Edubridgebd: A robust and intelligent distant learning management system with evaluation.

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Approval Certificate

This project titled " **Edubridgebd: A robust and intelligent distant learning management system with evaluation.**" submitted by Md Arafat Islam Khan, Student ID: 012222043, has been accepted as Satisfactory in fulfillment of the requirement for the degree of Master of Science in Computer Science and Engineering on 3/07/2024.

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Declaration

This is to certify that the work entitled "**Edubridgebd: A robust and intelligent distant learning management system with evaluation.**" is the outcome of the project carried out by me under the supervision of Supervisor: A. S. M. Fazle Rabbi, Adjunct Faculty, Assistant Professor, CSE, UIU, Tech Lead- AGM, Software Dept, Orange IT Ltd, United Group, Co-Supervisor: Dr. Suman Ahmmed, Associate Professor, CSE, UIU, Director, CDIP, UIU.

_____

Md Arafat Islam Khan,
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In my capacity as supervisor of the candidate's project, I certify that the above statements are true to the best of my knowledge.

_____

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_____

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Abstract

In recent years, online learning has grown tremendously, serving as both an alternative and a complementary option to traditional, face-to-face education. This growth is driven after outbreak of COVID-19 in part by students' active engagement with technology, often using it more extensively than they feel required to. Online learning's increased popularity is largely due to its flexibility compared to traditional educational environments. To support online learning, various platforms, such as learning management systems (LMSs), edtech products have emerged. The use of LMSs has surged recently, thanks to the integration of information and communication technologies as educational support tools. Despite the advantages of online learning, instructors face certain challenges, notably the difficulty of tracking the progress and activities of potentially larger cohorts and providing timely feedback to them. Edubridgebd is an innovative e-learning management system designed to follow the progress and activities of students and to offer a customizable platform aimed at improving student performance analysis and providing personalized feedback using modern educational tools and an interactive chatbot for answering quires. This platform aims to enhance access to quality education, enable educators to share their knowledge effectively, and empower learners to progress at their own pace while receiving tailored suggestions for improvement. Edubridgebd contributes to the overall development of the education sector in Bangladesh by leveraging technology to bridge educational gaps and foster continuous learning and improvement.

Acknowledgement

I extend my sincere appreciation to all who have contributed to the development and success of Edubridgebd. Special thanks to my Supervisor A. S. M. Fazle Rabbi and cosupervisor Dr. Suman Ahmmed in shaping this innovative e-learning platform. I also acknowledge the support and collaboration of educational institutions, people those advise us to implement and improve Edubridgebd. The mission to enhance student performance evaluation and personalized feedback would not be possible without the collective efforts and commitment of everyone involved.

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Chapter 1

Introduction

This is the initial segment of the report, and it comprises all of the relevant components of the proposed project, such as an overview, methods, and outcomes.

1.1 Project Overview

A Learning Management System (LMS) is a software platform that enables users, particularly students, to view, share, discuss, control, and track online learning activities and records. An Intelligent Learning Management System (ILMS) goes a step further by being adaptive and proactive, delivering content tailored to the expertise, learning style and user's knowledge. The eLMS include features and tools such as routing, materials usability, assessment, and knowledge generation (e.g., auto poetics) to optimize the learning experience. While these features enhance the LMS's functionality, it is crucial that users retain the ability to control their own learning experience, including the option to disable the intelligent features to access easily to all materials. The program must ensure these advanced features do not compromise usability or become a significant time burden for instructors. Edubridgebd platforms support both distance education and classroom instruction, allowing teachers to provide content, assign exercises, and create tests. However, traditional LMS approaches often deliver content uniformly to all students, regardless of their individual performance and behavior differences. Intelligent systems address this by automating interactions between educators, students, and academic institutions. The number of educational systems utilizing LMS is steadily increasing, with most institutions offering distance education relying on LMS to deliver their material online. The Learning Management System (LMS) serves as a pivotal tool in delivering educational content to students worldwide, particularly in higher education settings. These systems, such as Blackboard, Moodle, and dotLRN, facilitate access to high-quality educational materials and mediate interactions between students and instructors. The integration of intelligent agents within LMS platforms is transforming traditional learning paradigms by replicating the cognitive processes of both educators and learners. Artificial Intelligence (AI) technologies, rooted in human intelligence concepts, are increasingly shaping the

educational landscape, particularly in regions like Bangladesh, where internet and smartphone usage are on the rise, driving demand for online learning solutions.

1.2 Motivations

In recent years, the education sector has undergone a significant transformation. The initial paradigm emphasized direct interactions between instructors and students, supported by repetitive process automation. This evolved into the second paradigm, which relies on LMS platforms. This model has further advanced with the integration of AI systems that replicate intelligent procedures for both instructors and students, based on detailed information provided by LMS services. Over the past few decades, LMS platforms have gained prominence, significantly aiding educators in delivering educational content to students. The most notable examples include technological challenges in education due to a lack of funding. And this is in a market where potential demand for outnumbers supply, with millions of schools, thousands of colleges, and universities waiting for the right time to upgrade technologically(The Financial Express). EdTech companies face various operational challenges across engineering, content, product management, interaction etc. for their students(Dhaka Tribune). Need to integrate AI providing instructional guidance, LMSs demand considerable interest in enhancing their products to be smarter and more efficient.

1.3 Objectives

The purpose of the e-learning website is to provide a platform for individuals to share their knowledge and expertise with others who are seeking to learn. The website will cover a wide range of subjects, including those relevant to school, college, university, job and professional exams. This makes the website accessible to a diverse range of users, who can learn and teach from any location. I want to make an e-learning website template in which will have admin module, student module and teacher module. In student module students can attend quiz, test, exam and learn the lessons. There are contents for student for their preparation. There is also a question bank. Students can see their result sheet and performance comparison in the graph. Teacher can use teacher model. They can teach the students, examine the answer sheets, ready the result, use the question bank, give the feedback, see the student performance. Any organization can use this template and we will customize it to serve their purpose. Furthermore, artificial intelligence (AI) significantly enhances diagnostic processes across various devices. In this context, the project explores

integrating AI into an online chat program, adding an intelligent component to the e-learning network. This Smart Module enriches the local ontology with insights from querying a remote database, providing autonomy and intelligence to enhance educational benefits. The chatbot model within the LMS serves as a valuable tool for addressing student queries and supporting learning.

1.4 Methodology

I have read lots of research papers, journals, articles. Each has suggested some recommendations out of those some are similar.The finding from the study titled "Towards A Pedagogical Paradigm Shift: An Examination of Online Higher Education in Bangladesh during the COVID-19 Crisis," has exemplified a progressive e-learning management system addressing critical challenges in student evaluation, feedback provision, and AI-driven assistance in Bangladesh. Addressing this gap, this project introduces a tool and resources for automatic analysis and feedback within learning management systems. The developed tool aims to enhance the practice of analysis and feedback, providing instructors with efficient means to support student learning. JavaScript and OpenAI model are used for developing this project consists of these innovative features underscore its potential to revolutionize education delivery and enhance learning outcomes.

1.5 Project Outcome

Edubridgebd is a peer-to-peer skill-sharing platform that allows individuals and organizations to share skills and exchange technical knowledge, effectively bridging skill gaps. Learners can access all video lessons on the Edubridgebd platform through a subscription or opt for purchasing individual courses. Skilled individuals can partner with the platform to create and offer courses, as well as run MOOCs. Edubridgebd is also exploring partnerships with educational institutions to provide analytics support and digitize paper-based exams. Schools and universities can leverage this learning management system (LMS) to facilitate remote learning and manage interactions among teachers, students, and parents. This approach ensures that quality education is accessible to individuals regardless of their location, broadening educational opportunities for all.So our target audience for e-learning management systems includes universities, colleges, schools, educational institutes, EdTech companies, individual learners, corporate training departments, professional development organizations, non-profit educational programs, government training programs, online course providers, vocational training centers, continuing education providers,

language learning centers, healthcare education programs, certification and credentialing bodies, tutoring and coaching services, distance learning universities, military education and training programs, and public libraries offering educational resources.

Overall, Edubridgebd stands out as a pioneering e-learning management system tailored to enhance student performance analysis, evaluation, personalized feedback, and chatbot assistance. Leveraging modern educational tools and technologies, this platform strives to democratize access to quality education, empower educators, and provide students with personalized guidance for academic improvement.

Chapter 2

Background Study

This chapter addresses the studies utilized in the proposed system, along with other eLMS-related efforts that share similar features.

2.1 Preliminaries

In the early to mid-1990s, experimentation with online courses began, gradually increasing in popularity [1]. By Fall 2017, approximately 6.66 million students in the USA were enrolled in online courses, which accounted for 33.7% of the total student enrollment. The growing acceptance of online learning among students is attributed to its flexibility, vast access to information, personalized learning options, and opportunities for community education through intercultural interactions [2].The COVID-19 pandemic, first detected in humans on December 31, 2019, in China, rapidly spread worldwide . As of April 1, 2021, the pandemic had infected around 129.57 million people and caused 2.83 million deaths globally [3]. To protect students from COVID-19 and ensure the continuity of education, many universities worldwide transitioned to online classes. This shift posed significant challenges due to the lack of prior digital experience among teachers and students, inconsistent internet access, and the risk of student dropouts [4].In Bangladesh, the University Grants Commission (UGC) reported that nearly all private and public universities began online classes by the end of June 2020, despite facing multiple obstacles, to mitigate academic and financial losses [5].

2.2 Literature Review

E-learning encompasses the utilization of computer and web-based technologies to deliver educational solutions, emerging as a vital tool for educational institutions worldwide. Online learning has witnessed exponential growth lately. This surge can be attributed partly to the widespread use of technology among students, who often engage with technology beyond mandatory requirements [8]. The flexibility of online learning, as noted, contributes to its popularity compared to traditional educational settings [9]. To facilitate online learning, various platforms such as Learning Management Systems (LMSs) have emerged in recent decades [10]. The adoption of LMSs has surged due to the integration of information and communication technologies as educational support tools [11].

