REAL TIME E-LEARNING PLATFORM

19-079

Project Proposal Report

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DECLARATION OF THE CANDIDATE & SUPERVISOR

We declare that this is our own work and this proposal 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.

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

Signature of Supervisor Date

ABSTRACT

This proposal is a solution for shortcomings in conventional education system mainly based on universities. e-Learning is simply meaning using electronic devices and technologies for educational purposes. With the growing use of these technologies on universities suggest the future of the classroom will rely heavily on e-learning. Like technology ease the life of people, this product will ease the student academic life. This solution includes a platform for e-learning by providing virtual classroom for the students with real classroom facilities. It will cover a normal classroom scenario by streaming the lectures so that students can interact with the lecture from anywhere around the world.

Keywords

e-Learning, real-time, transcoding, tracking

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1. INTRODUCTION

1.1. Background and Literature Survey

e-Learning is a rapidly developing industry and it is adopted by both corporates and academic institutes. [1]

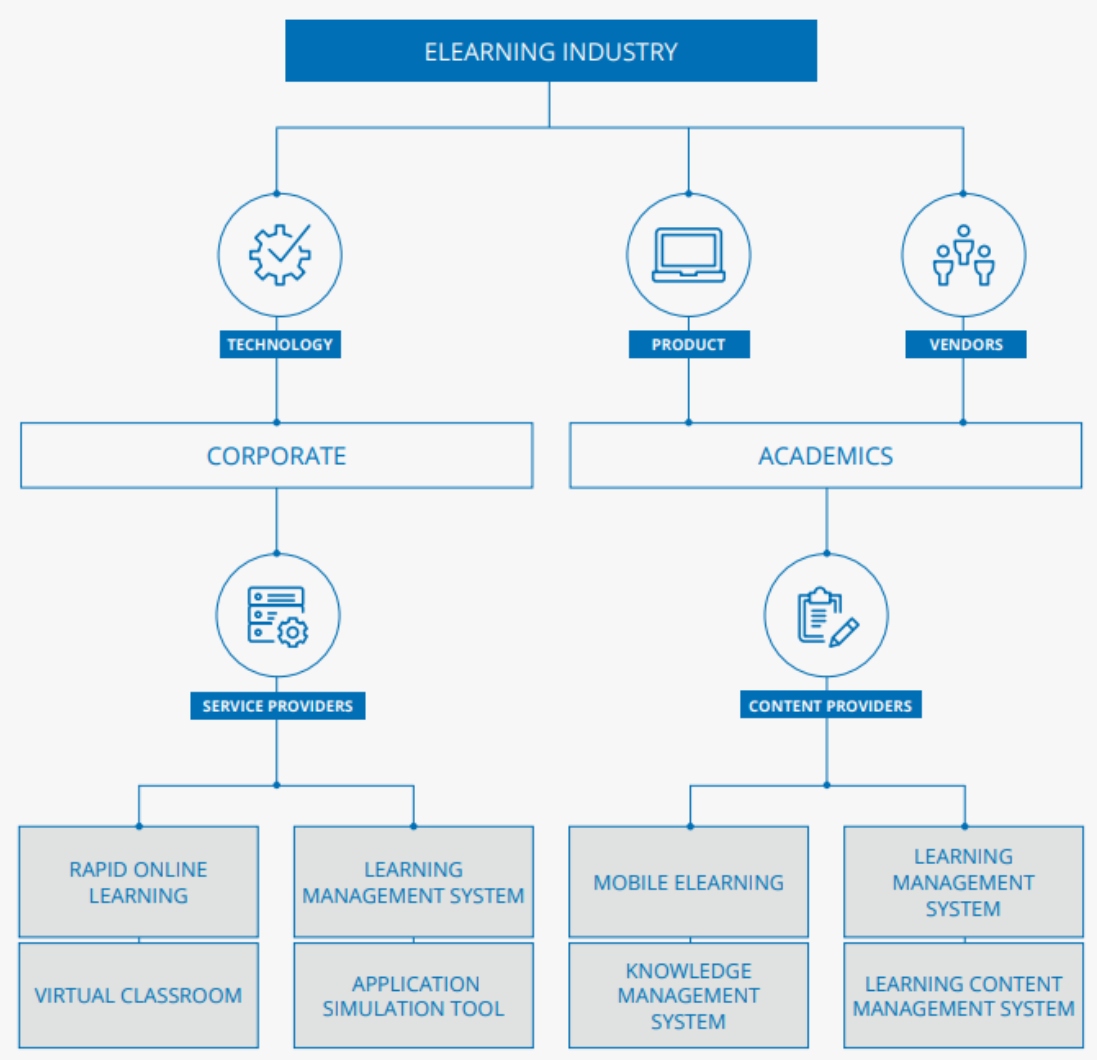

Figure 1.1.1: Distribution of e-Learning Industry

e-Learning is a common strategy used by almost every university in many different ways. It simply means using internet for educational purposes to access learning materials or communicating with other learners and lecturers.

1.1.1 e-learning and universities

As an impact of early stages of e-learning, universities and lecturers are used to communicate with students online, share and provide access to learning materials, external resources etc. As a result of further more use of e-learning, web based video courses are being published and can access over internet. [2]

