Student Activity Detecting and Reporting System for Online Learning Platforms

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Abstract - After the onset of the COVID-19 epidemic, people had to bring their work home. The working from home concept is not good for everyone, yet is suitable for some industries. The lack of positive outcomes of online lectures in the field of education is due to the lack of interaction between lecturers and students, amongst students themselves, misbehaviour of students, and misuse of microphones and cameras by students. Therefore, there is an urgent need to develop an online learning system that focuses on the positivity of learning outcomes. Existing systems are developed focusing on business perspectives. At present, there is a requirement to develop an application to overcome the said problems. Requirements for the application development were captured from previous research done by the researcher. The system focuses on tracking student behaviours using web cameras and by monitoring computer tasks. Protecting the privacy and security of users and enhancing learning accuracy by improving lecturer-student interaction during the class is the main objective of the system. Attendance marking is also generated during the main process. While making space to develop multi-platforms and using modern technologies, the most important target of the researcher is to keep students attached during online lectures as an online learning system, and the research concludes with the definitions of technologies and features that enhance the existing online learning platforms.

Keywords: distance learning systems, student-lecturer interaction, video conferencing, virtual classrooms, activity detection through webcam, activity detection through computer task monitoring

I. INTRODUCTION

With the onset of the COVID-19 epidemic, many countries had to restrict their socio-physical behaviour to minimize the spread of the virus. At the same time, they had to restrict their procedures to every sector of the working world to prevent the spread of the virus as a national interest. Not only the people but also the work of the government had to face the national interest. Therefore, as a more efficient solution, many work areas have had to translate their work environment into an online platform. Some areas have benefited greatly from working with the work from home concept, while others have had many problems and difficulties in fulfilling their responsibilities as well as in the way they did in the past. Among the critically affected areas, education is a big topic to consider and discuss to minimize the adverse effects and improve the effects as well as to find the best solutions for the past and the future. Teachers, lecturers, and students will face many difficulties in transforming physical education into an online platform. The physical classroom experience is very important when considering students' learning outcomes. Every aspect of teaching, in-class behaviour, attention, behaviour of the teacher, face-to-face communication, teacher/lecturer-student interaction, and student-student interaction experience greatly affects a good learning outcome when considering the best practices in physical classrooms. But when it comes to transforming education from physical classrooms into online distance learning methods, it is very difficult to meet the needs which had used by teachers/lecturers and students in physical classrooms.

Considering the platforms used to conduct online classes, they are not entirely optimized for holding a meeting for online education. Zoom, Cisco WebEx, Microsoft Teams, Google Meeting are some of the applications used to conduct online classes. These systems have been

developed for conducting meetings and video conferencing. These systems developed orienting participants, meeting conductors, administrators as users, and other security features have been developed largely focusing on business purposes. They perform better when managing the activities of an organization which may often focus on business purposes. However, teachers/lecturers, and students should focus on the importance of learning outcomes and use these system platforms, which leads it to a successful point.

The main problems that teachers/lecturers and students face while using online learning platforms are time management difficulties, lack of motivation, lack of lecturer/teacher-student interaction, difficulties in finding assignments, difficulties in identifying misbehaviors, minimum active attendance, lack of student-student interaction, minimal accuracy of attendance taking mechanism are decreasing the advantages of self-learning freedom which is the best advantage that a student can have from this distance online learning platforms. Distance learning platforms inspire the students to do self-learning and encourage to identify self-learning techniques. These reasons which are mentioned here are based on previous research done by the researcher. To avoid being happening these difficulties and problems when conducting online classes, existing systems need to be optimized, or a new unique system must be developed. From the requirements, the researcher has proposed a methodology to avoid the problems that exist when conducting online classes (virtual classrooms or video conferencing). The paper discusses how the requirements analysis is done and the flow of the development process with relevant phases. 'ActiveMeet' is an application with a set of features that enable you to conduct lectures (online classrooms) with the freedom to take advantage of online learning methods using advanced computer technologies.

II. RLATED WORKS

Studying existing applications related to the system and research on topics of findings, are needed to find the best ways to implement the system with the necessary components. There are several popular applications that are being used today with different types of features. The developers of those applications are doing research to provide the best experience for users while conducting online classrooms. Distance learning education inspires the students to do self-studies and a good nondisruptive own environments to do studies.

