Online Class Monitoring System – An Idea Demonstration

A REPORT ON PROJECT BASED LEARNING
(SEMESTER -II)

Submitted by

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Abstract

With the advent of the COVID-19 pandemic across the world, educational institutions have adopted the method of online learning, in order to maintain continuity among academics. As students are connected to the school via the internet, there are limitations on the level of supervision teachers could have on the students. Students often encounter distractions while studying in an online mode, which could be disadvantageous for their developing mental abilities. In order to counter this problem, I have proposed the Online Class Monitoring System (abbrev. OCMS) that can provide insights on how students are interacting with the online classes, including some of their device statistics. These details are communicated with a dashboard which the teacher/instructor can access. The system can track which applications are being used by the students while attending the lectures and many other useful insights. As a result, the system could eliminate all those circumstances where students happen to mislead the teachers, thus ensuring a truthful and transparent online learning experience.

ACKNOWLEDGEMENT

Place: Name of Student (in Capital) & Sign

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Chapter 1
INTRODUCTION

1.1. The Beginning of Online Education:

Even though the first online course was conducted in 1984 by University of Toronto [7] ,it was not popular in the world as compared to offline classes. But the boom in the online education system occurred during the COVID-19 period, the reason being unavailability of offline education, because during that period, online education was really new to most people and it was challenging too . But as said, need is the mother of innovation. So most professionals in the technical and corporate sector came up with fascinating ideas and products which changed the role of online education from being a helpless way to continue classes , to an alternative for offline classes. Due to this the number of students on online platforms increased immensely which had not happened before . Also it was really easy for an educator to expand his business and for schools and colleges , as it was not necessary to hire multiple teachers for the same subject. Thiis increased the quality of the teaching-learning process. But as online education began, it also gave birth to some problems which were hurdles for online education, of which the main problems are :

1) Lack of person to person communication
2) Lack of proper network and internet issues
3) Increase in screen time and increase in mental and physical disorders.
4) Decrease in concentration and seriousness of student in studies
5) Increase in malpractices in exams.
6) Distraction from social media and other sources due to misuse of mobile phones.
7) Unequal distribution of educational assets due to unavailability of resources in different parts of the world .

Out of all these problems, the main concern that we should broadly focus on, is the 'Decrease in concentration and seriousness of students in studies' and 'Increase in malpractices in exams and classes'.

1.2. Need for an effective way for monitoring:

As discussed earlier, the main problem in online classes was the decrease in concentration and seriousness of students in studies. We should find the root cause of the problem if we want to get a solution . As we(The creators of this project) are also students, and have experienced online education for almost 2 years, we are aware of the reasons for this problem. Most of the time, students are not able to focus on their online lectures because they are scrolling social media, playing online games or doing whatever they want to do at that time . Even if the teacher asks them to turn on the camera or microphone, they give excuses like the camera or mobile not working or having a poor internet network. The teacher has no other option other than believing in him . As these students are not attending the classes, they fail to complete the required syllabus in a short time before the exam. So,they follow malpractices to pass during the online exams. All these activities are resulting in weakening of the education system.

Thus, it is necessary to find some way to monitor what the student is doing during the online classes, so that we can help that student to focus on their studies again and gain confidence .

1.3. Effective solution to solve the hurdles in online education:

There might be a lot of solutions for the problems discussed above, but we have to work in limited constraints, so that we can reach some realistic solution. As we also need to consider the fact that we should have the easy solution which is under our current scope, at the same time, we also have to look for financial constraints, because most of the students in India come from poor or middle class families who cannot afford very expensive solutions. Thus we reached a solution with which we can track the activity of students during online classes with permissions like camera and usage access. Our solution also displays the time duration over which the student attended the class and whether he/she was present in front of the camera . To do all this, we have an idea of making an android app in which we can include all these features and collect this data, which can be used for beneficial purposes and in helping the student and provided data to the teacher/parents.

1.4. OCMS - A tool to handle the problems of online education:

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OCMS stands for Online Class Monitoring System which is the name of our project. It is in the form of 2 android apps , OCMS Dashboard and OCMS Student . OCMS dashboard collects the data from OCMS student app. OCMS-S app collects the following information from the students android phone during the online class

1) Presence of students in front of camera

2) Camera access information

3) The activity of the student during the class (e.g. which app he is using): If the student is using another app other than OCMS-S, the app will mark the absence of the student and will display the app which he is using

4) The total time duration in which the student was present in the meeting . We also generate a report in CSV(Comma Separated Values) form to the teacher dashboard so that the teacher can detect the overall activity of students during the class time .

