REAL TIME E-LEARNING PLATFORM

19-079

Software Requirements Specification

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DECLARATION

I declare that this is my own work and this system requirement specification does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature	Date
W.A Geeth Sameera	IT16119086		

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of Supervisor Date

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1 Introduction

1.1 Purpose

The purpose of this SRS document is to give a detailed understanding and overview about the lecturer tracking component of the proposed e-learning platform. This document will collect and analyze all associated ideas that define the proposed system with respect to its intended clients. Documented ideas and outlined concepts may be discarded or changed as the product develops. intended audience of this document are the members of research group, project supervisor Dr. Malitha Wijesundara and co supervisor Mr. Pramadhi Athapaththu.

1.2 Scope

This document covers the requirements of the Lecturer Tracking component. Intention of this document is to provide a guide to the developers who design and build the solution. Scope of the SRS is also to describe the tools and techniques that are going to be used in developing this component. The technologies referred in the implementation of this component is also discuss in this document.

Real-time lecturer tracking is a part of the real-time e-learning platform solution. It will behave like a real cameraman by identifying lecturer and start sending video stream to a streaming server over a local network. Same video stream is processed using a specialized tracking algorithm. Output of the algorithm is a set of commands to a PTZ camera which moves according to those commands. Algorithm use lecture movements in the video frames to see his position relative the frame and map it to a set of PELCO commands which assist PTZ camera to move in the same direction and speed.

Here it is applied to detect and track a single person in a lecture hall. But this can be further modified and improved to fulfill needs in surveillance industry to detect and track people based on given conditions like behavioral anomalies.

1.3 Definitions, Acronyms, and Abbreviations

Term	Definition
Open CV	A standard C++ library used for computer vision applications
PELCO Commands	Pelco D protocol is a popular control protocol for Pan/ Tilt/ Zoom camera or Pan/Tilt head. The format for a control command consists of 7 Hexadecimal bytes [1]

Table 1.3 1 Definitions for terms used in SRS

Acronym / Abbreviation	Definition
CNN	Convolutional Neural Networks
PTZ Camera	Pan Tilt Zoom Camera
RAM	Random Access Memory

Table 1.3 2 Glossary of Acronyms

1.4 Overview

Lecturer Movement tracking system is an advance tracking algorithm based on computer vision which records lecturer movements throughout the lecture automatically. PTZ camera will be used to track down the lecturer movements with the help of PELCO commands obtained by processing the video output of the same camera inside an image processing server.

1.4.1 Main Goals

- Implementing a face registering system for lecturers which will be used by the tracking algorithm
- Using a motion tracking camera instead of using a fixed camera with a wide view to capture the lecturer in real-time

1.4.2 Specific Goals

- Identifying lecturer face and start lecturer tracking automatically for already registered lecturers
- Providing the facility to track an unknown lecturer by registering him at the lecture time (ex: Visiting lecturer)
- Accurately tracking the lecturer and obtaining a quality video which will be streamed to students in real-time

1.4.3 Users

The users of this system will be the lecturers using smart class rooms for their lectures

1.4.4 Organization of SRS

This SRS document is focused on the research component 'Real Time Lecturer Tracking'. The document consists of four main chapters. The first chapter describe about purpose, scope and structure of the document.

Second chapter explains product perspective with interfaces, constraints and limitations. It describes the product functions and informal requirements of the system and focuses on the assumptions and dependencies.

Third chapter discusses about the specific requirements of the system. It describes the external interfaces that communicate with this system and explains on the non-functional requirements.

Final chapter includes all the supporting information such as references and appendices in this document.

2 Overall Descriptions

With the development of e-learning, smart class room concept evolved very rapidly to help improve distance learning. Many software solutions were introduced to assist the problem. But none of the solutions were perfect as the traditional class room. Proposed solution will bring the overall solution closer to the traditional class room by streaming a video which will look like an actual cameraman is moving with the lecturer and capturing the video.

This type of tracking is used in surveillance cameras to identify and track people. But this solution incorporates face recognition with real time tracking and it will be used to produce a quality video output which will be send to a media server to be streamed.