Distance education is a good way to conduct online learning activities when physical attendance is not required. Instead of physical classrooms, online classrooms allow students to learn individually in their study paths. CQUniversity conducted a survey on the satisfaction of using distance learning methods to conduct an undergraduate degree course in engineering and found that using the zoom platform to conduct online classrooms results in better student satisfaction. Students with a clear background with additional teaching mechanisms can also enjoy tutorial lessons. Not only for individual goals but also as a group of students who are satisfied with conducting sessions across the magnifying platform as a distance learning method. The use and features of magnification increase students' satisfaction with their learning outcomes, thereby reducing their ability to work as instructors (lecturers/teachers). (Taylor, Mcclanachan and Mumtahina, 2017)

Not only is COVID-19 currently causing epidemics, but many counsellors use online methods to conduct counselling programs. There are three main parts to conducting counselling programs through online platforms. The effectiveness productivity across platforms including WebEx greatly influences students' positive results when considering student groups. There are six best practices that help students to be active in sessions, some of which the researcher mentioned are technically connected to enhance positive outcomes based on research objectives, allowing students to feel the session as a community. Content that provides counsellors goals and aspirations provides a timely feedback mechanism. WebEx is a great way for students to actively engage, allowing users to share their voices and video. The third part also allows users to use multimedia services, such as YouTube videos and presentations through meetings. (Keengwe and Bull, 2016)

Primarily for this study, the required observations of students' patterns in attendance and involvement were determined with the use of Blackboard LMS. According to the findings of this study, their active participation has a positive impact on student achievements & in terms of their final grades. Being a part of developing & encouraging virtual classroom concepts, the researcher was astonished as the study proved that how student engagement affects bringing online lecturing sessions to success. Student–lecturer interaction, attendance frequency & active participation have a major influence on students' online learning process & on their path to achieve the educational goals by coming up with flying colours. As explained in the research, with the virtual learning facility & having 24x7 access to the educational materials & course content students tend to obtain higher grades & passes with minimum participation in the online classes. However, the study further describes how the assessment of students is directly related to their active interaction with the online learning programs. The conclusion of the finding is that the spirit of being present is the key to the success of learners in a distance learning space. (Rapposelli, 2014)

The publication questions that how effective it is to continue education as specifically for teaching English as a foreign language for a selected sample of medical students with the use of Zoom technology which is known as a popular distance learning tool. The researcher points out as obvious as it is the English language is a universal medium of communication & way of expressing thoughts & feelings on an international platform which can be identified as a tremendous contribution to the world of communication. When it comes to teaching such language, it should be a more interactive, motivating & engaging method of education in order to gain its maximum output. So that according to the findings of the study, teachers have been able to convert the education system to a rich interactive manner with the use of Zoom technology which is one of the new software-based conference room solutions. With the available various special features, learners always can actively collaborate with the sessions. As an interactive method of distance learning study reveals that the educators & the

students find the new method of teaching as an effective way of communication. As summed up in the study this innovative approach of distance learning is improving learning outcomes with more interactions in-between students & teachers. (Guzacheva, 2020)

The study is on the effectiveness of online learning. It is based on a direct comparison between virtual learning opportunities & the traditional in-class educational system. Previously observed insights within many educators & students, express that they are more in-live with this emerging distance learning space by considering expenses when it comes to being physically present in an institution. Findings have proved that many students appreciate these online learning methods as more effective since they are actively participating in the programs and the intended learning outcomes can be gained eventually. Though it has null & positive reporting, the researcher has demonstrated & determined the distance learning system is a success as another path that is optional for the learners. While concluding many findings and challenges being discoursed in reference to the subject. Discussion on the effectiveness of the distance learning format is ultimately dependable on the presence & lively contribution towards the lecturing or learning process from those who are signed up to the virtual learning platform. That is the reason why the publication has emphasized the fact that distanced education is moderately at least as effective as the traditional system. (Nguyen, 2015)

The research is mainly focused on how students are adapting to the concept of online education which is caused by Covid-19 pandemic. The further researcher discussed the barriers which are students collectively facing when it comes to participation in online lectures, such as coverage issues, power failures, mental tension, etc. Reported facts in the study are brought to a summation against the elements which are gathered by actual surveys. Especially the survey on the 'Duration of a class preferred by students' showcases the students' commitment & desirability towards online education. The study is also concerned about the psychological atmosphere when participating in distance learning programs with students' emotional

strikes. Most importantly with social distancing, students are badly missing their social life which seems to be a stimulation for the active engagement towards the online lectures. The study reveals when students attending to the online lecturing sessions, they feel connected & live with the learning process. The frustration of learning in a virtual environment might lead to losing their interest in attending classes. Hence the research consists of a study on the feelings & moods of learners when it comes to active participation. (Palamattath, 2020)

