Informatics Institute of Technology

In collaboration with

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Software Development Group Project

5CCGD007C

Module Leader's Name- Mr. Banu Athuraliya

Demolition Crew

Level 05

Team members

1. Suhith Nanayakkara - 2019403 - w1761338
2. P.G. Charani Hasara - 2019442 - w1761112
3. Hamza Ziyard - 2019407 - w1761340
4. S. Hiruni Silva - 2019158 - w1761071
5. Ginura Weliwatta - 2019469 - w1761118
6. Samadhi Udara -20191064 -w179031

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1. Introduction

1.1. Chapter Overview

This chapter is focusing the background of the main problem that addressed in the project. The details about problem background, aim, objectives, scope of the project, feature comparison chart and proposed solution are added under this chapter.

1.2. Project background

Education is one of the fundamental needs of human according to International Human Rights named by United Nations, it is identified as one of the main human rights. Therefore, to fulfill this right, students must have a quality education system to learn (Un.org. 2020). Quality Education is one of the Sustainable Development Goals (SDGs) which the world tries to achieve in these years. Creating a good and quality environment for education helps to develop skills and knowledge. Therefore, the world is searching for new innovative ideas to promote quality education worldwide (United Nations Sustainable Development. 2020).

Online learning is one of the most famous topics in the education field worldwide. Even though online learning fulfills the right of having Education, in some instances it fails to give a quality education because there are many issues occurred with the minimum interaction between teacher and student. Therefore, there should be a system to analyze the engagement and performance of students in online learning using developed technologies. The engagement of students totally affects for the success of online classes, but in many cases students are not giving their fullest attention by assuming that teacher cannot analyze their engagement. On the other hand, students easily loose the concentration for the lesson and their minds are easily get diverted from the lesson. For now, only sudden polls, verbal questions by the teacher, chat messages and participation can measure their engagement. Those activities do not make any reliable feedback to both student and teacher (Jenna K Gillett-Swan, 2017).

Normally students change their emotions with the rate of their interest to engage in online learning, those emotional changes affect for the concentration towards the lesson, at the same time concentration affects directly to the engagement of a student towards the class. In physical classes teachers can easily identify those changes of students but when it comes to online classes it is one of the biggest challenges. Therefore, the present online learning system needs to be modified by these features to establish a quality learning environment for students (Moutan Mukhopadhyay, 2020).

1.3. Aim

- Fulfilling the right of having education
- Supplying quality education for children in online learning
- Improving the interaction between teacher and the student in online learning
- Improving students' knowledge and skills productively in online learning
- Improving teachers' teaching skills in online learning procedure
- Providing a reliable self-evaluation on the productivity for both teacher and student in online learning

1.4. Objectives

1.4.1. Research Objectives

- To investigate different types emotions students, show when participating in an online learning session.
- To examine how emotions of a student can affect their concentration and interest in an online session.
- To implement other additional features that can increase the effectiveness of online based learning and teaching.

1.4.2. Academic Objectives

- Gaining knowledge on the latest technologies used in various aspects of machine learning used in this project.
- Advancing critical evaluating and problem-solving skills.
- Improve skills such as project management, team coordination and time management.
- Acquire the practice to publish a well-structured academic document

1.4.3. Operational Objectives

Objective	**Description**
Finding the requirement	• Identify the issues teachers and students face during online live classes • Perform a survey for teachers and students on requirement of such a system and find further improvements for the system
Gathering data	• Obtaining a dataset of facial expressions • Collecting data on facial features of different expressions
Research on existing work	• Examine similar research based on emotion analysis • Evaluate different techniques used in online learning • Determine the most suitable technologies used in data science
Implementation	• Developing the model within the time frame
Test	• Use the solution in an online live session and evaluate the test cases

Table 1.1 Operational Objectives

1.5. Scope of the project

Project scope is the part of project planning that involves determining and documenting a list of specific project goals, deliverables, features, functions, tasks, deadlines, and ultimately costs. In other words, it is what needs to be achieved and the work that must be done to deliver a project.

1.5.1. In Scope

- **A system to keep the student interested in online classes**
  The teacher and the students are mainly considered here. This system will ease the student-teacher bond and to keep the student interested and engaged in the lesson.

- **Third party involvement**
  Also, the parents are involved as in to increase the parent-teacher bond, helping the students' progress over their education.

- **Hardware requirements**
  To use this facility, the user must have a good quality web camera. Otherwise, this system cannot analyze the students' faces to identify their emotional status.

1.5.2. Out of Scope

Here we discuss about the aspects which cannot be analyze by this system.

- **Technical faults**

Errors due to unstable internet connection and low-quality camera, etc. will affect this system. But the system will not be able to fix these errors as those are apart from the system scope.

- **Complex or Unusual diseases**

Diseases or defects that can cause abnormal facial or eye movements and impairments will affect the outcome from this system. These are non-systematic errors. Hence, negligible in the system In-scope.

1.6. Proposed solution for the problem is described by the Rich picture diagram and features of the prototype.

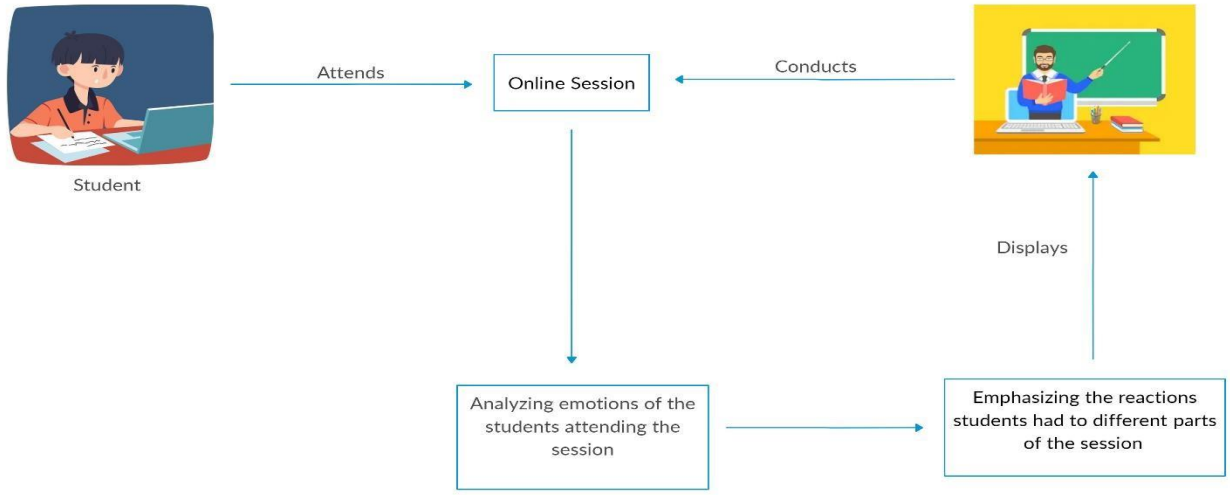


Figure 1.1 Rich picture diagram

1.6.1. Features of the prototype

The features of the prototype are,

- **Identifying the emotional status of the students.**

  By analyzing the webcam picture of the student during the online sessions, the model in the application will predict the emotional states of each student at different portions of the session which will be available for the session conductor.

- **Notifying the session conductor, the instances the students showed different levels of interest.**

  By analyzing all the students' emotions throughout the session, the model will present the session conductor with a summary as to which portions of the session were the students most engaged and active and the portions the students were least active and appeared confused.

- **Recommending the session conductor what topics of the lesson the students prefer more.**

  According to the interests of the students in the session, the model will recommend the session conductor with similar topics and teaching methods that will peak the interests of the students more.

- **Implementing a chat bot for a more engaging experience.**

  A chat bot will be implemented for the students to have interactive and engaging learning experience with conversations of both text and text-to-speech.

- **Implementing a web application.**

  The web application will be implemented with all of the above-mentioned features.

1.7. Problem Definition

Not having a system for analyze student engagement and performance in online learning is the main problem addressed in the project.

1.8. Chapter Summary

This chapter summarized researched areas on the project background. The details about the process of research and implementation of the project are described in next chapters.

2. Literature Review

2.1. Chapter Overview

This chapter will explore the literature review which will focus on critically analyzing existing data to identify the technologies and approaches that are currently in use to overcome our problem background. We will be comparing different features of different applications of existing products to analyze their advantages and disadvantages to decide on the best approach to implement this system

2.2. Similar products and technologies

Features	OUR PRODUCT	GOOGLE MEETS	ELEVATE	HELLOJOY
Web App				
• Video conferencing	✓	✓	X	X
Student Engagement Online Activity Analysis				
• Student emotion recognition system.	✓	X	X	X
• Analyzing student engagement	✓	X	X	X
Chat Bots				
• Engage with mentally inactive students	✓	X	✓	✓
• Pop lesson related questionnaires	✓	X	X	✓
Host Voice Tracker				
• Voice-to-text	✓	✓	X	X

• Emotion analysis tracking using lesson taught	✓	X	X	X

Table 2.1 Feature Comparison Chart

2.2.1. Comparisons on prevailing Emotion Recognition Systems

Emotion recognition is the ability of recognizing the current state of a person using different approaches like facial expressions and their conversations.

Emotion recognition can be done by four methods in common and they are, facial recognition, text recognition, voice recognition and brain or heart wave recognition.

EEG signals detects the brain dynamics in response to different emotions of a person. (Zhang et al., 2016) whereas ECG signals detect the heart rate in response to different emotions of a person and provide the appropriate results. (Torres-Valencia et al., 2016) This type of a continuous tracking may cause effects to the human body due to the direct impact to their brain or heart.

Text recognition is also an important method of tracking emotions. A questionnaire can be sent to the community and using their answers their activeness can be analyzed. (Putra and Arifin, 2019) But it would lack of accuracy unless enough data is trained to the modal.

Text conversations of an individual from social media will also give a great result on the current mind set of an individual. (Poria et al., 2019) But disadvantages such as research challenges can be provoked by using this type of a technology to track the emotion of an individual.

Audio emotion recognition system is one of the latest craziest type of emotion recognition. Using a great understanding on the audio of an audience it would be able to provide a great result in emotion recognition. (Cunningham et al., 2020) But the accuracy of voice tracking is comparatively less than tracking facial expressions of an individual.

Emotion recognitions using facial expressions can be done in several ways. Eye tracking, facial movement are some of the main methods followed in emotion tracking. Emotion recognition using eye tracking is accurate but it is relatively a new approach for emotion detection. (Lim et al., 2020)

So this research will be mainly focused on tracking emotions of students using their facial expressions as that is the most effective method to be implemented in our system.

For the video conferencing tool and the chat bot open-source projects are used. Through a critical research, Jitsi is chosen for the video conferencing tool and Botpress is used for the chat bot. The justifications for the selection of these tools and the links to their official websites are moved to Appendix C.

2.3. Research Gap

With the current pandemic situation in the world online based learning has become a huge trend in most educational institutions. Video conferencing software are the most common platforms used in online live

classes. Other than that, some academic institutions use collaborative learning for their teaching purposes.

When using above methods, educators should use different techniques to determine the engagement of the student because it directly affects to the student performances. In sessions with a lesser number of students, teachers monitor students from their webcams. Other than that, teachers engage with students by asking questions relevant to the subject materials where the students can answer through the microphone, chat, or answer through an online whiteboard. But it is not practical when conducting classes with a larger number of students. In such live classes they generate polls, create engaging quizzes, or get feedback from students using reaction emoji's.

In this project the engagement of the student in online live classes is detected by analyzing the emotions of that student. Emotional status of a learner is very important because it causes the student to be attentive and thus increasing the learning and memorizing curve. Student having positive emotions are more engaged in studies while and negative emotions shower less engaged studying activities (Reschly et al., 2008). One thing that is lacking in an online class is the ability of the teacher to detect an emotional response from the student. Since learning is a 'communicative event', without proper communication student can feel 'alienated' in the lesson (Mann, 2005).

Emotion analysis can be performed through analyzing text, speech and facial expression. This model uses machine learning and data science techniques to analyze emotion from facial expressions. Face and the facial features will be identified real time from the web cam using Viola and Jones algorithm (Jones and Paul, 2003). This algorithm is an extremely fast way detect features since it scales the features instead of scaling the whole image (Kumar and Videla, 2018).

First the image is converted into a grayscale image. AdaBoost training machine learning algorithm with using an image dataset of faces and a set of non-face images to train the model. Then the algorithm then converts that image into an integral image to make detection of Haar- like features more efficiently. Then the algorithm cascades through the image identifying the classifiers(features) using a decision tree and if all the classifiers get approved algorithm detects the face on the image.