Proposed solution will keep a database of facial ID's of known lecturers in the client university. Once the lecturer entered the class room specialized camera (PTZ Camera) will identify the lecturer and tracking will be initiated. If the lecturer is not in the database or he/she is a visiting lecturer, they can quickly register themselves in the system continue as a registered lecture.

Registered lecturers will be identified by using CNN with greater accuracy whereas on time registering lecturers will be identified and tracked using Haar Cascades

2.1 Product Perspective

There are other similar products available in the market. Eduscope is one of them

Features	**Eduscope**	**Proposed System**
Smooth Real-Time Tracking	No	Yes
Real-Time Face Detection	Yes	Yes
Real-Time Face Recognition	No	Yes
Using CNN For Improved Face Recognition	No	Yes

Table 2.1 1 Comparison with existing systems[2]

2.1.1 System Interfaces

Lecturer Tracking Component does not communicate with other systems or components. Therefore, it does not have any system interfaces.

2.1.2 User Interfaces

Tracking Manager desktop application to manage tracking.

2.1.3 Hardware Interfaces

PTZ Camera will be used as an input device to record the lecturer movements and to provide a continuous video stream for the tracking algorithm to keep tracking the lecture

2.1.4 Software Interfaces

Tracking algorithm is powered by Open CV 4.1

2.1.5 Communication Interfaces

Tracking component need to be connected to streaming server. When lecturer starts streaming from the main application, the video obtained from the PTZ camera will be send to the steaming server via LAN connection or internet. For that a LAN connection or a high bandwidth internet connection is required.

2.1.6 Memory Constraints

A minimum server PC with a core i7 processor and minimum of 32GB ram is required to run the application smoothly.

LAN connection is required with a minimum bandwidth of 24Mbps

2.1.7 Operations

Once completed tracking algorithm can be accessed using a desktop application which will be available as an exe

PTZ camera should be connected to the PC correctly

User should open the main web application and properly authenticate to start streaming

2.1.8 Site Adaptation Requirements

User does not have to configure the tracking manager application. After installing the application properly, it will detect the PTZ camera if any, automatically and do all the configurations on its own. User simply has to open the application and log in to the system using valid credentials. With a proper pre-configured face details or on time selected face details, the tracking can be done.