Many platforms have been implemented on this domain to accomplish above requirements. Those services are implemented focusing a wide range of end users other than e-Learning requirements for universities.

1.1.2. University e-learning strategies

As the awareness of availability of these technologies spread among universities, many universities have taken measures to incorporate these technologies in their teaching-learning process.

One of the strategies is to monitor student's learning style to provide valuable advices and instructions for students and lecturers to optimize student's learning process. [3]

Another frequently used strategy is to enhance the lecture hall experience for the students by giving the opportunity to interact with the lecturer by sharing presentations, quizzes, feedbacks, etc... using technologies like Bluetooth and Wi-Fi. [4]

Universities have taken measures to livestream lectures for the accessibility of both on-campus and off-site students. [5]

1.1.3. Demand for e-learning

Most recently there is a growing demand for self-paced e-learning where students can follow the learning materials at their own pace. This is important because every student has a different pace of catching-up with the teaching where some of them can be considered as fast learners while others may be slow. The ideal current solution is to provide interactive content using different approaches such as video streams, quizzes, polls, etc...

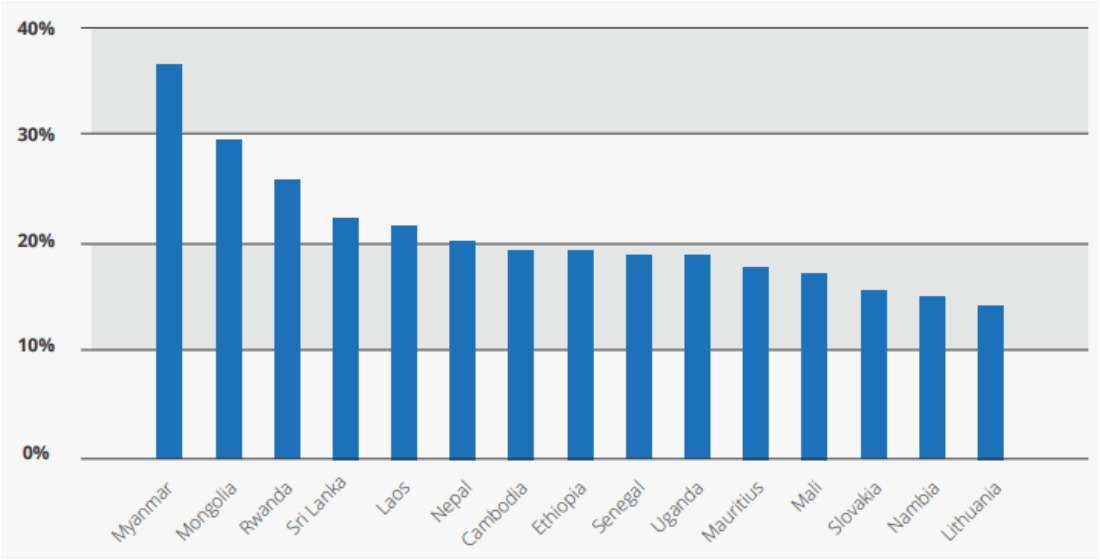

Figure 1.1.2: 2016-2021 Worldwide e-learning 5-year Growth Rates By Country.

Figure 1.1.2 shows the predicted growth rate of demand for e-Learning industry up to 2021 according to a research carried out by Docebo.[1] So clearly there is a business value for our proposed solution, which is a fully optimized real-time e-Learning platform that can be adopted by universities and will be profitable as well as beneficial for both the institute and students.