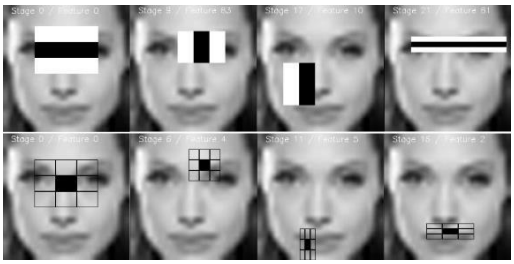


Figure 2.1: Detection of Haar-like Features(Fabien, 2020)

This model specifies in recognizing the 7 emotional states anger, disgust, fear, joy, sadness, surprise, and neutral which is also the most potently used Ekman's emotion classification. These emotional states are the result of the combination of face actions. These actions can be identified by the Facial Expression Coding System (FACES), a system to classify human facial movements by their appearance on the face. (Magdin and Prikler, 2017)

Figure 2.2: Seven primary emotional classification(C. H and P. , 2020)

However, emotion recognition may be affected by factors such as light conditions and changes of head positions of the individuals. These will be more sensitive for methods using 2D image analysis hence methods with 3D model analysis would prove more favorable. (Tarnowski et al., 2017)

2.4. Research on Approaches and techniques

2.4.1. Facial detection

Facial detection is a major domain in computer vision and object detection fields. This system uses facial recognition to detect to detect the students' face in a live online session from the live feed from student's web cam. Therefore, it's vital to select an approach which allows real time face detection from a low-resolution image. Facial detection can be achieved by 3 main categories of approaches namely, feature based, image based and template matching (Cho, 2009).

- **Facial feature approach**

Feature based approach distinguishes unique characteristics of the human face such as edges and skin color. Histogram of Oriented Gradient (HOG) detects the edges by the distribution of intensity gradients (Dalal and Triggs, 2005) and it is popularly used with SVM classifiers in facial recognition (Dadi and Pillutla, 2016; Mady and Hilles, 2018) due to its high accuracy. Skin color analysis recognizes the intensities of human skin of different races. But these algorithms were not successful since other parts of the body has the same skin color (WSEAS and Bulucea, 2009). Main set back in feature-based approach is inability to detect faces in complex environments.

- **Template matching approach**

In this approach main features of the face such as eyes, mouth and nose are detected and the distances between those prominent features are measured to verify the image to be a face. This technique is used in Eigenface algorithm. Principle Component Analysis is used in that to reduce the dimension space for robust processing. This requires a small dataset but it's less sensitive to different poses.

- **Image based approach**

These methods use face and non-face datasets with cascaded classifiers to detect faces. Viola Jones algorithm (Jones and Paul, 2003) which is an extension of AdaBoost training is the most widely used face recognition algorithm. Conversion of the image to an integral image give this algorithm a high processing speed. Convolution Neural Networks (CNN) and Artificial Neural Networks (ANN) also comes under this category which gives high robust image detection (Farfade, Saberian and Li, 2015a; Le, 2011). These utilizes deep layers of classifiers for recognition of human faces.

2.4.2. Emotion detection

The previous section discusses the techniques used for face detection that have been implemented in existing research. The ensuring phase will entail the various emotion classification and recognition techniques including feature extraction. Machine learning algorithms have been proven to contain a great potency in pattern recognition and classification, hence can be used in various emotion recognition systems. (Hassouneh, Mutawa and Murugappan, 2020). The extracted facial features of students need to be classified to determine the relevant emotional status of the students and there are many popular machine learning approaches that can be used to achieve this process.

According to Ivanovaa and Borzunov, neural networks based on Keras and Theano neural network modeling libraries can be trained to obtain effective emotion classification models (Ivanovaa and Borzunov, 2020). Also, Raut states that by using Support Vector Machines (SVM) algorithms, a stable model which can handle data overfitting can be created which can also work with non-linear data in high dimensional spaces (Raut, 2018). Munasinghe claims that random forest classifiers will aid in creating a potent model that will have an enhanced ability in handling missing values in the dataset (Munasinghe, 2018). Additionally, in accordance with Sohail and Bhattacharya, K-Nearest Neighbor (K-NN) classifiers may aid in developing a model for multi modular classification in a considerably less amount of time (Sohail and Bhattacharya, 2007).

Furthermore, according to Shahreza, Linear discriminant analysis (LDA) can also be used to create a model for emotion classification (Shahreza, 2017).

Since all above-mentioned machine learning algorithms can be used for emotion classification and recognition purpose, for a better understanding of the comparisons and distinctions between these algorithms, the advantages and limitations of each algorithm is detailed in the table below.

Algorithm	**Advantages**	**Limitations**
Neural networks	• Can model with nonlinear data with multiple inputs • Ability to work with incomplete knowledge • Fault-tolerant • Accurate	• Require much more data than any other traditional machine learning algorithms • High processing time and slow learning • No specific way to determine its structure
SVM algorithms	• Effective in high dimensional spaces • Handles non-linear data efficiently • Prevents over-fitting • A stable model	• Choosing an appropriate Kernel function is difficult • Long training time • Complex • Large memory requirement

Random forest classifiers	• Accurate outputs • Reduces overfitting • Automates missing values in the data • Normalizing of data is not required	• Needs more computational power • Long training time due to combination of decision trees • Does not clarify the importance of each variable
K-NN classifiers	• No Training Period • New data can be added effortlessly without impacting the accuracy of the algorithm • Easy to implement	• Does not work well with large datasets or high dimensions • Need feature scaling • Vulnerable to noisy data, missing values, and outliers
LDA	• Simple • Fast and portable • Easy to implement • Good for face recognition and dimension reduction	• An old algorithm, hence poorer prediction than other algorithms

Table 2.2 Advantages and Limitations of different algorithms used for emotion classification

2.4.3. Keyword Recognition

Keywords recognition is used to trigger the engagement detection for a specific part or a pre identified subtopics of the lesson. When the system identifies keywords from teacher's speech it starts to execute the given function. There are 2 approaches that have been identified to recognize keywords from audio signals.

2.4.3.1. Speech Recognition

The primary component of speech recognition is the speech, then the physical sound of the speech is converted to an electric signal by using the microphone. After that this analog signal converts to digital data by an analog to digital converter. After digitized there are various methods to utilize the speech to the text (Subramanian, D, 2020).

With the assumption that the statistical properties of the signals do not change over a brief timescale, hidden markov model (HMM) is applied in modern speech recognition systems. In a general HMM, the speech signal, which is divided into fragments, is mapped into a vector combining the frequency and the power spectrum of each fragment. In decoding, groups of vectors are mapped with the trained models. Along with this voice activity detectors are employed to consider only the signal portions that mostly likely to contain speech. (Acharjee et al., 2015)

Speech recognition services are available for use online through APIs and different Python SDKs. There are a variety of packages for speech recognition namely,

1. apiai
2. assemblyai
3. google-cloud-speech
4. pocketsphinx
5. SpeechRecognition (PyPI, 2020)
6. Watson-developer-cloud.

Out of these the SpeechRecognition library serves as a wrapper with flexibility which can be applied for popular speech APLs such as Google Web Speech API. In addition to these, PyAudio package can be used to access the microphone to capture the audio signal (Python, R, 2012).

2.4.3.2. Trigger Word Detection

This approach is based on the technology that allows platforms or devices to trigger or to wake up hearing a certain word which is identified as the trigger word. Trigger word detection is applied in different popular devices like Google Home, Apple Siri and Amazon Alexa. The advantage of this approach is that we can train the models with limited, reasonable amount of data. However, in the application for the online learning system, it is difficult to identify key words which are common for all classes to train the model and make it available for the future usage. Keywords are chosen by the teacher before the class and there is a wide variability in those from class to class. That endorses a challenge on this approach when it is to be used with customized key words. (Chengwei, 2017)

2.5. Chapter Summary

This chapter describes details about the literature survey conducted on the proposed solution to address the current problems associated with online learning and student engagement. Here, technical side of the similar available products, research carried out by global research community, application of data science in solving the identified problem are explained in detail.

3. Project Management

3.1. Chapter overview

This chapter will explore the most appropriate project management methodologies for this project. A detailed account on most suitable process models and project management methods will be given in the following chapter. The risks involved as well as the mitigation plan for the system will be identified and the data gathering methods, communication plan and the activity schedule and project deliverables will be detailed. The work breakdown structure and Gantt chart diagram are also illustrated in this chapter.

3.2. Methodologies

3.2.1. Process Model

A process model is known as a sequence of processes or phases to be followed in developing high quality products. It is also known as the Software Development Life Cycle (SDLC) model. The main phases of a process model are stated below.

Figure 3.1: Software Development Process

There are several SDLC models designed to follow the sequence of process according to different projects. Four of the models which were suitable for this project and a small description about them are stated below.

- **Waterfall Model**
  - In this model all phases need to be completed in a sequential manner.
- **Iterative Model**
  - Verifications of the process is done after the sequence followed as in the waterfall model.
  - And this can be iterated till the end product becomes productive.
- **Spiral Model**
  - In this model there will be iterations after following the steps as in waterfall method.
- **Agile Model**
  - This model is a combination of iterative and incremental models.

According to this project the most suitable process model is the agile model.
In this model the processes are divided into timelines so that features can be developed in each iteration according to the customer's feedback. In building a complex project the most suitable model is also the agile model as it is the most flexible method.
In developing our project features, feedback of the target audience is very important. So the agile model becomes the most effective model. Updates can be done while continuing the project development. In

Figure 3.2 Agile model (Amit,2020)

this case also the agile method becomes the most effective one. The figure below depicts a clear view on this model.
Productivity of our project can be fulfilled by following this model. The reasons for rejecting the rest of the models are stated in the table below.

Process Model	Reasons on Rejection
Waterfall Model	It is way too simple and the end product should be definitely known which increases the risk in the project.
Iterative Model	System architecture issues may occur as verifications are done once the model is built.
Spiral Model	The indefinite loop makes this method more time consuming and too complex.

Table 3.1: Other process models and reasoning

3.2.2. Project management method

Methodologies like Scrum, Waterfall, Kanban, Scrumban, Lean, eXtreme and PRINCE2 are some of many popular project management methodologies. In this project we will be using PRINCE2 methodology as it a structure with full stack methodology. 'Projects in a Controlled Environment (PRINCE2)' is a process-oriented methodology created for IT projects.
PRINCE2 methodology gives greater control of resources and the ability to detect any issues at an early stage of the project, reducing the risk. The major benefits of using PRINCE2 in our project are,

- Less experienced required
- Time and Cost effectiveness
- Focus on quality of the product

Figure 3.3: PRINCE2 methodology (Scott, 2017)

Method	Reasons for not selecting the method
Scrum	High risk, no finite end and highly experienced team required.
Waterfall	Makes changes difficult and delays testing until completion.
Kanban	Lack of time and overcomplicated.
Scrumban	Difficult to manage and hard to track progress.
Lean	Difficult to change over and lack of time.
eXtreme	Lack of documentation and requires highly experienced teammates.

Table 3.2: Other process methodologies and reasoning

3.2.3. Analysis and design approach

Analysis and design the system will performed by Object Oriented Analysis and Design approach. UML diagrams used in this method can give a clear visualization of the class structure and relationships which can present precise blueprint of the system. Moreover, the use of independent classes for this system can immensely support in readability and debugging of the code.

3.2.4. Programming methodology

Implementation of the prototype for EdEmo will be done using OOP programming methodology that supports the Model/View/Controller Design Pattern. Using OOP will help make the code flexible and mountable hence can be prolonged for a long period of time. Components of the code can be reused with OOP, making the system more efficient. (Leff and Rayfield, 2001) Further details on how the OOP methodology was used for the implementation of EdEmo will be described under the implementation chapter.

3.2.5. Testing methodology

The system can be tested using two types of testing methodologies, they are

- Black-Box Testing
- White-Box Testing

Comparison between Black-Box Testing and White-Box Testing

Black-Box Testing	White-Box Testing
The internal workings of the system can be unknown by the tester.	The tester must have the knowledge on full internal working of the system and the code.
Algorithms cannot be tested	Algorithms can be tested
Data driven or functional testing	Structural and code based testing
Only a trial-error testing method	Data domains and internal boundaries can be tested

Table 3.3: Comparison between Black-Box Testing and White-Box Testing (Software Testing - Methods – Tutorialspoint, (2020))

By considering features of these 2 methods, Black-Box method can be used to test the system by an external user and developers to check errors and as trial testing of the system. White-Box Testing can be used by developers and testers to check the detailed investigation of internal logic and structure of the code and algorithms are also tested by this method. (Software Testing - Methods – Tutorialspoint, (2020).

