Online Social University

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ABSTRACT

The COVID-19 pandemic has reported the highest disruption of education systems in human history. It has affected more than 1.6 billion learners across over 200 countries. Closures of in-person universities, institutions, schools, and other learning spaces have impacted more than 94% of the world's student population. The existing platforms that provide online learning content do not provide targeted learning and are expensive. The paper offers a solution to this problem. The Online Social University (OSU) project enables students, especially emerging software engineers continue learning even during a pandemic. The system effectively delivers the real-time university experience in online settings. The entire system was designed by allowing interaction among different modules. The paper covers the introduction to the problem, systems' architectural design, related works, modules interactions, and acknowledgment of the project.

CCS CONCEPTS

• Software and its engineering • Social and professional topics • Information systems

KEYWORDS

social, e-learning, university, online, student, e-library, companies, system, e-learning web portal

ACM Reference format:

Ashawini Thakur, Prachi Pundir and Muyang Wang. 2022. Online Social University: Online Application. In *Proceedings of ACM Woodstock conference (WOODSTOCK'18). ACM, New York, NY, USA, 3 pages.* https://doi.org/10.1145/1234567890

1 Introduction

Education is the most powerful weapon we can use to change the world" argues Nelson Mandela. Many students after high school want the chance to go to college, but the expense in furthering their education is their drawback. In some countries around the world and back in our nation's history, young people seeking higher education could attend public colleges for free. On top of that pandemic has made the situation worse.

COVID-19 has negatively impacted almost all careers, and software engineering is no exception. A recent survey suggests that software engineers across the world have experienced 5% job loss and 31% of software engineers emphasized the major job security issue. At the same time, the quick technological improvements and information advancements have set a large base for web learning. Instructors and researchers are increasingly fascinated by this learning style. But, most e-learning systems available nowadays are expensive and follow 'the course-based approach' of getting certification on completing a single course, which makes students not quality of other required skills.

This is creating unseen trouble in the IT industry. To solve this concern, IT professionals require a learning platform capable of directing students using the 'career path focused approach' directing students to their dream job. Our proposed system mitigates this requirement and is effective in student management, library management, offering certifications, organizing courses considering students' career goals, and organizing other learning tasks. The project intends to replicate the real-time university learning experience for the Computer Science community during the pandemic time. The notable advantage of the proposed solution is it nicely structures the learning path for students considering their career goals. We are more focused on making this system in line with real-time university operations.

The operation and implementation of the system are module-based with ensures the interaction among different modules. The list of modules primarily covers student management, library management, course management, and web portal application. The system is highly interactive since it enables users to switch between these panels of the system and ensures flexibility. The paper offers a clear idea

about previous work in this line and the high-level architecture of our system. In this paper, we have also discussed our future work to make this system more social.

The report is organized in the following way. First, we begin with the relevant background introduction and present examples of how the project is useful for software engineering during COVID. We then present the Related Work section that goes through the similar work done in the research literature. In the method section, we discuss the architectural design of the software. We describe in detail the design decision, process, and testing approach used in the project. Then we discuss the code deployment and maintenance plan to maintain the project. Towards the end, we also present the opportunities to improve the project via future work and current limitations and conclude by reiterating the problem statement and summarizing key contributions.

2 Related Work

COVID-19 lockdown and social distancing have led to closures of schools, colleges and affected major university operations and education facilities across countries. This has brought a paradigm shift in the delivery approach to the entire education system through the adoption of various online platforms. Distance education and online learning became a panacea for the unprecedented global pandemic, despite making education and educators face multiple challenges. The worsening situation of COVID-19 has completely changed the education pattern and students' preferences. The education system and educators across the world have adopted "Education in Emergency" through various online platforms and are compelled to adopt a system that they are not prepared for [1].

Overall, the education system and the educators have adopted the "Web learning approach" through various transitions from traditional face-to-face learning to online learning can be an entirely different experience for the learners.There are multiple e-learning sites and applications available these days [4]. A list of the widely famous applications includes edX, Udemy, and Coursera, among others. Big tech companies like Google, and Microsoft have also shown interest in offering paid e-learning platforms. Besides this, universities are introducing online degree programs and enrolling students on large scale. All these existent systems work well for students and professionals who wish to enhance their knowledge and get better paid. Unfortunately, the biggest problem with all these systems is they are all paid versions.