Despite the benefits of online learning, instructors face significant challenges, particularly in monitoring the progress and activities of potentially unlimited-sized cohorts [12]. Analysis and feedback are critical components of the teaching-learning process, enabling students to identify learning gaps and assess their progress [14]. Effective feedback should provide specific information addressing learning tasks or processes to bridge the gap between desired and actual understanding or skill development [15].

In online learning environments, where face-to-face interaction is limited, the quality of analysis and feedback becomes even more crucial [17]. Reinforcing feedback enhances the quality of students' projects, particularly in online peer assessment environments [6]. However, the large size of student cohorts in online learning settings poses challenges in providing adequate and timely analysis and feedback.

Recent literature highlights the significance of personalized feedback and its impact on student engagement and learning outcomes [6][14]. Empirical studies demonstrate the efficacy of automated feedback systems in enhancing student learning outcomes. Immediate feedback positively impacts student performance, leading to improved learning outcomes [23]. Similarly, technology-driven feedback mechanisms enhance teaching efficiency and foster self-assessment skills among students [22].

The arguments supporting the involvement of students in the feedback process are compelling [16]. This importance is underscored by the potential for automation and personalization in feedback systems, which can significantly reduce the workload of instructors [12][19][20]. Many studies reviewed here show that these systems alleviate instructors' tasks primarily through student dashboards displaying basic statistics [22], systems that compare student results with predefined solutions [23], and feedback specific to certain domains, such as programming problems [6][7][8][9][10] and essay evaluation [11][12][13]. A significant portion of the literature focuses on intelligent tutoring systems for automatic feedback, which explains the reduction in instructor workload [14].

Recent educational research highlights that providing instructors with detailed information about students and the learning environment can enhance the quality of feedback at scale and allow for adjustments in course content and methodology to improve educational outcomes [15][16][17].

Effective feedback must include clear performance criteria and positive motivational support [17]. More crucially, feedback should guide students in learning strategies to address their misconceptions [17]. To this end, automatic feedback should incorporate data on students' learning processes in addition to their assessment responses. Recent literature recommends systematically informing instructors about student progress to facilitate the creation of effective feedback messages on student activities and performance [6][7].

Dashboards and visualizations have been extensively utilized to provide feedback on students' learning processes and progress, proving effective in improving student performance [6][8][9][10][11]. Some researchers have employed NLP and machine learning techniques to facilitate or enhance the analysis process [13][14][15][16]. The growth of learning analytics and educational data mining explains the increasing use of these methods, which are becoming a trend in semi-automatic analysis systems [17][18][19][20]. However, such applications require substantial data to develop robust models applicable across various contexts [21][22]. Overall, this research area shows significant potential to provide valuable information for improving educational outcomes.

Furthermore, the integration of AI technologies into e-learning platforms holds promise for enhancing adaptability and customization. Current learning systems often lack adaptability, delivering uniform content to all users regardless of individual needs and preferences [10][11]. However, AI can enable personalized learning experiences tailored to each learner's requirements, thereby improving engagement and learning outcomes.

2.2.1 Learning Management System Overview

LMS platforms have evolved rapidly, integrating instructional content, technical features, and interactive methods. Educational institutions, including Blackboard, Moodle, and dotLRN, benefit from the cost-effectiveness and versatility of these technologies in facilitating learning and teaching processes. However, the plethora of LMS options available on the market poses challenges for institutions seeking to adopt new tools [31].

To enhance learner success, LMS analysis incorporates various motivational modules aimed at improving engagement. A prototype was developed to identify the most effective motivational module, with the project conducted online to accommodate diverse learner needs [32].

The multitude of learning management systems (LMS) available in the market makes it challenging for educational institutions to choose the most suitable one. Selecting an LMS that meets all or most of the institution's requirements is crucial, as an incorrect selection can disrupt predefined criteria and negatively impact the learning environment [31]. Therefore, higher education institutions must carefully evaluate all relevant factors before implementing an LMS to ensure student success and approval [33]. A thorough competitive analysis of available options can provide valuable insights into the strengths and weaknesses of different LMS [34].

Research has explored various e-learning structures with different modules focused on an LMS, assessing how each component influences learning motivation. Findings indicate that a well-designed e-learning system can cater to diverse learning styles and needs, thereby enhancing the educational experience [32]. The project design tools help identify students' academic styles and promote the necessary learning opportunities. A well-managed LMS can be both effective and secure for a diverse range of learners [35]. The project design is versatile, supporting applications based on Android, JavaScript, and HTML, making it compatible with most web servers. As a cloud-based LMS, this system demonstrated its efficacy and reliability over a three-year testing period, yielding satisfactory results [36].

2.2.2 Analysis Overview

E-learning systems serve diverse purposes across technical, corporate, and educational domains. Within the realm of education, these systems leverage analysis to assess students' actions in comparison to traditional didactic content and evaluation methods [18]. Each e-learning course follows a distinct lifecycle comprising preliminary, intermediate, and final phases, guiding the creation of program content. The primary challenges encountered by the authors included handling a large volume of data and managing the diverse formats used to present information [37]. The instructional network connects teachers and students, while the learning management system facilitates data evaluation and storage, serving both educators' and students' needs. The time lapse between data collection and evaluation posed a limitation on the classifier's performance [38]. Through the integration of IT with LMS, this project proposes offering more advanced assignments of analysis to high-performing students, thereby enhancing learning outcomes and fostering equitable educational opportunities. Learners are stratified based on their performance ratings and engagement across various services. This integration underscores the transformative

potential of flexible learning environments and optimizing [31]. Common processes within e-learning frameworks include mining relationships, clustering, prediction, human judgment/exploratory data analysis, and model-based discovery.

2.2.3 Feedback Generation Overview

Feedback serves as a crucial support structure for learning, offering valuable insights into learners' progress towards their educational objectives and enhancing their self-regulation skills [14]. However, providing effective feedback, particularly in online courses with large student populations, presents a significant challenge for educators [13]. Despite the increasing research focus on feedback systems, there is a lack of comprehensive analyses of the progress made in this area as documented in existing literature. Learners play a crucial role in evaluating Intelligent Tutoring Systems (ITSs), as their experiences can address issues related to system usability [40]. The projects under review attempt to provide evidence of the applicability of their methodologies to broader contexts. Providing feedback is crucial for supporting learning progress, offering valuable insights into learners' advancement towards their educational objectives and enhancing their self-regulation skills [17]. However, delivering effective feedback, particularly in online courses with large numbers of students, poses a significant challenge for instructors [15][16]. While there is growing interest in research on feedback systems, there is a dearth of comprehensive analyses of the progress made in this field as documented in existing eLMS. Effective assessment technology and strategies, including rubrics, consistent communication, and feedback, are essential for achieving pedagogical success [39].

2.2.4 Artificial Intelligent Overview

Artificial intelligence (AI) has been advancing rapidly due to ongoing technological innovations worldwide. AI refers to the capability of machines to exhibit intelligent behaviors typically associated with human intelligence rather than natural human intelligence [41]. The primary objective of AI is to explore how machines can be developed to execute tasks traditionally performed by humans. AI encompasses various well-established domains such as language analysis and logic programming, representing significant disciplines within the field [42]. Adaptive education systems leverage diverse AI methodologies like large language model, Fuzzy Logic (FL), Decision Trees, Bayesian systems, Neural Networks, Genetic Algorithms, and Hidden Markov Models. These AI techniques are implemented in various ways within adaptive education

systems, serving multiple purposes such as enhancing and emulating the student question-answering process to develop automated and dependable training-learning models, including chatbots [43].

2.3 Summary

Numerous studies have demonstrated the positive impact of effective analysis and feedback on learning outcomes [16][17][18]. AI has a wide variety of applications that have made learning more flexible and better results for students [7]. This project explores the integration of electronic feedback mechanisms to streamline teacher feedback processes, including monitoring, assessment, result declaration, and access to supplementary learning resources. The project's significant contribution lies in the implementation of a new LMS architecture that enhances automated analysis and feedback services, incorporating chatbot. Tested as a cloud-based system, this LMS will be both effective and reliable.

Chapter 3

Application & Benchmark Products

This chapter delineates the current market size and various applications of e-learning management systems (eLMS) and edtech products. It highlights the leading companies in this space and their roles across different segments.

3.1 Current Market Size

Market size can be broadly divided in three categories- Conventional market, Coaching Centers, Online market.

3.1.1 Conventional market

Here is the data for conventional market size.

Pre-primary	Learners	Total 3.58 million Government: 1.13 million Other: 2.45 million	Females: 1.79 million Males: 1.79 million Net enrolment: 94.2%
	Institutions	Total: 106,852 Government: 63,440 Other: 43,412	
	Teachers	Total: 30,540	
Primary	Learners	Total:17.3 million Government: 13.5 million Other: 3.8 million	Females: 8.8 million Males: 8.5 million Net enrolment: 97.9%
	Institutions	Total : 134,147 Government:374,738 Other: 310,662 Females: 426,651(62.2%)	
	Teachers	Total: 685400 Government: 374738 Other: 310662 Females: 426651	
	Completion:	Primary completion rate:92.3%	
Secondary	Learners	Total: 15.7 million	Net enrolment: 66.6%
	Teachers	Total: 406717	

Table 1: Key education service delivery indicators in 2019 (researchgate.net/publication)

