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
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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 main purpose of this document is to give a clear understanding about the scope, functional and non-functional requirements, dependencies along with the other relevant specifications of Student Questioning Handling & Whiteboard component (SQHW) of the proposed real time e-Learning system. In addition, this document will illustrate the issues related to the current systems and actions to be performed by the development team are described in order to come up with a better solution. From this document developer will get a better understanding about the functionalities of the component and can be used to verify the user requirements. Here user can get an idea whether the system will meet the user's requirements or not and requirement of the hardware, software and other dependencies.

The intended audience of this System Requirement Specification are the members of the research group, project supervisor - Dr. Malitha Wijesundara, project co-supervisor – Mr. Pramadhi Athapaththu.

1.2 Scope

This document covers the requirements of the real time e-Learning system which creates a real classroom scenario for the users who connected to the lecture from outside the lecture hall. Students able to interact with the lecture via internet using the system. SQHW component develop for the users to enhance the interaction between lecturer and the student connected via internet. If there are any questions has to asked from the lecturer in real time by the students connected via internet, he/she would be able to do so using the SQHW component. Furthermore, this document describes the technologies, concepts, flow of the system using diagrams. Since this document will discuss the features and technologies to be used and will be guideline which will act as the reference to the developers to understand the final output with certain limitations.

1.3 Definitions, Acronyms, and Abbreviations

Acronym/Abbreviation	Definition
SQHW	Student Questioning Handling & Whiteboard

Table 1.3.1 – Acronym/Abbreviation

1.4 Overview

SQHW is one of the major component of the main real time e-Learning system. This module enhances the interaction between lecturer and the student connected via internet by introducing real time questioning facility. Students can ask questions in different ways. Using webcam and the microphone, using chat box type and send the question. There is a whiteboard facility which can be used by the students to ask questions more clearly by drawing or writing.

1.4.1 Main Goals

The main goal of the SQHW component is to create facility for the students to interact with lecturer in real time. The system will allow interact with the lecture using multiple medias.

1. Audio & Video – Using web cam and microphone
2. Text – Using chat box

Furthermore, white board facility enhanced the interaction between lecturer and the student when asking questions.

1.4.2 Specific Goals

The specific goals of the SQHW component are as follows.

- To alert the lecturer when student wants to ask a question.
- Provide access to the whiteboard facility for the student when asking the question.
- Provide a list of students who connected to the lecture from outside.
- Provide chat box to type questions and send files.

1.4.3 Users

The main user group focusing on this system are university students. The students who are unable to attend the lectures due to some reasons are them. Through this system, trying to create a real class room scenario for the students connected via internet.

2 OVERALL DESCRIPTIONS

Problem

For a university student attending lectures is a must to understand and study the subject materials. Here the most common teaching model of the world is meeting the instructors and students in real time and learn. In this teaching model there are several drawbacks that has to be concerned and they will be addressed as the research problems. One of them is student has to shape their personal schedules around university as the class based learning schedule not changed according to student personal needs. When he cannot attend due to some reasons, he won't able to cover the lectures again and it would be a huge loss considering from the student side. Even if the student attends the lecture he can't memorizing or write all the necessary content and sometimes may forget things memorized with the time.

Furthermore, there are several problems to be concerned even after the real time e-Learning system developed. One is to create the real classroom scenario considering the student questioning. So it will be useless if there is no way to communicate with the lecturer and the student in real time to ask questions from the lecturer. And the other one is to enhance the interaction between lecturer and student. In real classroom scenario student can use whiteboard or paper to ask questions more clearly by drawing or writing. Those are the identified problems when developing e-Learning system.

Solution

The proposed solution for the identified problems would be an e-Learning system to overcome lecture missing problems as well as content non-reusability problems. The overall expectation of the system is to provide better experience as a real class room scenario with many useful functionalities.

The system covered with four components as

- Real time audio/video transcoding component
- Face tracking component
- Student Question Handling & Whiteboard (SQHW) component
- Video player with data analytics component

This document covers the functionalities of the SQHW component. The main objective of this component is to build up a way to handle the real time questioning facility with the ongoing lecture. Student can mainly ask questions using his webcam and microphone through video and audio medias. Rather student can use chat box to interact with lecturer with text and uploading files when necessary.

The proposed system is a web based application and SQHW component is focused with two main functions.

1. Controlling the questioning function
2. Whiteboard function

The functionalities are described below more clearly.

1. Controlling the questioning function

When we considering the procedure to ask a question using system, first the student has to notify the lecturer that he has to ask a question. When student click the ask question button a request will be sent to the lecturer showing that the specific student is willing to ask a question. With the confirmation of the request by lecturer, student able to ask the question with his webcam and microphone. If the student wants to ask the question using chat box procedure would be different. Here no need to send a request to the lecturer, instead student can type the question in chat box and send. So the lecturer would be notified if any new messages received and the chat box is a broadcast chat box. Other connected students also could able to see the chat.