1.2. Research Gap

e-Learning is a common topic around the world in this era which is also still evolving with the advancement of technology. Most demanding feature for existing market is for real-time platforms where users can actively interact with the other party.

current e-learning platforms consist of:

- one-way live streaming with considerable low latency
- Storing streams and video playback
- Lecturer Recording and tracking
- Vector based whiteboard for lecturer

Given below is a comparison between existing systems and the proposed solution.

Feature \ Systems	Eduscope	Proposed system
Real-time streaming	Yes with considerable latency	yes
Adaptive Bitrate enabled video player	No	Yes
Lecture tracking	Yes	Yes with capability of tracking using face and body
Lecture recognition and automatic login	No	Yes
Vector based Whiteboard	No	Yes
Text-based lecturer student interactions	Yes	Yes
Video-based lecturer student interactions	No	Yes
Statistics and analysis of usage of content	No	Yes
Secure video player with content protection	No	Yes
Voice to text conversion of video content	No	Yes

Table 1.2.1: Comparison

1.3. Research Problem

The most common teaching and learning practice adopted by many enterprises has always been a classroom with one or more instructors and learners meeting physically and in real-time. But in this teaching model, there are several drawbacks which will be addressed as problems within this research.

A classroom based learning experience means the class schedule is predetermined and not subject to change. Students must shape their personal schedules around school instead of the other way around. If plans unexpectedly change or an emergency comes up, the student cannot adjust the class schedule to turn in the work at a different time. This is one of the main problems that this research will find solutions for.

Content non-reusability is another problem that can be found in classroom learning. Memorizing or writing all the necessary content while listening to a lecture is difficult. Therefore, students might miss many important points that the lecturer is pointing out during a lecture.

2. OBJECTIVES

2.1. Main Objective

Implementation of an e-Learning platform which facilitate real-time interactions between students and lecturers through a web application and also provide vital and useful statistics for the institute to improve their standards related to prevailing educational structure.

2.2. Specific Objectives

- Lecturer face detection and tracking by using a single PTZ camera.
- Streaming both projector screen and lecturer tracking video feed to server.
- Transcoding video streams from RTMP/RTSP to WebRTC maintaining minimum delay and high quality.
- Providing the facility to access the lecture feeds even after they are being streamed in case if the student needed to revise the lecture again for any clarifications
- Streaming multiple lectures simultaneously.
- Developing a management console for maintaining separate session per each lecture, user connection handling and load balancing and resource handling as per the requirement.
- Provide online students with the facility to watch the lecturer, projector screen, whiteboard, and the live chat real-time and simultaneously using only a web browser. They may decide which feed to give priority.
- Provide an in-depth analysis on the students' interactions with the lecture feeds, their technical background, contents of the lecture materials, etc. as a feedback to improve the future performance.
- Converting audio stream of the lecture into text stream to provide the students to search videos using video contents as keywords
- Students can raise hand, if there any questions that has to asked from the lecturer.
- Provide access to the whiteboard facility for students when asking questions.
- Developing a chat box to ask questions by typing and upload files whenever needed using chat box.
- Whiteboard will be a vector based drawing window.

- Lecturer will able to see the online student list who connected to the lecture.
- Developing a web application containing all the features required by both lecturer and student to interact with the platform.