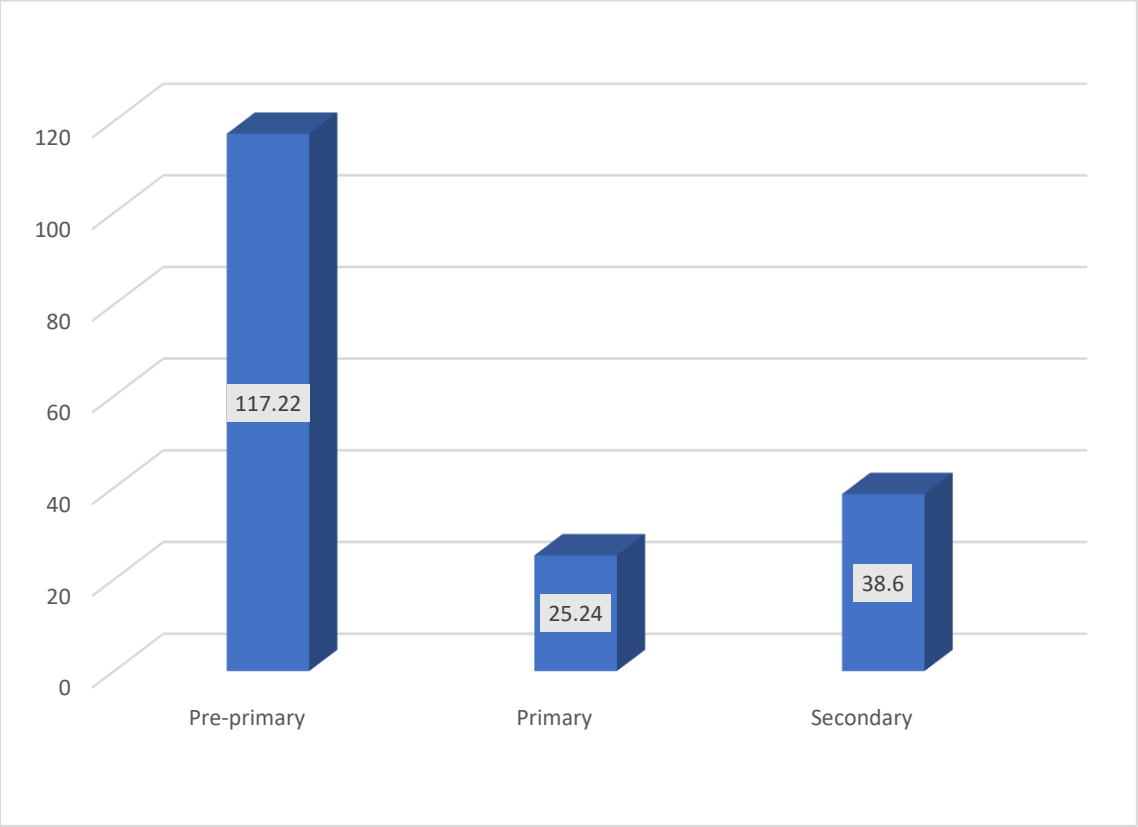


Figure 1: Number Of students per teacher in Bangladesh (researchgate.net/publication)

3.1.2 Coaching Centers

The offline coaching market in Bangladesh is estimated to be worth BDT 25,000 crore and is experiencing steady growth(futurestartup.com). When including segments such as job preparation and skills development, the market size becomes significantly larger.

3.1.3 Online market

Internet penetration in Bangladesh has doubled over the past five years, with an average annual growth rate of 13.5%. Currently, about 67% of the population uses the internet. Although smartphone usage in Bangladesh lags behind its Asia Pacific peers, it has been steadily increasing, with 41% of mobile phone users now owning smartphones(futurestartup.com). Many companies are working to achieve product-market fit, while others have recently introduced their products. Despite growing competition, much of the market remains untapped. With a market size of US$ 10 billion, there is ample opportunity for companies to thrive if they offer quality products.

As new companies enter the market, many will seek funding. The offline education sector offers a glimpse of the potential for the edtech market, which has the capacity to surpass offline education by expanding both in depth and breadth. Industry insiders report that over the past several years, more than 10 million students have utilized online learning services. Several estimates predict that the edtech market in Bangladesh could reach several billion dollars by 2030.(The Financial Express).

3.2 Market Leaders

Markets/vertical	**Edtech players**	**Prominent offline players**
K to 12	Shikho, 10 Minute School, Cholpori, Shohopathi	The market is highly fragmented, featuring numerous smaller local players alongside national players such as Udvash..
After-school programs	Cholpori	Kumon, Kids'Time
Admission Coaching	Shikho, 10 Minute School, Interactive Cares, Udvash	This market is equally fragmented, with Udvash operating nationally and many smaller local players spread the country.
Competitive coaching	Interactive Cares, Uttoron, 10 Minute School	Additionally, there are numerous offline players in this space..
Skills Development	10 Minute School , Interactive Cares, Bohurbibhi by Shikho , BDjobs Training	Other institutes in this category include Creative IT Institute, BITM, Chalk Penchil, BDjobs Training, NITT, and several others.

Table 2: Segmentation of Market

3.3 Venture Capital (VC) in edtech

The recent funding round has positioned Shikho as the highest-funded edtech startup in Bangladesh, with a total of $6.5 million USD raised so far. The company's previous investors include Learn Capital, Wavemaker Partners, Anchorless Bangladesh, among others. Venture capital firms have shown considerable interest in the Bangladeshi edtech sector. Notably, Shikho was the first Bangladeshi edtech company to secure VC funding, having raised $1.3 million from Anchorless Bangladesh and strategic partners in late 2021 (Dhaka Tribune, 2021). In early 2022, 10 Minute School raised $2 million from Sequoia Capital, bringing its total investment to $4 million from both national and international investors. Thrive Edtech secured $180,000 in mid-

2021, totaling $355,000 in VC funding. Venture capital has been a pivotal factor in the growth and development of startups (The Daily Star, 2020).

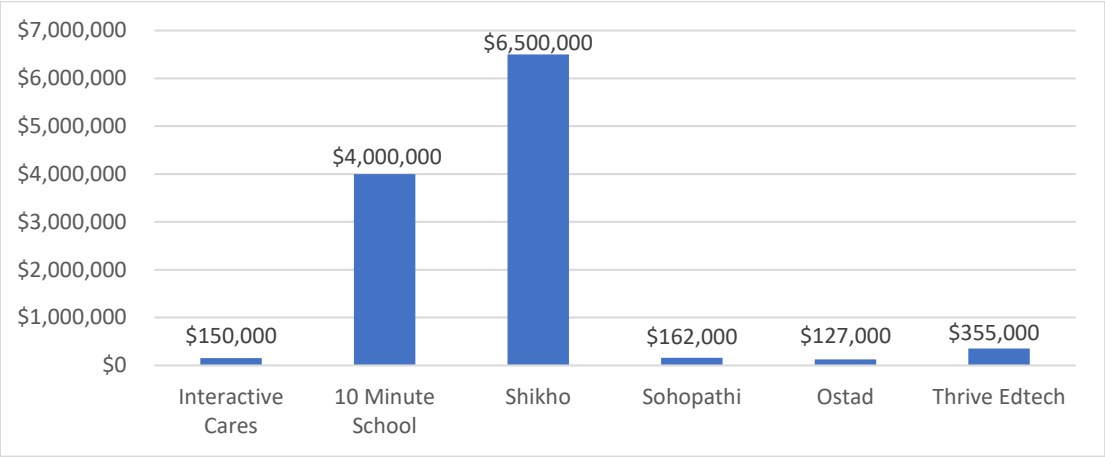


Figure 2: VC Funds for different entities (The Daily Star, 2024)

Interactive Cares, a Dhaka-based edtech startup, raised $100,000 in a seed round during the 9th cohort of Accelerating Asia's accelerator program, accumulating a total of $150,000 in investment. Sohopathi has raised $162,000 in seed funds, while Ostad has received $127,000 in total investment (Future Startup, 2023). Before the Covid-19 pandemic, distance education was experiencing gradual growth. In 2018, 34.7% of college students had enrolled in at least one online course, up from 33.1% in 2017. The number of students involved in online learning surged from 0.16 million in 2018 to around 6 million in 2022, with 89% of funding coming from foreign sources. In Bangladesh, the average monthly expenditure per student is USD 20, with 50 million regular students, making the market size approximately USD 1 billion annually (Dhaka Tribune, 2023).

In the first half of 2021, Bangladeshi edtech startups collectively raised around $2 million. Before the pandemic, edtechs held a 5% market share in the education sector, which is expected to rise to 10% post-pandemic. Experts forecast that the edtech market in Bangladesh will reach USD 700 million by 2025 (Business Inspection BD, 2023)

Chapter 4

Methodology

An overview of the proposed system is presented in this chapter, which are data for supporting the assumption and requirements as well.

4.1 Assumption

The inquiry was conducted concurrently to provide a thorough analysis of the research problem. In the study titled "Towards A Pedagogical Paradigm Shift: An Examination of Online Higher Education in Bangladesh during the COVID-19 Crisis," a convergent parallel design of mixed-method research was utilized to deeply understand the impact of the COVID-19 pandemic on higher education. An online survey was administered to 500 students, complemented by a focus group discussion (FGD) involving 8 students selected through convenience sampling as part of the qualitative approach. Universities were chosen using a purposive sampling technique, while students were selected through a convenient random sampling process. Table 3 provides demographic information about the participating students and teachers.