2. White board function

When student ask the question after lecturer granted the permission, whiteboard editable function will be allocated automatically for the student who asks the question. When the student writes on whiteboard it will be broadcasts to the lecturer as well as all the connected students. This whiteboard creates with specific functions that ease the using of whiteboard. Student can use different color pens, eraser with different sizes,

and the line eraser which erase whole line you draw. All the line coordinates drawing here will be send to the database for future usage of analytics component.

Technologies

Chat box – HTML5 Web Sockets

- Establish a solid connection between server and the browser
- Fast and persistence communication
- Low latency

Whiteboard – HTML5 Canvas

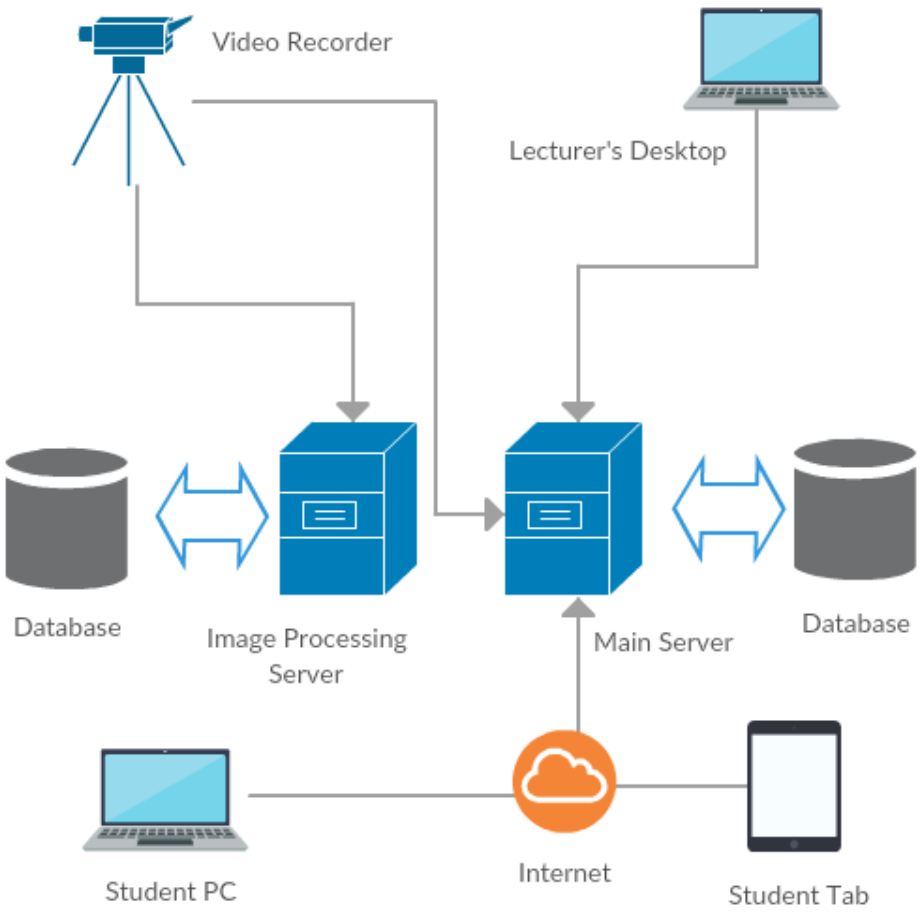

Figure 2.1: Overall Architecture Design

2.1 Product Perspective

The proposed e-Learning system is an app with more newly introduced features which resolves various problems existing with students relating the studies. When considering the literature review there are systems that trying to overcome those problems, but the solutions target only on solving one or rare scenarios which are not fully helpful for the students. The proposed SQHW component is a very rare solution which will be implemented comparing to the other systems.

Eduscope is a recently deployed real time e-Learning system by the students of SLIIT. It consists with more features compared to the other systems. But it also didn't cover the fully requirement of the students. Here is the comparison with Eduscope along with our proposed real time e-Learning system.

