

How is a MOOC Management System Different from a Learning Management System?

Aditya Vadlamani, Lavanya R, Revathy KT, Prabhakar TV
Indian Institute of Technology Kanpur, India
{adityav, lavanya, revathy, tvp}@iitk.ac.in

Abstract

With lockdown-induced campus closure in northern India, there was a need to reuse an existing MOOC management system to offer campus-based courses in an online mode. We did so successfully in our institution (F2F mode) with over 400 professional courses in a single term covering about 8000 students in UG and PG programmes. There are serious differences between a MOOC management system(MMS) and a typical LMS. We overcame serious challenges through technological innovations:

- We needed to develop a “content bubble” for video content to avoid using platforms like YouTube (for copyright reasons) and had to provide nearly all the features that this platform can provide (such as multiple resolutions and range of access devices);
- In a MOOC, lectures are pre-recorded and released in batches; in our courses, Faculty are required to deliver them live; we therefore integrated a video conferencing platform with many automated features (e.g. scheduling the lecture, recording attendance);
- An MMS does not require strict ID management; however, access to our courses is restricted; we did an advanced integration of ID management with institute’s own IT systems (LDAP servers) to facilitate ease of log in;
- Assessments require to be completed within the time limit, but this can be affected by network conditions at student’s end (failures can occur when uploading answers); we developed an innovative procedure to facilitate ease of submission;
- Analytics in the MOOC MS was modified to measure student engagement rather than content engagement.
- Differently abled students need special features on the platform

1. Introduction

Massive Open Online Courses(MOOCs) have been around for more than a decade. Software for running MOOCs, called MOOC Management Systems(MoocMS)[1], and Learning Management Systems(LMS)[2, 3] have been developed and some are available in open source as well. Coursera[4], EdX[5], Swayam[6], AgMOOCs[7], mooc4dev[8] are examples of MOOC portals which make use of these software for delivering online courses. While the core functionality between an LMS and a MOOCMS is the same there are some differences which we noticed when we had to go online for college credit courses with the coming of the pandemic. This paper talks about these differences and how they were incorporated into a MOOCMS to move it closer to an LMS.

IIT Kanpur is one of the premier science and technology Institutes of India with over 8000 students and 400 course offerings per semester. mookIT was a platform developed at IIT Kanpur and has been extensively used in offering online course and portals like agMOOCs, MOOC4DEV and for offering one-off MOOCs by several Universities like Nigerian Open University, University of South Pacific Fiji, Open University Mauritius, Athabasca University, Ministry of Education Trinidad and Tobago etc. One can see more of these details at the mooc4dev[8] portal which is run in collaboration with the Commonwealth of Learning, Vancouver. mookIT was modified and extended to serve as an LMS and was used in IIT Kanpur to offer more than 1,600 courses over the last five semesters. This is the HelloIITK[9] portal. Each of the following sections discussed these features and differences.

1.1 Design principles of mookIT

mookIT[10] was designed and built with the following design principles in mind:

- the platform must be easy and intuitive to use
- course management must be simple
- should not demand high levels of technical maturity from users
- should be efficient with server resources
- should be built using open-source technologies

1.2 Architecture of mooKIT

mooKIT follows a REST architectural style. It uses Drupal [11] content management system as the backend engine to handle the content and users. The main engine runs on MEAN stack, making it lightweight and extremely scalable with the ability to run on low-end servers. The architecture of mooKIT is shown in figure 1.