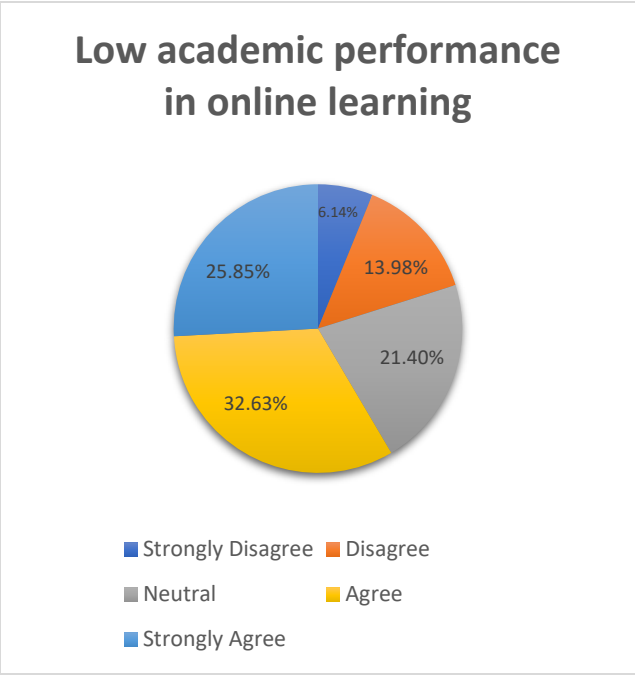
Year of study	**Frequency**	**Percentage**
1st year	178	35.60%
2nd year	163	32.63%
3rd year	72	14.40%
4th year	51	10.17%
Postgraduate (Masters)	36	7.20%
Total	500	100.00%
Location	**Frequency**	**Percentage**
Urban	173	34.53%
Suburban	68	13.56%
Rural	260	51.91%
Total	500	100.00%
Prior Online learning experience	**Frequency**	**Percentage**
Have (edX, MITx, Coursera etc.)	218	43.64%
Have not	282	56.36%
Total	500	100.00%
Used applications	Frequency	Percentage
University apps	23	4.66%
Zoom	321	64.20%
Google Classroom	115	23.09%
Total	500	100.00%

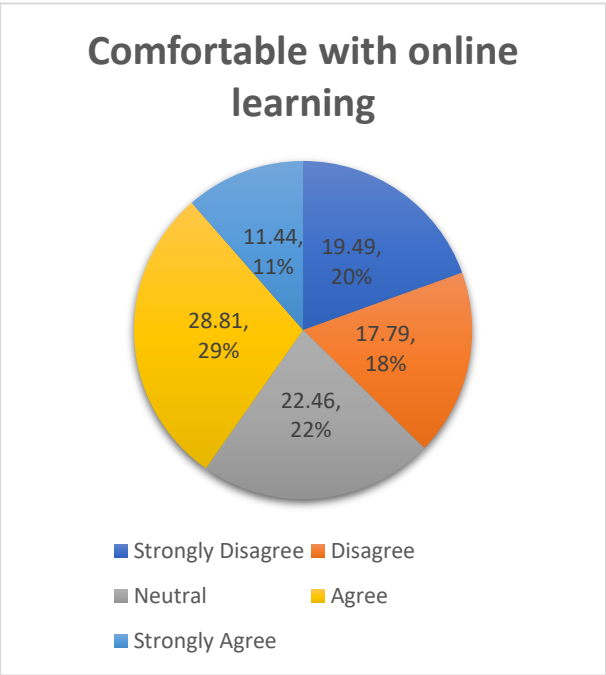
Table 3. The profile of university student

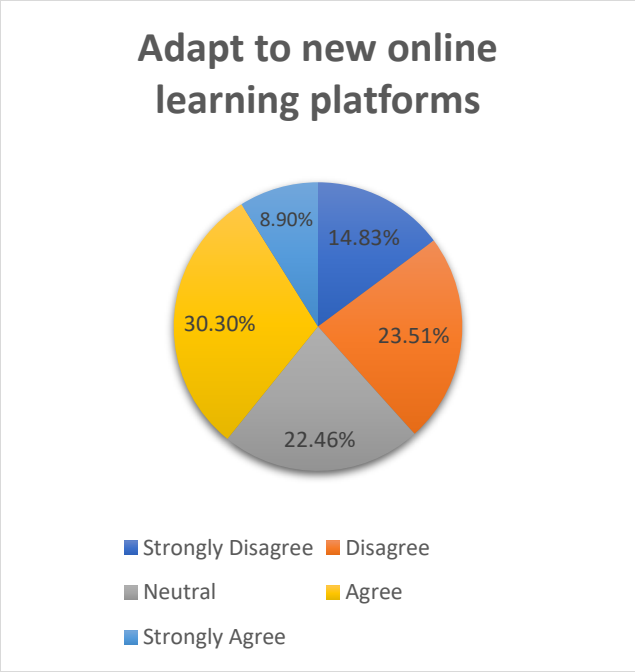
Table 3 details the profiles of the university students who participated in this study. The sample consists of 500 students across five different academic years, with the majority being first and second-year students. Approximately half of these students reside in rural areas, and around 56% had no prior experience with online learning.A 5-point Likert scale was used to evaluate the online learning experience of university students in terms of enjoyment, performance, satisfaction, and cost. The results from the student responses are presented in Table 4. The students were divided regarding their comfort with online learning, with around 40% feeling comfortable (M=2.95, SD=1.31). Similarly, students were split (approximately 38% each for and against) on their ability to adapt to new technological learning platforms (M=2.95, SD=1.22). Over 58% of students reported low academic performance in online learning (M=3.58, SD=1.19). Regarding satisfaction, more than 44% of students were satisfied with the feedback from online teaching and learning processes (M=3.11, SD=1.25), but about 40% were dissatisfied with the learning assessments in online education (M=2.81, SD=1.22). Nearly half of the students found online learning to be quite expensive (M=2.81, SD=1.22).

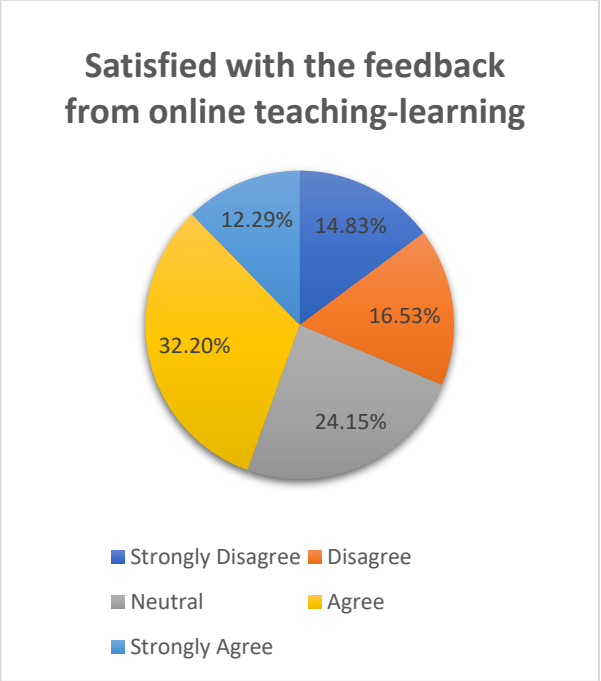
Aspects	Statements	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	SD
Enjoyment	I am comfortable with online learning	19.49%	17.79%	22.46%	28.81%	11.44%	2.95	1.31
Performance	I can easily adapt to new online learning platforms	14.83%	23.51%	22.46%	30.3%	8.9%	2.95	1.22
	I have low academic performance in online learning	6.14%	13.98%	21.4%	32.63%	25.85%	3.58	1.19
Satisfaction	I am satisfied with the feedback from online teaching-learning	14.83%	16.53%	24.15%	32.20%	12.29%	3.11	1.25
	I am satisfied with the learning assessment of online teaching-learning	19.92%	19.28%	27.75%	26.27%	6.78%	2.81	1.22
Cost	Online learning is costly	7.20%	34.11%	14.41%	11.02%	33.26%	3.75	1.22

Table 4. Students' responses towards different factors


Low academic performance in online learning
6.14%
13.98%
21.40%
32.63%
25.85%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Comfortable with online learning
19.49, 20%
17.79, 18%
22.46, 22%
28.81, 29%
11.44, 11%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Adapt to new online learning platforms
8.90%
14.83%
23.51%
22.46%
30.30%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Satisfied with the feedback from online teaching-learning
12.29%
14.83%
16.53%
24.15%
32.20%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree

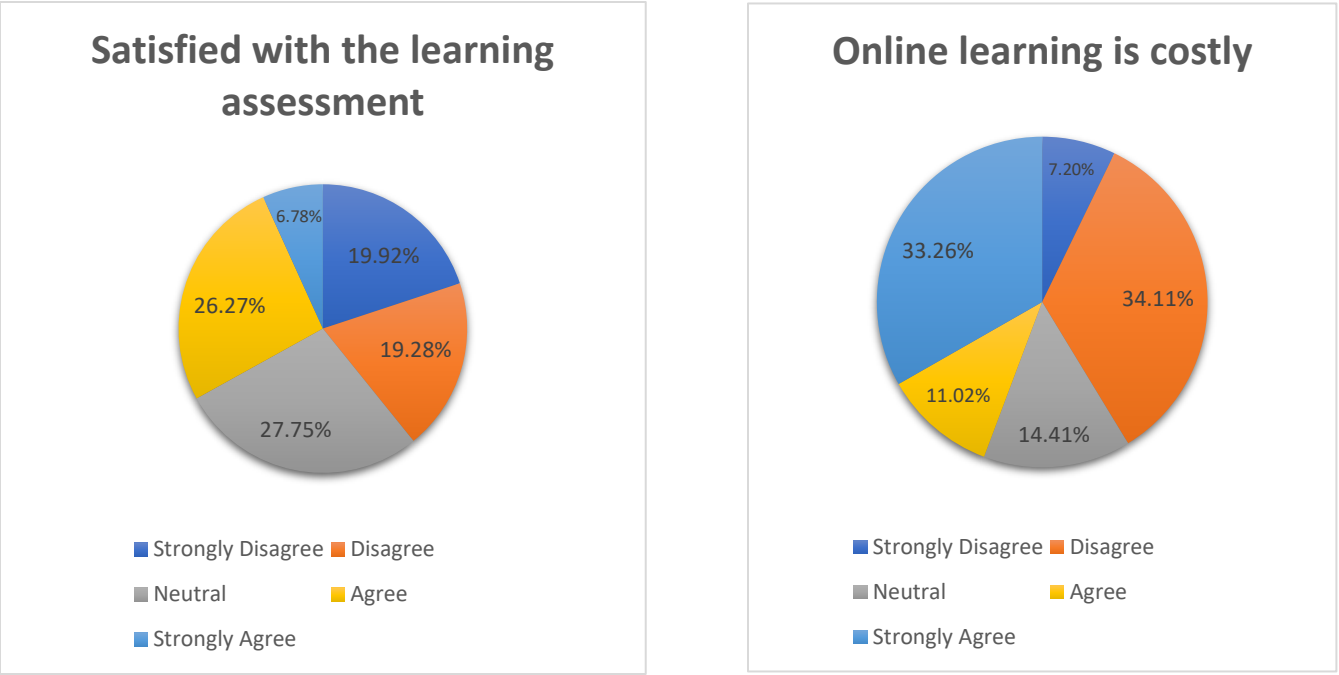


Figure 3: Students' responses towards different factors

The findings indicate that the majority of students in the study lacked previous experience with online education. Rural students, in particular, are less comfortable with online classes compared to their urban counterparts and find adapting to online classes challenging. According to Xu and Jaggars (2013), most students were unfamiliar with online platforms in their earlier academic life, leading to adaptation difficulties. Student responses to the online assessment process were generally negative, with rural students expressing more dissatisfaction than urban students. Teachers reported implementing various strategies for constructive assessment, which may be challenging for some students, reflecting concerns similar to those expressed by the students. Another study supports the notion that online assessment is challenging due to factors such as the distance between teachers and students, workload, time management, and the use of technology However, some researchers argue that online assessments can be better and faster than traditional paper-pencil methods. It is pointed out that inexperienced students struggle with online assessments and should receive training before transitioning to an online environment. In a study, it had been suggested that proper monitoring, need-based assessment, and interaction between teachers and students are essential for creating more engagement of students for online classes. So based on this finding I need to bring a solution which will provide-

• The platform will be developed using a modern web development framework and technology stack.