Systems / Feature	Eduscope	Proposed system
Vector based Whiteboard	No	Yes
Text-based lecturer student interactions	Yes	Yes
Video-based lecturer student interactions	No	Yes

Table 2.1.1: Comparison with Eduscope

2.1.1 System Interfaces

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

2.1.2 User Interfaces

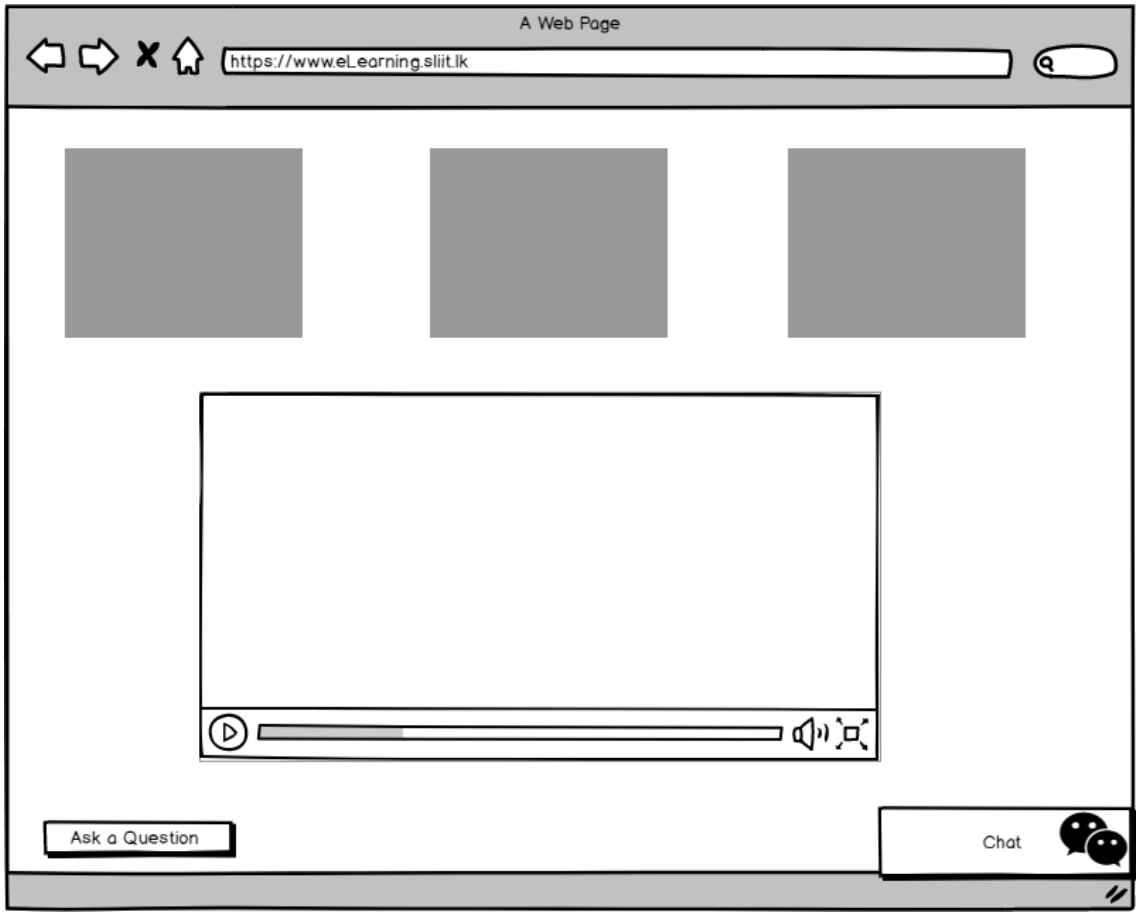

Figure 2.1.2.1: User Interface (Questioning or Chatting)

2.1.3 Hardware Interfaces

Real time e-Learning system is a web application that provides class room scenario in real time for the students over the internet. So there is no needed of having special hardware to run this application. But in case when asking questions students needed a webcam as well as a microphone.

2.1.4 Software Interfaces

The proposed system run over the browser as it's a web app, it needs latest version of the browsers. Since this module uses getUserMedia API it's needed browsers to compatible with this API and most browsers are compatible with the latest versions. Further system will use SQL database to store data.

2.1.5 Communication Interfaces

All the feature of this app working with the internet. So SQHW component also needed an active internet connection to connect with the server and for the streaming of student video feed, audio feed detected by the webcam and microphone.

2.1.6 Memory Constraints

There is no need of space for the processing or storing application as this is run over the internet. But for the better experience and to run the app effectively and smoothly it's recommend to have minimum 1GB RAM.

2.1.7 Operations

- Before using the e-Learning app you should be a registered student of a university/ school/institute used this system.
- By using student credentials given by the university log in to the app.
- Set up webcam and the microphone before send a request to ask questions.

2.1.8 Site Adaptation Requirements

The user doesn't need any special operations to do for using the system. In SQHW component when asking the questions granted permission to access microphone and webcam is the only necessary task to do.

2.2 Product Functions

Here we are going to discuss the major functions of the SQHW component. This component handles the functions around students who connected through internet. So to create the scenario of a real class room we have to consider different aspects to cover the whole scenario. Whiteboard, face to face questioning with the lecturer, draw or write something to ask the question clearly are the major scenarios that would have in a classroom considering the student side. This component covers all these scenarios with the functions discussed under this section. Architecture diagram (Figure 2.2.1.1) shows the interaction of the SQHW component with the server and how the video streams

during questioning time. In use case diagram (Figure 2.2.2.1) shows the functions of the entire component.