5) Our app is available in a variety of languages like Marathi, English,etc. because we believe that knowledge should not be a barrier for learning or a between consumer and application. Thus, it helps users to understand and use the app in their own language .

The technical details, the impact and importance of our project along with limitations are discussed in further sections .

Chapter 2

LITERATURE SURVEY

Many papers have reviewed different AI Proctoring systems comprehensively and given the issues, technological advancements, hardware and software limitations and necessities of the technology. They also give existing examples of online proctoring systems that may or may not use AI. These papers have also outlined different types of problems that students and teachers may face during the process of conducting exams. These papers also identify different malpractices by students in an online setting for the exam. We also get guidelines for an ideal proctoring system for online exams. These features can be implemented in future versions of the software to make it better. This is supplemented by a lot of news articles on exam cheating, methods to avoid malpractice in exams, and how students can evade the online proctoring system during an online exam. The papers also show how academic integrity has reduced in the pandemic. Hence online proctoring has become even more important in this day and age. Some of the papers also show how cheating is affecting academic integrity, which affects the students' ability to learn. These papers say that if the system of assessment of institutes can't be trusted to provide accurate results, in case of exams and assessments during academics, the validity of qualifications and degrees is challenged. They also suggest that students who cheated previously are more likely to cheat again. This can be detrimental to students' mental health. The solution to these problems can be an online proctoring system designed to help teachers better monitor students to preserve academic integrity.

2.1. Observed effects in online learning due the pandemic

According to [3] and [7], due to the outbreak of the corona pandemic, millions of learners and active teachers were forced to continue online classes including in India. The aim of this paper is to study how online classes have fared for the teachers and students in India. It includes various aspects like setting it at home, knowledge transfer, comfort, evaluation and future aspects. The data is collected from google form and results were discussed in two ways - teaching versus the learning group and

online versus the regular classes. It also enlightens how to improve the technologies to make online education more effective.

As central government institutions imposed a lockdown on 16th March 2020 all educational institutions started online classes from May 30, which also created a lot of problems. Students were asked what they thought were the causes of occasional impedance at their online classes, in such a way that they can choose multiple problems. Network connection issue (76%) was the most opted choice.

Another concern regarding online classes which was addressed in the survey was the attentiveness of students. This question was aimed at identifying the level of participation and focus of students during online classes. About 30% of the students confirmed that they were not attentive in online classes compared to regular classes.

It was found that about 65% of the students agreed with the idea of conducting exams online rather than offline. Also almost 87% choose evaluation based on assignment or homework. Although the assessment of students has been carried out through different modes, it is a daunting process, as the students cannot be monitored during the evaluation in case of any malpractices.

2.2. Techniques used in online proctoring systems

According to [1], [4] and [5], from the 6 million students enrolled for higher education in India, thousands are found to be cheating during online exams and most of them are not seriously attending online classes. Here are some ways by which we can prevent cheating in online exam:

1. Prevention of question copying
2. Prevention of screen sharing (especially during online examinations)
3. Preventing candidates from opening any other window during exam process
4. Capturing photograph of candidates using remote web camera
5. Live streaming of remote candidate using web camera

All these features along with more advanced tools are adopted in 'Eklavya' app which is an online exam evaluation app.

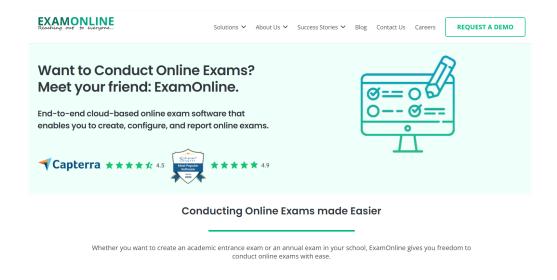## 2.3. ExamOnline.com - an online proctoring tool

Fig 2.1. The website ExamOnline.com is an online proctoring tool.