• A hosting platform and domain name to host the website.

• A database to store student and teacher information, as well as results and performance data.

• The development of a Tutorial, assessment, feedback and AI chatbot.

• The successful integration of various website features, such as the student and teacher modules, admin module, and question bank.

• The platform will be accessible through a web browser on desktop and mobile devices.

• The platform will be regularly maintained and updated to ensure optimal performance, security and cost effective.

4.2 Requirement Analysis

User Requirements

1. Student Module

- Ability to attend quizzes.
- Access to lessons, study materials, feedback and archive of past questionnaire.
- Ability to view results and performance comparison in graph format
- Ability to chat with chatbot for personal quires.

2 Teacher Module

- Ability to teach students and prepare sheets (i.e. quizzes).
- Create study materials i.e tutorials, the question bank.
- Ability to take attendance and provide examination and class progress marks.
- Ability to make evaluation setup form.

3. Admin Module

- Create classes and subjects.
- Create and assign teacher to subjects.
- Create students for particular classes.
- Circulate notices.

System Requirements

Technical Requirements

- SaaS model
- AI-assisted functionality for question selection
- Customizable for different organizations

4.3 Functional Non-Functional requirement

1. Functional Requirements

- User registration and login
- Form management
- Question bank management
- Result and performance tracking

2. Non-Functional Requirements

- User-friendly interface
- High performance and scalability
- Data security and privacy
- Mobile compatibility

4.4 Software specification

For the educational project named EduBridgeBD, a comprehensive tech stack has been employed to deliver a modern and efficient web application solving issues i.e. proper monitoring, need-based assessment, and interaction between teachers and student. The project utilizes various technologies to ensure a seamless experience for users and robust functionality behind the scenes.

4.4.1 Frontend

On the frontend, EduBridgeBD utilizes React.js, a powerful JavaScript library, to build dynamic user interfaces. React.js enables the creation of interactive components that efficiently update in response to data changes, ensuring a responsive and engaging user experience. The project uses Material-UI (MUI) to style the frontend components. MUI is a popular CSS framework that implements Google's Material Design principles. It provides a rich set of pre-built components and styles, allowing for the rapid development of a polished and consistent user interface.

4.4.2 Backend

On the backend, EduBridgeBD employs Node.js, a server-side JavaScript runtime, to manage server logic and API integrations. Node.js supports efficient event-driven, non-blocking I/O operations, making it ideal for developing scalable and high-performance web applications.

For data modeling, the project uses Mongoose, an object modeling tool for Node.js and MongoDB. Mongoose offers a straightforward, schema-based solution to model application data, facilitating robust and organized data management. Mongoose helps to define schemas for documents (data structure), providing validation, type casting, and other features to interact with MongoDB effectively from a Node.js application.

4.4.3 Database

To manage the application's data, EduBridgeBD utilizes MongoDB Atlas, a fully managed cloud database service based on MongoDB. MongoDB Atlas offers a flexible and scalable NoSQL database solution, allowing for seamless data storage, retrieval, and management.

4.4.4 Server

Firebase is used for hosting the EduBridgeBD application, providing a reliable and scalable platform for deploying web applications and serving content to users worldwide. Firebase Hosting simplifies the deployment process and ensures fast and secure delivery of web assets.

Additionally, for online server hosting and management, Render.com is utilized by EduBridgeBD. Render.com provides a cloud platform for deploying and scaling web applications, handling server-side operations efficiently and securely.

4.4.5 IDE

The development environment of choice for EduBridgeBD is Visual Studio, a versatile integrated development environment (IDE) that provides tools and features to streamline code editing, debugging, and project management. Visual Studio enhances productivity and facilitates collaboration among team members working on the project.

By combining these technologies and services, EduBridgeBD delivers a modern, scalable, and user-friendly educational platform. The project's tech stack ensures robust functionality, optimal performance, and ease of development, empowering educators and learners to engage effectively in the digital learning environment.

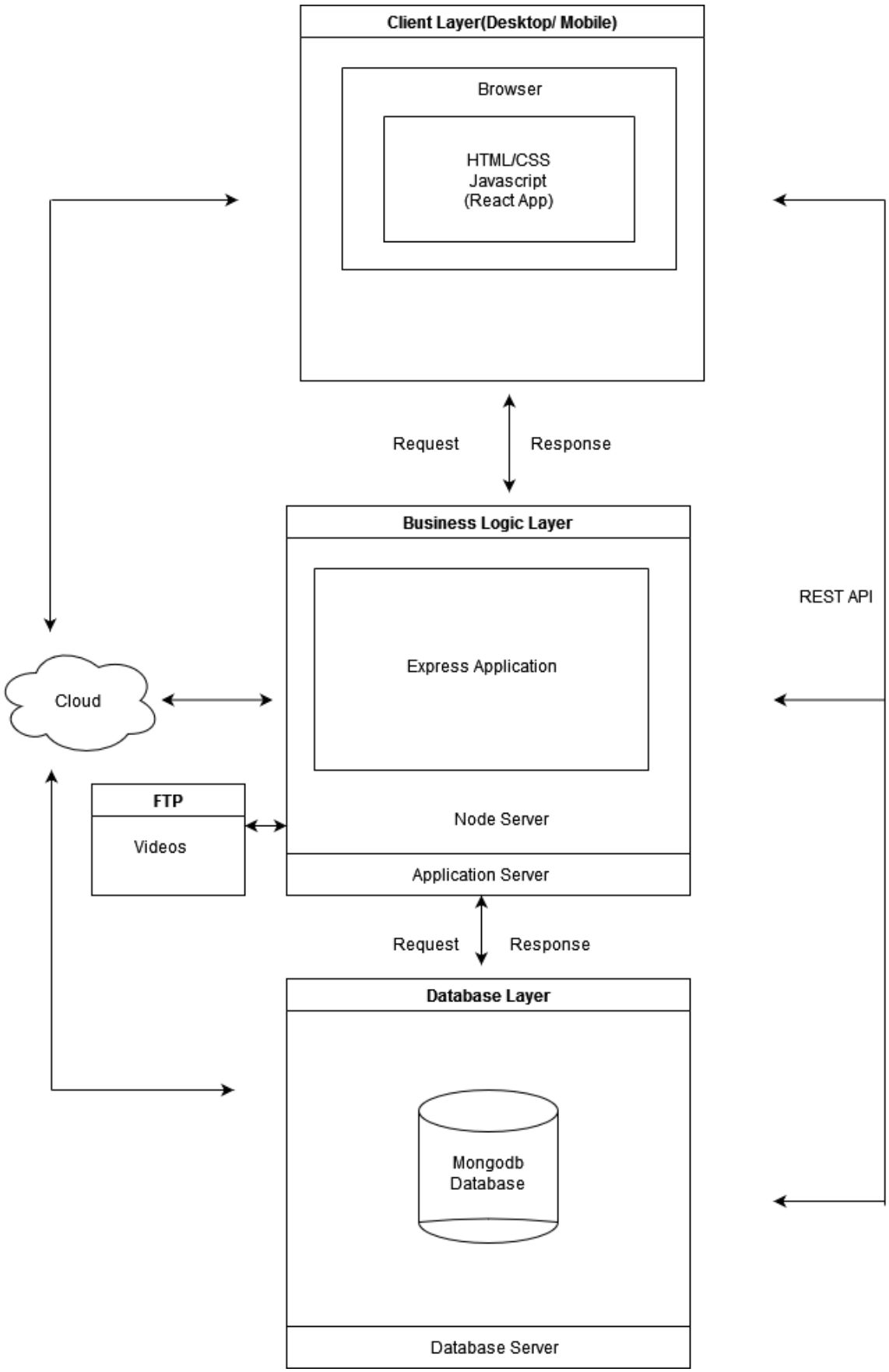


Figure 4: Software Architecture

4.5 Artificial Intelligence

In the innovative project named EduBridgeBD, an AI-based chatbot has been developed utilizing cutting-edge technologies and tools to create an intelligent conversational experience. The chatbot serves as a conversational retrieval agent, leveraging advanced capabilities to understand and respond to user queries effectively.

To enable robust information retrieval, the chatbot integrates with Serp API, which provides access to search engine results pages (SERPs) and assists in fetching relevant information from the web in real-time. This integration enhances the chatbot's ability to provide accurate and up-to-date responses to user inquiries.

The core intelligence of the chatbot is powered by ChatOpenAI's GPT-3.5 Turbo, an advanced natural language processing model that excels in understanding and generating human-like text. GPT-3.5 Turbo utilizes deep learning techniques to process and generate responses, enabling the chatbot to engage users in meaningful conversations.

To optimize memory and enhance conversation context, the chatbot utilizes buffer memory and chain tools. Buffer memory allows the chatbot to temporarily store and retrieve relevant information during conversations, while chain tools facilitate the management and organization of conversational chains for improved coherence and continuity.

The chatbot's conversational capabilities are further enhanced by LLM Chain (Large Language Model Chain) and OpenAI's GPT-3.5 Turbo Instruct, which enable the chatbot to process complex language patterns, instructions, and queries more efficiently.

For query-based retrieval, the chatbot employs a retriever tool that efficiently fetches and retrieves specific information from a knowledge base or database. This tool enhances the chatbot's ability to respond accurately to user queries by leveraging predefined retrieval strategies.

