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E-learning Management Web-App with Video Conferencing

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ABSTRACT: *This article describes architecture of online learning web application which provides students and teachers a platform to interact with each other in a systematic way. This app is basically designed for institutions who wants to conduct their own way of learning and engaging students virtually besides physical classroom. The idea behind this app is to have all at one place, to let teachers convey their teachings to students in efficient way through content management where students can access the study material easily without having to go through the trouble of gathering study material from different platform. It provides access to new technologies for assessing their student's performance through variety of assessment tools. Example engaging students through quizzes and having discussion through video conferencing. In this document we have considered existing applications that focuses on distant learning and have analyzed their main features and requirements and the areas which needs further improvements in our application.*

Key Words: E-learning, web-app, Computer Applications, Technology, tools, Education, distant-learning, virtual classroom, study material, video conferencing, assessment tools.

1. INTRODUCTION

The development of information technology (IT) in education has led to the expansion of new teaching and learning methods at universities[1].Stonebreaker and Hazeltine (2004) describes Virtual learning as the delivery of learning through electronic mediation that reduces the gap when the instructor and the learner are separated in either time or place. E-learning is the form of distant learning. The virtual classrooms have evolved with advancement technologies to grab the attention of students and ease of accessibility. Many organizations have deviated their applications from old technologies towards new ones considering users needs. Web based applications have emerged into more complex, interactive and present real time data. That needs lot of complex coding and toolsets.

Nowadays Open-Source tools have gain popularity due to the large community groups and people supporting and assisting each other. There are various open-source web frameworks like Django and JavaScript frameworks which are popular due to their enhance productivity and code-reuse.

Online learning system are often complex due to the features like video conferencing ,content management, course updates ,chat and social media embedded. To design such complex applications, toolsets such as frameworks and API are most preferred. There are many video conferencing platforms such as Zoom, Google-meet emerged during the lockdown period and highly used by education, medical, business and It industry. Scope of digital learning and video conferencing have enhanced and people are more open to it. This paper approaches a way to design an application that combine both the toolsets video conferencing and content management with more secure environment which is more important aspect considering data security. Due to the new trends in development of educational systems and the necessity of developing applications that can be accessed remotely, the security management of e-learning systems and the access control have attracted more and more the attention of researchers and web application developer[3].This research focuses on designing web application including the key feature that is changing the quality of the video call that is lacked by most applications for this we chose to use a video conferencing tool Jitsi-meet, which is an open source ,customizable ,can be locally installed and integrated into local systems thus providing ease of accessibility with secure environment.

1.1 PROBLEM STATEMENT

Universities and Schools have been trying to manage and schedule their classes online through video conferencing platforms like Google Meet , Goggle Classroom and Zoom. Submission to gathering study notes maintaining them has been a quiet hassle for students. The problem involves in having to use different platforms for different needs which cannot be customize and used as per our needs. That results in unordered distribution of study content to students. Also increasing risk of security.

1.2 OBJECTIVE

Our main objective behind the project is to develop a web-application which provides :

1. Better communication between student and teachers.
2. Prevent scattered data and resources provided by faculty.
3. Device friendly and responsive.
4. For providing better and well organised content management.
5. Combining video conferencing and content management system together.

1.3 BENEFITS OF USING E-LEARNING WEBAPP

1.3.1.WHY WEB-APP?

Web applications saves lot of time of a user rather than installing an app that uses more space and time. You can access them anytime anywhere. Nowadays web-based applications have been enhanced with advanced technologies like frameworks and libraries. Which make them reliable and flexible.

A. User friendly

This app UI design saves user the time of going through the trouble of learning the app itself. It is responsive approach, makes it cross-platform and device friendly(that means can be open on any device).

B. All at one place

Teachers contact with their students through different platform for keeping them updated and share study content. Most of the time the study material gets deleted or missed which then teacher or student have to invest their time to find other content, gathering and sharing, instead of focusing on the work. Our web-application avoid such hassle. Keeping all content at one place.

C. Improved felxibily

Web application are easy to access through browsers at any time and saves lot of time of user having to install the app.

D. Security

Authenticating users(2step-verification)and managing passwords using good password manager which generates random key for the passwords that are stored in the database. Most important getting data backup regularly is essential.