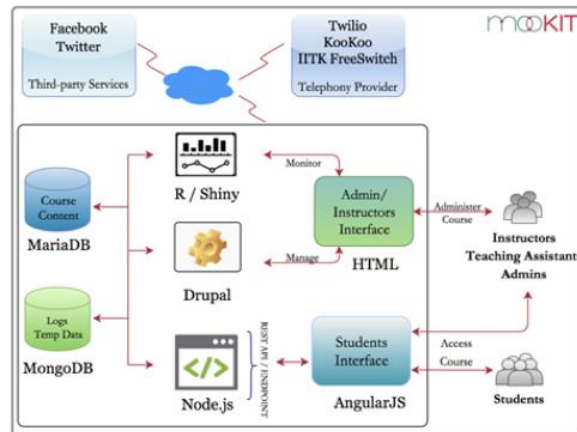


Fig 1. Architecture of mooKIT as MOOC management system

1.3 Features of mooKIT, a MOOC Management System

- **Scalability:** mooKIT is designed to scale by shifting most business logic to the client-side, freeing server resources. This architectural decision gives the server the ability to handle many users simultaneously.
- **Analytics:** mooKIT has a state-of-art analytics module, which provides a comprehensive analysis of student activities. It provides an easy-to-use analytics dashboard, which gives insights about the course as a whole and at an individual level.
- **Interactions:** mooKIT has integrations with social platforms like Facebook and Twitter and forums and hangouts on the platform where students can interact with each other. Using audio forums, users can express thoughts and ideas in detail rather than type.
- **Certifications:** Certificates for students can be automatically generated using templates based on the criteria set by instructors.
- **Blockchain-based credentials:** Tamper-proof, independently verifiable certificates issued on the Bitcoin blockchain
- **Progressive mobile applications:** mooKIT has mobile apps for iOS and Android platforms. The course content is cached locally, making it available even when the device is offline.

In the following sections, we discuss how we modified mooKIT the MOOC Management System to make it into HelloIITK a Learning Management System.

2. Content bubble for videos

mooKIT expects the videos to be on Youtube and a Youtube video player was integrated with the mooKIT platform. This design choice was for the following reasons.

- **Familiarity with YouTube:** YouTube being a globally used platform, is familiar to MOOC audiences. From our experience, we found that many of the students, often coming from developing nations, face issues with internet connections. If a familiar technology is a part of what could be a new experience, it helps them realise, if they have issues with the videos, the problem could be at their end, rather than assuming and writing to the course team that there are technical issues with the video platform.
- **Better viewing experience:** YouTube is very mature in terms of technology and content delivery. It often figures out the best resolution based on the user's bandwidth capability and is adaptive to bandwidth fluctuations. With a globally deployed content delivery network, it automatically plays the videos from the servers nearest to the users bringing down the lag and wait times.

- **Minimal infrastructure:** Running a video service can be very expensive and needs huge computational resources. Such a huge investment doesn't make sense in typical MOOC settings with smaller budgets and audiences.

However, keeping videos on YouTube exposes the videos to the open internet, meaning anyone who can get hold of the link can watch and share the video. This model doesn't work with videos which are copyrighted and need to be exclusive to an Institute. Hence we had to create a YouTube-like service within HelloIITK to be used by the Faculty using AWS media services. We call a content bubble.

Before the creation of transcoding service, the video files uploaded by the Faculty which were often in high resolution and large in size, running into hundreds of megabytes, were quickly becoming a problem for the bandwidth constrained students. We received feedback that the students were burning out their daily internet quota on just two or three videos. There was an immediate need to create a solution which can dynamically adapt to students bandwidth and can convert uploaded high resolution files into lower resolutions. Hence we created a transcoding service and implemented it in HelloIITK..

2.1 How does HelloIITK transcoding work?

When an instructor uploads a video, first it goes to S3 storage service on Amazon Web Services(AWS)[12]. Then, it is sent to AWS MediaConvert[14], a transcoding service which transcodes the uploaded video to multiple resolutions, formats, streaming protocols with variable frame rates, bit rates and several other profiles. Videos uploaded to HelloIITK portal are converted into three resolutions, **270p, 360p and 576p**. Rather than converting them to mp4 files, we transcode them into HLS compatible format which makes the videos stream better, given that the students have a wide range of bandwidth connections. In HLS streaming, chunks of videos are downloaded and displayed by the player rather than accessing as one single mp4 file, which makes the whole experience smoother and less prone to buffering.