3.2.6. Data gathering methods

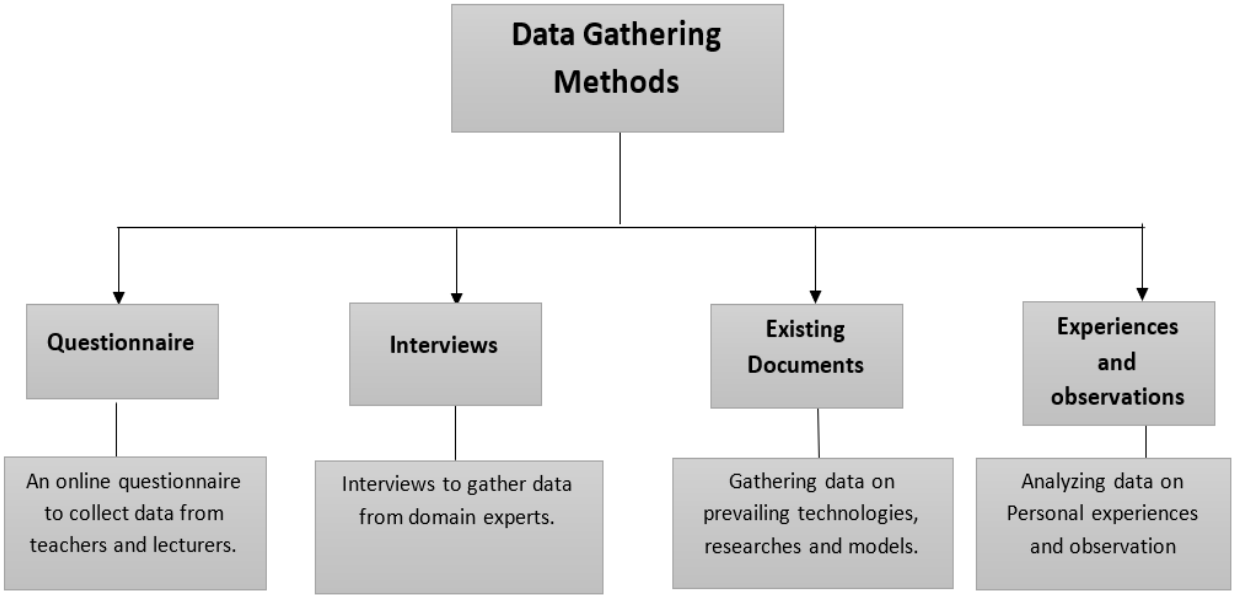


Figure 3.4: Data gathering methods

3.3. Communication plan

Description	Attendees	Actions
Weekly feed back	Lectures- 1.Mr. Banuka Athuraliya 2. Mr.John Sriskandarajah 3.Mis. Krishnakripa Jayakumar 4.Mr. Nuwan Jayawardene 5.Mr.Sriyan	• Feedback on idea pitch. • Feedback on project. • Feedback on report. • Feedback on system requirements specification. • Talk about challenges, issues facing . • Spread sheet is updated every week. • Upload special thing face book page. • Sends information via email each week to raise awareness about feedback.

	Students- Team members of Demolition Crew	• Agree on actions for next meeting.
Group discussions and meetings	Team members- 1.Suhith Nanayakkara 2.Hiruni Silva 3.Hamza Ziyard 4.Charani Hasara 5.Ginura Weliwatte 6.Samadhi udara	• Groups receive calls through whatsApp, discord. • Meetings are held through MS team, • Discord. • Upload weekly task in trello. • A google drive link and github upload for all documents

Table 3.4: Communication Plan

3.4. Research and mitigation

The possible risks involved with this project and a detailed account of the mitigation instances for each is detailed in the table below.

Risk No.	Description	Probability	Impact	Mitigation Action
R1	Lack of understanding of techniques and technologies needed for implementation.	High	High	Seeking expert advice regarding technologies and techniques along with constant self-studying with research.
R2	Hardware and software fails during implementation.	Medium	High	Back up all data including documentation and coding for the prototypes daily. Having a backup computer if there are any technical difficulties with the primary system.

R3	Scope creeping during development due to addition of new requirements.	Medium	High	Monitor the scope of the project frequently and at any time new requirements need to be added. Aim to complete the critical tasks first and only take in new requirements depending on the available time.
R4	Unable to meet deadlines due to the complexities arising during development	High	High	Prioritize the available tasks and avoid letting the project scope grow uncontrollably.
R5	Insufficient time to perform test and train model.	Medium	High	Planned amounts of times should be allocated for the model to be trained and to have sufficient testing.
R6	Selected approaches for the project become unsuccessful.	Low	High	Alternatives should be explored by using advice from domain experts and more research.
R7	Agreed upon design approach changing during implementation.	Low	High	Design should be cross validated with domain experts at the beginning stage of implementation to avoid changes.
R8	Getting sick.	Medium	High	Planning work ahead without procrastinating.

Table 3.5: Research and Mitigation Table

3.5. Drivers of the project

Drivers of the project is mentioned in the table below,

Driver	Contributors	Contribution
Stakeholders	Teacher, lecturers Students	Support to identify problems in the selected domain Provides feedback after utilizing the product
Developers	Team members of Demolition Crew	Research on the selected domain

		Develop the proposed solution
Supervisors	SDGP module team	Assisting the project Provides weekly on the development progress
Sources	Research papers, journals, conference papers, websites, videos, forums	Contains information existing research and technologies to implement the project

Table 3.6: Drivers of the project

3.6. Activity schedule and project deliverables

The activity schedule and project deliverables are given below.

Date	Activity	Duration
17/11/2020	Finalizing the project idea	7 weeks
21/11/2020	Completed the Initial Report and the Literature Review	1 week
22/11/2020	Submission of the Literature Review	1 week
30/11/2020	Submission of the completed Literature Review	1 week
01/12/2020	Completed the SRS	4 days
06/11/2020	Completed SRS and Project Management	2 weeks

Table 3.7: Activity schedule and project deliverables table

3.7. Gantt Chart diagram

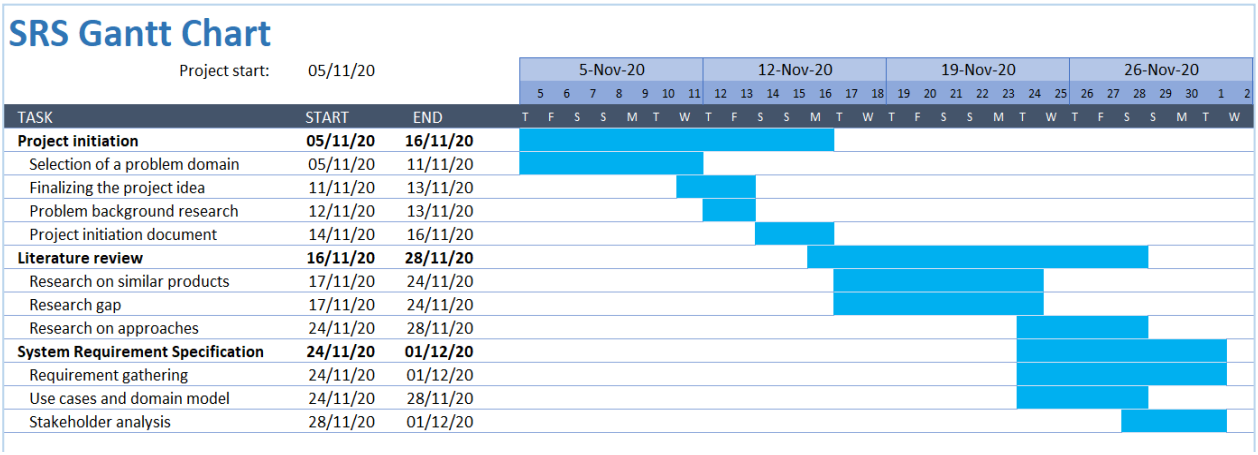


Figure 3.5 Gantt Chart

3.8. Work Breakdown Structure

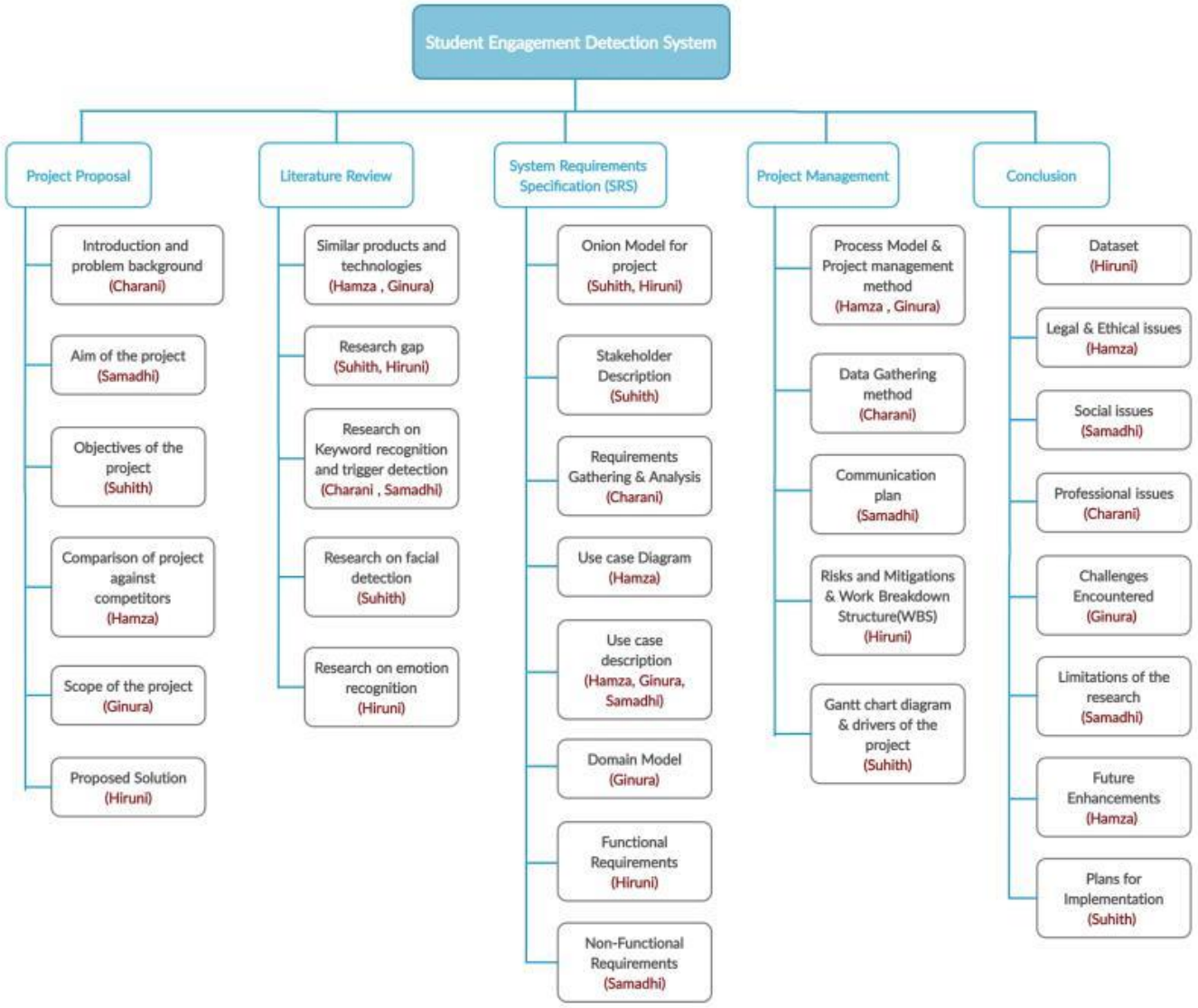


Figure 3.6: Work Breakdown Structure

3.9. Chapter Summary

This chapter gives a detailed account of the project management procedures. The agile model was selected as the process model and PRINCE 2 was selected as the project management method. The risks that could arise during implementation of the system along with their mitigation actions were identified. Data gathering methods, communication plan and the activity schedule and project deliverables were also detailed. The work breakdown structure (WBS) and the Gantt chart diagram were also illustrated in this chapter.

4. System Requirements Specification

4.1. Chapter Overview

The previous chapter describes in detail the feasibility, strengths, and weaknesses of existing techniques in the development of student engagement detection and improvement system for online learning. This chapter focuses at identifying the appropriate stakeholders, techniques in requirement gathering, use case diagrams, use case descriptions in order to identify and document functional and non-functional requirements of the system.