Any institution conducting an online examination can use online proctoring tools. These tools have an inclusion of various technologies and techniques. The primary users of these tools are universities, schools, colleges, and corporations. Technologies being used in online proctoring are:

1. Liveness detection : To check if a person sitting in front of the camera is alive.
2. Recording the session so as to resolve any discrepancies if any.
3. Disabling desktop sharing: Desktop sharing needs to be avoided as it can lead to mass cheating in exams.
4. Collecting device specific information like I.P address, location to produce a detailed proctoring log.
5. Face recognition: Verifying the student identity at the beginning and end of the examination so as to avoid replacements.
6. Second camera feed (360 view): Detection of any person who is trying to help the candidate, with the help of the 360 view camera

ExamOnline [6] provides these features in their online proctoring tool, which they provide as a paid service. Their services could be extended to mobile phones and web apps as well. Along with online proctoring tools, evaluation exam registration software are also made available.
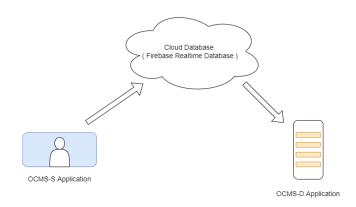
Chapter 3
WORKING PRINCIPLE

Fig. 3.1 The basic implementation of OCMS

Our system consists of two applications that are the endpoints from where the users will interact with the system. The first application, called 'OCMS Student' (abbrev. OCMS-S) is designed for the use of students and it will monitor students' behaviour using various techniques. The second application, called 'OCMS Dashboard' (abbrev. OCMS-D) is for teachers who can view the status of all students who have entered a simulated virtual meeting. In the context of the OCMS-S application, 'users' are analogous to students whereas for the OCMS-D application, 'users' are analogous to teachers.

As mentioned in earlier sections, our system runs on a 'dummy' meeting platform and the role of both the above-mentioned applications is to demonstrate our idea. The OCMS-S app collects information from the students' devices which is then displayed on the OCMS-D app. Thus, our system consists of a unidirectional flow of information that is facilitated with the help of a cloud database.

1.1. Framework

Both apps OCMS-S and OCMS-D are made with the Android framework. Android is an Linux-based open-source mobile OS that can be used as a framework to develop mobile, Wear and Auto applications. The Android framework natively supports two languages, Java and Kotlin. Kotlin is an open-source programming language and

provides cleaner syntax along with a vast collection of APIs for UI, networking and asynchronous programming.

Due to these reasons, we adopt Kotlin in both the applications.

1.2. OCMS-S Application

The OCMS-S application collects data from the user's camera and the app usage history to determine the following statistics:

- Presence of the student in front of the mobile device
- Presence of the OCMS-S app on the students' mobile display.
- Analysing the status of the camera, usage access and audio permissions
- Detection of the app that is being used on the mobile device

Presence of the student in front of the mobile device:
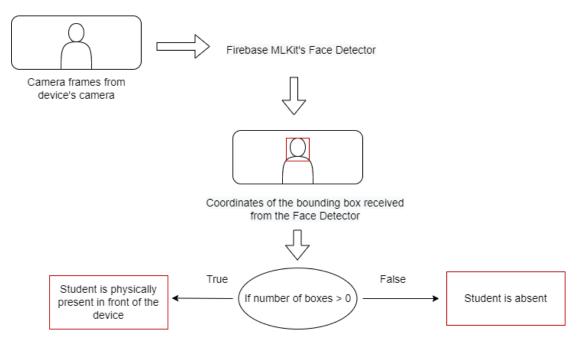

Fig. 3.2 Determination of presence/absence of the student using face detection

If the student is physically present in front of the mobile device, it implies that the student is attentive and is able to focus in the class. This functionality is achieved with the help of a face detection system that runs on the stream of frames obtained from the device's camera.

We're using Firebase MLKit's face detection system [9] that can detect faces in a given image. If the number of faces is greater than one, we conclude that the student is attending the online class.

As there is no face classification system, anyone can replace the position of the student without stimulating OCMS's face detection system. This is a known limitation and can be overcomed by including an algorithm that can classify faces of the students.

Presence of the OCMS-S app on the students' mobile display:

In order to determine if the student is using the app in which the online class is being conducted, we use a combination of various Android APIs. As soon as the student clicks the 'back' or the 'home' button on their device, OCMS-S goes into the background and this change is detected. This change in the app configuration is communicated with the cloud database.

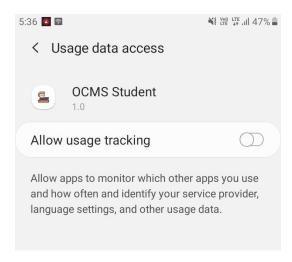***Detection of the app that is being used on the mobile device***:

Fig. 3.3 OCMS-S app requires the usage stats permission

Android provides the UsageStats API [11] that can be used to determine the app that is being used by the student. By the means of the API, the name of the app that is currently being used, can be accessed and sent to the Firebase server so that it can be communicated with the dashboard.