Once the transcoding is complete, the videos are distributed to CloudFront, a content delivery network which has servers located all across the world. Distribution using CDN makes the experience for the users faster, as the content is played from the nearest CloudFront server to the user rather than from a single server located in one place. For example, a user in Tamilnadu(a province in India), India gets their videos from a CloudFront in Server in Chennai, whereas as a student in Rajasthan, India gets the video from a CloudFront server in Delhi, while a student in the US will access the videos from servers closest to them in the US, while the HelloIITK portal is being served using AWS servers in Mumbai data centres. All this distribution happens in a matter of seconds.

We transcode videos into three resolutions for the following reasons:

1. From our experience, we found that academic videos need not be recorded in high resolutions with high frame rates. Often they are screen captures of PPTs with voice over.. Since bandwidth is a major concern for the student, we decided to go with smaller resolutions with lesser frame rates as opposed to high resolutions. In some courses, we were able to bring down the video sizes from about a GB to less than 200MB.
2. It is expensive to transcode videos. In fact, transcoding into just three resolutions was the major expense by far in running the entire HelloIITK portal, often accounting for about fifty percent of monthly AWS bills.

Between September 2020 and April 2022, the Faculty uploaded more than 41,000 videos, resulting in 7.3TB of S3 storage consumption. And these videos were converted to several resolutions resulting in the consumption of additional 10.6TB S3 storage. The following graphs show the number of videos uploaded and storage consumed over time between January 2021 and April 2022.

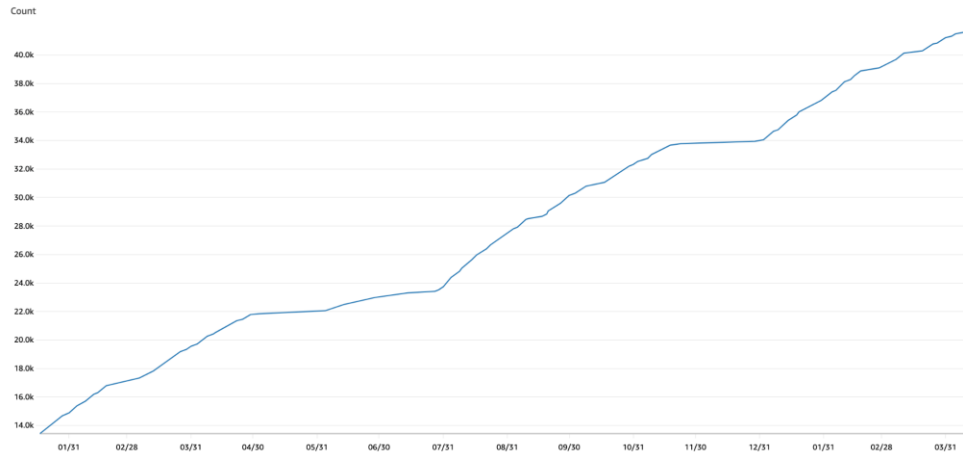


Fig.2 Cumulative number of lectures uploaded by Faculty over time between Jan '21 and April '22