4.2. Stakeholder Analysis

4.2.1. Onion model

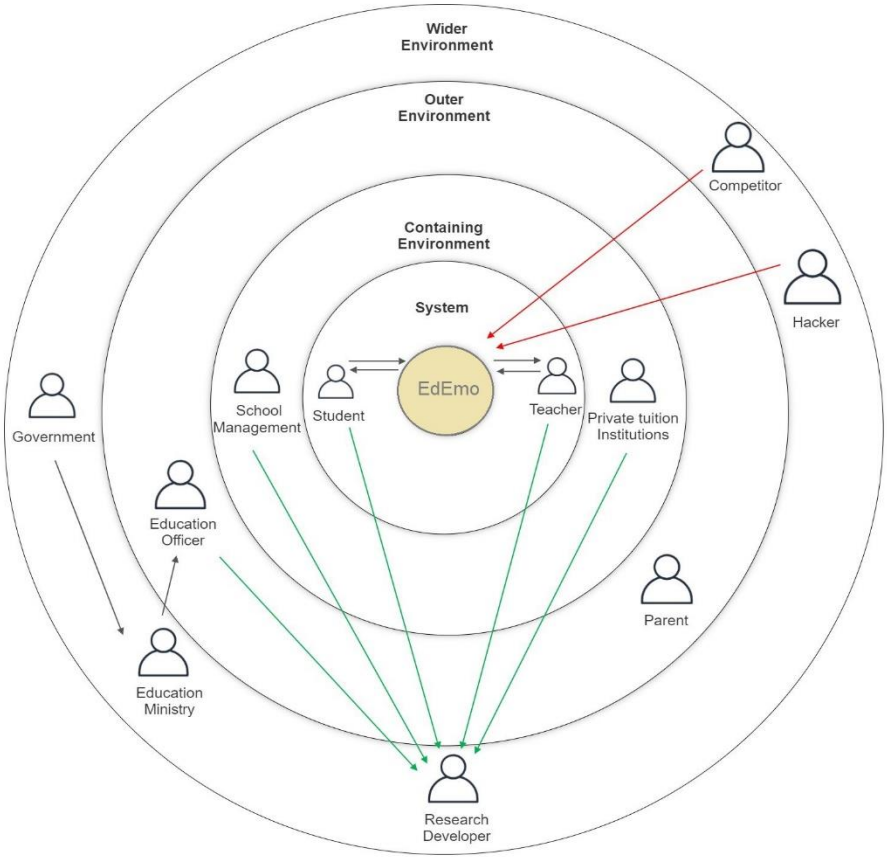


Figure 4.1: Onion Model of EdEmo

The figure above showcases the Onion model for our proposed system. All the stakeholders of the system are detailed below.

4.2.2. Stakeholder descriptions

All the stakeholders of the system are detailed below by dividing them into different stakeholder positions.

Operational roles	Stakeholder	Viewpoint
Normal operator	Teacher	Will use the system to conduct online teaching sessions and will get automatic feedback from the system
	Student	Will attend the online sessions conducted via the platform and show various expressions which will detected by the system
Functional beneficiary	School management	Will be able to handle education matters in an efficient way
	Parents	Will support underage students to operate the system to attend live classes and assure they are attending classes on time
	Education officers	Wants to monitor the conduct of schools and performance of students
Financial	Private educational institutions	Wants to conduct more online courses with higher success rate
Operational beneficiary	School management	Will handle all issues and support staff in using the software through the department.
Regulator	Education ministry	Will work implement rules assigned by the government to schools
	Government	Will assign rules for physical classes in a pandemic situation which can increase the users of the system
Negative stakeholder	Competitor	Wants to implement a better system than this project
	Hacker	Wants to gain unauthorized access to live web cam feed

Table 4.1 Stakeholder details

4.3. Requirements Gathering

4.3.1. Techniques for requirements gathering

Techniques of Requirement Gathering	
Method 1	**Literature Review**
The Literature review was a summary of researched details on the main domain and solution. Research Papers regarding the main domain and the previous solutions for this domain added more knowledge on this issue and it helped to identify innovative ideas to expand existing technologies.	
Aim: Gathering knowledge on existing technologies and products	
Method 2	**Online Questionnaire for teachers and lecturers**
An online questionnaire was a better way to analyze the importance of the proposed solution to the main identified problem. Therefore, online questionnaires were a helpful approach to accumulate an expansive sum of information necessities from geographically scattered individuals and producing charts and other visuals after analysis.	
Aim: Gathering opinions of the target audience regarding the addressed problem and the solution island wide	
Method 3	**Formal interviews with Educational officers, principals, lecturers and teachers**
Formal interviews were organized to gather information from responsible parties to the success and feasibility of the system. Qualitative data regarding the main problem and solution were collected by presenting mainly targeted questions and getting most accurate opinions.	
Aim: Gathering quality data from domain professionals	
Method 4	**Informal interviews with different individuals involves in Education field**
Due to Covid19 pandemic, some individuals were connected through telephone and online video conferencing to give their opinions. This method was not easy as there were network connection issues, changing of time slots and personal reasons.	
Aim: Gathering quality data from domain professionals	
Method 5	**Brainstorming**

Brainstorming sessions with team members, teachers and lecturers added more knowledge regarding the issue addressed. Their personal opinions, experiences and different ideas were collected through this method.
Aim: Finalizing the most relevant and innovative ideas which are appropriate for the system

Table 4.2: Techniques of requirement gathering

4.3.2. Online Questionnaire design

The online questionnaire was mainly focused for teachers and lecturers who engage in online teaching. In the questionnaire they can give their opinions on prevailing methods of engagement analyses of students in online learning and the proposed solution. They can give their feedback regarding the addressed issue. The questionnaire was passed through principals, teachers and lecturers as they are the targeted audience of this system. In order to increase the readability, this questionnaire was created in both English and Sinhala languages.

4.3.3. Formal and Informal interviews with domain professionals

Formal interviews were organized to gather qualitative data from domain professionals like educational officers, principals, lecturers and teachers. Face to face interviews, interviews by telephone calls and video conferencing were main ways used to contact with those individuals. Opinions towards the prevailing systems and the proposed solution were collected through those interviews. Opinions of their respective staff and prevailing systems were collected in those interviews.

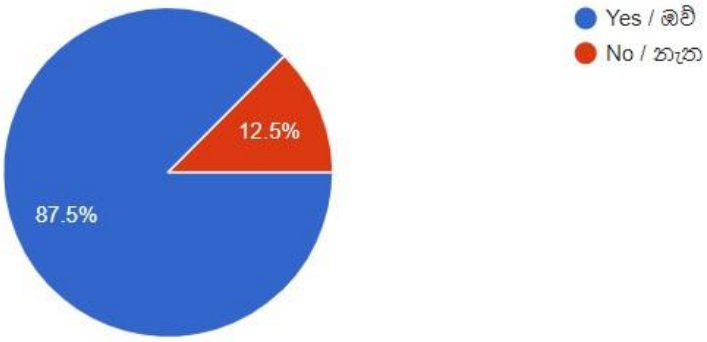
4.4. Analyzing Gathered Data

4.4.1. Analyzing data gathered by the Online Questionnaire

The online questionnaire was created for teachers and lecturers as they are the target audience of the project. The survey started from 6th December 2020 and got 80 responses from different teachers from different schools in different areas and lecturers from different state and private universities. A detailed explanation on our main questionnaire problems, results and their analysis are given below. The rest of the answers are attached in the appendix.

Do you use any video conferencing software for teaching purposes? ඉගැන්වීමේ අරමුණු සඳහා ඔබ වීඩියෝ සම්මන්ත්‍රණ මෘදුකාංගයක් භාවිතා කරනවාද?

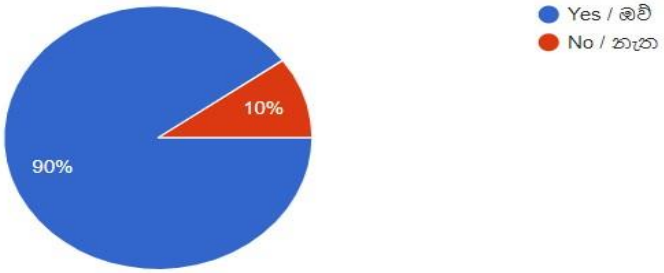
ප්‍රතිචාර 80



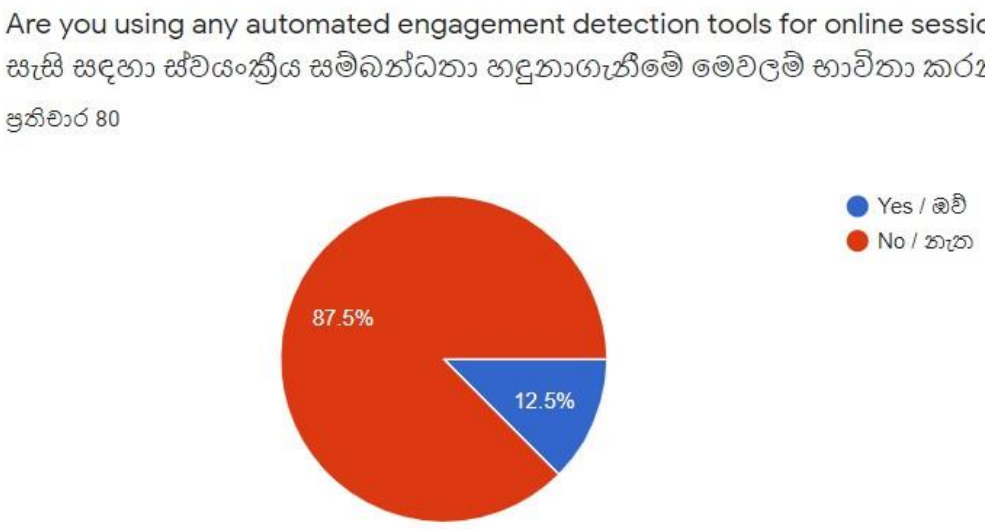
Analysis: 87.5% were voted Yes as due to COVID 19 pandemic they had to teach through online class, while 12.5% were not engaging in online learning. That means a majority of teachers and lecturers are using online learning to teach students.

Would a system that automatically detects the engagement levels of students be beneficial in online teaching? සිසුන්ගේ සහභාගීත්ව මට්ටම් ස්වයංක්‍රීයව හඳුනාගන්නා පද්ධතියක් මාර්ගගත ඉගැන්වීම් සඳහා ප්‍රයෝජනවත් වේද?

ප්‍රතිචාර 80



Analysis: 90.0% were chosen Yes as they need a system that automatically detects the engagement level of students.



Analysis: 87.5% were chosen No as they didn't find any automated engagement detection tool in online learning. The majority of target audience have the need of this proposed solution.

Table 4.3: Analyzing data gathered by the online questionnaire

4.4.2. Analyzing data gathered by interviews

The formal and informal interviews were organized to gather information and opinions of domain experts. Formal interviews were face to face interviews and informal interviews were done by using telephone and video conferencing platforms. They have given their opinions towards the prevailing conditions and the importance of having a system to detect student engagement automatically along with many other issues that they are facing in conducting online classes. The summary of all the interviews are given below. All the details that they have given are attached to the appendix.

Interviews with Principals and Vice Principals of local and international schools in Sri Lanka	
Names and positions of the interviewees	• Ms. H.E.V. Deepika Jinasena (Principal of D.S.Senanayaka College Matara) • Ms. Asmin Ziyard & Ms. Amina Zuhair (Vice Principal and Principal of Ilma International Girls School)

Difficulties mentioned by interviewees on online learning	• Difficulty in evaluating the engagement of students • Data connection issues • Lack of interaction between teacher and student • Teachers are tired and they get bored in online teaching • Lack of knowledge in online tools • Hardship in conducting examinations online
Recommendations and feedbacks of interviewees on project	• As the teachers will be able to get the attention of the students easily. And the students will not feel bored when interacting with the chatbots. And the analysis report will increase the efficient of teaching also. • It would help to create the physical classroom atmosphere to students and teachers.

Table 4.4: Interviews with principals and vice principals

Interviews with lecturers of Universities in Sri Lanka	
Names and positions of the interviewees	• Ms. Theshani Nuradha (Lecturer of University of Moratuwa, Department of Electronic and Telecommunication Engineering)
Difficulties mentioned by interviewees on online learning	• Difficulty of conducting final exams online • Difficulty in evaluating engagement of students • Difficulty in conducting laboratory sessions • Due to technical issues students and lecturers have to create many sessions • Lecturers cannot see each student through the screen specially when the class size is higher, and the lecturer is away from the laptop as he or she is near the physical white board • Students might not provide their honest feedback at the end of the session or a part of the lesson
Recommendations and feedbacks of interviewees on project	• If it is possible to detect student engagement, it provides a better feedback for the lecturer to improve and also to provide better learning experience for students. In the classroom we can identify whether students are attentive or bored and contact them within the class itself to ask whether they have any problems in understanding the lesson.