To optimize data indexing and search performance, the Chabot utilizes Pinecone's upsert document feature and OpenAI embeddings, enabling fast and efficient retrieval of relevant information based on user input.

Lastly, the chatbot benefits from recursive character text splitter technology, which aids in breaking down and processing complex text inputs into manageable units, enhancing the chatbot's ability to understand and respond to diverse queries effectively.

In summary, the AI-based chatbot developed for EduBridgeBD incorporates a sophisticated blend of conversational AI technologies and tools, empowering it to deliver intelligent and personalized interactions with users. This innovative chatbot plays a pivotal role in enhancing the educational experience by providing instant assistance, answering queries, and facilitating engaging conversations within the digital learning environment.

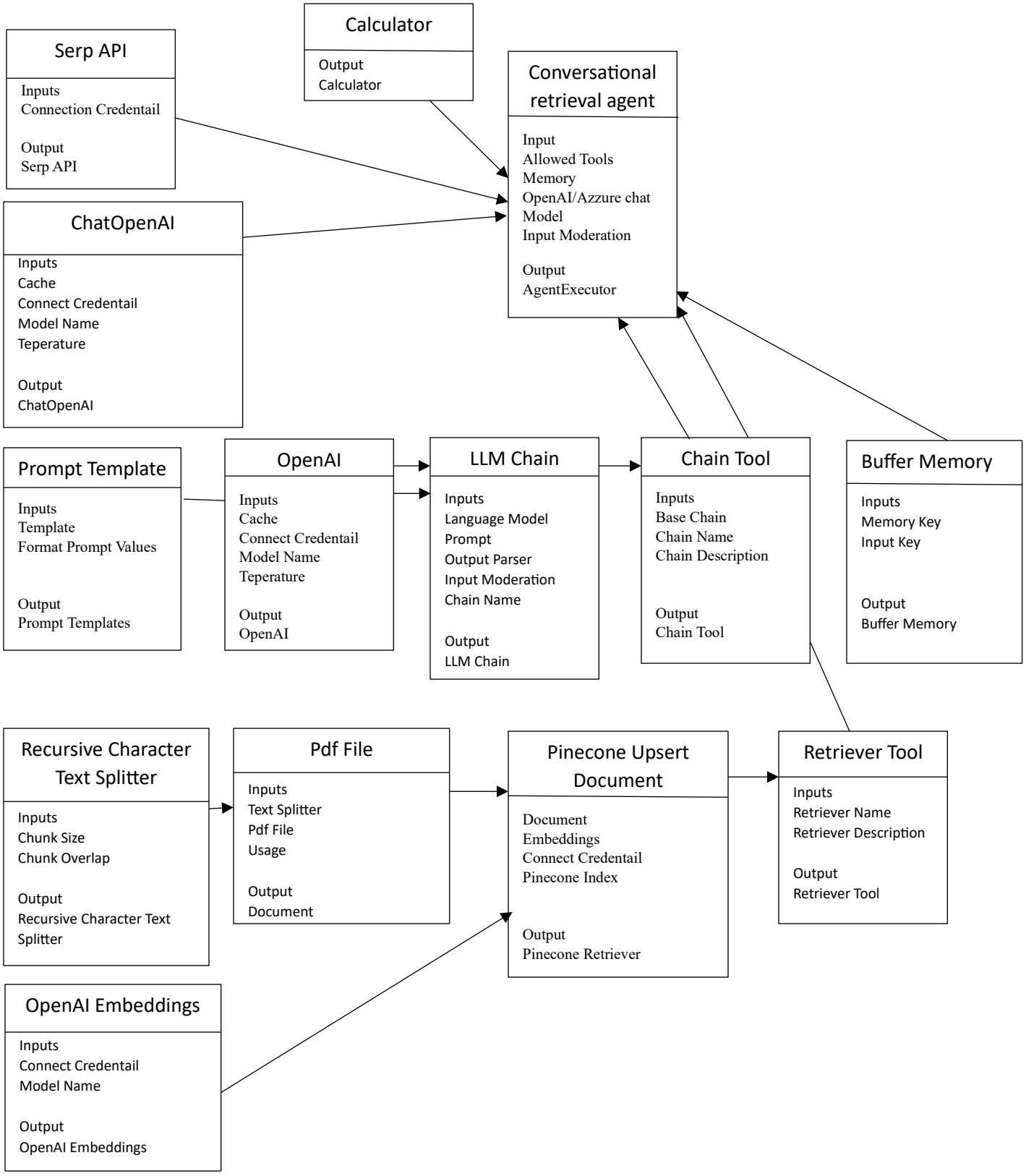


Figure 5: DataFlow of AI Chatbot

4.6 Network Architecture

Network architecture defines how network services and devices are structured to fulfill the connectivity requirements of client devices and applications.

The client-server network model is designed to allow end users, known as clients, to access resources like songs, videos, and other data from a central computer, referred to as the server. The server acts as the central controller, while all other computers in the network are clients.

In this model, the server is responsible for performing major operations, such as security and network management, and managing resources like files, directories, and printers. All communication between clients goes through the server. For instance, if Client 1 wants to send data to Client 2, it must first request permission from the server. The server then authorizes the communication, allowing Client 1 to initiate the data transfer to Client 2.

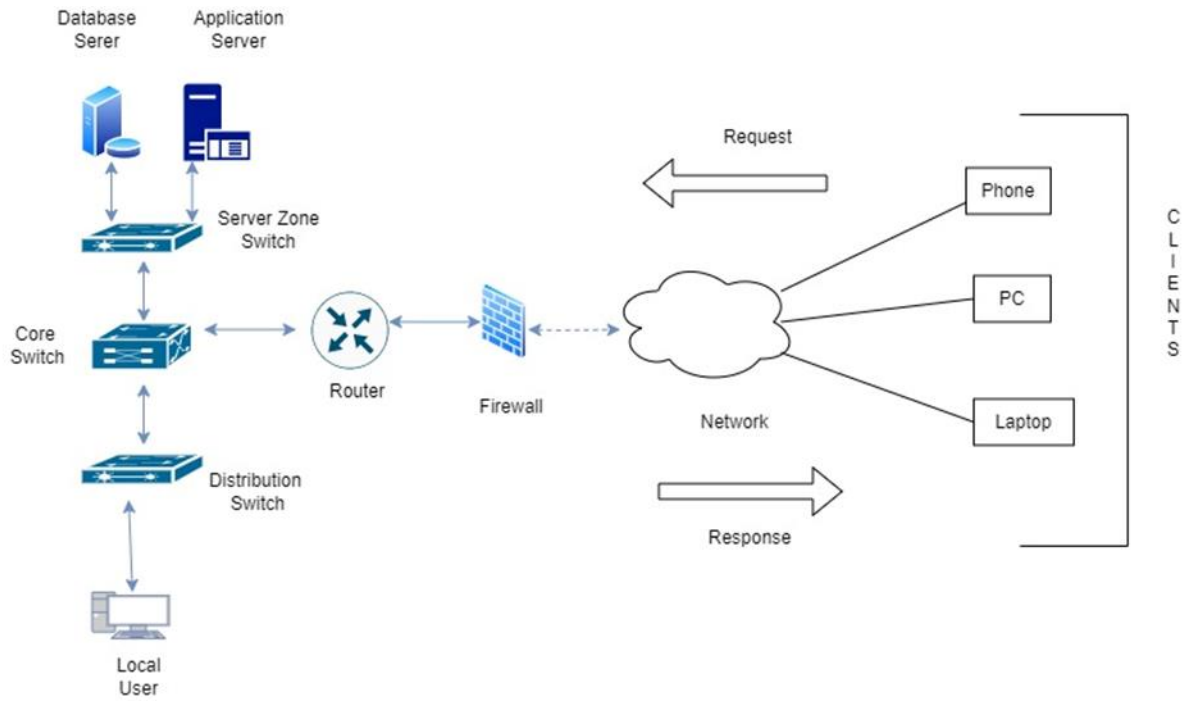


Figure 6: Network architecture for eLMS

Chapter 5

Results & Discussion

This chapter describes all the necessary tools in detail with environment setup, testing, evaluation, and result and discussion.

5.1 Environment setup

The following tools, programming languages are used to develop the proposed system:

1. Figma: The user must log into Figma before starting a new project. The next step requires the user to drag and drop an object into place. Lastly, the user may export the file from the web page.
2. Frontend Setup: Install Node.js and npm.Visit the official Node.js website and download the latest stable version (LTS) of Node.js, which includes npm (Node Package Manager). Install Node.js: Run the installer and follow the installation instructions for operating system.

   Open a terminal
   node -v
   Install Create React App Globally
   npm install -g create-react-app
   Create a New React Application
   npx create-react-app my-app
   Navigate into Project Directory
   cd my-app
   Add Dependencies
   npm install package-name
   npm install axios
   Build for Production
   npm run build
   Deploy React Application
   git init

```
git add .
git commit -m "Initial commit"
```

3. Backend setup

   Create the Main Application File

```
const http = require('http');
const server = http.createServer((req, res) => {
  res.statusCode = 200;
  res.setHeader('Content-Type', 'text/plain');
  res.end('Hello, World!\n');
});
const port = 3000;
server.listen(port, () => {
  console.log(`Server running at http://localhost:${port}/`);
});
```

   Install a Package

```
npm install express
```

   Run Application with Express:

```
node app.js
```

4. Database Setup:

   Create a New Project:

   After logging in, click on "New Project".

   Enter a name for your project and click "Next".

   Build a Cluster:

   Click on "Build a Cluster".

   Choose the cluster tier. The free tier (M0) is suitable for learning and small projects.

   Choose the cloud provider (AWS, Google Cloud, or Azure) and region that is closest to your location for better performance.

   Click "Create Cluster".

   Step 3: Configure the Cluster

   Set Up Security:

Database Access: Click on "Database Access" on the left-hand menu.

Click "Add New Database User".

Enter a username and password. Note down these credentials as you'll need them to connect to the database.

Click "Add User".