1.4 REQUIREMENTS

A. Hardware Specification :

- Processor - i3
- RAM - 2GB
- Hard Disk - 10 GB
- I/O Device - mic, speaker, camera

B. Software Specification :

- Front-End Language – Html, CSS, JavaScript
- Front-End Framework – Bootstrap
- Back End Language – Python
- Back End Framework – Django
- Other – psycopg2 (database adapter)
- Database - PostgreSQL
- Operation system - Windows 7 & above

The web application is based on two components: The video conferencing part and study content management. The architecture of the web-app is built on HTML(for structure), CSS(for styling), JavaScript(for event handling), JQUERY(JavaScript library), Bootstrap5(html, CSS and JavaScript framework). These technologies form the front-end design of the application.

It is supported by "Django" the MVT(Model View Template) framework in the backend. It is most popular framework which consist of variety of plugins uses Python as language. Frameworks are basically a structure that provides a developer a foundation to build application on. It makes code-reuse which saves lot of time of developers and focus on development.

The database is an essential part of a web-based application where the user's data get stored. The database used is PostgreSQL. It is open-source with wide community. The database supports various indexing techniques and replication methods. It has high capacity for fault tolerance and runs on all operating system. Django makes use of ORM(Object-Relational-Mapping) which lets developers write all table definition in python and it translates the python code to chosen query language.

The other requirement of the application is the video conferencing tool "Jitsi" which is open-source platform composed of set of other projects. It is customizable, flexible and user-friendly too with many features like screen sharing, recording, direct YouTube streaming and able to see the connectivity of other participants. Adding password to the room and changing the quality of the video call are some key features of jitsi-meet. It has wide community support and can be locally setup on the computer or on cloud servers. Making the virtual classroom environment more secure and flexible.

1.5 FEATURES

Users like the applications which are featured rich with user friendly environment. Specially when the user is getting the desired content. Our architecture defines such an application which have following features listed below:

1. Create/Join meeting and setting passwords to room(Jisti).
2. Screen sharing and whiteboard.
3. Screen Recording using any other tool on your computer and uploading it directly or using Jitsi recording feature and saving to drop box providing link to it.
4. Managing the video call quality and able to see the connectivity rate of participants.
5. Upload/view/edit and delete documents(notes, assignments, presentations and video lectures).
6. Post/view important updates and get email.

1.6 CHALLENGES

During the lockdown period many universities/schools and every other department faced the issue not able to continue their work and suddenly changing their work flow to digital platform. Nobody expected it and was new to every one at starting people struggled but now it is the new normal in people lives. The scope of digital learning increased the challenges for developers and organizations how to make the platforms secure and user friendly for users. Question arises how will the student feel the classroom environment virtually? But now there are lots of companies coming up with the solution for this problem.

The main focus is to develop an active learning environment not just a teaching environment involving use of lot of IT tools/Api/resources for engaging the student as well as teachers having active participation and enhancing the quality of education[4].

1.7 USER AUTHENTICATION

When user register's as a teacher they will be directed to Homepage. After registration they will get account verification message. After successful verification the user will be able to login and directed to the Homepage. Admin will have the authority to verify, remove or add teacher or student.

1.8 USER ROLE

According to the user roles and permission set by the admin the user's data get stored into two groups teacher and student. Every time when the user's login they will get the requested page of the branch and semester they chose during registration. When teacher login they will be able to access extra features and have higher privileges than student. When student login they will be able to access few features. Other features will be restricted in their case.

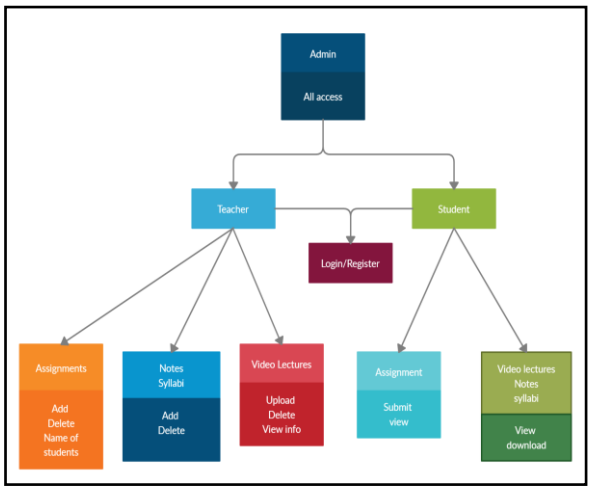


Figure 1. User Roles

1.9 DESIGN AND IMPLEMENTATION

1.9.1 CONTENT MANAGEMENT SYSTEM :

Architecture of the application uses Django framework which makes it easy to breakdown the whole system into small modules or components. These modules are later integrated with the templates (written in html). Other files like images , css and js files are stored in static folder. Everything is created in an environment. Then a folder is created which holds project and apps. Thus, moving an environment is like moving an image file.