2.2 Product Functions

2.2.1 High level diagram

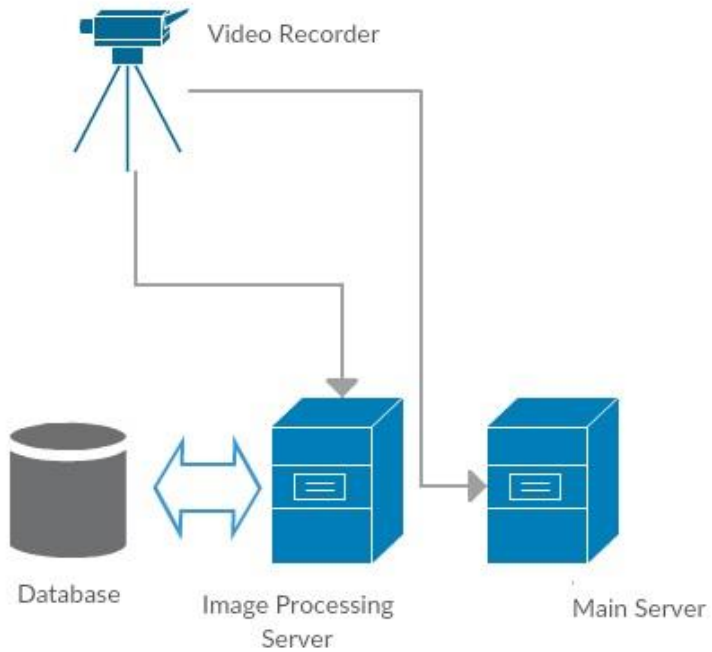

Figure 2.2.1 1 High level diagram of tracking process

2.2.2 Use Case Diagram

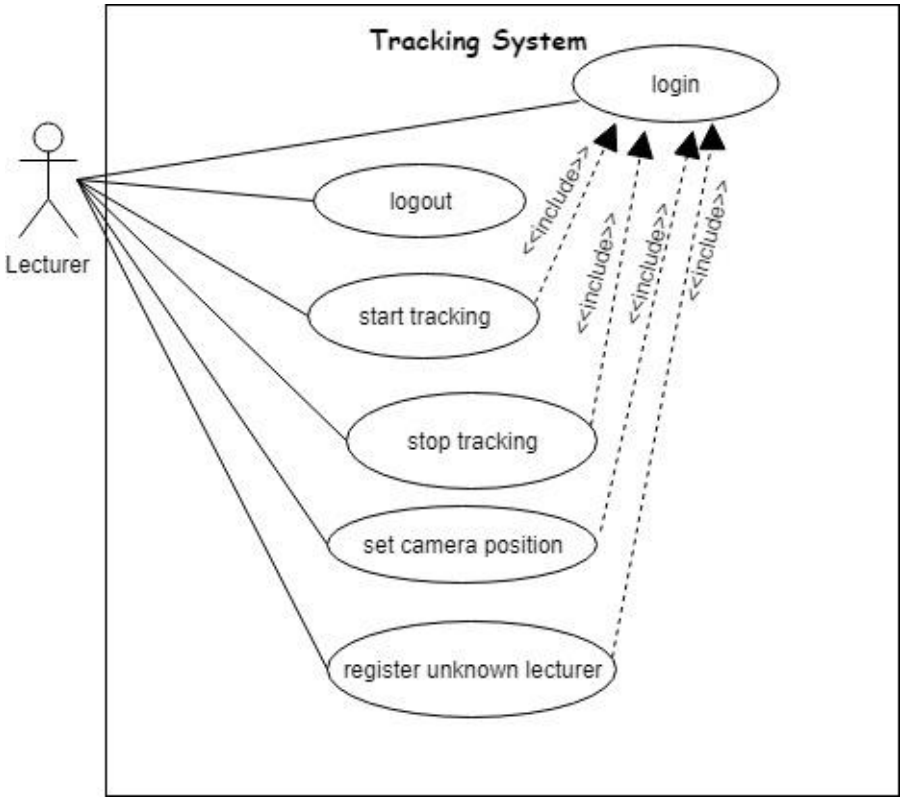

Figure 2.2.1 2 Use case diagram

2.2.3 Use Case Scenarios

Use case ID	UC_1	
Use case name	Start Tracking	
Goal in context	Tracking a known lecturer throughout the lecture	
Pre-condition	Lecturer should be logged in	
Post-condition	None	
Primary actor	Lecturer	
Secondary actor	None	
Main flow	**Step**	**Action**
	1	The use case begins when lecturer click on start tracking button in the application.

	2	Lecturer face will be surrounded by a green square and lecturer details will be displayed in a box just above lecturer head.
	3	Video status will be changed from standby to streaming
	4	Camera will be moved according to the lecturer movements
	5	Streaming server will receive a continuous video feed until lecturer stops tracking

Table 2.2.3 1 Use case scenario – Tracking a known lecturer

Use case ID	UC_2	
Use case name	Tracking a unknown lecturer throughout the lecture	
Goal in context	Streaming lecture	
Pre-condition	Lecturer should be logged in	
Post-condition	None	
Primary actor	Lecturer	
Secondary actor	None	
Main flow	**Step**	**Action**
	1	The use case begins when lecturer click on register lecturer button in the application.
	2	All the faces in the camera view is recognized and surrounded by yellow squares
	3	Lecturer can select the person's face who is doing the lecture on that particular day and press select button in the application
	4	Then lecturer can start tracking by clicking on start tracking button
	5	Streaming server will receive a continuous video feed until lecturer stops tracking

Table 2.2.3 2 Use case scenario – Tracking an unknown lecturer

2.3 User Characteristics

Any person with the proper user credentials and a basic knowledge about how to use a simple software, can use this software easily.