Network Access: Click on "Network Access" on the left-hand menu.

Click "Add IP Address".

You can allow access from anywhere by adding 0.0.0.0/0, but for security reasons, it's better to add your current IP address.

Click "Add IP Address".

Wait for the Cluster to Be Provisioned:

Step 4: Connect to Your Cluster

Get the Connection String:

Click on "Clusters" in the left-hand menu.

Click on the "Connect" button for your cluster.

Choose "Connect Your Application".

Select your driver and version (e.g., Node.js and the latest version).

Copy the connection string provided.

5.2 Result

In the educational platform known as EduBridgeBD, there are currently three distinct modules: Admin, Teacher, and Student. Within the Admin module, administrators are required to sign up by providing specific information, including their ID, name, email, password, and school name. The Admin Dashboard component encompasses various metrics such as Total Students, Total Classes, Total Teachers, and a notice board. Additionally, the Classes component allows administrators to manage class details, including creation of classes by providing class names. Similarly, the Subjects component enables administrators to manage subjects by creating them, along with details such as subject name, subject code, and number of classes. The Teachers component facilitates the management of teachers' information, including creation, along with assigning teachers with login credentials. Likewise, the Students component allows for the management of students' information, including creation, along with assigning students with roll numbers, names, and

passwords after class selection. The Notices feature enables administrators to circulate notices visible to teachers and students within their school. The module also includes a user profile and logout button in the sidebar.

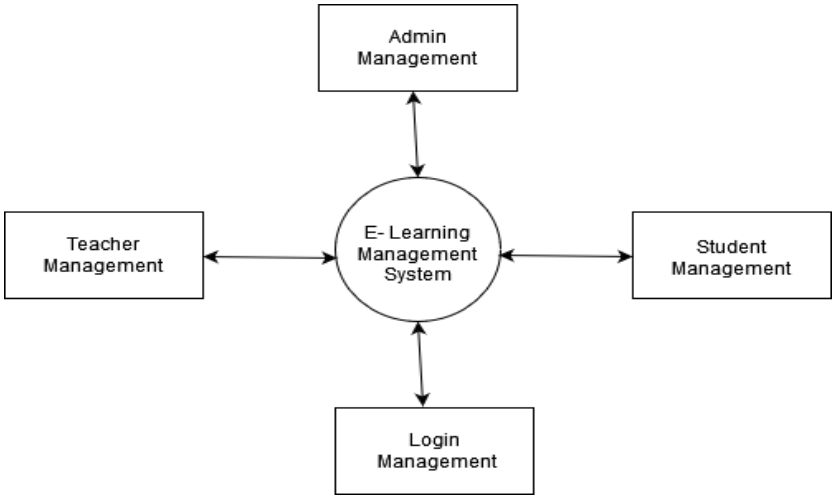


Figure 7: Modular Diagram for eLMS

In the Teacher module, teachers are required to login using their email and password. The Teacher Dashboard component provides an overview of Total Students and a notice board. The Classes component allows teachers to manage class details, including taking attendance, recording semester marks, and monitoring class progress for their students. The Quiz component enables teachers to create quizzes for their subjects, along with viewing quiz results. Additionally, the Tutorial module allows teachers to upload tutorial videos for their students and access a list of uploaded videos. The Questionbank module allows teachers to upload questions for their students The Evaluation module allows teachers to set mark percentages. Similar to the Admin module, this module also includes a user profile and logout button in the sidebar.

In the Student module, students must login using their roll number, name, and password. The Student Dashboard displays Total Subjects, Total Quizzes, attendance details, and notices. The Attendance component allows students to view their attendance percentage and the number of days present or absent. The Quiz section enables students to participate in quizzes created by their subject teachers. The Tutorial section allows students to access tutorial videos uploaded by teachers. The Question bank section shows questions uploaded by teachers The Analysis section

provides students with performance comparisons, including quiz scores, attendance, semester final marks, and class progress marks, displayed in charts. The Feedback section presents students with their performance metrics, categorized as Exam marks, Class progress marks, Quiz Marks, and attendance marks, along with comparisons to averages. Additionally, an AI-powered Chatbot is available to answer students' inquiries. The Result card presents the final result of students.