3. METHODOLOGY

3.1. System Overview

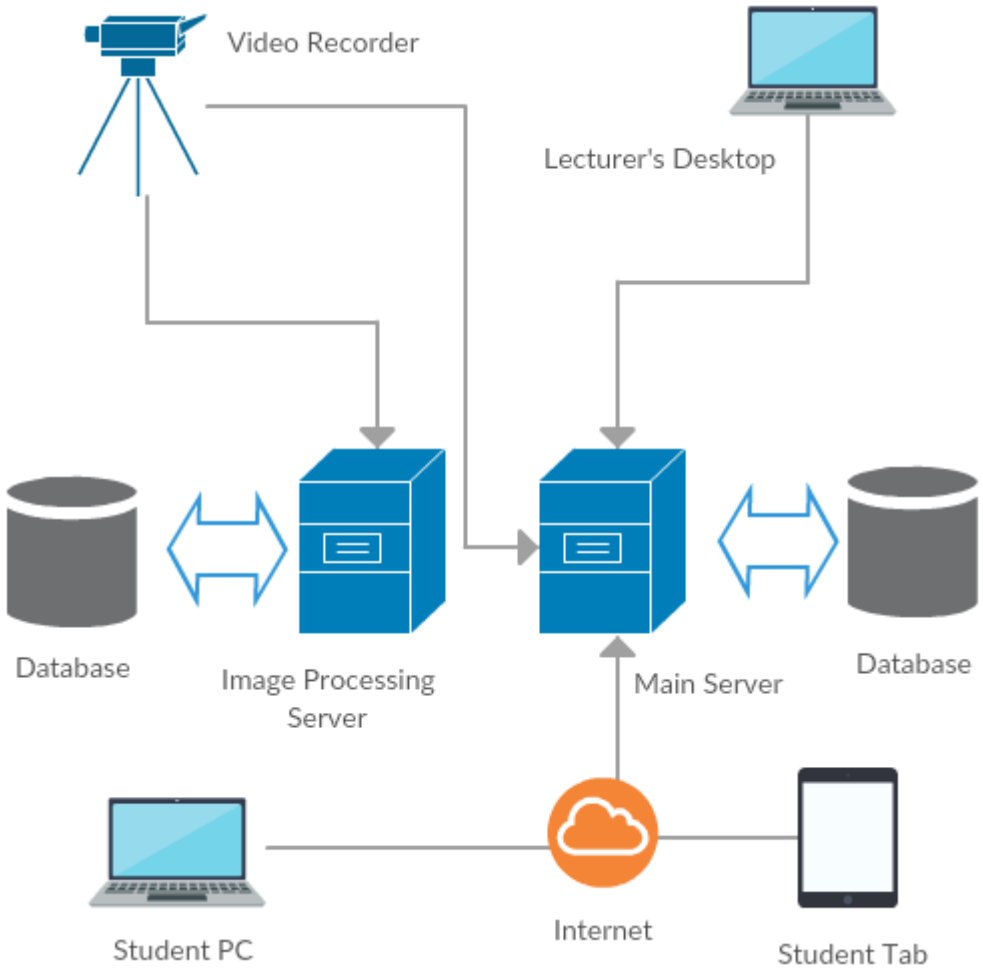

Figure 3.1.1: Architecture Design

The system we are proposing will be developed as a web application in order to make the solution platform independent and to provide mobile support with less development effort.

Figure 3.1.1 shows the architecture design for the proposing real-time e-learning platform.

A database will be created using face-ids of the existing lecturers. Using a PTZ camera, already registered lecturers will be automatically identified. Then the live feed will be sent to a dedicated server where it will be processed and it will determine the camera movements so it will keep the lecturer in the view. PTZ camera will be operated in response to the PELCO commands from the server based on the video feed.

If there are multiple registered lecturers in the camera view, one lecturer can be selected for tracking and only that lecturer will be tracked. If the lecturer is not registered in the database, he/she can get registered before the lecture so that he/she will be tracked throughout the lecture.

Also as shown in Figure 3.1.1, the same feed from the tracking camera will be sent to the Main Server using Real-Time Messaging Protocol (RTMP) / Real-Time Streaming Protocol (RTSP) for live streaming purposes along with the projector video feed. A transcoding server is used to convert above RTMP/RTSP feeds into WebRTC with multiple variants like 1080p, 720p, etc.