Table 4.5: Interview details with university lecturer

4.5. Models

4.5.1. Use case diagram

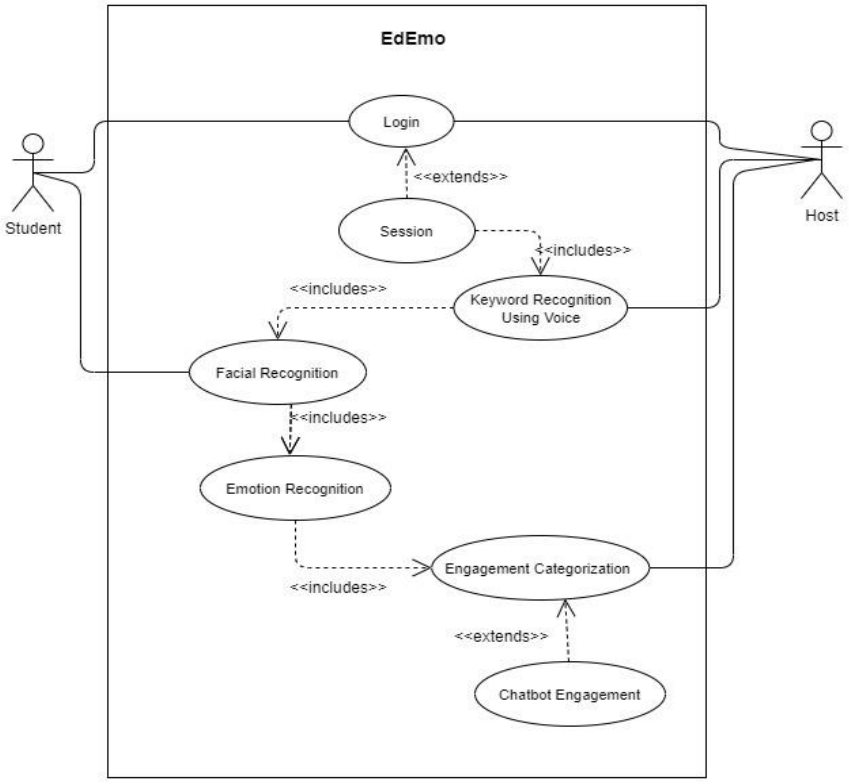


Figure 4.2 Use case diagram

As stated in the use case diagram above, student and the host (teacher or lecturer) are internal actors and the IT department of the school is an external actor. The IT department will have to only maintain the whole system.

The student and the host will have to login into the system so that the host will be able to create a session and the students will be able to join to the session.

Once the host mentions the respective key word the analyzing of student engagement begins till the next key word is mentioned. The student's facial recognition will be captured to detect the current emotion of the student. Chat bots are then popped to the students who are less engaged in the session.

And at the end of the session the host will be able to get a categorized result of the student engagement.

4.5.2. Use case description

In considering the above use case diagram, three main use cases were chosen and given their descriptions. They were chosen according to their priority levels. Student engagement detection using facial recognition, Keyword recognition using host voice and chat bot engagement with student are the three main use cases of this system. Their respective descriptions are stated below and the rest of the use cases are stated in the appendix.

4.5.2.1. Use case description for Engagement detection using facial recognition

Use case Id	UC ID-5
Use case Name	Engagement detection using facial recognition
Priority	High
Primary Actors	Student, Host
Description	The host will be able to have an analysis of the current emotional state of the student.
Pre-conditions	- Should have an active internet connection. - Should have a web cam in their device.
Main Flow	1. Use case begins once the hosts keyword is mentioned 2. Student engagement using their emotions is then captured/ detected. *Use case ends providing a student engagement analysis to the* 3. host once the next key word is mentioned.
Alternative flow/ Extension Flow	2.a. If student connection breaks down - Engagement detection of that student will break down.

Table 4.6 Use case description for Engagement detection using facial recognition

4.5.2.2. Use case description for Keyword recognition using host voice

Use case Id	UC ID-3
Use case Name	Key word recognition using host voice
Priority	High
Primary Actors	Host
Description	The host will be able to track the engagement analysis of the students between the timelines of the keywords mentioned
Pre-conditions	- Should have an active internet connection. - Should have a clear microphone

Main Flow	1. Use case begins once the keyword and the mentioned word of the host are matched 2. Student engagement using their emotions is then analyzed. 3. Use case ends once the next key word is mentioned or once the session is ended.
Alternative flow/ Extension Flow	1.a. If the microphone is not clear enough or the host connection is interrupted. - The keyword and the mentioned word of the host will not match. - A timeline analysis will not be provided.

Table 4.7 Use case description for Keyword recognition using host voice

4.5.2.3. Use case description for chat bot engagement with student

Use case Id	UC ID-7
Use case Name	Chat bot engagement with student
Priority	Moderate
Primary Actors	Student
Description	If the student is less engaged during the session a chat bot will be popped up to increase his/ her engagement.
Pre-conditions	- Should have an active internet connection.
Main Flow	1. Use case begins once the system identifies that the student is less engaged in the session 2. A chat bot is then popped to the relevant student as a friend in need. 3. Use case ends once the student quits the chat.
Alternative flow/ Extension Flow	3.a. Chat bot inactivity - If the student doesn't chat with the bot it leaves. - It leaves when the student commands to quit.

Table 4.8 Use case description for chat bot engagement with student

4.5.3. Domain Model

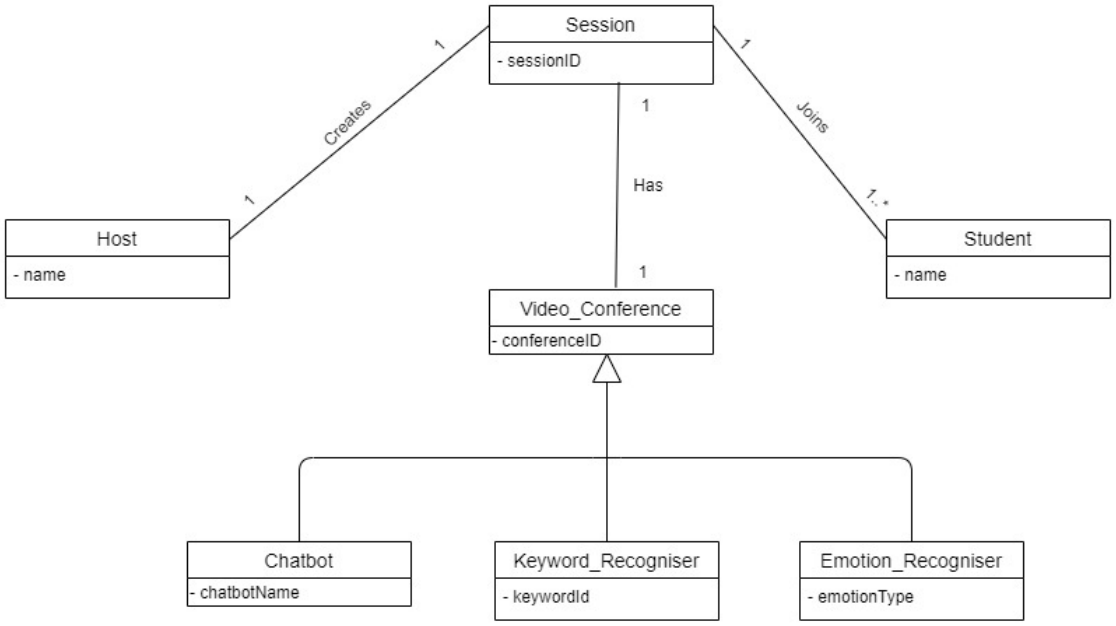


Figure 4.3: Domain Model

One host can create only one session. One session can only have one host. One session can have many students. One session must at least have one student. One student can have only one session. Many students can have one session. One session can have only one video conference. One video conference can only be in one session.

4.6. Functional Requirements

The table below entails a detailed account of the functional requirements of the system alongside their priority levels.

FR No.	Requirement description	Priority level
1	Analyze facial features of students through webcam.	High
2	Extract necessary facial features by comparing to dataset.	High

3	Identify and classify according to appropriate emotional status using the extracted features.	High
4	Analyze audio throughout the duration of the session. Identify and extract from the audio when the keywords entered prior to the session are spoken.	High
5	Identify and extract from the audio when the keywords entered prior to the session are spoken.	High
6	Present the session conductor with a report of the engagement levels of students to different portions of the session decided by recognizing the topic name through speech at the end of the session.	Average
7	Creating a video conferencing tool to determine student facial features through webcam.	Average
8	Creating a chatbot for students so that the session can be more interactive and engaging.	Low

Table 4.9 Functional requirements

4.7. Non-functional requirements

Requirements	Description
Performance	Online engagement activity analysis should work well without any significant amount of problems with lag or performance.

Reliability	Must act reliably to the school management system or university management system and resolve the issues raised.
Usability	The system should be user friendly and not complicated. The host should be able to familiarize themselves with student engagement in online interaction.
Accuracy	The system must be highly accurate in analyzing the student engagement activity.

Table 4.10 Non- Functional requirements

4.8. Chapter summary

This chapter focused on different techniques for requirement gathering to identify functional and non-functional requirements with the assistance of the stakeholders identified. The analysis and main inputs obtained from these techniques have been described in this chapter. Identifying use cases and mapping the use cases and their descriptions with functional requirements is included.

5. Conclusion

5.1. Chapter Overview

This following chapter will discuss the concluding remarks of the project EdEmo. In this final chapter, the dataset used for the model will be discussed in detail as well as the legal, social, ethical and professional issues that arise and challenges encountered when completing this project. Also, a detailed account of the limitations of research, the future enhancements of the project and plans for implementation of EdEmo will be discussed below.

5.2. Dataset

As we have discussed in the previous literature review chapter, for the proposed model, the decided upon algorithm for facial detection is Viola Jones Algorithm and the algorithm for emotion classification is Support Vector Machines. The dataset that has been decided use for the training and testing of the model is the 2013 Facial Expression Recognition (FER) Challenge data set.

The FER-2013 dataset comprises of 8,000 labeled images in the training set, 3,500 labeled images in the development set, and 3,500 images in the test set. Each image in FER-2013 is marked as one of seven primary emotions: joy, sadness, fear, surprise, disgust, and neutral, with joy being the most prevalent emotion. The data in FER-2013 comprises of both posed and unposed headshots, which are 48x48 pixels grayscale images. All data have been automatically displayed with the face centered, hence approximately capturing the same extent of space in each image. The FER-2013 dataset was created by

assembling the results of a Google image search of each emotion and alternative words for the primary emotions. (Quinn, Sivesind and Reis, 2017)

5.3. Legal, Social, Ethical and professional Issues

EdEmo must clarify its legal, social, and professional issues for the better outcome. All these issues are considered when collecting data from target audience, collecting datasets, collecting data from previous research, blogs, and eBooks. The legal, ethical, social and professional issues of EdEmo are described below.

5.3.1. Legal Issues

In building EdEmo open source projects were used for the video conferencing tool and the chatbots engagement.

Jitsi is the open source tool used to develop the video conferencing. This tool was developed by reputed companies like ComCast, JetBrains, Symphony. The source code for this tool is available in GitHub. Chat bots were made using Botpress which is and open source conversational AI platform. The tool is available for any users in the web. This tool has been made legal for all users by Botpress Inc. company.

The links of the Jitsi and Botpress open source websites are mentioned in the appendix.

The datasets for facial expressions and emotion recognitions were legally collected form the FER 2013 which is publicly available in Kaggle. This dataset has been uploaded publicly which helps many people to either contribute facial images or take use of them which makes it legal.

5.3.2. Social Issues

The project EdEmo has no racial, religious, or cultural influence. This project can provide an environment where students are interested in learning as well as a quality education in online teaching. EdEmo is very important in pandemic seasons. EdEmo has given the opportunity to students to participate in online classes from any corner of the world All that is needed is their voice. The only language currently used in the project is English. Datasets for voice recognition, attendance checking system, subtitles and translation options, mind games for students, building of an LMS support will be added in later as a future enhancement.

5.3.3. Professional Issues

The data from the domain experts were taken by conducting interviews very professionally. The interviews were conducted after informing about the sections and the focused areas of the interviews to give them sufficient time to prepare for the interview. The answers given by interviewees were not altered and considered as it is.

The online questionnaire was conducted only for target audience and it was prepared in both English and Sinhala languages to increase the professionalism of the questionnaire as the readability and user-friendliness was high. Data were not created for the survey and all the data were legally collected.

5.4. Challenges Encountered

The following problems and challenges were encountered during this project.

- **Time limit**
  - Since the project idea changed for 3 times, there was less time to go ahead with this idea and also to make research.

- **Team gathering Issues**
  - Since the pandemic, it was a challenge when holding meetings. There were many issues like having poor connection, inability to gather all participants and having deflective concentration on the project.
- **Lack of knowledge**
  - The lack of knowledge in the technologies that used in this project made difficult to get a clear idea about how to initiate the development of the project.