2.4 Constraints

Tracking algorithm shall operate on PCs independent of the operating system which has minimum speed of 3.0 GHz and a 32 GB of RAM. Python shall be the implementation language along with the Open CV 4.1.

2.5 Assumptions and Dependencies

Real-time face recognition is required a good lightning condition. Since the lecture is carried out in a smart class room, light condition is assumed to be good.

PTZ Camera will be operated using set of PELCO commands which is transmitted using LAN. To achieve the best performance network strength is assumed to be in a good condition.

2.6 Apportioning of Requirements

The requirements mentioned in sections 1 and 2 of this SRS document are primary specifications. Requirements mentioned in section 3 are referred to as requirements (or functional) specifications. The two levels of requirements are intended to be consistent. Inconsistencies are to be logged as defects. If a requirement is described in both primary and functional specifications, then the functional specification is used to develop the application.

3 Specific Requirements

3.1 External Interface Requirements

3.1.1 User Interfaces

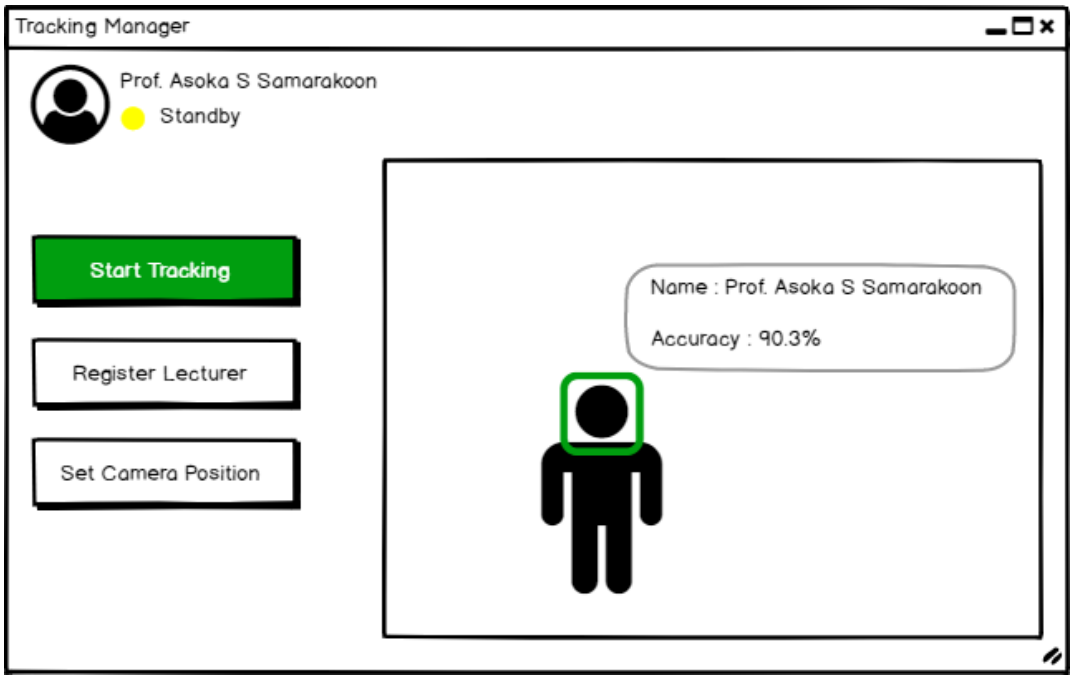

Figure 3.1.1 1 User interface 1

Above interface shows the main UI after user logged in to the tracking manager. Mainly there are three options to operate with. If the lecture details are correct and he or she is recognized by the system, they can proceed by clicking on start tracking button