2.2.1 High Level Architecture Diagram (SQHW Component)

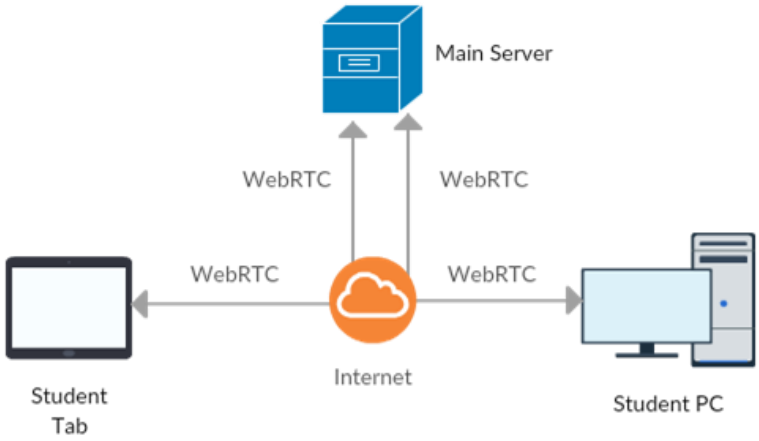

Figure 2.2.1.1: Architecture Diagram (SQHW Component)

Video feed coming from the student webcam send to the server as WebRTC over the internet. Also video feed coming from the server to the student pc streams as WebRTC.