New technologies like "Docker" makes transporting application from development to production level easy. Bootstrap templates are more productive way to build beautiful responsive layouts. The UI/UX design help to win the consumers' confidence and make them use your application or website providing what they are looking for[7].

1.9.2.MODULES :

- The application is module based that is broken into pieces into different modules. The first module is the Landing-page when the user types the domain name. This page consist of introduction of web-app and some buttons for register/login as teacher or student.
- User Registration module is where the user will provide details like username, email-id , password to be set. And fields like branch and Semester.

- User Login module is where user is asked to login through registered username and password.
- Homepage is the page user is promoted to when they login. Showing the user profile, subjects of the particular branch they selected.
- There are other modules such as notes, assignment and video lectures and syllabus etc.

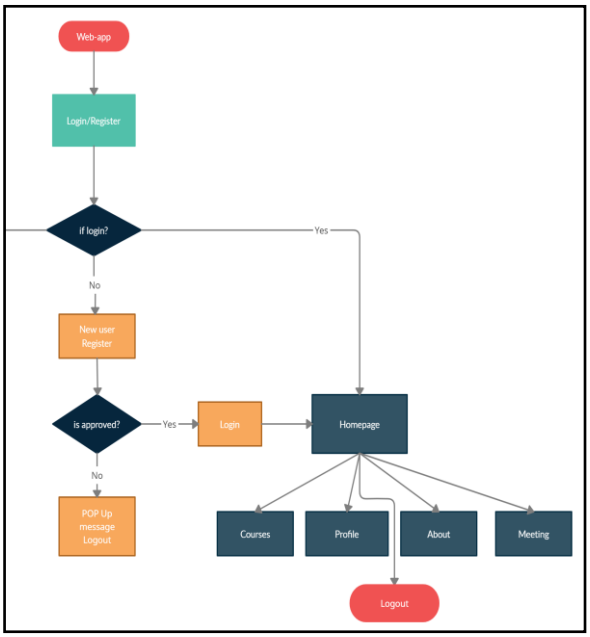


Figure 2. Flow chart

When user first register into the web-app and then logs in , they will not be able to see the homepage because the admin hasn't approved the user. Only after admin validates the information provided by the user by clicking on the approval checkbox in the custom admin panel an automated generated email will be sent to the user that their account has been approved.

The webpage filters the user who are superuser(admin) to be shown in the table. Custom User is the table under which we have created fields. Objects. All() method fetched every user from the table except admin. Then if else is applied, where if the user is approved by the admin the below send mail() function will get triggered which consist of message, from email i.e., from whom the email is being sent, recipient which fetched the email-id of the user as shown below.

```
def pendingreq(request):
    ap = CustomUser.objects.all().filter(is_superuser=False)
    if request.method == 'POST':
        form = ApprovalForm(request.POST or None,instance=request.user)
        if form.is_valid():
            user = CustomUser.objects.get(is_approved=False)
            user.is_approved = True
            user.save()
            subject = 'Welcome to Digilearn!'
            message= f'Hi {user.first_name}{user.last_name}, Your Account has been approved by the admin.Please login again.'
            from_email= settings.EMAIL_HOST_USER
            recipient = [user.email]
            send_mail(subject, message, from_email , recipient,fail_silently=False,)
            form.save()
            return redirect('pendingreq')
    else:
        form = ApprovalForm(instance=request.user)
    #we are passing dictionary here and storing in context variable
    context = {'form':form,'ap':ap}
    return render(request,'accounts/pendingreq.html',context)
```

Figure 3. Code showing logic behind sending automated email to the user.

For connecting the database to the web-app code we have used a database adapter "psycopg2" which is provided by Django for the ease of retrieving and storing the data. It enables us to use the python language for accessing the data stored in the database without needing to write queries.