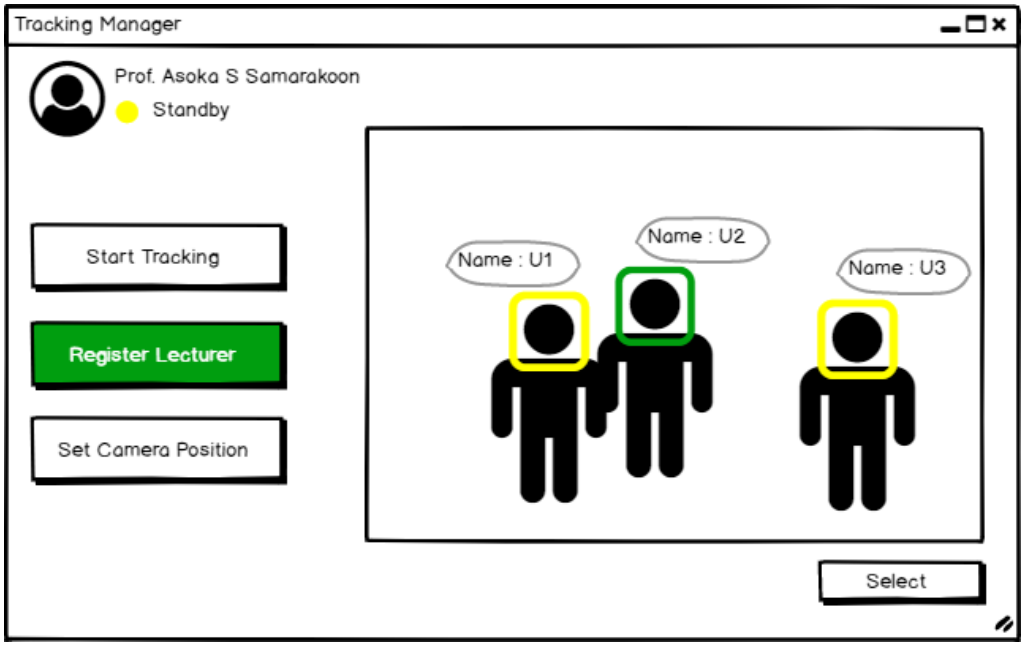

Figure 3.1.1 2 User interface 2

If the lecturer is not recognized or not registered in the lecturer database, then they will be provided with an option to select a person to be tracked at lecture time itself. After selecting a face user can click select to proceed with tracking.

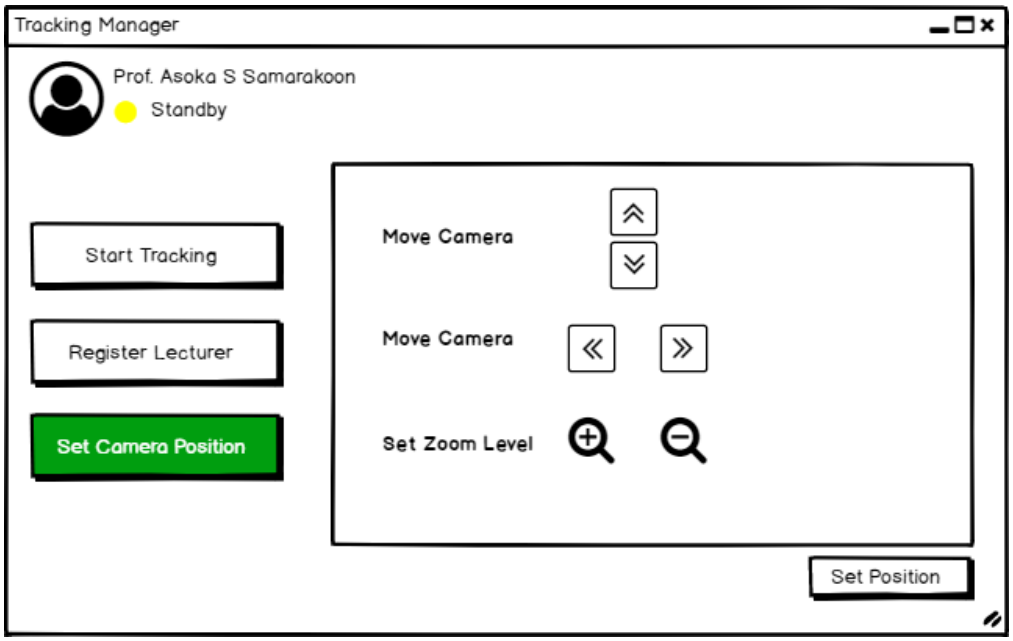

Figure 3.1.1 3 User interface 3

If the lecturer does not need real-time tracking, he can set camera position manually to a preferred view and continue the lecture.