5.5. Limitations of the Research

• To achieve outstanding precision, the project datasets must be detailed. Improving the data in the database will further enhance the quality of the prototype.

• Scope limitation- This can be applied to any domain to make any online teaching method successful. Implementation has been performed in a manner that can be used to automatically classify problems in any domain that uses feedback. The scope of this project will therefore be expanded and strengthened.

• As a limitation, voice recognition might not be recognized sometimes as we don't feed any datasets for voice recognition in the system.

•This currently only allows teachers to identify student facial emotional adaptations in online classes.

5.6. Future Enhancements

Due to the limitation of time some features are currently unavailable in EdEmo. This system can be built up with more features by time. Some of the improvements are stated below.

5.6.1. Datasets for voice recognition

In order to improve the accuracy of the system, the recognition of host voice can be enhanced using datasets. By feeding datasets of different types of voices the system will be more efficient.

5.6.2. Emotion Categorization using student facial patterns

Due to limitation of time datasets were collected through legalized websites. By time we can be able to collect more facial patterns and emotion types of the students to make this system's emotion categorization more accurate.

5.6.3. Attendance checking system

With the time we can add the feature of checking student's attendance using their facial images. This will also improve student engagement in online sessions.

5.6.4. Subtitles and Translation options

With the time the option of subtitles can be added. So, the students who feel uncomfortable by listening to the session will have the option of reading the subtitles. Translation options can be implemented if this system has a global impact in conducting online sessions.

5.6.5. Mind games for students

Students can get the opportunity of playing small mind games to get their concentration back. This can be an additional improvement to the chatbots. This improvement can also be done by time.

5.6.6. Building of an LMS

A complete learning management system can be made with having this video conferencing tool in the system. Students and teachers will be able to pass announcements, have discussions, conduct exams within the system. By time the EdEmo video conferencing tool can be developed to a School of University Learning Management System (LMS).

5.7. Plans for implementation

Implementation of the proposed system will be carried out in three stages

1. Development of the emotion recognition component
2. Development of the keyword recognition component
3. Linking the data science component to the video conferencing tool

Detection of the face from webcam feed is done using OpenCV library since contains trained HaarCascade models required for Viola-Joes algorithm. The emotional stage of the detected face will be detected by using SVM classifiers categorizing them into 6 six different emotions. For each emotion, a concentration level will be assigned.

Speech to text technique will be used to recognize the keyword from the teacher. To achieve this SpeechRecognition Python SDK will be used.

Jitsi open-source video conferencing software will be used to implement the proposed system.

5.8. Chapter Summary

This above chapter discussed the concluding remarks of the project EdEmo. It contained a detailed discussion of the dataset used for the model as well as the legal, social, and professional issues that will arise and the challenges encountered when completing this project. Finally, a detailed account of the plans for implementation of EdEmo is discussed as well. Also, a detailed account of the limitations of research, the future enhancements of the project and plans for implementation of EdEmo were also discussed above.

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7. Appendix

Appendix A: Literature Review

AppendixA.1: Building Video Conferencing tool

OPEN SOURCE	CORE FEATURES	COMPONENTS REQUIRED FOR OUR PROJECT
Jitsi	• Written using Java. • Compatible with Web RTC standards. • Supports Android and IOS devices.	• Screen sharing • Document Sharing • Etherpad plugin can be used as a whiteboard. • Flutter codes available for mobile app modifications.
Jami	• Secured by end-to-end encryption. • Supports Android and IOS devices.	• Tele-conferencing • Media Sharing • Text messaging
Element/ Riot	• Acts a team management software. • Secured with Matrix's end-to-end encryption. • Supports Android and IOS devices.	• Tele-conferencing • File Sharing • Tools like twitter, Slack can be used collaboratively.
BigBlueButton	• Specially made for online learning. • Secured with end-to-end encryption. • LMS like Moodle, Sakai, Blackboard can be connected using plugins. • Supports Android and IOS devices	• Tele-conferencing • Screen sharing • File Sharing • Polls can be made

Table 7.1: Video conferencing tool comparison

Appendix A.2: Building Chat bot

OPEN SOURCE	Programming Language	Features
Botpress	• JavaScript	• Natural interpretation of language • Multi-channel use • Analytics • Editor
Dialogflow	• NodeJS	• Cross Platform Support • Integrations • Analytics • Multi-Lingual Agent Support • In-Line Code Editor
Bot Framework Composer	• NodeJS, C#	• Machine Learning speech to text. • Multilingual • Prebuilt entities
Wit AI	• Python, Ruby	• Multilingual • Built-in entities • Supports for more than 80 languages

Table 7.2: Chatting bot comparison

Appendix B: System Requirement Specification

Appendix B.1: Online Questionnaire summary –Question 1

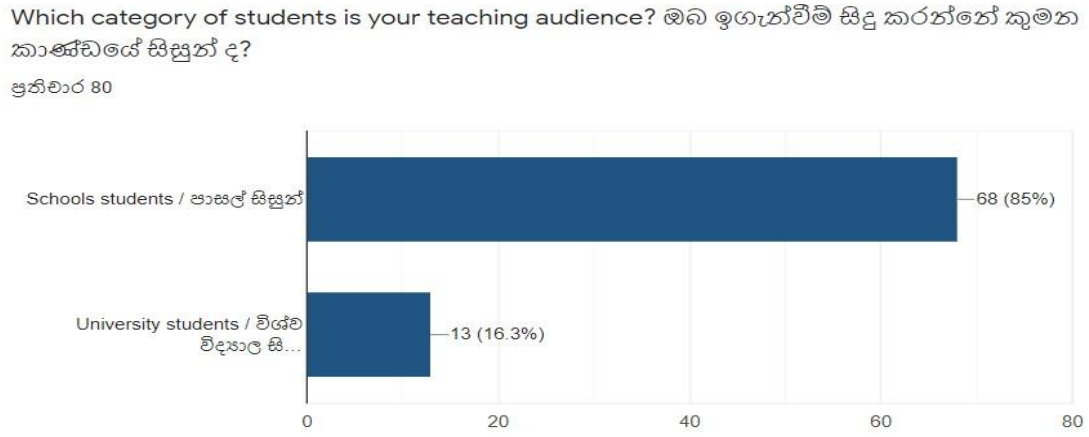


Figure 7.1: Online result 1

Appendix B.2: Online Questionnaire summary –Question 2

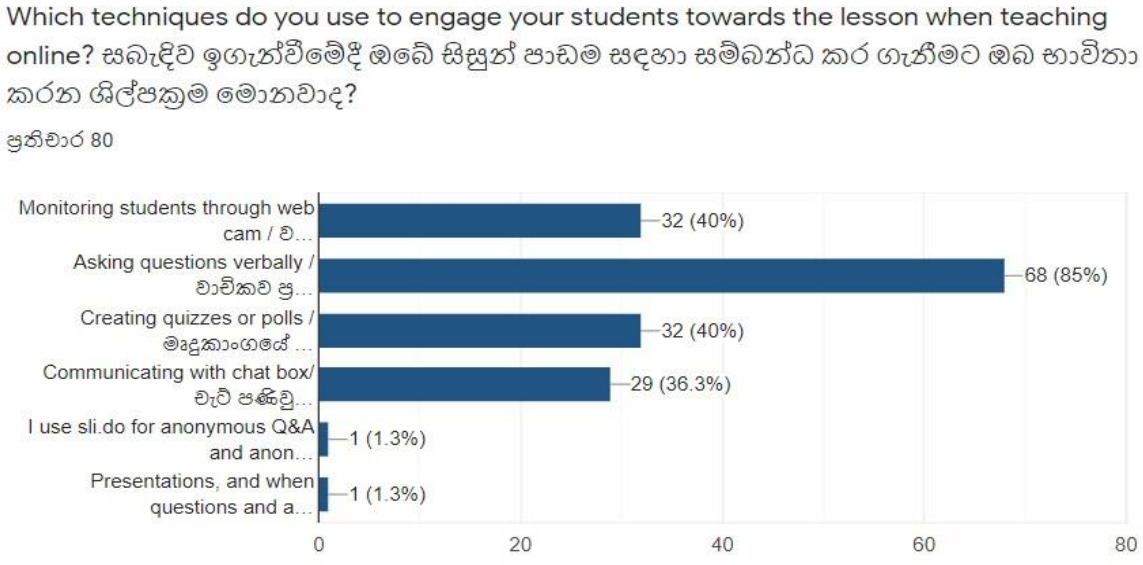


Figure 7.2: Online questionnaire result 2

Appendix B.3: Online Questionnaire summary –Question 3

From a scale of 1 to 5, how satisfied are you with the engagement of your students? 1 සිට 5 දක්වා පරිමාණයකින්, ඔබේ සිසුන් සම්බන්ධ කර ගැනීම පිළිබඳව ඔබ කෙතරම් තෘප්තිමත්ද?

ප්‍රතිචාර 80

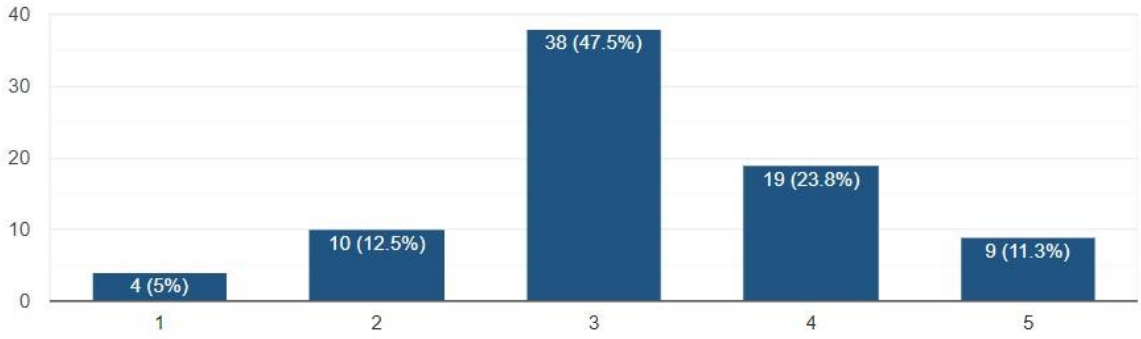


Figure 7.3: Online questionnaire result 3

Appendix B.4: Online Questionnaire summary –Question 4

Answers given for the automated engagement analyzing methods

If yes, what are they? ඔව් නම්, ඒවා මොනවාද?