2.2.2 Use Case Diagram (SQHW Component)

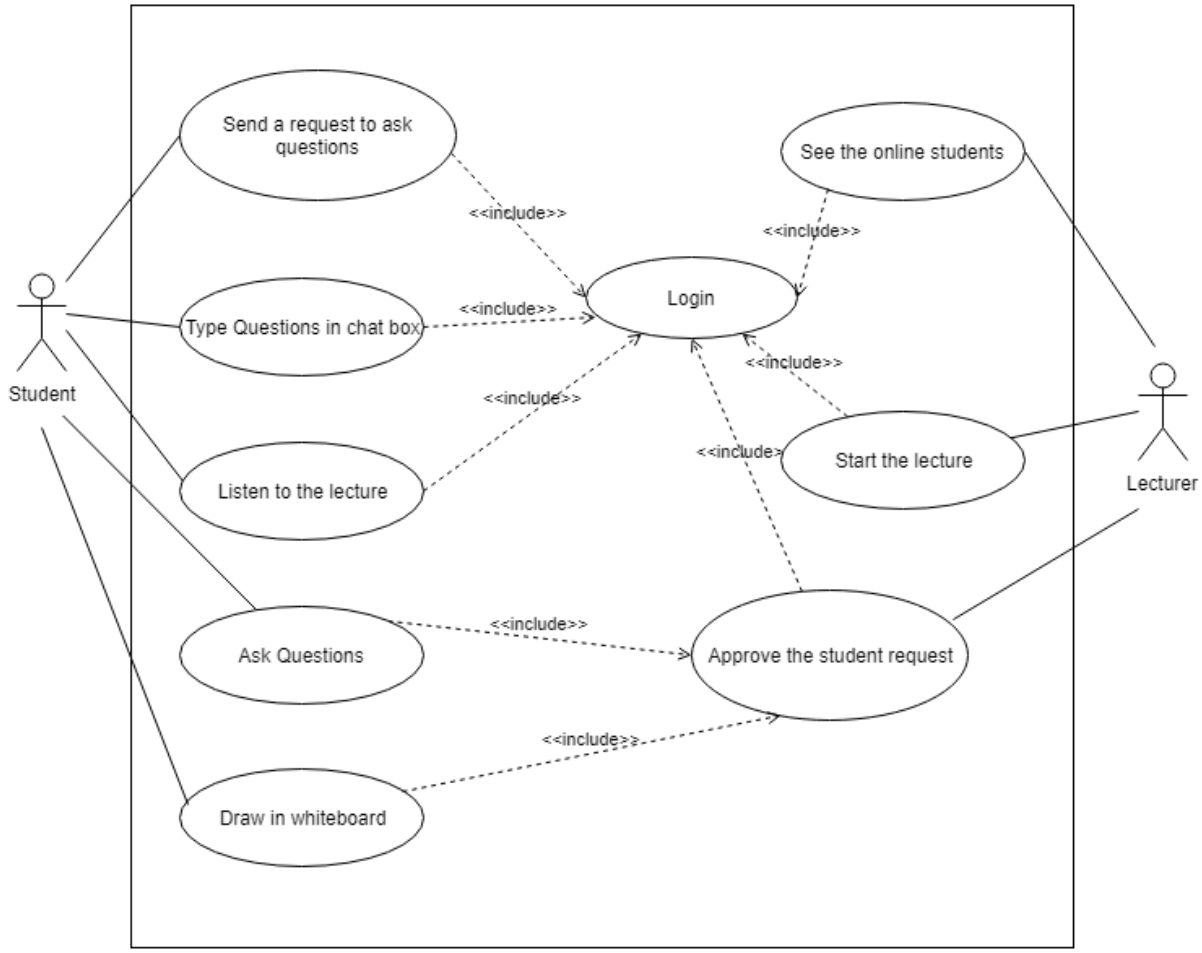

Figure 2.2.2.1: Use case diagram of SQHW component

2.2.3 Use case scenarios

Use case ID	UC1
Use case name	See the online students
Goal in context	See the online students who connected to the lecture
Primary Actors	Lecturer
Pre-conditions	1.Lecturer should login to the system
Main flow	1. Lecturer click the online student button 2. App will pop-ups the current online student list

Table 2.2.3.1: Use case scenario 1

Use case ID	UC2
Use case name	Send a request to ask questions
Goal in context	To ask the questions request has to be send to the lecturer
Primary Actors	Student
Pre-conditions	i. Student should login to the system i. Student should connected with the live lecture
Main flow	1. Student clicks ask question button 2. Student click 'yes' on the confirmation box
Post-conditions	A request will be send to the lecturer for confirmation

Table 2.2.3.2: Use case scenario 2

Use case ID	UC3
Use case name	Ask questions
Goal in context	Ask the questions using student webcam and microphone
Primary Actors	Student
Pre-conditions	i. The request should be accepted by the lecturer
Main flow	1. Student allows to use microphone and webcam 2. Ask the question 3. Draw using whiteboard 4. End the session
Post-conditions	Video, Audio & Whiteboard streams to all connected students

Table 2.2.3.3: Use case scenario 3

Use case ID	UC4

Use case name	Approve the student request
Goal in context	Decide whether to approve or decline the request sent by student for questioning
Primary Actors	Lecturer
Pre-conditions	The request for questioning should be sent by the student
Main flow	1. When a request comes from a student there will be a notification 2. Lecturer decide whether to approve or decline the request by clicking the button
Extensions	2a. If the lecturer didn't approve the request student will not be able to ask the questions
Post-conditions	Student will able to ask the question

Table 2.2.3.4: Use case scenario 4

Use case ID	UC5
Use case name	Type questions in chat box
Goal in context	Ask the questions using chat box
Primary Actors	Student
Pre-conditions	Student should connected to an ongoing lecture
Main flow	1. Student clicks chat box at the bottom of the UI 2. Chat box will be maximized 3. Type the question and click send button 4. Close the chat box
Post-conditions	Question will be streamed to all the connected students

Table 2.2.3.5: Use case scenario 5

2.3 User Characteristics

This application is developing for the students who are unable to attend the lectures due to some reasons. Users for this application can be

- University Students
- School Students
- Any other institutional students

Although the application is developing for the above user categories, we are mainly focusing the university students when developing and this will be developed considering their requirements. Students can connect to the lecture from anywhere through internet. As this an application with simple UI's, user can adapt to the functionalities easily.

2.4 Constraints

The proposed e-Learning system will be developed as a web based software. There are several constraints to be considered by the developer as well as client. The identified constraints are as follows,

Hardware Constraint

- Any device with a WebRTC supported browser
- Continuous internet connection (Min speed: 3Mbps)
- Webcam & Microphone (Optional)

Software Constraints

- Node JS
- MySQL
- React JS

2.5 Assumptions and Dependencies

Assumptions made on the SQHW component are as follows:

- User have at least a slight knowledge about using the internet and to operate the application.

- During the lecture, one time only one student can ask the question with the confirmation of the lecturer.
- Student give permission to operate the microphone and webcam when asking the question.
- Student internet connection will not be interrupted.

2.6 Apportioning of Requirements

The procedure will be different to approach specific requirements as this product will be an outcome of a research. But the major functions and components of the product will not be subjected to change. The section 1 and 2 described the major requirements of the proposed system and they will not change while in section 3 it will be discussing the specific requirements. Primary requirement of this component is to create the virtual whiteboard to interact with the lecturer.

After successfully implementing the features of the previously mentioned function next function will be to handle the real time questioning facility. This focus with the audio and video streaming only. After implementing the features successfully next and last focusing function will be implementing the chat box. This order will be follow to implement the SQHW component successfully.