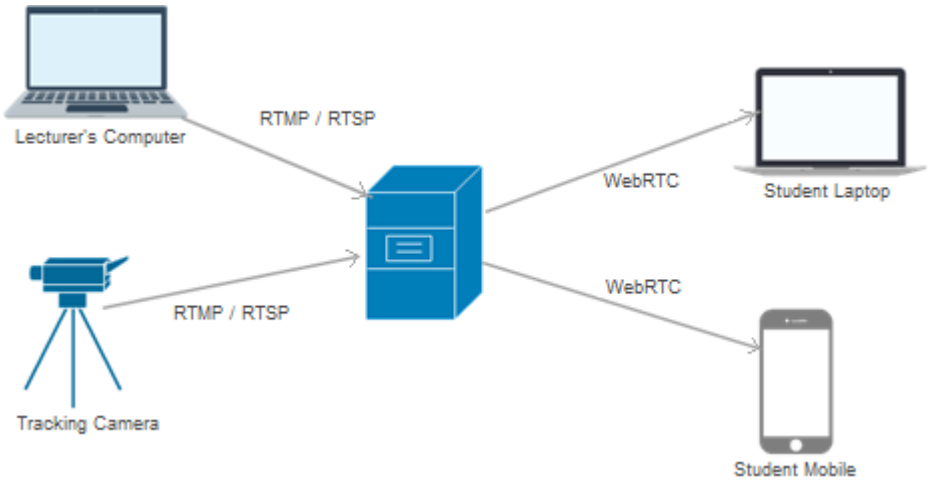

Figure 3.1.2: Transcoding Protocols

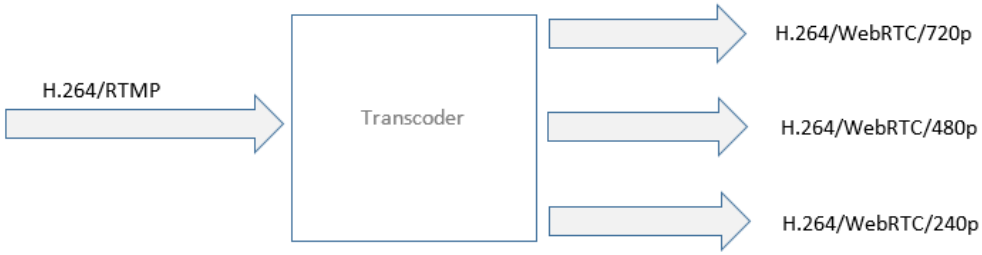

Figure 3.1.3: Transcoding Protocols

A text stream will be generated from the audio stream of the lecture using a voice to text conversion module which is running parallel to other modules of the server.

Also all the video feeds received at the main server will be stored for the use of video playback feature.

Server will be able to stream multiple lectures simultaneously. Each lecture will be assigned to a session where multiple users can join. Load balancing and resource allocation will be handled per session considering the demand for the session. These details will be monitored and controlled by a management console.

In the student's interface of the proposed web application, there will be media player with multiple views for camera feed, projector screen feed, whiteboard, chat window and student question video feed (only when available). The layout of the player will be a dynamic one allowing the student to maximize any view as he/she likes.

This player will be used for both real-time and playbacks. In real-time, students can participate in the chat, ask questions and use the whiteboard after permission is given by the lecturer. But in playbacks, these whiteboard and chat will replicate the original experience by automatically animating the whiteboard and scrolling the chat on seeking the playback timeline. At any time, all the feeds will be in sync.

Additionally, the video contents can be searched using the keywords that are already been translated in the main server using the voice to text conversion module.

In the background, player will collect various data like which parts of the video played and skipped, which video feed was maximized at any given time, which device was used to play and which time of the day it was played, etc. These data will be analyzed and statistics will be displayed in the management console.

3.2. Flow of the Project

Here we are going to discuss how we implement the proposed project. For the implementation we are using agile software development life cycle model. SDLC creates a structure for the developers to design, creates and deliver high quality software product. [6] Following phases in SDLC are used to implement the system.

- Feasibility Study

- Requirements Gathering and Analysis
- Design
- Implementation
- Testing

3.2.1. Feasibility study

Feasibility study was done to determine the potential for the success of the project. Availability of technical resources required, cost analysis for the project etc. was evaluated before the project startup.

We mainly focused to check whether the resources that already available is enough to do the project. For our project PTZ camera is the high cost physical hardware that we needed. We already got it from our supervisor and found that other resources are maintainable costs.

3.2.2. Requirements gathering and analysis

Prior to the implementation of the system, it's vital step to generating a list of requirements to ensure that the system will be implemented as expected. Requirement Analysis is critical to the success or failure of a system. [7] In order to become the product successive, it's very important to study about the research area widely. Through this analysis we will be able to clarify whether the proposed system will give the required solution for the research problem addressed. Here are the main activities involved in requirement analysis during our research.