Analysing the status of the camera, usage access and audio permissions:

Students may turn off the camera, audio or usage access permissions that may affect the functionality of online meeting apps or even OCMS. Hence the status of these permissions is communicated to the Dashboard as well. If a particular permission is turned off, the educator can connect with the student and investigate the issue further. In order to modify the access level of a permission in Android, the user needs to exit from the on-screen application and navigate to the settings of the device. This brings OCMS in a 'background' state i.e. when the application is in the back-stack.

The change in state is detected by OCMS and it executes a function that rechecks the status of each permission and informs the Dashboard if any changes have occurred. This feature may not work at an instance, when the permission is first disabled and then OCMS is opened.

1.3. Cloud Database

Fig. 3.4 An overview of the data stored in Cloud database

In order to send data from the OCMS-S apps to the OCMS-D app, we've used Firebase Realtime Database, a web services platform from Google. The Realtime Database is a noSQL database that stores data in a hierarchical format i..e in the JSON format.

The OCMS-S app writes data to the cloud database to a certain node that is characterised by a unique ID allotted to each OCMS-S app (or to each student). Both apps OCMS-S and OCMS-D contain Firebase Realtime Database dependencies that make REST API calls to the Firebase servers to read, write and update the data.

We chose Firebase as it provides an easy-to-use API in Android eliminating the need of making API calls and is useful for quick prototyping. In further sections, we also discuss the use of a Python script that facilitates the testing of the OCMS-D application without the need of the OCMS-S application. The script interacts directly with the Firebase server and is used to simulate a virtual classroom with the required number of students.

1.4. OCMS-D application

Fig. 3.5 OCMS Dashboard application

The OCMS-D application provides a graphical interface that can display the data gathered from the students' devices (via the OCMS-S application) and also provide additional features upon them. The application fetches the data from the Firebase server and also makes updates in the UI if the data is modified.

Changes in the Firebase data are evident, as the status of each student is updated in real time and these changes need to be communicated with the OCMS-D app. In order to listen for data changes, we use Firebase's APIs and then make the changes in the UI. The rate at which changes are made in the Firebase database is high, as we're

gathering real time data from each student and for multiple parameters. These changes need to be processed asynchronously else the application may consume more memory resources. In order to overcome this problem, we use Kotlin's Flow API [10] that can be used to construct a data stream which runs asynchronously.

The OCMS Dashboard application can also generate reports, in which the presence or absence of the student or the app that a particular student was using is recorded with the corresponding date and time. This information is useful while analysing the behaviour of the students during an online class.

Chapter 4

FEATURES AND LIMITATIONS

4.1 Limitations

We discuss certain limitations of our system and possible solutions that could increase the robustness of the system.

4.1.1. Scalability

The scalability of a system is defined as its ability to have more users as and when required, without the need of additional external support.

Our app has a limit of 100 concurrent users due to a bottleneck in our database solution. Therefore, for this app to be scalable, we need to upgrade our database solution and market the app accordingly. This puts a hard limit on the number of users for our app.

Increase in the number of users in the app increases latency in the app. The data in our database will be updating at a rapid pace when the number of users increases. Due to this, the database cannot cope with this load and begins to lag. This results in outdated information being displayed on the app, which affects the app performance and gives a false impression to the teacher about the student being attentive when he is not,or vice versa.

4.1.2. Inconsistency in processing of data in terms of time delay

The speed at which our app processes the data is not uniform across all platforms and depends on the memory available to some extent. The more memory available, the less time it takes for the application to reflect the new users to the dashboard.

The speed at which OCMS transfers or downloads data from the cloud database depends largely on the internet speed available at the location.

4.1.3. Potential Privacy Issues

Before using the app, the student agrees to give the usage access permission and the webcam permissions. Usage access permissions give the app the data to track the apps

that the user visits and the app that the user is on right now, to enable the app to display whether the student is present or absent in the online classroom. If this data is not secured well, then it could lead to catastrophic consequences. Companies could sell this data to the highest bidder, compromising the users' privacy.

