 1602 44  B.L.S. Deshan | * Project Management * Requirements Gathering * Requirements Analysis * Module Design * Implementation * Examination Invigilation Module * Testing * Database Handling | * SQL Server 2008 * Microsoft Visual Studio 2008 * Microsoft Office * Crystal Reports * Video Camera * Electronic Display Device |
| IT 10 1907 08  K.U.S. Madanayake | * Requirements Gathering * Requirements Analysis * Module Design * Implementation * Candidate Registration * Automated Paper Marking Module * Testing * Database Handling * Technical Writing | * SQL Server 2008 * Microsoft Visual Studio 2008 * Microsoft Office * Crystal Reports * Android Mobile Device * Wi-Fi Router |
| IT 10 1504 12 R.M.G.S. Rathnayake | * Requirements Gathering * Requirements Analysis * Module Design * User Interface Design * Implementation * Candidate Identity Verification Module * Testing * Database Handling * Technical Writing | * SQL Server 2008 * Microsoft Visual Studio 2008 * Microsoft Office * Crystal Reports * Video Camera * Electronic Display Device |
| IT 10 0005 40  T.L. Amaradasa | * Requirements Gathering * Requirements Analysis * Module Design * Implementation * Android Client Application * Testing * Database Handling * Technical Writing | * SQL Server 2008 * Microsoft Visual Studio 2008 * Microsoft Office * Crystal Reports * Eclipse Indigo * ADT Plugin * Android Mobile Device * Wi-Fi Router |

# 5.0 Budget

|  |  |  |
| --- | --- | --- |
| **Budget Item** | **Amount (Rs.)** | **Sub-Total (Rs.)** |
| Hardware Costs | | |
| High Quality Video Camera | 30000.00 |  |
| Wi-Fi Extender | 3000.00 |  |
|  |  | 33000.00 |
| Software and Utility Costs | | |
| Visual Studio 2008 Professional | 10000.00 |  |
|  |  | 10000.00 |
| Administrative Costs | | |
| Courier Fee (For delivery of High Quality Video camera ) | 500.00 |  |
|  |  | 500.00 |
| Study Material Costs | | |
| Professional C# 3rd Edition Text Book | 3500.00 |  |
| Handbook of Face Recognition | 9500.00 |  |
|  |  | 13000.00 |
|  |  |  |
| Total Expenses |  | 56500.00 |
| Overhead @ 10% |  | 5650.00 |
|  |  |  |
| Total Budget |  | **62150.00** |

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# Appendices

* **AEIS** (Automated Examination Invigilator System) is an Information System focused on automating the examination process and minimizing the difficulties faced by examination invigilators as well as candidates of the examination.
* **Invigilator** is someone who watches examination candidates to prevent cheating.
* **Face Recognition** given still or video images of a scene identify or verify one or more persons in the scene using a stored database of faces.
* **Motion Detection** in [video surveillance](http://www.webopedia.com/TERM/D/digital_video_surveillance_system.html), motion detection refers to the capability of the [surveillance system](http://www.webopedia.com/TERM/D/digital_video_surveillance_system.html) to detect motion and capture the events.
* **Inter-Class Similarity** is the similarity of the faces in a single context.
* **Intra-Class variability** is the variations of human faces due to head pose illumination conditions, expressions, facial accessories and aging effects.
* **Microsoft SQL Server** is a relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases.
* **Wi-Fi** is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network.
* **Software Developer** is a person or organization concerned with facets of the software development process wider than design and coding, a somewhat broader scope of computer programming or a specialty of project managing including some aspects of software product management.
* **Microsoft Visual Studio** is an integrated development environment (IDE) from Microsoft.
* **Integrated Development Environment** (**IDE**) is a software application that provides comprehensive facilities to computer programmers for software development.
* **Android** is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers.
* **Operating System** (commonly abbreviated *OS* and *O/S*) is the software component of a computer system that is responsible for the management and coordination of activities and the sharing of the resources of the computer.

# Further Readings

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