First, we create classes and the fields we require in our models.py file.

```
from django.db import models
from django.core.validators import RegexValidator
from django.contrib.auth.models import AbstractUser
from django.core.validators import MinLengthValidator


class CustomUser(AbstractUser):
    branch=(
        ('cse','computer science engineering'),
        ('other','other'),
    )
    year=(
        ('1st','first year'),
        ('2nd','Second year'),
        ('3rd','Third year'),
        ('4th','Fourth year'),
    )

    Branch = models.CharField(max_length=70,choices=branch)
    Year = models.CharField(max_length=70,choices=year)
    is_student = models.BooleanField('student status',default = False)
    is_teacher = models.BooleanField('teacher status',default = False)
    username = models.CharField(max_length=70,unique=True)
    phone_no = models.CharField(max_length=10,validators=[RegexValidator(regex='^[0-9
    email = models.EmailField(max_length=70)
    password1 = models.CharField(max_length=32,validators=[MinLengthValidator(4)])
    password2 = models.CharField(max_length=32,validators=[MinLengthValidator(4)])
    avatar = models.ImageField(upload_to='images/avatars/', null=True, blank=True)
    is_approved = models.BooleanField('Approved status', default = False,blank=True)
    def __str__(self):
        return self.username
```

Figure 4. Represents class and fields in models.py file

There are two commands used that help create tables into the database are:

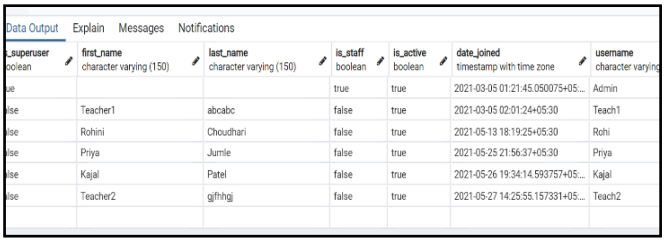
```
C:\Users\Acer\projects\Mintos>python manage.py makemigrations
```

This is the first command which makes the migrations of the fields we created in our class module.

```
C:\Users\Acer\projects\Mintos>python manage.py migrate
```

This is the second command which create the tables in our database.

The figure below is the "pgadmin4" a GUI tool which helps use to manage our database.After migrating the classes, the table is created with the class name and fields under the classes.



Data Output | Explain | Messages | Notifications

_superuser boolean	first_name character varying (150)	last_name character varying (150)	is_staff boolean	is_active boolean	date_joined timestamp with time zone	username character varying
ue			true	true	2021-03-05 01:21:45.050075+05:...	Admin
lse	Teacher1	abcabc	false	true	2021-03-05 02:01:24+05:30	Teach1
lse	Rohini	Choudhari	false	true	2021-05-13 18:19:25+05:30	Rohi
lse	Priya	Jumle	false	true	2021-05-25 21:56:37+05:30	Priya
lse	Kajal	Patel	false	true	2021-05-26 19:34:14.593757+05:...	Kajal
lse	Teacher2	gjfhhgj	false	true	2021-05-27 14:25:55.157331+05:...	Teach2

Figure 5. Represents the register user table in our database.

1.9.3.VIDEO CONFERENCING COMPONENT

The other requirement of the application is the video conferencing tool "Jitsi" which is open-source platform composed of set of other projects. It is customizable, flexible and user-friendly too with many features like screen sharing, recording, direct YouTube streaming and able to see the connectivity of other participants. Adding password to the room and changing the quality of the video call are some key features of "Jitsi-meet".

It has wide community support and can be locally setup on the computer or on cloud servers. Making the virtual classroom environment more secure and flexible. Jitsi Meet provides functionality also to integrate your calendar so that you can schedule your meetings and date.

Advantages of using Jitsi Meet API :

1. We can customize Jitsi meet as per your requirements
2. Adding Room password
3. Share screen and screen recording
4. Storing the recorded video call on Dropbox
5. Shows connectivity rate of another user
6. You can manage video quality
7. You can livestream a YouTube video
8. Invite others
9. Whiteboard
10. Disable /kick
11. Mute everyone
12. Moderator
13. Changing the background
14. Integrating the calendar

We have deployed Jitsi meet using digital ocean by the domain "degilearn.ddns.net" which we have passed in script tag of our code.

```
<script>

var button = document.querySelector('#start');
var container = document.querySelector('#jitsi-meet');
var api = null;

button.addEventListener('click', () =>
{
    var domain = "digilearn.ddns.net";
    var options = {
        "roomName": "",
        "parentNode":container,
        "width": 1200,
        "height": 680,
```

Figure 6. Jitsi.html file showing domain where we have setup Jitsi meet

After entering the meeting room, the domain is triggered and the Jitsi meet API opens up in the iframe. Enter your name and join meeting with microphone off/on and camera on/off. Also, you can set your background and many other options available as shown in fig(6). Jitsi meet provides end to end encryption and is an open-source project. Many developers contributed and are still which is big advantage over the other applications as it will become more and more user friendly and efficient in time.