ප්‍රතිචාර 10

N/A
MPP
White board
Whiteboard
-
MS Forms
Forms
Jamboard,Socrative,PowerPoint

Figure 7.4: Online questionnaire result 4

Appendix B.5: Online Questionnaire summary –Question 5

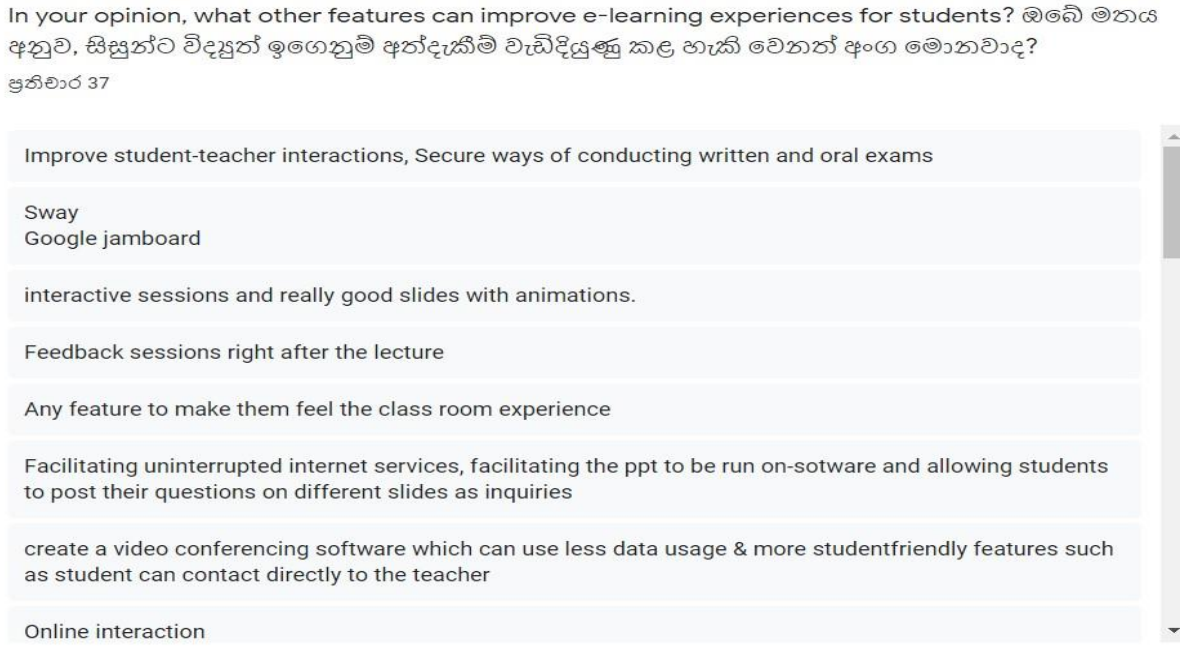


Figure 7.5: Online questionnaire result 5

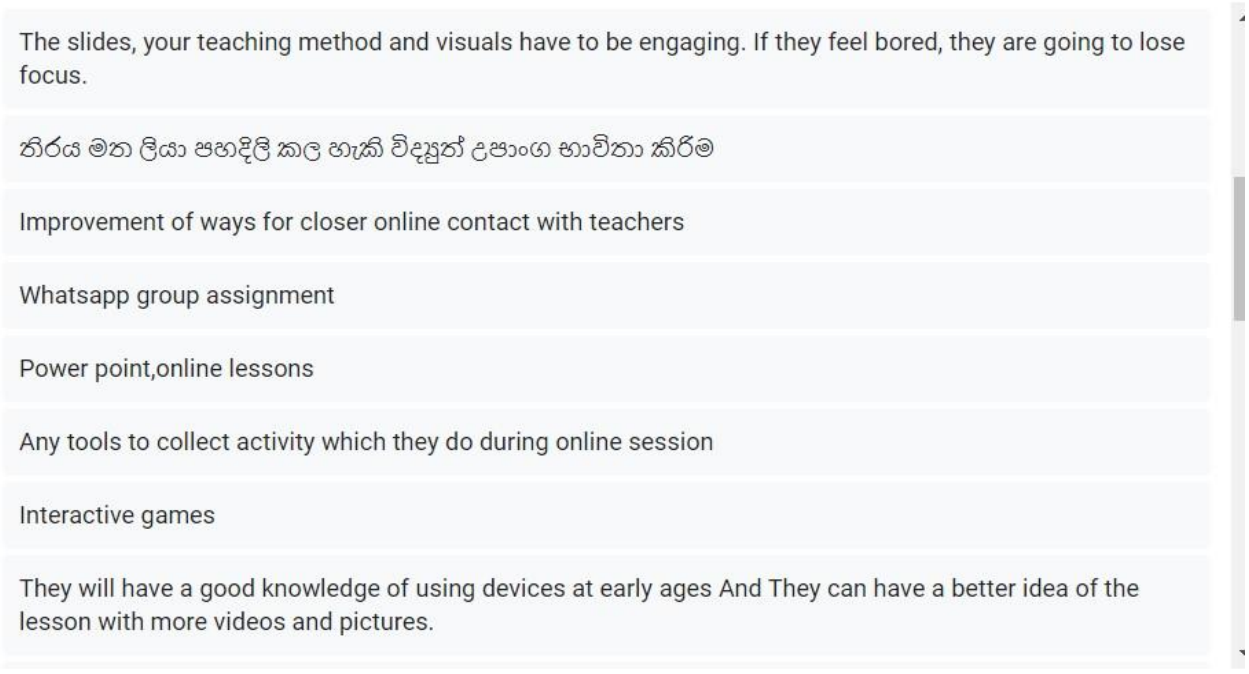


Figure 7.6: Online questionnaire result 6

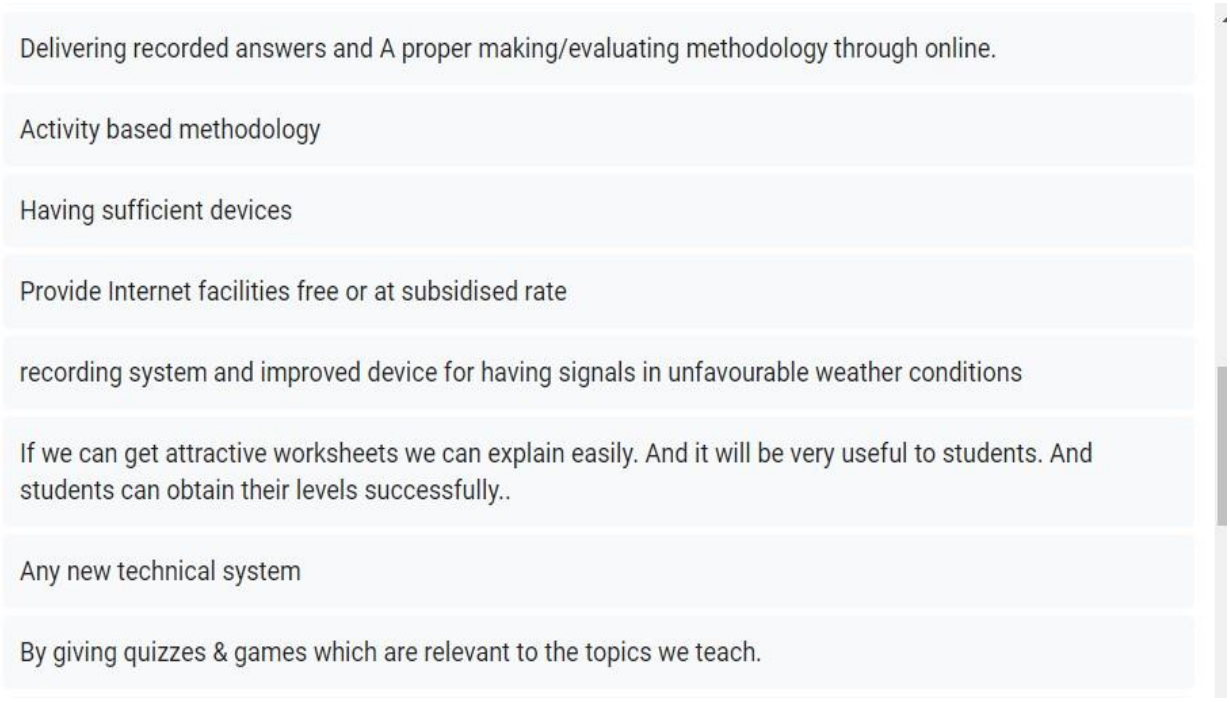


Figure 7.7: Online questionnaire result 7

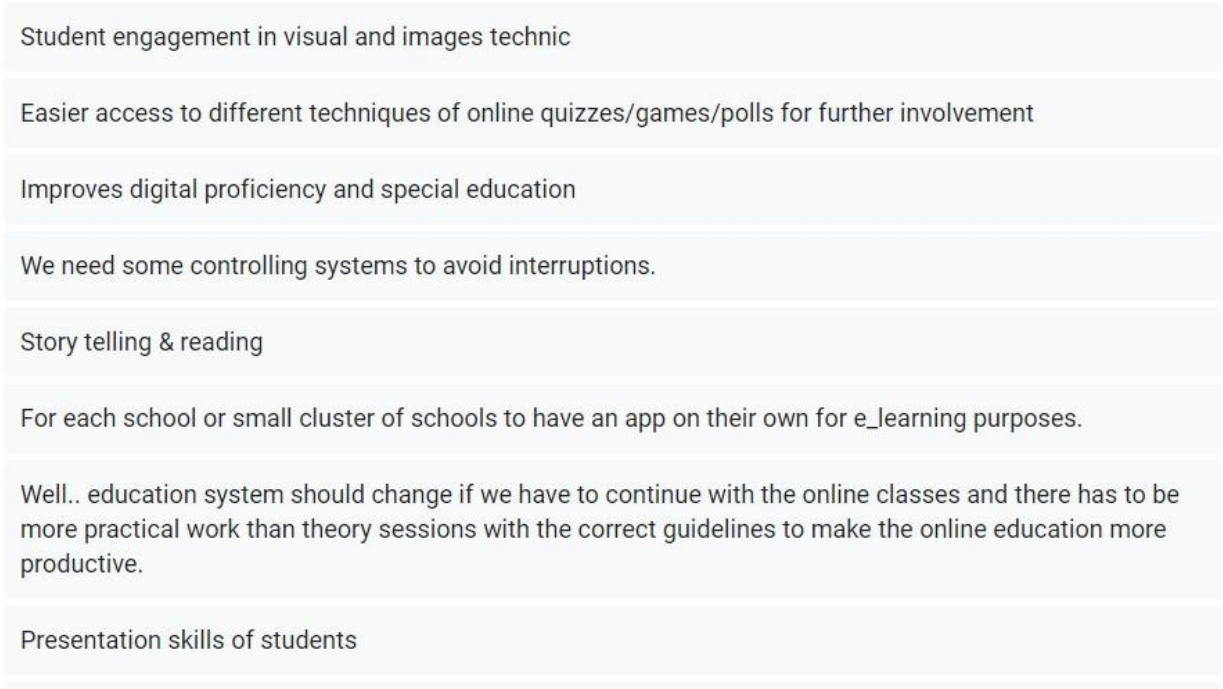


Figure 7.8: Online questionnaire result 8

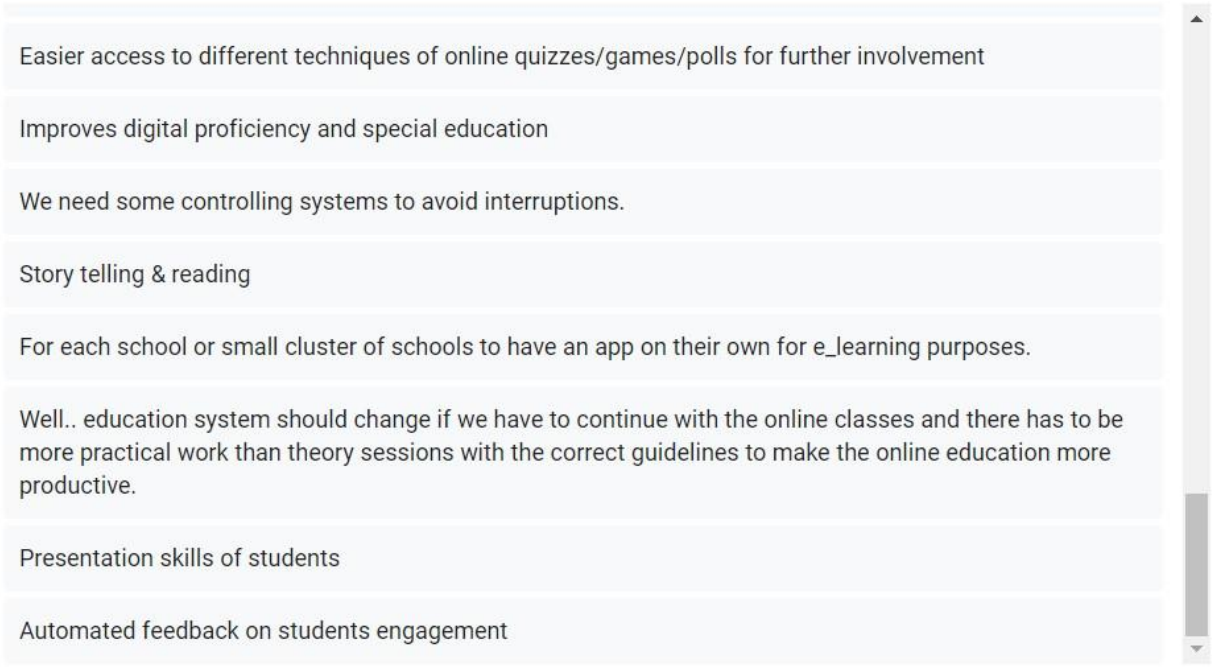
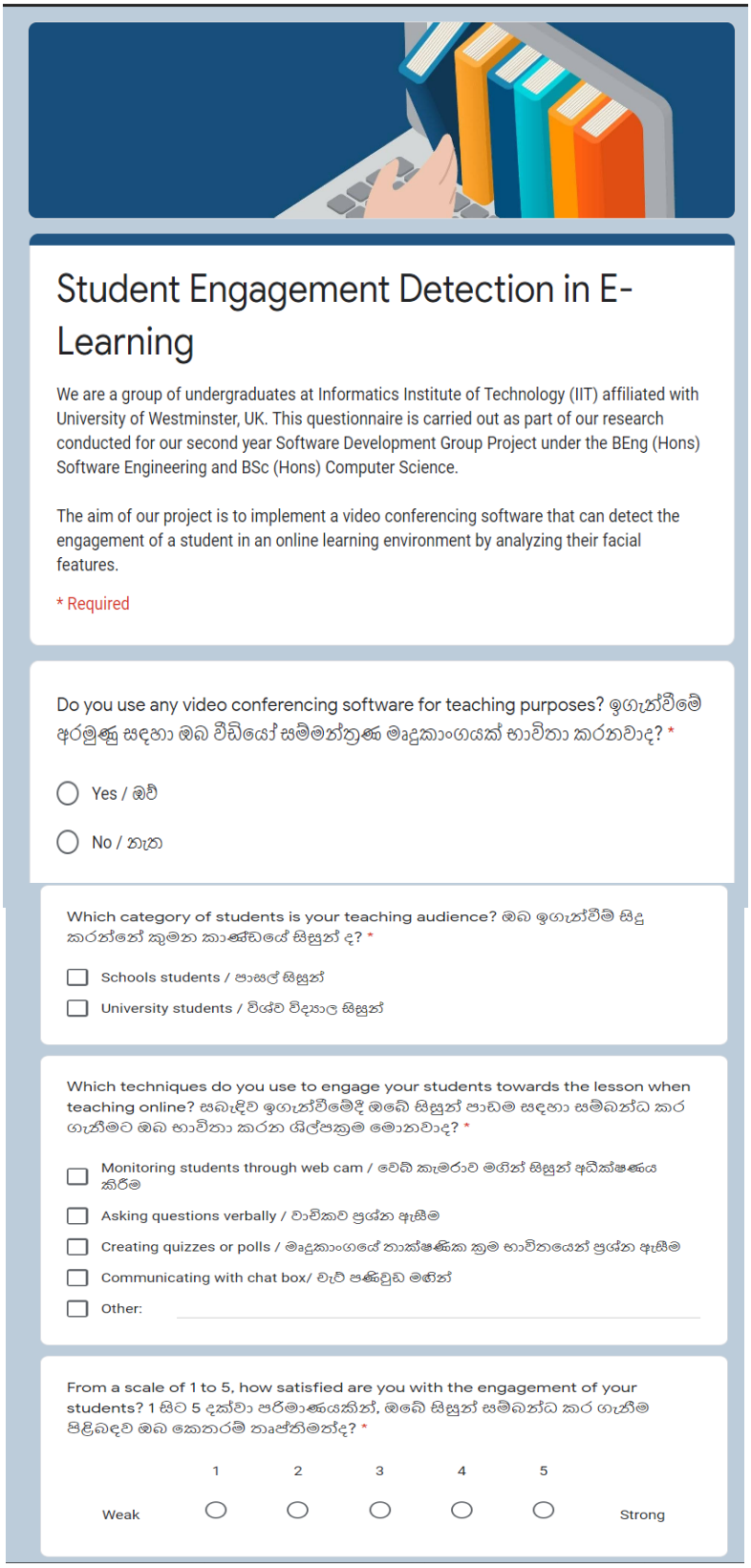