To solve the problem of students willing to learn but lacking financial backup, government agencies and some universities are also taking steps. Universities are employing the concept of "Free College" for students who cannot afford education and it is witnessing high popularity in COVID-affected nations[2]. This concept has inspired us for bringing the project - "Online Social University". Our system will be beneficial for students, software industry employees who have lost their job during pandemics, and other industry experts who wish to improve their skills. The well-structured preparation of the study and complete one-on-one assistance makes it distinct from all available options.

3. Method

The online social university has built on its high-level architecture design. Low-level designs for each module and complexity analysis of the system have been carefully considered at each stage of system design.The project follows SDLC stages throughout its life and offers justice to every level of the design stage.Apart from its high-level architecture the system follows ER- design of the system for every independent event and obeys its class and structure diagrams.

3.1 High-level Architectural Design

Figure 1 represents the high-level architecture of our proposed solution - Online Social University (OSU). The OSU system has its high-level architecture bifurcated across different levels of software development [5]. At its initial; layer the system is enabling access to its users and validating access to the systems. For this project, users considered can be an administrator of the systems and can be a student holding limited control over the system.For the administrative part, the system has offered access to significant design-making tasks including registering users into the system, organizing courses for each semester, granting or declining students' access to the e-library, and producing assignments and exams. However, for students' access, the system limits access to course selection, assignment submissions, books request, books search, and tracking of the progress of different courses.

At the next level of the system design, it is offering an interface, a web portal for the users to interact and access different components of the online social. There are different modules based on which the user can interact with the systems. The web portal designed for the system is

ensuring user-friendly interaction with the system and its components. After the successful registration and enrollment from the web portal, the users will get a unique ID to log in and complete authentication tasks. This will enable the users to access the system and make challenges in the accounts[3].

For managing different work modules of the system's design, the project responsibilities are distributed across distinct independent modules. These modules are dedicated to the one major area of the system and perform all tasks required for that part of the project. The list of distinct modules includes Student Management Module, Library Management Module, Course Management Module, and a Website Interface, among others. These modules have a Microsoft access database engine at their base for managing data organization and data retrieval tasks.

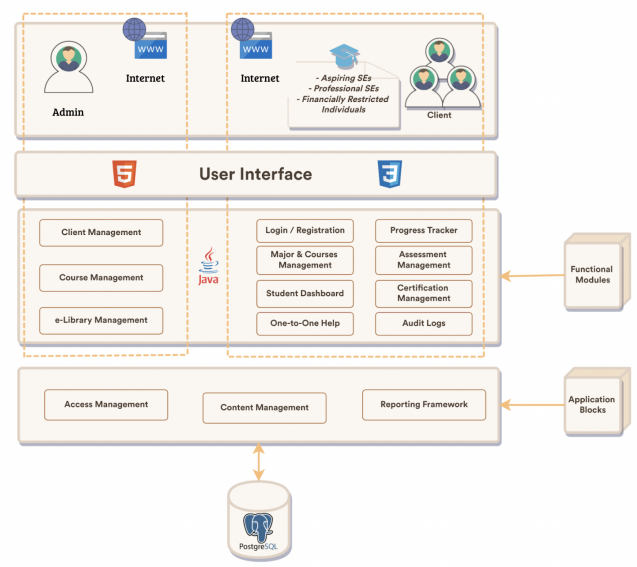

Figure 1. High-level Architecture Design

Student and library management are specifically designed with java and have a Microsoft access database at the backend of these modules. The student management module specifically enables administrative authorities to perform decision-making tasks including managing courses per semester, allowing access to students, adding members for access to the library, and providing certifications among others. On the other hand, the library Management module effectively handles different events required for managing an online library. The list of operations includes sending book requests, holding books, assigning books, and searching books, among others.