III. DESIGN & IMPLEMENTATION

In the process of implementing the system, the researcher gathered the requirements of previous research based on a survey and analysis. From the findings of the research, there are several potential problems with using existing systems and applications used by instructors and students to conduct online classes. Problems that arise during lectures for a good outcome, come from students 'inattention and inability to keep students' attention from lecturer / teacher lectures. And low student-to-student interaction, there is no mechanism to prevent student misconduct during lectures, and poor attendance when it is mandatory to attend to assess student progress. Students' positive learning outcomes are reduced difficulties in conducting online classes rather than physical classes. Therefore, the system needed to implement it should be designed to avoid these existing problems. As an education-oriented system, the system should be designed and implemented according to a student-lecturer-oriented approach. Therefore, for a positive learning outcome, it should be planned and implemented as the requirements have been gathered by analysing the survey information conducted by the researcher in the previous study. Online distance learning methods are very useful when considering some of the advantages that are not available when conducting physical classrooms. Advantages of conducting online classrooms are,

•No disturb like in classrooms.

•Each student can concentrate the teacher or lecturer very clearly – because everyone participates the lecture by turning off their mics and cameras. Therefore, any disturbances from others do not affect to the concentrate of the student.

•Students and teachers have more time for readying for the lectures and lessons - no time wasting for transportation, no time wasting for readying, no need to make special attention for meals, mind is free without other considerations.

•Can take clear notes – lecturer is clear in talking because students are only hearing what lecturer speaks.

•Inspiring to self-learning – each student must participate the lectures individually from their home, therefore everything except group works force the students to do individually.

•Teachers can use more interactive methods when teaching

- presentations, screen sharing, white board, games related to subject modules, clear example suggestions like simulation videos.

•Very effective and interactive method for visually and hearing-impaired students – partially it is very helpful to visually and hearing-impaired students because the laptop is the source, they get their lectures. They can volume up, use headphones, zoom presentations, brightness up if any difficulties occur. They can adjust the source at their own requirements for a better result.

•Recording facility of lectures – Each meeting application gives a feature to record meetings. In physical classrooms there is no opportunity to rewind lectures if any students missed it or did not able to understand. But online classrooms with the usage of such applications let students to take this opportunity.

The difficulties should be avoided, and maximum benefits can be obtained from the systems by taking advantage of online distance learning lecturers/ teachers and students. Therefore, the researcher introduces a system that helps to monitor and analyse students' behaviours and activities during online lectures. The researcher can identify the active and non-active needs of the researcher as follows. The system also has the functions of an online meeting application. But the additional functions mentioned here are only those related to the student behaviour tracking system.

![KDU IRC logo]

Functional Requirements

Table 1 Classification of functional requirements under user requirements

User	Functional requirements
Lecturer	•Create an account. •Login •Scheduling meetings •Inviting meetings •Getting notifications of student's activities (sleep detection, not attending with lectures) •Getting notifications of computer activities (extra activities which are not related to lectures) •Getting notifications of in-class computer-based assessments & activities •Receiving detailed attendance reports
Students	•Attending meetings •Receiving detailed report of active participation to lectures

Non-Functional requirements

•UI design – the targeted users are students and lecturers. They can use the application very easily. The system carries complex processes inside, but the interfaces must be user- friendly and simple to use.

•Performance – real time activity tracking and notifying is a core part of the application. To do that processes the system must work in a good performance condition.

•Reliability – students can take the advantage whenever something found to miss lectures. It is very important that the outputs which is generated by the system to lecturer or host are reliable.

•Efficiency – this system is designed for mainly enhancing the learning outcome of online lectures. Therefore, it is a must to work efficiently for good results.

•Security – tracking activities through camera is critically affect to the privacy of students or attendee. Therefore, the security of the system must be in a good level to perform the processes.

•Accuracy – not reliability lies on the trustworthy of the results from the system, but the system should function at a higher level of accuracy for reliable results.

The proposed system was developed for use in windows and the web. Therefore, it is decided to be designed to be implemented according to service-oriented architecture. When spreading the system services throughout a big potential of users. Multiplatform support, multi-OS support and multidevice support can be guaranteed with SOWP. Zoom, WebEx, Microsoft Groups and Google Meeting have the same features included when considering the user interface and system features. The features which should be proposed to include within the system are,

•Monitoring and notifying about students who are sleeping or not sitting in front of the computer which means not attending to lectures actively.

•Monitoring and notifying about students who use non- related computer software to ongoing lecture. (computer games, watching movies etc.)

•Generating attendance sheets by analysing the time of student's active involvement to lectures.

•Tracking in-class assignments which are based on computer software. (By task monitoring on computer)

The system design can be shown as follows which is designed respect to the analysed requirements and features.