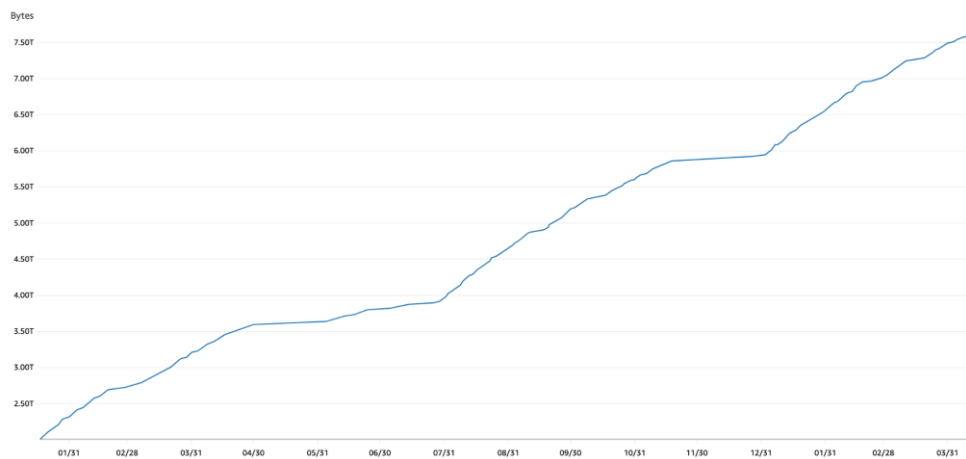


Fig.3 Storage used for transcoded files over time between Jan '21 and April '22

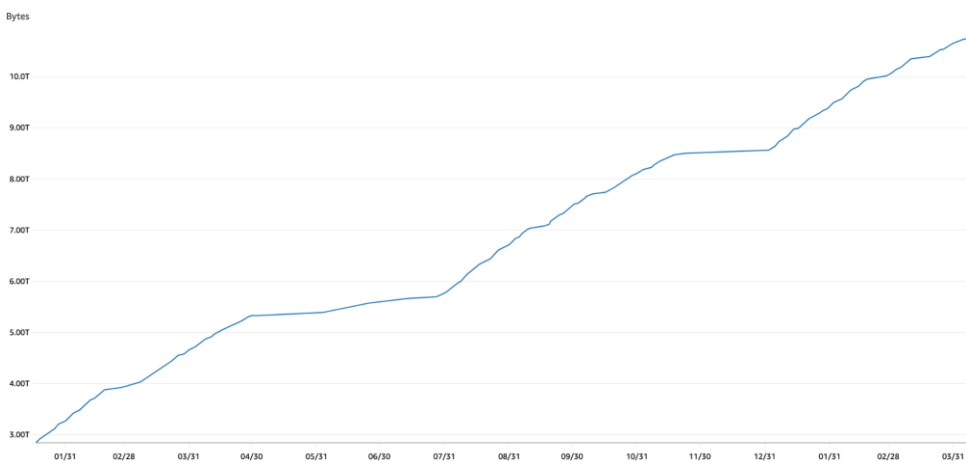


Fig.4 Storage used for original video files over time between Jan '21 and April '22

3. Pedagogical Style

Typically live lectures are not a part of MOOCs. Course material is pre-recorded videos which are periodically uploaded and any related doubts/questions are answered using discussion forums in the form of text. However,

in an LMS used in a classroom setting, apart from pre-recorded lectures, Faculty also conduct live lectures and keep office hours by teaching assistants and tutors over a video conferencing platform like Zoom.

To carry out the office hours and live lectures, IIT Kanpur purchased 650 Zoom licences and they were allotted to each Faculty members and some are kept to be used by teaching assistants and tutors on a rotation basis. To facilitate a smooth experience while using HelloIITK and Zoom, we integrated Zoom with HelloIITK with the following features:

- **Create a meeting:** Meetings can be created and scheduled within HelloIITK portal. A list of past and upcoming meetings is shown in the portal.
- **Start a meeting:** A meeting can be launched from the HelloIITK portal itself.
- **Notify students:** An announcement is created and emails are sent to all the registered students of the course with a link to join the meeting at scheduled time.
- **Download attendance and meeting recording:** The list of all the students who attended an office hour or a live lecture is made available for the instructors. This information can be used to take attendance. Similarly a recording of the session can also be downloaded right from the HelloIITK portal.