3 SPECIFIC REQUIREMENTS

3.1 External Interface Requirements

3.1.1 User Interfaces

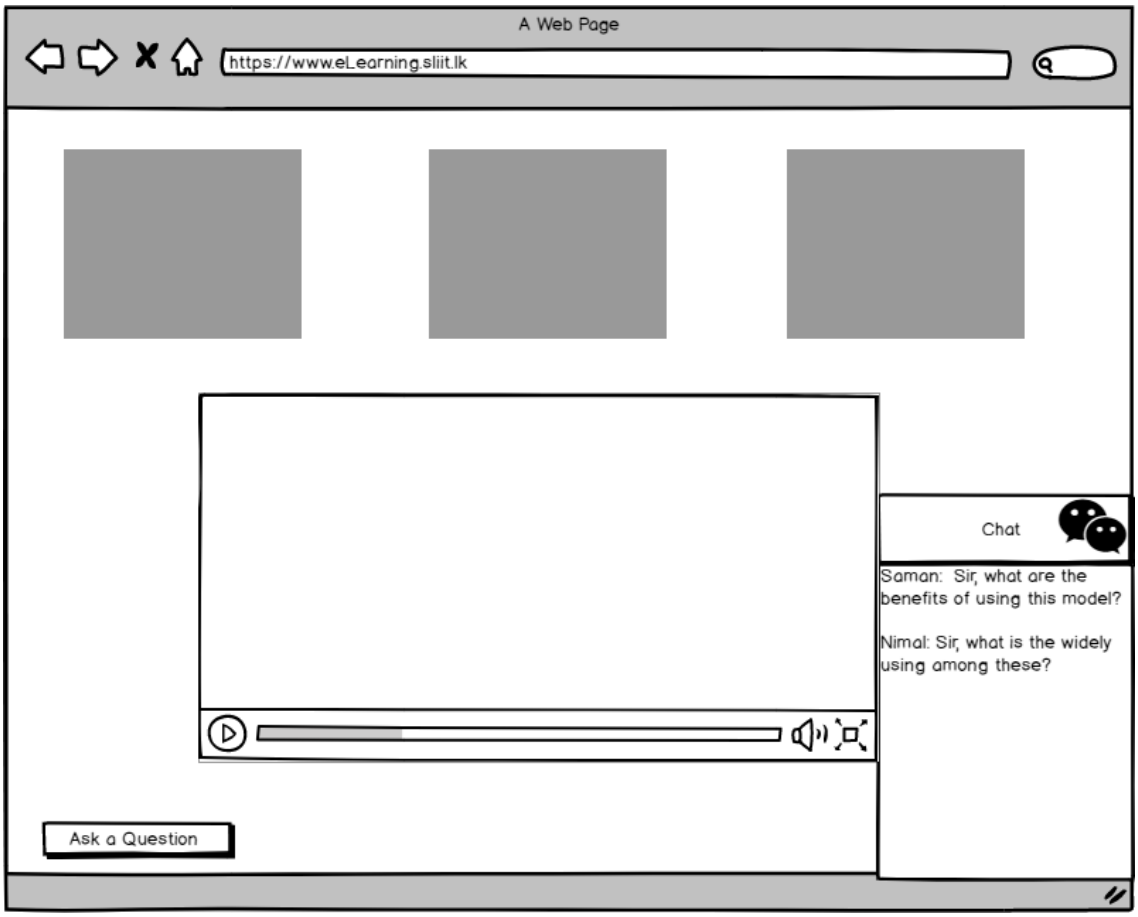

Figure 3.1.1.1: Chat Interface

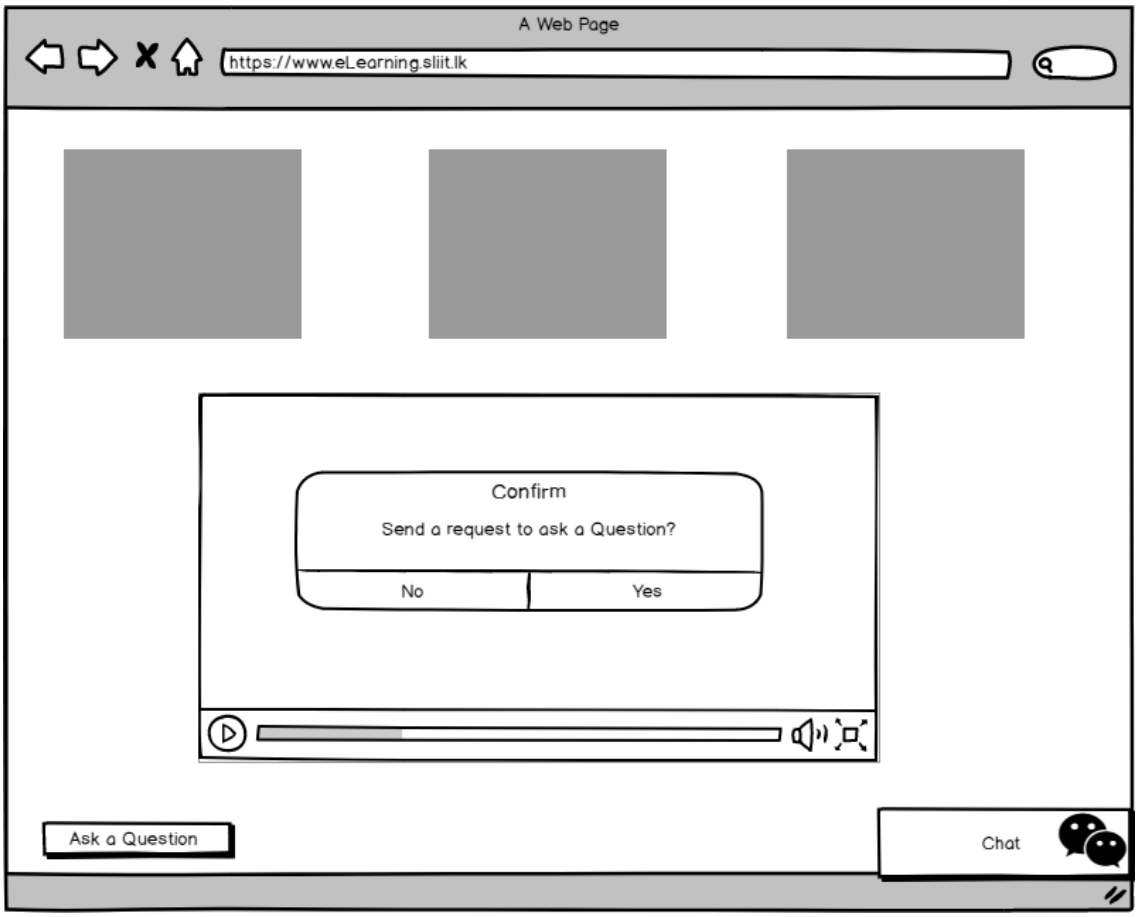

Figure 3.1.1.1: Questioning Request Interface

These are the two user interfaces used in SQHW component. When student wants to ask a question using chat box, he/she should expand the bottom right corner chat box first. Then the student can type the question that he/she wants to ask and send it. (Figure 3.1.1.1)

There is an 'Ask a Question' button placed on left bottom of the page. This will use to send a request when the student wants to ask a question using voice based questioning facility and whiteboard facility. After confirming the confirmation box, the request will be send to the lecturer. (Figure 3.1.1.1)

3.1.2 Hardware Interfaces

Webcam – Since SQHW component handles questioning facility, webcam is needed to capture the video of the student.

Microphone – It is compulsory to have microphone when asking questions. Otherwise student wont able to ask questions using voice based questioning facility.

3.1.3 Software Interfaces

There are some software interfaces dealing with our proposed system when designing and implementing. From those software interfaces some will use in SQHW component also. getUserMedia API is one of the software interface that used in SQHW component. This API is use to capture the video and audio feed of the student from webcam and microphone. Rather MySQL will be used as the database for this application. So the drawing coordinates of the SQHW based whiteboard will be saved on MySQL database along with the time.

3.1.4 Communication Interfaces

Internet is the main compulsory communication interface required for this system. As this is web based application user needs to go to the website and login. To operate the app with real time updates constant internet connection is required as the real time audio/ video streams over the internet.