4.1.4. Inaccuracy In Face Detection

In this app, we can detect whether a student is present in front of the camera but we can't detect whether he/she is the student itself or a proxy. Also we can't say whether the face we are recognizing is an image or a real person. To overcome these difficulties we need to implement some advanced ML (Machine Learning) algorithm which may require a higher level of knowledge and also more time for implementation, if we want to add it in our app but it's probably possible.

The performance of the face detection algorithm depends on various factors like,

1. Lack of proper lighting - If the lighting conditions are poor, the face of the student may not get detected.
2. Physical obstructions - If the face of the student is partially or fully obstructed by some object, the face detection algorithm will not be able to detect the student's face.

4.1.5 Lack of Investment

As this project is completely developed by first year engineering students for their PBL project, we can't invest a large amount of money in order to develop this app on a large scale. If we want to make this app as a real Video Calling App which can be used for taking online classes and exams, we need a large team of freelance developers who are efficient in some skills to make this app highly scalable. We can't afford these developers and other high cost frameworks or paid extensions. Also we are completely dependent on open source. If we want to contribute our app via open source, we need some support from good programmers of open source but very few good programmers want to contribute in open source, and most of the programmers only want to get a paid internship. Thus, we are afraid of not getting a good response from the open source community .

  Also, at this level, we can only give a small part of our time(as we are college students and can't give our time exclusively) to do this project. We need to learn and

implement some of the features in order to overcome   most of the difficulties, which will require a bigger time span, but it's not difficult to overcome the difficulties and one day we will achieve our goal.

4.2. Features

4.2.1. Analysing student learning patterns

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13:24 25-06-2022 kaustubh netke वर्गात नाही
13:24 25-06-2022 kaustubh netke वर्गात आहे
13:24 25-06-2022 viahal क्लासरूम ॲप वापरत आहे
13:24 25-06-2022 viahal वर्गात आहे
13:24 25-06-2022 kaustubh netke वर्गात नाही
13:24 25-06-2022 kaustubh netke वर्गात आहे
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13:24 25-06-2022 viahal इतर ॲप वापरत आहे
13:25 25-06-2022 kaustubh netke वर्गात नाही
13:25 25-06-2022 kaustubh netke वर्गात आहे
13:25 25-06-2022 kaustubh netke इतर ॲप वापरत आहे
13:25 25-06-2022 viahal is using YouTube
13:25 25-06-2022 kaustubh netke क्लासरूम ॲप वापरत
13:26 25-06-2022 kaustubh netke क्लासरूम ॲप वापरत
13:26 25-06-2022 kaustubh netke वर्गात आहे
13:26 25-06-2022 kaustubh netke इतर ॲप वापरत आहे
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Fig. 4.1 The report generated by the OCMS-D application

Most of the students are facing concentration problems during online classes. The reason is the presence of a lot of distractions. As mobile phones are the best medium for learning in online education, they are also a source of distraction for students. A lot of students just want to scroll Instagram or just waste their valuable time on a mobile phone in their hand. In offline mode, teachers can personally monitor what a student is doing during the class. Thus students have no other option, other than focusing on the teacher. Thus OCMS provides real time tracking of students for the entire duration of class and can provide a detailed report of the student's activity during the online class , the duration of time he/she was present in the meeting and the number of times he switched to another app. Thus, the teacher can detect which student is not focusing during the class and hence can personally monitor the student and help them to grow in academics and personality .

4.2.2 Can monitor students and their behaviour to identify problems for learning in online class environment

As learning should always be a double centric process, it will benefit each and every individual only when there is healthy interaction between teacher and student. OCMS targets on improving this interaction in order to enhance the quality of online education. Most people may think that this app can hamper the privacy of students, but at the same time we are only using the data which can not provide material or psychological threat to students. We want to monitor the students' activity only in order to help the teacher and the student to enhance their experience of online education.

Also with large scale applications, we will provide some feature which will improve security of data and we will only display the data in safe hands i.e teacher/guardian of students because we respect the privacy of students and our main objective is to help students only.

4.2.3. Increases quality of online learning to reduce lack of understanding

Most of the time students who are not attending the lectures attentively during online classes are unable to understand the material that the teacher is teaching. Also teachers are also unable to understand whether the students are able to understand the material that is taught .This problem is decreasing the quality of future professionals of India who want to copy in their exam as they are not attending the lectures.

We also need to consider the situation of students and we can help the students by providing some external stimulation to help them to gain their intellectual potential and OCMS will definitely help the students to gain their confidence that they can do their best .