Our course management modules handle all the operations where students can manage their course progress, perform assignments and request one-on-one assistance for any course queries. The reason for building our project on two different platforms is for managing accessibility at two different levels., Student Management Module and Library Management Module are used by teaching staff who will be accessing that information in a fixed place and the device they are using is more predictable, so we decide to create a desktop application for them to have a more stable user experience. On the other hand, Course Management Module and the Interface are more often used by the students, who could try to access the application using different kinds of devices, so having a web-based application would be more flexible and grant easier and quicker access to the students

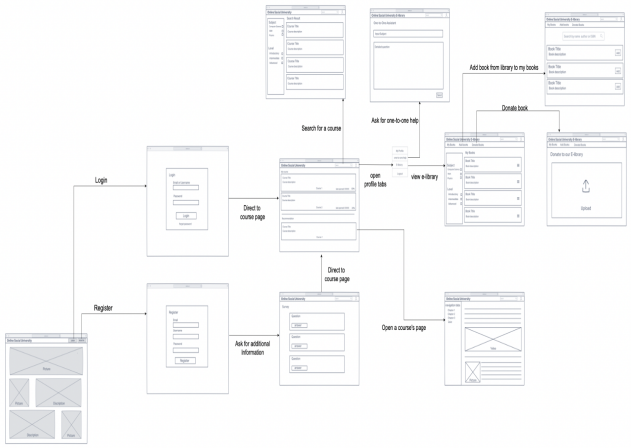

Figure 2. System Class Interaction Design

Figure 2 represents how system classes are interacting with each other and how they can be connected within the system. We have achieved the designing and implementation of the independent modules so far. Integrating the system into one and making these classes from distinct project modules interact with each other is what we are currently counting on.

3.2 Test Approach

Testing is mainly achieved with the manual black-box testing performed against the list of test cases. Figure 3 demonstrates the sample test cases for the login page. This presents our approach for manual black-box testing. We have listed our test cases for each java form and made testing against the list of test cases. The complete student and library management modules are tested with the manual black bo testing. These were highly complex

modules of the systems and were demanding high time and effort for defining automated test cases.Instead, manual testing was pretty achievable with the limited time given. For Course Management Module, because it is created using the framework Angular, we performed our test using Angular CLI which is based on Karma and Jasmine, it can be run by inputting “ng test” in the shell while Angular is installed, we also preformed testing by feeding different JSON input to the module manually and observe the behavior of the website. For other Modules, the test is done by manually inputting different values in the UI including correct inputs, boundary value inputs, empty inputs, and illegal inputs. For all the modules we also invited people around us to help as testers. We successfully found many bugs in the process of testing including problems like the UI doesn’t fit on certain screen sizes and functions not supported in certain browsers. Our friends not only helped us find bugs but also points out places where the UI is not that straightforward or doesn’t look good.

Test Case Id	Description	Expected Out put	Actual Output	Pass/ Fail	Figure No
1	User ID and password are blank	“Enter the User id and Password" Error message should be display	message displayed	Pass	4
2	User ID is blank	"Enter the User id" Error message should be display	message displayed	Pass	5
3	Password is blank	"Enter the Password" Error message should be display	message displayed	Pass	6
4	Wrong ID	"This ID is invalid" Error message should be display	message displayed	Pass	7
5	Wrong Password	"Password is incorrect. Please enter correct Password " Data should save in the database	message displayed	Pass	8
6	Cancelled User ID	" Your ID Was Cancelled Please Contact librarian" Blank data should be display	message displayed	Pass	9
7	Correct User ID And Password	The main form should be display and login history Data should save in the database	The main form displayed and Saved in database	Pass	
8	Press Forget “Password Button”	Forget Password Form Should Be Display	Forget Password Form Displayed	Pass	

Figure 3. Sample Test Cases

For example, the course tab in our course management system is supposed to navigate the user to the course, but previously only the title part of the tab is clickable, after receiving feedback about it, we changed it to make it easier to use.

```
describe( description: 'HomePageComponent', specDefinitions: () => {
  let component: HomePageComponent;
  let fixture: ComponentFixture<HomePageComponent>;

  beforeEach( action: async () => {
    await TestBed.configureTestingModule( moduleDef: {
      declarations: [ HomePageComponent ]
    })
    .compileComponents();
  });

  beforeEach( action: () => {
    fixture = TestBed.createComponent(HomePageComponent);
    component = fixture.componentInstance;
    fixture.detectChanges();
  });

  it( expectation: 'should create', assertion: () => {
    expect(component).toBeTruthy();
  });
});
```

Figure 4. Test code for Angular CLI

3.3 SDLC Process

Throughout the process of developing our project, we were using multiple agile development practices including the use