3.2 Classes/Objects

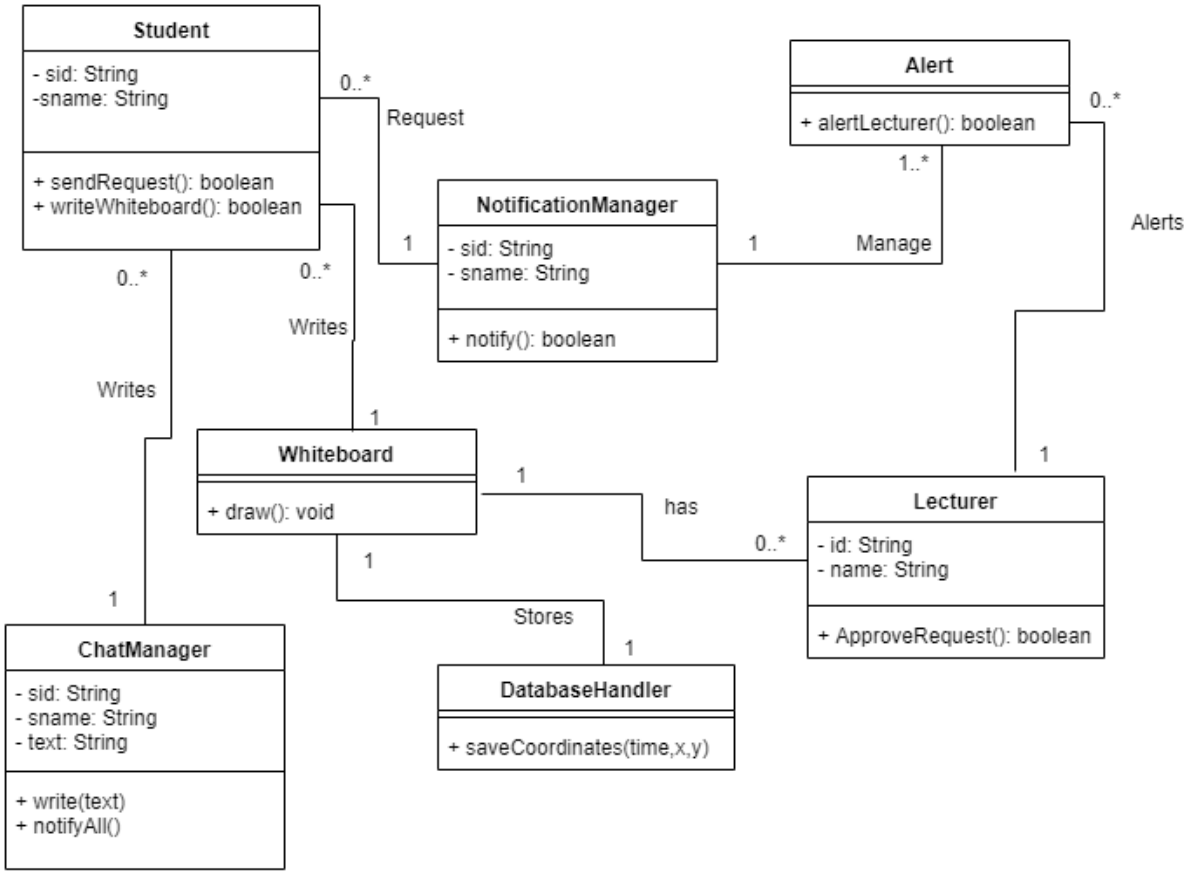

Figure 3.2.1: Class Diagram (SQHW Component)

3.3 Performance Requirements

The notification manager will get concurrent request from student to ask questions. It should be handle all the requests without any interrupt. Rather as this is a real time system all the requests, streaming should handle without any delay. Here we are using NodeJS as the backend so it can handle multiple requests asynchronously. According to the experiments we have done, the most suitable and powerful front end technology will be ReactJS for this system. It increases the efficiency of the system and it will be a huge benefit for the system.

3.4 Design Constraints

Proposed real time e-Learning web application supports almost in every latest versions of the browsers except IE, Opera Mini, IE Mobile and KaiOS Browser. This system

mainly works with a player which streams video feeds from lecturer, from student side and from lecturer whiteboard. So there will be an option to toggle the component which student wants from above mentioned scenarios and the selected option will be maximized. And the other screens will be minimized state but those modules should be run concurrency.

3.5 Software System Attributes

3.5.1 Reliability

Proposed system is a real time system. So the system should perform accurately without any delay. If there is any case of delay happen it will affect the overall system. The lecturer video when doing the lecture as well as the student's video of questioning should arrives the screens instantly. Since the system provides a whiteboard function to the students, it also needs to stream the contents write instantly. In a case of delay voice/video stream and drawing board acts differently. So the SQHW component also needs to handle the accuracy of the system to have a good reliability.

3.5.2 Availability

The proposed system will available anytime for the users. So the students can watch past lectures any time. But when considering the SQHW component it only available when there is live streaming currently going on. Then only the student can ask questions and interact with the lecture. Although system available 99.99% for the users, SQHW component available for a certain time period.

3.5.3 Security

The proposed system designed for the specific group of people related to the university, school or institute that using this product. So the users have to authenticate by providing valid username and password, will be able to login the system. The login credentials will be provided by the related institute/ university.

3.5.4 Maintainability

With the time database will be full of unwanted data that not suitable for the current modules. This will happen with the changing of syllabus, so it's no needed to store past

data and should remove them to enhanced the accuracy and speed of searching the database. And also after the graduation of students it's no need to store their login credentials. So the system should be maintaining by removing unwanted data from the database to increase the accuracy is a must. Further the system is expected to adding new features in new releases.

3.6 Other Requirements

While writing or drawing something on whiteboard it's needed to save the coordinates with the time. Application will use this coordinates in another module in replay mode function to show what has already drawn during that time of replaying. So the maintaining of this coordinates accurately with the time and saving them on database is a special requirement of this module. If something wrong during this saving coordinates or it saved inaccurately it may result in failure of the another module's function.

4 SUPPORTING INFORMATION

4.1 References

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