Figure 1 System Design Author (s) 2021
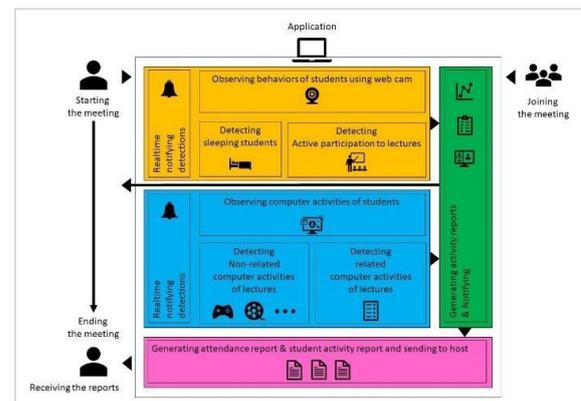
As a meeting application that is aimed to run on Windows operating system, it includes 4 major development modules. These include monitoring student activity via webcam, monitoring student activity via computer task monitoring, generating, and reporting activity reports, generating attendance reports, and sending to the host.

A. Student activity tracking through the webcam

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This is being used to track the misbehaviours, detect sleeping, detect whether the student is sitting in front of the computer to confirm the students whether they are attending to lectures or not. Turning off mics and cameras are very helpful when conducting online meetings. No background disturbances, zero interruptions of individual attention and it let the student to completely focus only to lecture at their eyesight. It helps to conduct the lecture without the disturbance of any activity of students and the noisy background of physical classrooms. This part is implemented using AI which helps to track facial behaviours including movements of the face(liveness), drowsiness, and sleeping. The whole part is developed using python programming language including OpenCV for facial recognition data inputs. This part is included in the windows application. Therefore, it can be able to work without any support from the server. Tracking something through a webcam is very critical when considering the privacy of the users. In this system, the tracking parts are done in the on-device-processing mechanism which tracks and processes on the device without a server connection, and the output result only be transferred through the network.

The sleep detection and movements(liveness) are tracked using points of face which is processed using a large dataset of facial data. The points are spotted as follows. (Bahadur, 2017)
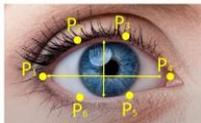
Figure 3 Points on eye (Bahadur) 2017

B. Student activity tracking through computer task monitoring

This is used to monitor students' computer related activities. This module can be used to identify a student who has already participated but does not connected to the lecture and is doing something else using a computer. This helps when any student does something that is not related to the subject module or to the lectures such as watching movies or playing

The sleepiness is detected through an algorithm as follows.

video games etc. The module records any kind of application that has been opened in the participant's computer. The lecturer can track when doing a in-class assignment using any computer software. As an example, if the assignment should be done using Cisco packet tracer, then the host or the lecturer can allow Cisco packet tracer to run without monitoring in the background of the computer of students. Sometimes students do not try to do in-class assignments if they are optional to perform, but it will affect the student's learning outcomes and subject module. In physical classes, the lecturer can test during class assignments. But when doing online classes, it will be missed.

EAR is the aspect ratio of the eye, which is then observed to be alive using the factors indicated with the value changes of x and y. If the EAR value is less than 0.25, the system will notify you that it is asleep. It is captured live when the student tries to cheat the software by using photos or something that looks like students but does not real.
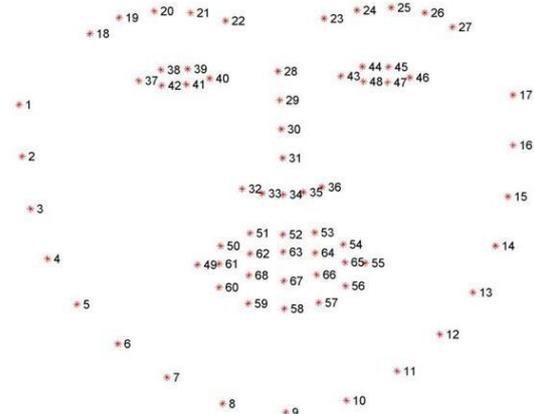
Figure 4 Points on face (Bahadur) 2017

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Figure 5 EAR calculating formula (Bahadur) 2017

Figure 6 User interface, notifications (Author) 2021

Figure 7 User interface, student activity tracking (Author) 2021

C. *Generating activity reports & notifying*

This is very important for the lecturer and the student. This module integrates student activity monitoring via webcam and computer activity monitoring. When a student is asleep or not in front of the computer or doing something using a computer that is not related to the lecture, it will immediately notify the lecturer or the host and mark the start time and end time and calculate the processing time through the system throughout the sleeping time of the student. Full activity with deadlines and times will be temporarily stored in a database until the end of the meeting.