- Refers to the previous research papers on research area
- Discussions with experts, supervisors in the field
- Find out more relevant details through the internet
- Studying about existing products relevant to the field

After gathering the requirements using above techniques next step is to analyze the gathered requirements. Here we already identified the research gap between existing systems and our proposed system. And now we also know what the current system doing and where it wants to go in the future. In order to analyze the requirements, it's important to create mind map before the implementation. It will help to get a clear visualization about the system functions as well as inter connections among them.

Finally, the SRS document will be created describing the nature of the project, software or application. This includes the purpose, scope, functional and nonfunctional requirements, software and hardware requirements of the project. According to the nature of the research functions may be slightly change in the future as it's not possible to get the exact output of the system right now.

3.2.3. Design

After requirement analysis phase, the requirements gathered in SRS document will be used as an input to the system and derived the software architecture to be used. Technical details of the design are discussed here such as risks, technologies to be used, time and budget. After designed the solution, it will break into smaller components to ease the designing of GUI and the design will be kept in the Design Specification Document (DSD).

3.2.4. Implementation

Complete system will be broken down into individual components and developed parallelly. After completing development of each component, unit testing will be carried out and then it will be integrated into one system. Further changes and CI/CD implementation will be done using a version controlling system like GIT.

3.2.5. Testing

Testing is the last phase of the SDLC before the product is finalized. Testing would be done according to the documented requirements in requirement analysis phase. After the finishing of each and every sprint, each member will perform unit testing to check whether the module is working according to the requirements. Thereafter the integration of each module system testing will be done to check whether the whole system working according to the requirements. Here security testing, stress testing will be performed to make sure that the system working fine and to verify the stability & reliability of the system.

3.3. Resources

3.3.1. Software requirements

- Node JS
- MySQL
- React JS
- OpenCv for python
- Python

3.3.2. Hardware requirements

- Server Side

Resource	Minimum Requirement
CPU	Core i5
Hard disk Space	500GB or above
RAM	16GB or above
Operating System	Linux

Table 3.3.2.1: Developer Side Hardware Requirements

- Client Side
    - Any device with a WebRTC supported web browser

3.4. Gantt Chart

	Task name	Start date	End date
		01/02/2019	11/28/2019
1	**ReLP**	01/02/2019	11/28/2019
1.1	Project Initiation	01/02/2019	01/06/2019
1.2	Project Pre-Assessment	01/06/2019	01/16/2019
1.3	POC on Technology	01/16/2019	01/28/2019
1.4	Project Charter Document	01/25/2019	02/01/2019
1.5	Project Charter Submission	02/01/2019	02/01/2019
1.6	Project Proposal Preparation	02/04/2019	03/12/2019
1.7	Project Proposal Report Submission	03/12/2019	03/12/2019
1.8	Project Proposal Presentation - Preparation	03/05/2019	03/13/2019
1.9	Project Proposal Presentation	03/13/2019	03/13/2019
1.10	SRS/DD/PPR	03/15/2019	04/22/2019
1.11	SRS/DD/PPR Submission	04/22/2019	04/22/2019
1.12	System Design and Planning	04/22/2019	04/29/2019
1.13	Design wireframes	04/29/2019	05/06/2019
1.14	Create a general theme for UIs'	05/06/2019	05/09/2019
1.15	Development of core features	05/09/2019	07/01/2019
1.16	Progress Presentation - I	06/18/2019	06/18/2019
1.17	Writing the research paper	06/01/2019	07/22/2019
1.18	Research Paper Submission	07/22/2019	07/22/2019
1.19	Unit Testing	06/12/2019	09/01/2019
1.20	Development of the entire features	06/29/2019	09/26/2019
1.21	Final Report (Draft)	07/26/2019	08/05/2019
1.22	Final Report (Draft)	08/05/2019	08/05/2019
1.23	Final Report (Draft) Correction	08/05/2019	08/23/2019
1.24	Final Report (Draft) Feedback Submission	08/23/2019	08/23/2019
1.25	Progress Presentation - II	08/26/2019	08/26/2019
1.26	Final Report Preparation	08/23/2019	09/08/2019
1.27	Final Report Submission (Soft Bound)	09/08/2019	09/08/2019
1.28	Integrate the System	09/26/2019	10/12/2019
1.29	System Testing	10/12/2019	10/23/2019
1.30	Final Submissions	10/23/2019	10/23/2019
1.31	Final Presentation Preparation	10/28/2019	11/12/2019
1.32	Final Presentation/Viva	11/12/2019	11/12/2019
1.33	Final Report Submission (Hard Bound)	11/28/2019	11/28/2019