Figure 5. Test result for Angular CLI

of a Git projects board and setting up meetings on a weekly basis, we tried to do scrum meeting every day, but due to the conflict in our schedule and we have projects and assignments from other classes that don’t allow us to work on this project every day, we eventually decided to have a short meeting via zoom every week or report our progress

in a group chat. The software development process we are using for this project is the waterfall model. Because this project needs to be finished in a single semester, there is not enough time to complete multiply iterations with an iterative model, so we decided to use a plan-driven model which is easier to schedule so we can finish the project in time, also the plan-driven model allows us to be more focused on each development stage as rolling back to the previous stage is time-consuming so we tried our best to avoid doing it. The reason we didn't choose the other plan-driven model is that we decided to spend more time implementing our project as our project is a relatively large project that contains four different modules, by the time implementation is finished, there will only be a limited time for testing. The process we chose to use helped us to better manage our time and be more organized on what we were doing, and the agile practices helped us better communicate with each other and easily keep track of the progress of each of the members.

3.4 Project Relevance to SE in Pandemic

The presented platform is tailor-made for the pandemic crisis to enable the free flow of knowledge and education. It has the following salient features. First, it enhances user intractability and student engagement over a virtual environment. Second, the open-source nature of the application provides cost-effective solutions to students facing pandemic hit economic crises. During the pandemic, about 1.2 billion students are out of the classroom and have limited resources. third, it supports virtual sharing and library environment- book exchange or donations. It offers custom-paced 1:1 guidance to meet students' time requirements working remotely.

Above all, it is a social movement to mitigate the student's needs and still ensure their academic freedom.

4. Deployment and Maintainance

Our project has four separate modules and they are in different programming languages so deploying may be a difficulty for us. Our plan is to create a new Java module that will call on the Library Management Module and Student Management Module, similarly, we will create an express JS server to serve the Course Management Module and the Website Interface together, so we can simplify our deployment process. Before deploying the two, we will also run more tests on them, because in the current state of our project, we didn't have time to do enough white box testing, and the newly created modules would also require additional testing. After the testing, we will deploy our project using Blue-Green Deployment because it is a relatively simple approach and is safer. After deployment, we will do more testing to make sure the software is deployed properly, and do stress tests to help us determine the maximum capacity of our software and make changes to the server accordingly.

The project we have now still has a lot of space for improvements, we will be doing all four types of maintenance, but our focus would be on corrective, perfective, and adaptive software maintenance. The corrective software Maintenance is important because the core functionality of our software depends on it. Perfective software maintenance is important because we don't have much feedback from the user's perspective during development, so there may be gaps between the need of the user and the function of our project which we will need to update according to the feedback of users. Adaptive software maintenance is important because the purpose of our project is to make it easier for software engineers to learn new skills, so it is extremely important to keep the course we have up to date and tries to cover as many topics as possible.

5. Current Limitations and Future Scope

While the current application addresses the foolproof prototype of the application for the social online university, there are still different avenues that can be worked out for the next-generation prototype. Firstly, the current application offers limited courses to clients (students). These courses could be enhanced to cover the different fields of studies beyond computer science and software engineering in particular. One of the key goals is to provide users with the target learning experience that they are looking for. The course content can be made more interactive to incorporate user feedback while displaying the learning content. For such an upgrade, we can consider immersive learning based on Augmented/Virtual Reality. AR/VR has been a great candidate to provide an interactive platform for digital learning. Second, we can use AI-based methods to provide custom content to the clients, and automate testing. The current application runs on a no revenue model. For the next-generation prototype, we can incorporate the revenue model by implementing a premium account for the user that will allow the user to use course accreditation from ruptured universities around the world.

6. Conclusion

In the project, we presented an online social university platform that allows software engineering students to grow

and learn during the current situation of a pandemic where we have limited outdoor and in-person educational experience. We highlighted the key aspects that relate to customer requirements when it comes to digital learning platforms. The online university platform is completely open-source and covers major learning content relevant to the field of software engineering. The application gives 1:1 project guidance, and academic and career advising. Self-paced open-source course materials to help students develop relevant skill sets to secure jobs and certifications for career enhancement. The project is powered by an effective database to enable easy retrieval of user/student data.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Chris Brown to provide the opportunity to work on the project and for important guidance throughout the semester. The author would also like to thank Teaching Assistant Mohammed El-Arnaoty for the course to valuable suggestions during office hours.

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