Figure 7.9: Online questionnaire result 9

Appendix B.6: Online Questionnaire form



Student Engagement Detection in E-Learning

We are a group of undergraduates at Informatics Institute of Technology (IIT) affiliated with University of Westminster, UK. This questionnaire is carried out as part of our research conducted for our second year Software Development Group Project under the BEng (Hons) Software Engineering and BSc (Hons) Computer Science.

The aim of our project is to implement a video conferencing software that can detect the engagement of a student in an online learning environment by analyzing their facial features.

* Required

Do you use any video conferencing software for teaching purposes? ඉගැන්වීමේ අරමුණු සඳහා ඔබ වීඩියෝ සම්මන්ත්‍රණ මෘදුකාංගයක් භාවිතා කරනවාද? *

- ◯ Yes / ඔව්
- ◯ No / නැත

Which category of students is your teaching audience? ඔබ ඉගැන්වීම් සිදු කරන්නේ කුමන කාණ්ඩයේ සිසුන් ද? *

- ☐ Schools students / පාසල් සිසුන්
- ☐ University students / විශ්ව විද්‍යාල සිසුන්

Which techniques do you use to engage your students towards the lesson when teaching online? සබැඳිව ඉගැන්වීමේදී ඔබේ සිසුන් පාඩම සඳහා සම්බන්ධ කර ගැනීමට ඔබ භාවිතා කරන ශිල්පක්‍රම මොනවාද? *

- ☐ Monitoring students through web cam / වෙබ් කැමරාව මගින් සිසුන් අධීක්ෂණය කිරීම
- ☐ Asking questions verbally / වාචිකව ප්‍රශ්න ඇසීම
- ☐ Creating quizzes or polls / මෘදුකාංගයේ නාක්ෂණික ක්‍රම භාවිතයෙන් ප්‍රශ්න ඇසීම
- ☐ Communicating with chat box/ චැට් පෙට්ටිය මඟින්
- ☐ Other:

From a scale of 1 to 5, how satisfied are you with the engagement of your students? 1 සිට 5 දක්වා පරිමාණයකින්, ඔබේ සිසුන් සම්බන්ධ කර ගැනීම පිළිබඳව ඔබ කොතරම් තෘප්තිමත්ද? *

	1	2	3	4	5	
Weak	◯	◯	◯	◯	◯	Strong

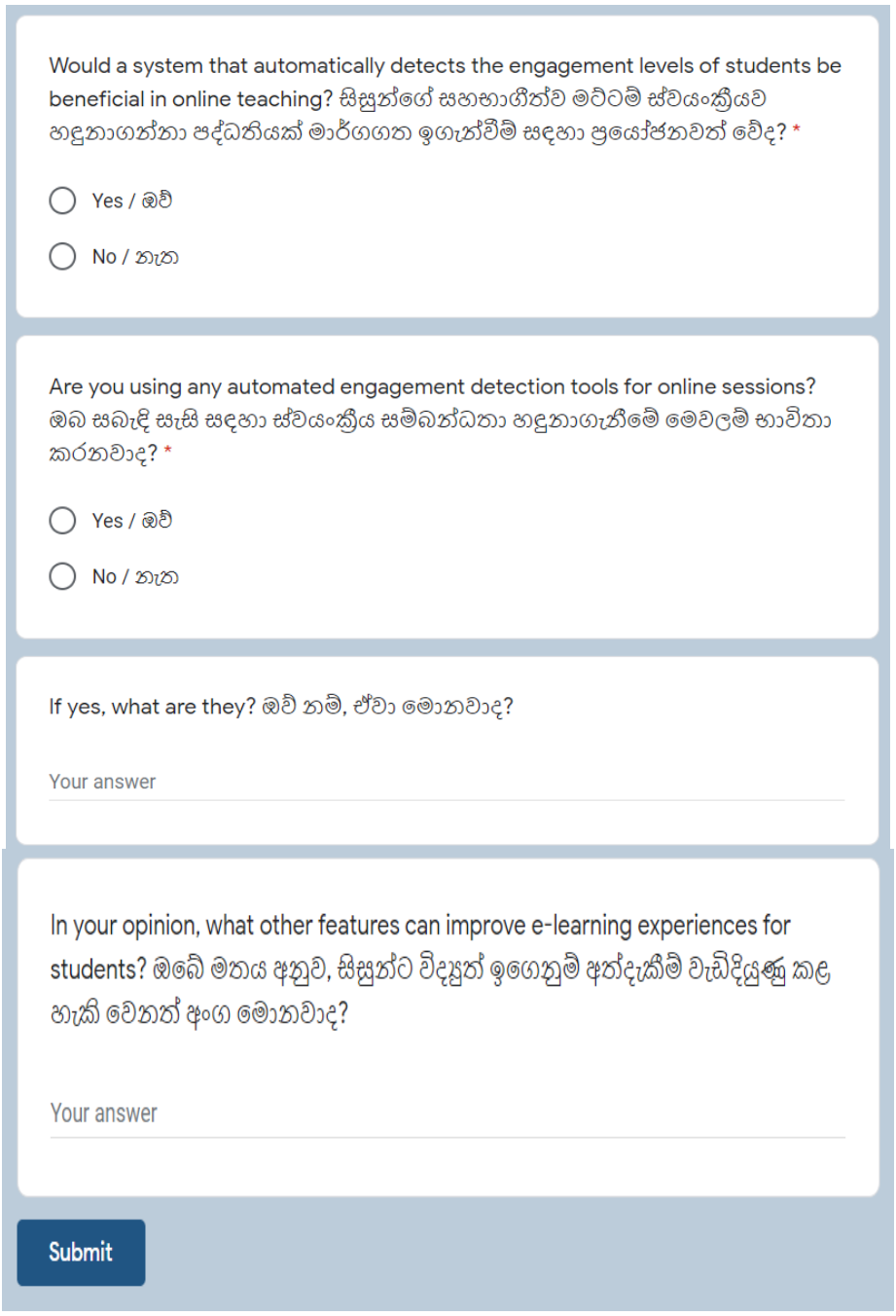


Figure 7.10: Online questionnaire form

Appendix B.7: Summary of interviews

Questions	Interviewee's details and their answers		
	1	2	3
Name	Ms P.G. Theshani Nuradha	Ms. Asmin Ziyard & Ms. Amina Zuhair	Ms H.E.V. Deepika Jinasena
Profession	Lecturer on contract	Vice Principal and Principal	Principal
School/University	University of Moratuwa, Department of Electronic and Telecommunication Engineering	Ilma International Girls School	D.S. Senanayake College , Matara
Number of students	Around 200	3000	385
Opinion on prevailing online learning methods	They are using zoom as LEARN offers a premium Zoom accounts. But it is hard to get hands on experience on lab equipment with that. Anyway, software related virtual tools can be incorporated to improve the teaching learning experience	Using Microsoft Teams for online learning and maintaining Cloud Smart. They mentioned about the difficulty in organizing examinations and evaluating students. Online teaching has made the teachers more tired and bored of teaching due to interaction issues.	They are using Zoom for online learning. Teachers have to put more effort to teach students as they cannot get a feedback on students' engagement. Parents are also satisfied with online learning methods.
Current challenges faced in online learning compared to physical classes	Technical issues, Data connection issues, hardships in doing lab sessions and holding final examinations	Device issues, data connection issues and less interaction between students and teachers.	Device issues, data connection issues, difficulty in collecting assignments and holding examinations
Opinion towards engagement detection	If it is possible to detect student engagement, it	It would be great. As the teachers will be able to get the attention of the students easily.	It would be a good opportunity for teachers and

from emotion recognition of students	provides a better feedback for the lecturer to improve and to provide better learning experience for students. Lecturers can identify whether students are attentive or bored and contact them within the class itself to ask whether they have any problems in understanding the lesson.	And the students will not feel bored when interacting with the chatbots. And the analysis report will increase the effectivity of teaching also.	students in their online teaching and learning. On the other hand, teachers can get a reliable feedback on the lessons that they have done to students. The usage of new technology in education field will create the learning and teaching methods more interactive to teachers and students.

Table 7.3: Interview summaries

Appendix B.8: Use Case diagram 1- Use case for Login

Use case Id	UC ID-1
Use case Name	Login to the session
Priority	High
Primary Actors	Student, Host
Description	The host and students can create or join the session after logging in to the system.
Pre-conditions	- Should have an active internet connection. - Should have a valid username and password.
Main Flow	1. Student or host should enter a valid username and password to join or create a session.
Alternative flow/ Extension Flow	1.a. If a student's connection breaks down or user enters an invalid username or password - The user fails to joins the session.

Table 7.4: Login use case description

Appendix B.9: Use Case diagram 2- Use case for Session

Use case Id	UC ID-2
Use case Name	Creating or Joining Session
Priority	High
Primary Actors	Student, Host
Description	The host will be able to create a session and the students will be able to join into the session.
Pre-conditions	- Should have an active internet connection.
Main Flow	4. Use case begins once the host and students are logged into the system 5. The system will be used as a video collaboration tool. 6. Use case ends once the session is stopped.
Alternative flow/ Extension Flow	2.a. If student connection breaks down - The student or host will have to rejoin the session

Table 7.5: Use case description for session

Appendix B.10: Use Case diagram 3- Use case for emotion categorization

Use case Id	UC ID-6
Use case Name	Emotion categorization
Priority	High
Primary Actors	Host
Description	The host will be able get a result of the categorized engagement analysis of the students
Pre-conditions	- Should have an active internet connection.
Main Flow	1. Use case begins once the system recognizes the engagement of the students 2. Then a visual analysis will be maintained throughout the session. 3. Use case ends once the session is ended

Alternative flow/ Extension Flow	1.a. If anyone's connection is lost - That relevant students emotion will not be tracked but the emotions of the remaining students will be analyzed.

Table 7.6: Use case for emotion categorization

Appendix C: Conclusion

Appendix C.1: Link for the video conferencing tool

https://jitsi.org/ - jitsi Open Source

Appendix C.2: Link for the chatbot

https://botpress.com/ - Botpress Open Source