When the meeting screen of the video conferencing which consist of toolbox consisting of microphone, camera, chat, screenshare, participants, tile view and some other necessary features.

As for the security of your room you can add password and enable lobby which provides more security to the user. It ensures that no unauthorized users to access the meeting. The objective of combining both the content management and video conferencing with more advanced tools has been achieved in this application.

2. RESULTS

2.1.OUTPUT SCREENSHOT :

The Fig.7 shows The Landing page is the example demo of the app which consist of login/register buttons and displaying introductory info.

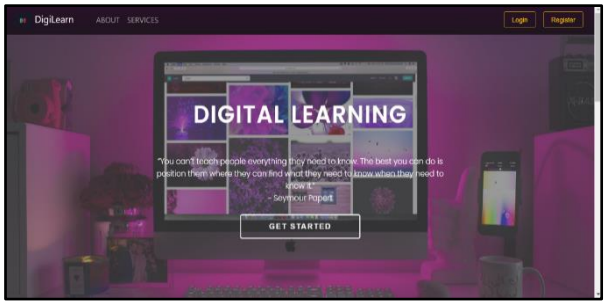


Figure 7. Landing page.

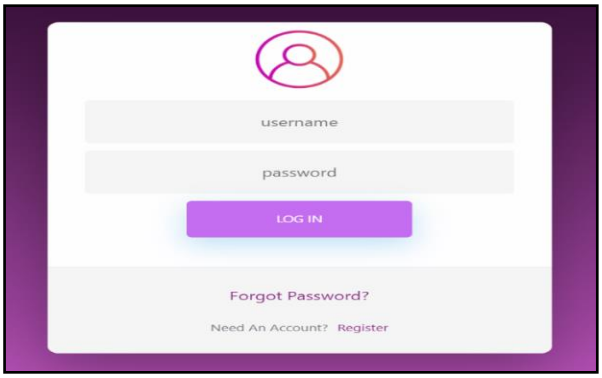


Figure 8. login page.

Fig.8.demonstrates login form consisting of username and password field. This fields are validated through the authentication code and on successful validation user is redirected to Homepage.

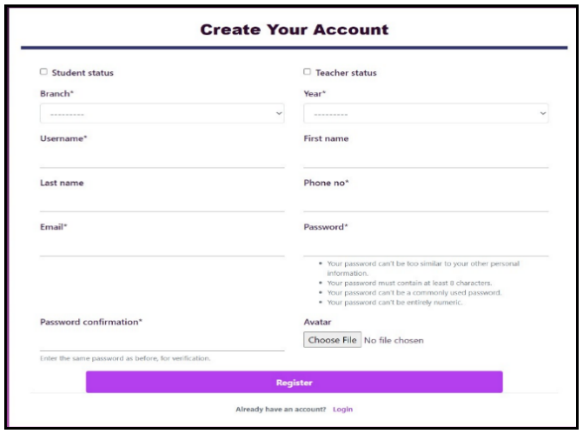


Figure 7. Registration page.

Above Fig.7:Is the Registration form. This module includes various user fields which user must fill up for the successful registration. So that login credentials can be validated.

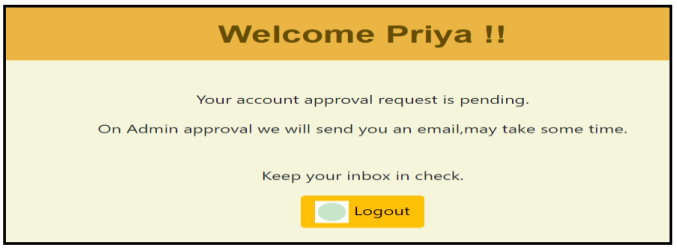
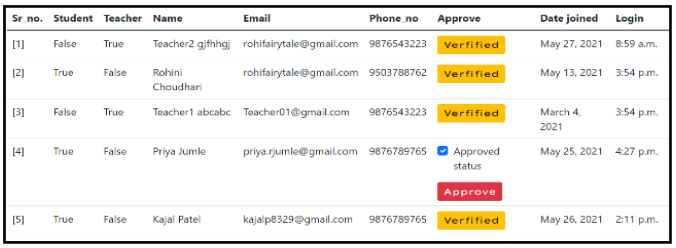


Figure 8. Approve pending request message

Figure 9. Course section of homepage.