4.2.4. OCMS can help students to develop discipline and respect to the education

Bunking of classes is common in many colleges. Thus most of the students who worked hard to get into top colleges lack discipline in their college and don't take their courses seriously, which is really bad for the college professionals. They forget the importance of discipline, which plays an important part in a person becoming a good programmer and a leader. At the same time, if they are not serious about their

course, they will be badly affected, as they are the pillar of development of our country, which will decrease the quality of education in our country.

4.2.5. Support for Marathi Language

Fig. 4.2 OCMS Dashboard app running in Marathi language

Our applications support Marathi language so that they can bypass the language barrier proposed by English.

4.2.6. Open-source development

The code for both the applications, OCMS-S and OCMS-D, is available on GitHub and we wish to develop this project further on the grounds of open-source. Open-source projects can be quickly developed with the help of a community, thereby ensuring the wide adoption of the project. OCMS is a system that we believe will greatly improve the quality of online education. The system would thrive in an open-source setting and it can be adopted in various educational applications and in various other languages.

4.2.7. Analysis of student behaviour

OCMS can generate a report wherein the presence and absence of each student is recorded. This data can be used to perform analysis of the student behaviour and in which time intervals students feel more distracted and inattentive.

Chapter 5
FUTURE WORK

5.1. Integration into existing online meeting platforms

As it is in the initial phase of development, OCMS (Online Class Monitoring System) is just a basic prototype in the form of an Android App for better monitoring during online classes and online exams. This technology needs to be integrated in other video calling apps, or we need to develop our own video calling app like MS teams and Zoom, which is a really big task but it is achievable.

5.2. Development of open-source project

We are thinking of making this app open source so that talented people from PICT as well as from the world can contribute to development of this app ,because we need a big team to scale the app on a large scale. As we have many examples and successbstories of very big projects like the Linux operating system , Git Version control system,etc. , we are also aiming to make this app open source so it can compete with existing giants in the online education industry like MS-teams. Also, we can provide all the best features to everyone free of cost . As the initial step, we have made the code of the app public to everyone, so that anyone from the world can contribute and add more features to the app.

The GitHub project is available at https://github.com/shubham0204/OCMS

5.3 Increase in Demand For Online Classes

As of now, demand for online classes and online exams is increasing day by day, despite decrease in the COVID-19 cases and regular ongoing of offline classes .The reason being ; easy access and cheaper alternative than offline mode to online education from remote areas of the world. Hence, we need a better and effective system to supervise students during online classes, which is one of the biggest

loopholes of online education. In the near future, the demand for effective online class monitoring systems will definitely increase, as the Android user base is almost 40 crore from the entire world which is a really big number. The large-scale applications of this app will affect millions of lives in the entire world in the future.

5.4. Availability as a cross platform app and windows version of app

As of now, OCMS is just a basic android application . But we want to expand our reach and we want to target iOS users as well . So, we want to launch OCMS for Windows and iOs as well.

5.5. Better AI/ML Algorithms to increase the efficiency of detection

We can add more advanced algorithms for face detection, which will improve the efficiency of our app and which will decrease the time lag for getting the information from OCMS - S .

5.6. Including battery information , location detection and internet quality information

As most of the time students give reasons such as poor internet quality for not being attentive in online classes , thus we can use some API's to record internet availability at student's side, so that the student can not lie to the teacher . Also, we can get the battery status of the student to detect whether he/she is lying to say battery issues for leaving the class . Also, a student's current location can help the teacher in most of the cases for assessment or viva.

Chapter 6
CONCLUSION

Due to its wide range of features that can help educators extend their supervision over the students, OCMS can significantly improve the overall quality of online education. Each feature described in the implementation of OCMS can provide additional information about the behaviour of the student.

We utilised Android APIs along with the Kotlin programming language in order to create both the applications. MLKit and Firebase Realtime databases were used as third-party libraries to implement the features and provide communication between the two apps. We gathered various statistics, like the physical presence of a student in front of a device, status of the camera and audio permissions and our application also allows the educator to export all the details in a text file.

The data, which is collected by the app, is only used by the teacher to help the student who is facing some problems, so that teacher can help him to find some solution .

Online classes would remain prominent in the future even in the post-pandemic era, as they provide remote educational opportunities to millions of students around the world. Improving the overall quality of online education remains the primary goal of our system. Our solution provides a platform for teachers to better serve the needs of students to help them achieve more in their lives.

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