D. *Generating attendance report and sending to host*

At the end of the session or after the meeting, it is mandatory in some institutions to mark the attendance of students to conclude their lectures.

Many existing systems have been able to generate attendance reports, but this is incorrect when considering student cheating patterns and generate fake results. Therefore, during the process of generating activity reports and database notification, they are updated with timely-data and then recorded in a report sheet with the analysed attendance.

Figure 8 User interface, attendance report (Author) 2021

The proposed system architecture can be described as follows. It is designed with the ability of adding multi platforms for increasing the potential of users.

Figure 9 System architecture (Author) 2021

Referring to system architecture, the system operates according to a service-oriented architecture. Spring Boot allows developers to run applications, especially service-oriented systems that have many libraries and services. And it is being developed on InteliJ IDE.

Frontend layer

Only the user interface with the views used to activate the user interface and the controller elements, which are the basic elements of the user application, linked between the backend and the API. There are two types of user applications defined: web application and Windows application. Here, the researcher focuses on the windows application because

windows are the most essential platform for holding meetings. Windows applications allows the developer to enable many features offline, such as the most essential device configuration feature for tracking activity through the webcam, rather than the Web application. At the front end, the Windows application has an AI component that helps identify and monitor students' activity behaviour via a webcam. When discussing system design, it is discussed under the heading of monitoring student activities through webcam.

WebRTC

The controllers communicate with the WebRTC API, which helps to hold meetings by sharing video and screen and it is very easy to integrate with Java. WebRTC is a communications service that can only be shared with Frontend.

Backend Layer

Backend is the core server of the entire system providing mirror controls, services, repositories, and database services. Developed using Java and XML, the backend is implemented using controllers, advisors that help communicate the relationship between services and the store. Supports communication between DTOs (Data Exchange Objects) and Institutional Funds, Services and Controllers. This is the layer responsible for managing meeting schedules, generating reports, sending links, user signing and signing in, and holding meetings.

Database

Where the user details, user credentials, meeting schedules, real-time notification data and real-time report generating data are handled. The backend includes the database system which is implemented using MySQL.

IV. DISCUSSION & CONCLUSION

The system is exactly same as Zoom software, a meeting application like Cisco WebEx, Microsoft Team or Google Meeting. But those applications have not been customized to consider the intervention for educational purposes. Due to the low interaction of students and lecturers and often the lack of inspiration, lack of background such as physical classrooms, learning methods in online distance learning systems are not in good condition. When considering the social behavior of students between a physical classroom and an online classroom, online classrooms increase the distance of social behavior of students. Among students' friends can wake their friends if fall asleep during lectures in physical classrooms. But this system allows other students to care about their friends through the system features. And interactions like liking, smiling, laughing, clapping which can be also found in Microsoft teams, Zoom are also integrated with the system. And time management is a very important part in this subject field. Because the effective attention time of a student in a continuous lecture always limited to number of minutes. Keeping the students by force will be a very bad reason to negative outcomes and feedbacks to lectures. Therefore, taking short breaks, playing educational games and discussing something else which may not relate to the subject but for refresh the students by time to time is a good ethical habit that can be maintain by a lecturer. And this system is more flexible because the two types of monitoring mechanisms (behavior and computer tasks monitoring) is not mandatory to perform during the lecture time. If the lecturer does not need one of them, he/she can conduct the lecture meeting without using these features. Going back to the physical classroom in a situation like the COVID-19 epidemic is difficult and risky and must be controlled. But there are a few additional benefits, and online classrooms can be updated to connect students to lectures to train them to take real advantage of online distance learning systems. The proposed method avoids many problems for lecturers/ teachers by avoiding time management difficulties, lack of motivation, lack of lecturer/teacher-student interaction, difficulties in finding assignments, difficulties in identifying misbehaviour, lack of correct attendance marking mechanism. Lack of student-student interaction in terms of active participation, prevention of self-learning freedom. This system allows the lecturer to get a clear idea of who the lecturer is, who is not in front of the computer, who misuses the computer during lecture time, and how the lecturer lectures by looking at the advance attendance report, changing the lecture style and other satisfying mechanisms. The system layout offers advantages such as adapting the system to multiple platforms with future work as Android and iOS applications. Using system-oriented architecture allows the developer to develop and add additional features without modifying to other layers of the system. When it comes to security. The Windows application is the most appropriate and advanced method used by lecturers to monitor

students' activities without compromising their privacy.

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