3.1.2 Hardware Interfaces

PTZ Camera is used to track the lecturer movements. Camera movements will be controlled according to the PELCO commands send through LAN by the tracking algorithm. Camera will be connected to the image processing server.

3.1.3 Software Interfaces

Apart from MySQL database which holds lecturer facial ID details, tracking algorithm does not communicate with any other software to perform tracking. But it uses Open CV library which is written in C++ to assist tracking algorithm in face detection.

3.1.4 Communication Interfaces

High bandwidth LAN connection is used to transmit PTZ camera output to tracking algorithm and PELCO commands from image processing server

3.2 Classes/Objects

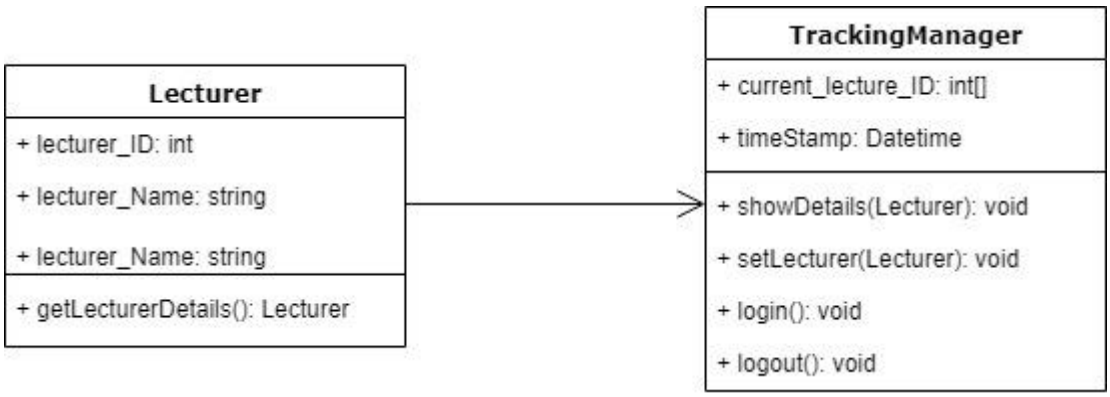

Figure 3.2 1 Class diagram

3.3 Performance Requirements

Computing Resources:

• Processor speed of 3.0GHz, 32GB of RAM and free storage of minimum 100GB is required to run the tracking algorithm smoothly.

Response time:

• The system will track lecturer movements in real-time with minimum delay.

3.4 Design Constraints

Minimalistic UI design is used with a light color theme.

3.5 Software System Attributes

3.5.1 Reliability

In real time tracking, algorithm must send accurate commands to PTZ Camera to move accurately and smoothly. So the algorithm will be designed in a manner where all the movements are accurate any smooth

3.5.2 Availability

System should be 99.99% available with a proper camera connected to it

3.5.3 Security

Proper credentials should be provided when logging in to the system. Face details of the lecturers are encrypted and stored in database along with their login credentials.

3.5.4 Maintainability

Tracking algorithm along with the face detection and recognition components will be implemented in a modularized way where updating or upgrading individual module is possible without having to implement entire system.

3.6 Other Requirements

Before starting live streaming lecturer can perform a test streaming session to check whether the camera is working correctly

Being able to switch between automatic tracking and fixed camera position where lecturer can adjust the camera position and continue the lecture.

4 Supporting Information

4.1 References

[1] Serialporttool.com. (2019). *Test Pelco D Protocol with Comm Operator* |. [online] Available at: http://www.serialporttool.com/sptblog/?p=4830 [Accessed 13 May 2019].

[2] Serialporttool.com. (2019). *Test Pelco D Protocol with Comm Operator* |. [online] Available at: http://www.serialporttool.com/sptblog/?p=4830 [Accessed 13 May 2019].