The figure 9. Displays the semester seventh related to the branch and semester selected by the student at the time of registration.



Sr_no.	Student	Teacher	Name	Email	Phone_no	Approve	Date joined	Login
[1]	False	True	Teacher2 gjfhhgj	rohifairytale@gmail.com	9876543223	Verified	May 27, 2021	8:59 a.m.
[2]	True	False	Rohini Choudhari	rohifairytale@gmail.com	9503788762	Verified	May 13, 2021	3:54 p.m.
[3]	False	True	Teacher1 abcabc	Teacher01@gmail.com	9876543223	Verified	March 4, 2021	3:54 p.m.
[4]	True	False	Priya Jumle	priya.rjumle@gmail.com	9876789765	Approved status / Approve	May 25, 2021	4:27 p.m.
[5]	True	False	Kajal Patel	kajalp8329@gmail.com	9876789765	Verified	May 26, 2021	2:11 p.m.

Figure 10. Approve pending request message

The figure above represents the pending request file where admin will approve the pending user request.

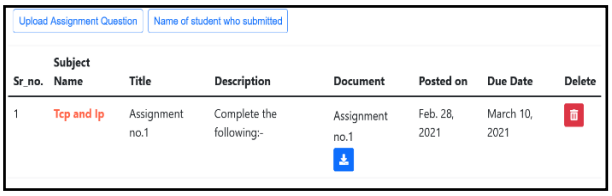


Figure 11. Assignment section (teacher login)

The figure above is the assignment section where there are options for faculty and students to access the uploaded data or to add the same to it.

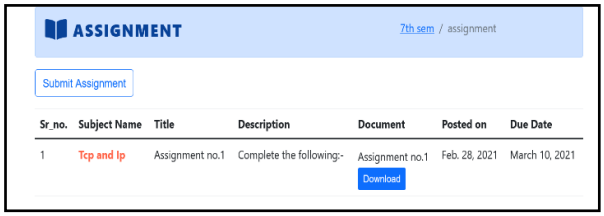


Figure 12. Assignment section (student login)

The fig14.Represents the video conferencing call page interface.

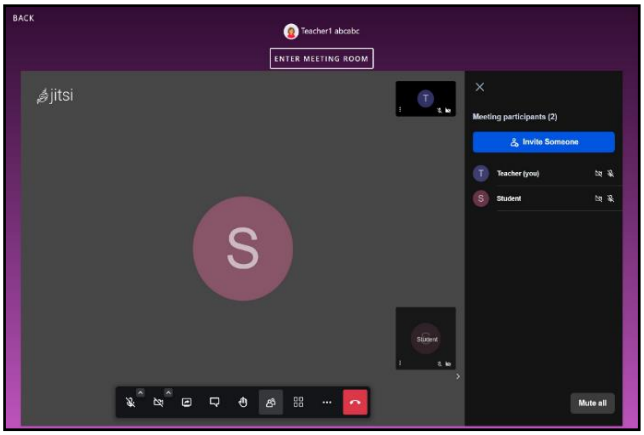


Figure 14. Video Conferencing section

3. CONCLUSION

We surveyed and researched about variety of tools which can be used for better interaction and efficiency of developing a web-app. Analyzed different learning management system(moodle,google-classroom,canvas) and another video conferencing tool such as zoom and google-meet used them and came up on certain conclusion. Doing so, we realized the open-sourcing power that is enhanced over the years due to wide community support. Using Jitsi and integrating it with learning management system making a feature rich application. Through this report designing web-application combining video conferencing using a powerful tool like Jitsi with content management system will make it easier for university/school students to avoid the hassle mentioned in the above problem statement in the report. Both the areas provides more flexibility in distant e-learning system To achieve a more polished functionality there is more to be done and thanks to the open-source community there are chances for growth of such web application.

ACKNOWLEDGMENT

The ideas and the concept of this project involve lot of guidance and assistance from other people and we are extremely privileged to have got this all along our project. All that we have is done under their supervision and assistance. We would like to thanks our guide Professor "**Mr.Annaji M.Kuthe**", Department of "Computer Science and engineering" providing us an opportunity to do the project work and giving use all support and guidance till the completion of our project.

DECLARATION OF INTEREST

The authors declare that they have no competing interest with other authors.

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