4. Identity Management over multiple courses

Universities establish identities of the students at the time of admission and they are enforced during the entire stay of the students at the universities. However, in MOOCs, identities are not strictly established. Although platforms like Coursera verify government issued identities at the time of issuing certificates, many times students are linked and identified using identifiers like email address and contact number. With the HelloIITK portal, there was an obvious need to strictly enforce student identity in an online setting without having to establish and re-verify. Hence, we integrated HelloIITK portal with IIT Kanpur’s LDAP server, thereby giving the ability to students and Faculty to login with their existing institute credentials. Such integration also benefited us with course add/drops. Rather than sending us the extensive list of student information, the office Dean of Academic Affairs, responsible for all the academic related matters, instead sends us a list of emails to be added to a course. Since a student enrolled in certain Dual degree programs can have more than one roll number, email id is used as the unique identifier for each student.

5. Assessments are a major issue

A major difference between a MOOC management system and an LMS is the number of assessments conducted and the challenges they bring upon. Students who take up a MOOC often do it to learn a new subject or enhance their existing knowledge and are not much concerned with a letter grade, whereas in a classroom setting, emphasis on grades is put to a higher degree.

Three different types of assessments are available on HelloIITK portal: Quiz, Assignment and Exam. Quizzes can have multiple choice questions with one or more correct options, short answer questions and descriptive type questions where students can type in the answer or upload a file. Students upload answers as files for Assignments and Exams.

As the first semester progressed, we found and also received feedback that students are unable to submit assessment related files in time. They wait until the last minute to submit the file and due to intermittent bandwidth connections the submission may not go through. Technical team was often consumed by retrieving files and answering student and Faculty queries. To deal with this issue, we automatically started allotting 10 extra minutes for assessments with file upload type questions.

The following table summarises the extra submission time for quizzes.

| Type of assessment | Timed | | Untimed | |
|--------------------|-----------------------------|-------------------------------|-----------------------------|-----------------------------------|
| | File uploads | No file uploads | File uploads | No file uploads |
| Quiz | 10 minutes extra time given | Submission at the end of time | 10 minutes extra time given | Submission at the end of deadline |

Table 1. Extra time for Quizzes

Since assignments and exams only allow file uploads, extra 10 minutes are automatically given.

There were many reports about collaboration and cooperation amongst students in answering the assessments. We had to implement extensive logging to trace the misuse that may be happening. Essentially every single click on the platform, the IP address. Some of it is discussed in [13].

6. Analytics

One of the major attractions of mookIT as a MoocMS is its learning analytics. Using graphical dashboards about student registrations, engagement and assessments, the instructors could get a bird's eye view of where the MOOC audience as a whole and an individual student's stand, and make necessary adjustments to the course. However, in HelloIITK, the analytics module needed to deal with information generated outside the platform as well - like marks for assessments conducted outside the platform. Participation in Forums was also considered important. We incorporated these two features so that a course on HelloIITK portal can act as a tool for the instructors to organise all the information about the course. The essential difference is in the perspective of interest - in a MOOC one sees the content engagement analytics like video view, whereas in a LMS one is interested in the students' attendance in live classes(which is in the Zoom platform) and participation in class discussions.

7. DAP student provisions

Online courses have posed special challenges for students who are differently abled. Learning management systems need to support special features to support Differently Abled Persons (DAP).

- Colour coding to identify functionality is not enough since many people are color challenged. It is estimated that 10% of males are color blind. To overcome this, every button on the LMS platform that is color-coded is also indicated through an icon.
- Messaging is the basic communication mechanism and often becomes important when the student needs to communicate with the Instructor. Since typing long messages can become a challenge, we permit the student to record messages on the platform and send them in lieu of text messages.
- For students with disabilities the Institute permits extra time to submit the answer scripts in an extra time. It is normally about a third(33%) of the scheduled duration. The platform recognises that a student is a DAP student and accepts submissions with this margin
- DAP students whenever they register for a course are recognised by the platform and the Instructor and the Teaching Assistants are informed.

8. Conclusions

The new architecture of HelloIITK portal is shown in the image below.