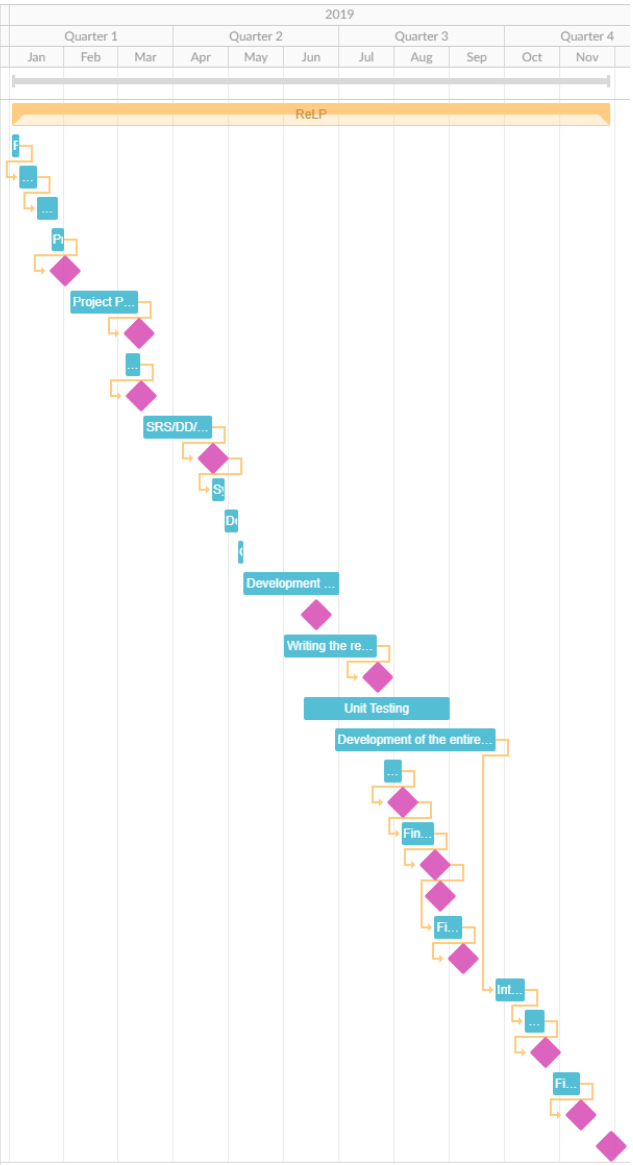

Figure 3.4.1: Gantt Chart

4. DESCRIPTION OF PERSONNEL AND FACILITIES

Student ID	Student Name	Work Allocation
IT16131002	A.M.H.B.Athapaththu	● Implementation of video transcoding module. ● Implementation of management console which includes session management, user connection handling and load balancing. ● Generating a text stream from the audio stream of the lecture to facilitate the search facility in lecture content.
IT16124936	P.G.R.S. Gamlath	● Designing a video player with dynamic layout for live streaming as well as later playbacks. ● Syncing all the video, audio and text streams for a complete lecture experience. ● Data capturing for an in-depth analysis of how each student interacted with the lecture. This data will be used to assess all the students, lecturers, lectures individually.

		• Implementing video content search using generated text stream.
IT16132306	H.M.S.S. Herath	• Create vector whiteboard and allow students to use it when asking questions. • Create chat box to type & send the question and upload files whenever needed. • Raise hand to ask questions • Transfer webcam and microphone feeds of students when asking the questions.
IT16118096	W.A. Geeth Sameera	• Identifying and initiating face tracking automatically at the lecture time. • Provide an option to select the lecturer for unregistered lecturers at the lecture time • Based on the facial ID, tracking lecturer movements using a PTZ (PAN, TILT, ZOOM) camera

		• Process video feed within the server and commands to move the PTZ camera movements will be send accordingly to continue lecturer tracking.

Table 4.1: Work Allocation

5. BUDGET

Description	Total Amount (Rs.)
Traveling charges	1000
Communication charges	1000
Printing charges	1500
Stationary charges	500
Internet Facility	5000
Hosting charges	20,000
Cost for devices	115,000
Other charges	1000
Total Project Cost Estimate	

Table 5.1: Budget

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