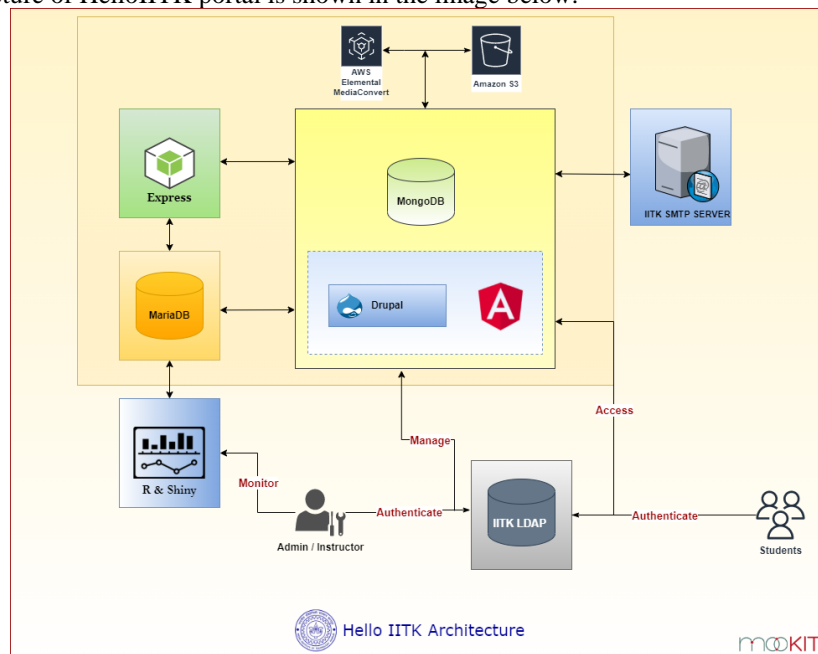


Fig.5 Architecture of HelloIITK, a Learning Management System

With all the modifications and changes, we were able to successfully run more than 1500 courses and helped the students carry on their studies in unprecedented times. Over the coming months, we plan to develop HelloIITK with more LMS features like improved and new types of assessments, calendar-like interfaces to keep track of activities in all enrolled courses etc.

References

- [1] <https://www.mookit.in> mooKIT MOOC Management System, accessed on 13 April 2022
- [2] <https://openedx.org> The Open EdX learning Management System, accessed on 13 April 2022
- [3] <https://moodle.org> MOODLE Learning Management System, accessed on 13 April 2022
- [4] <https://www.coursera.org/in> Coursera online courses portal, accessed on 13 April 2022
- [5] <https://www.edx.org> EdX online courses portal, accessed on 13 April 2022
- [6] <https://swayam.gov.in> Swayam online courses portal, accessed on 13 April 2022
- [7] <https://www.agmoocs.in> MOOCs for Agriculture portal, accessed on 13 April 2022
- [8] <https://www.mooc4dev.org> MOOCs for Development portal, accessed on 13 April 2022
- [9] <https://hello.iitk.ac.in> IIT Kanpur Online Courses portal, accessed on 13 April 2022
- [10] Prabhakar TV, Balaji Venkatraman, Revathy KT, mooKIT - a MOOC platform for Developing Countries, International Conference on Multidisciplinary Research MyRES, Mauritius, 2018, <http://oasis.col.org/handle/11599/3047>
- [11] <https://www.drupal.org> Drupal Content Management System, accessed on 13 April 2022
- [12] <https://aws.amazon.com> Amazon Web Services, accessed on 13 April 2022
- [13] Neeta Singh, Lavanya R, Aditya Vadlamani, Revathy KT, Prabhakar TV, Moving An Institute Online - Challenges and Experiences submitted to Pan Commonwealth Forum 10, Alberta Canada, result awaited
- [14] <https://aws.amazon.com/mediaconvert/> AWS Elemental Mediaconvert, accessed on 15 April 2022