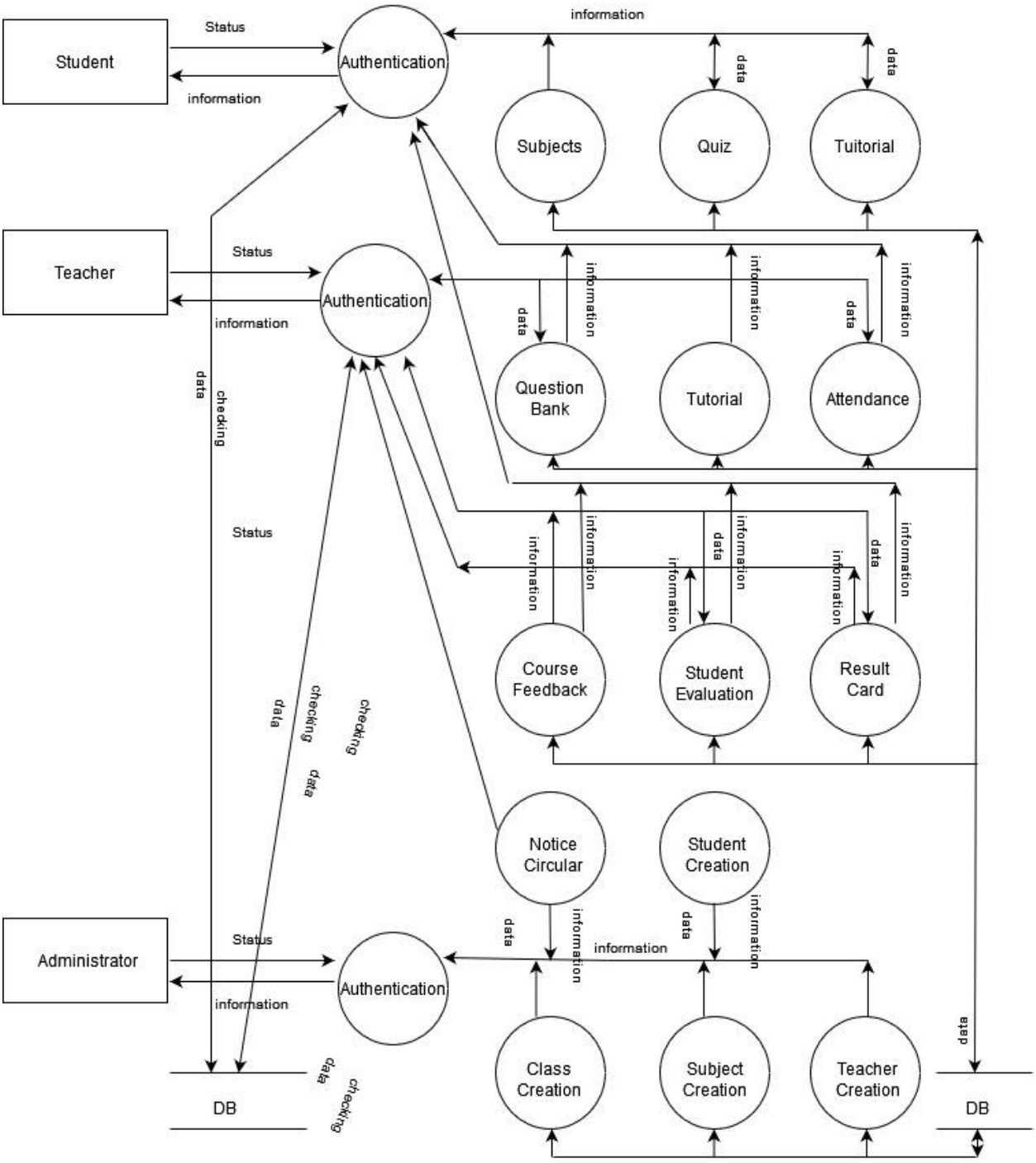


Figure 8: Inter modular communication for eLMS

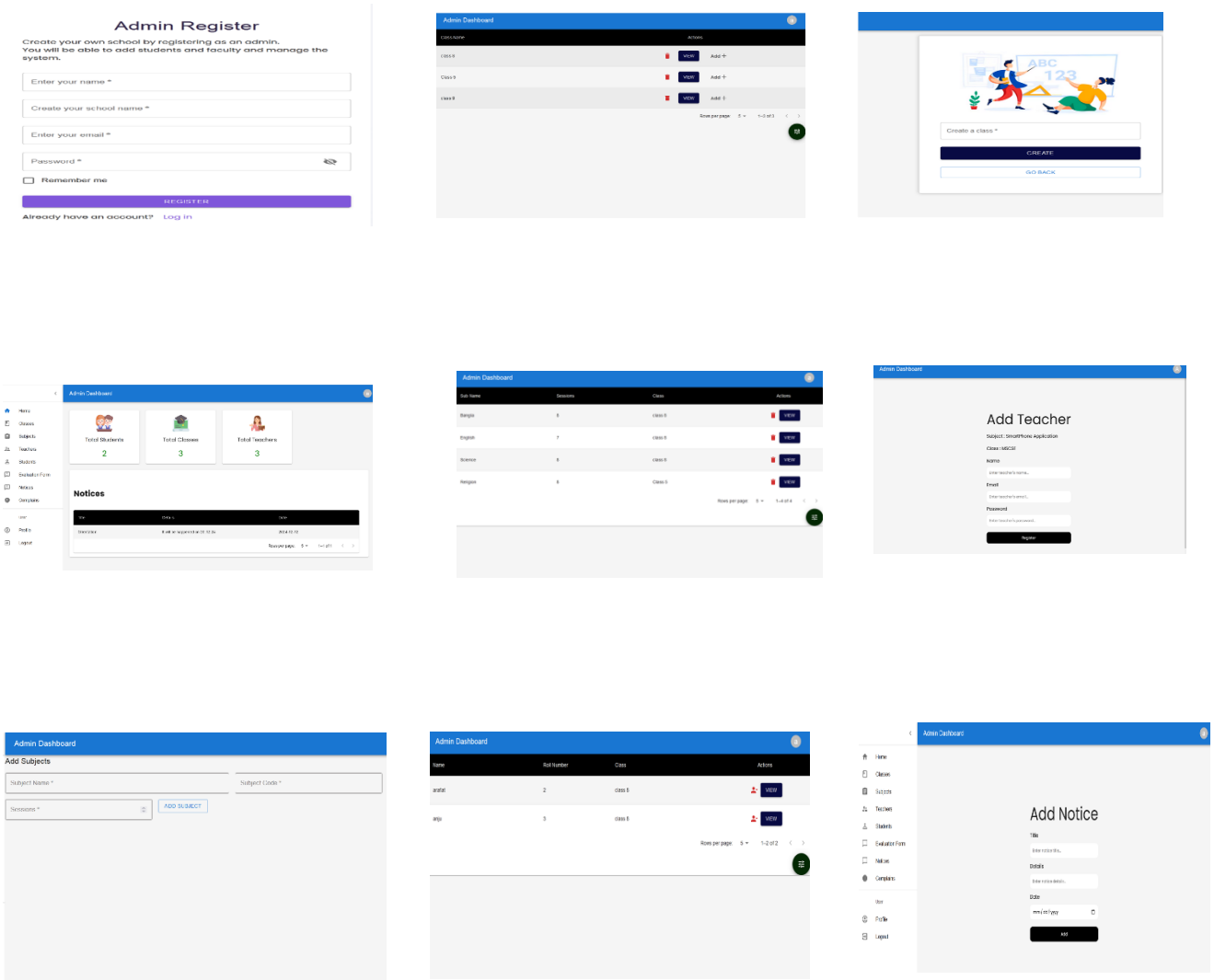


Figure 9: Admin Module of Edubridgebd

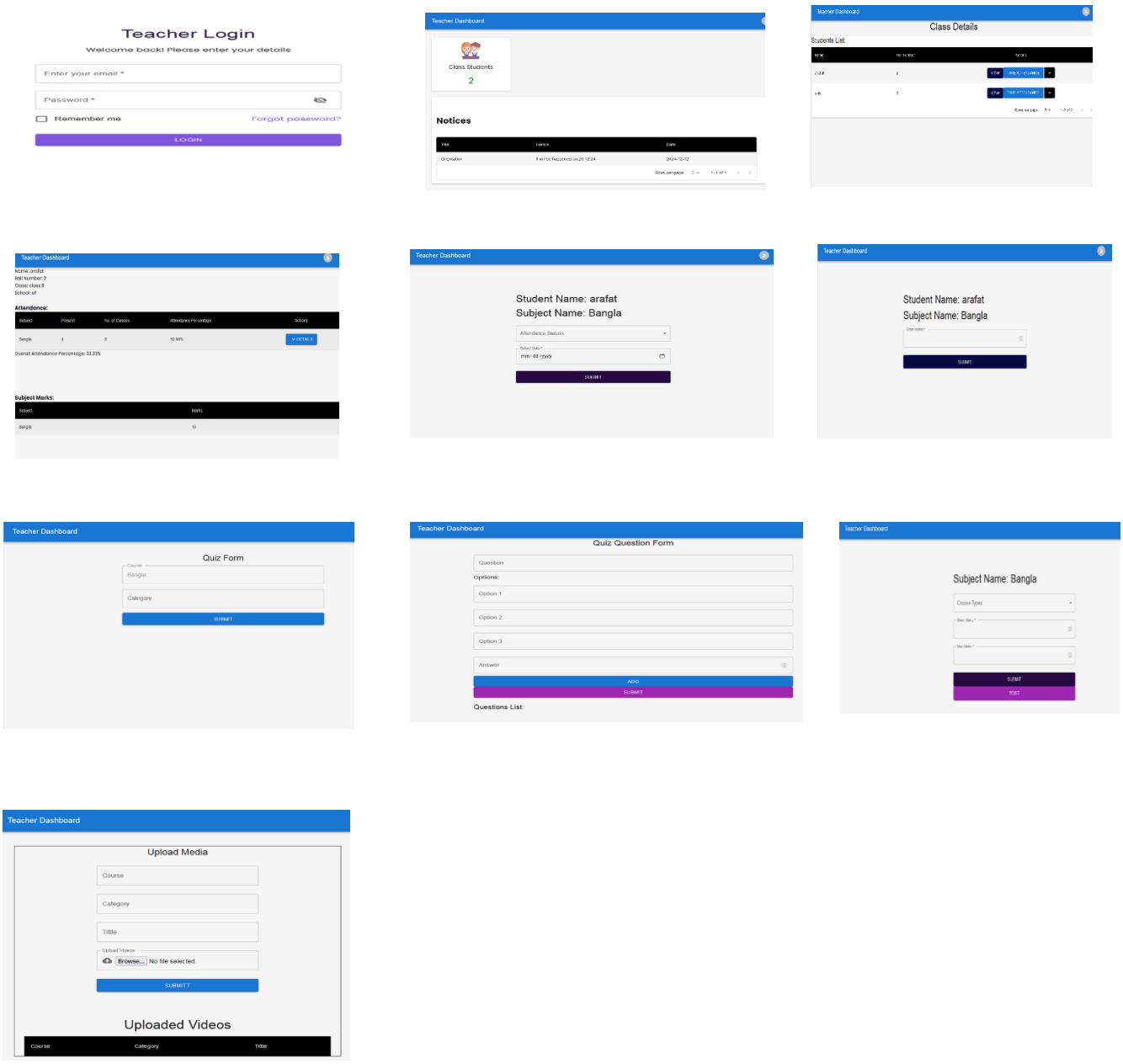


Figure 10: Teacher Module of Edubridgebd

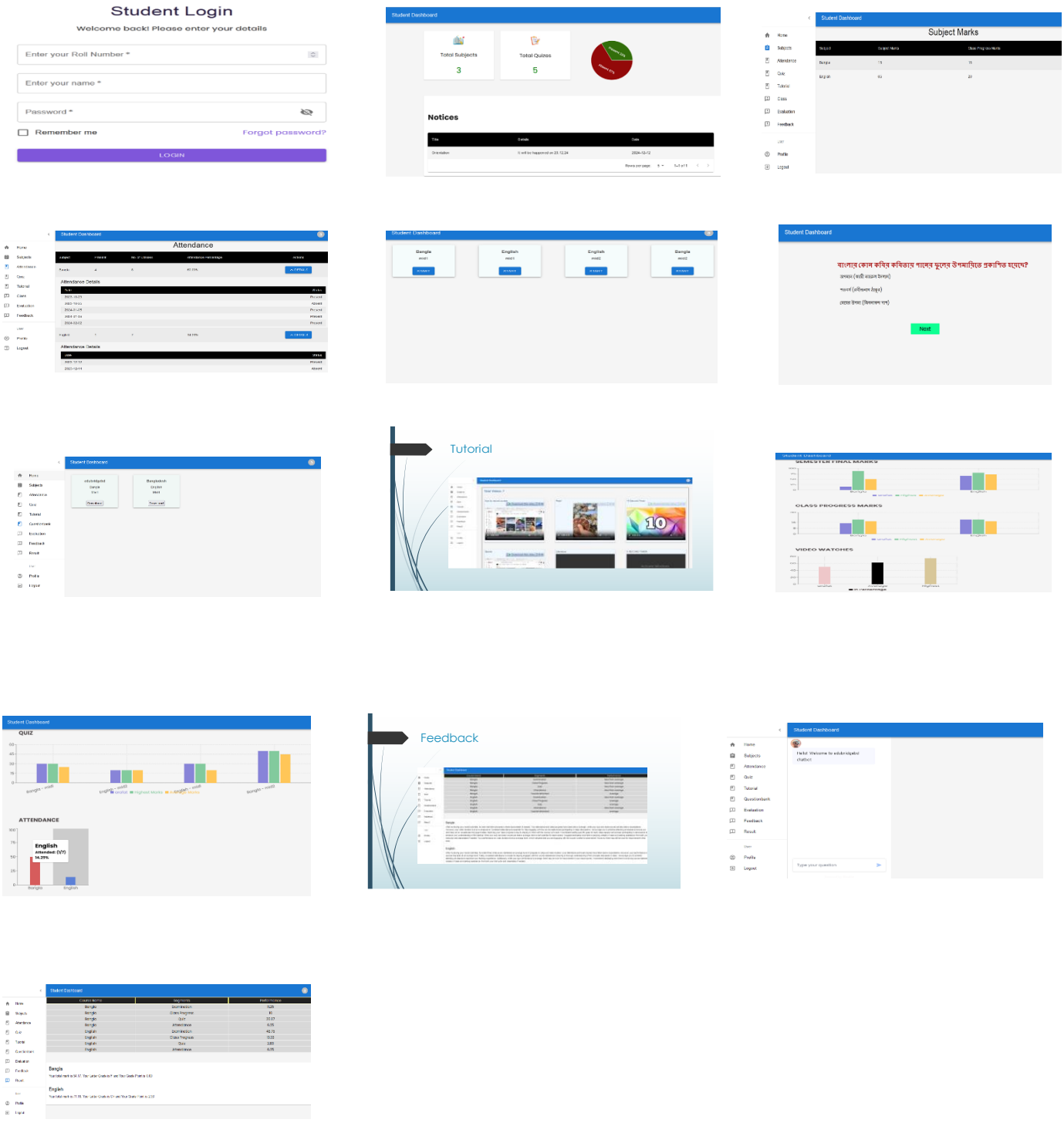


Figure 11: Student Module of Edubridgebd

5.3 Required Links & LOC

Website Link: https://e-learning-site-c9f41.web.app/

Github Link: https://github.com/arafatanjan/elearningsite-client

Line of codes : Total LOC is 14,895.

FrontEnd

language	files	code
JavaScript	113	11,047
CSS	7	291
XML	4	121
Markdown	1	38

BackEnd

language	files	code
JavaScript	31	1,773
controllers	13	1,152
middleware	2	44
models	14	429

Figure 12: Line of codes

Chapter 6

Quality Management System

This chapter discusses A Quality Management System (QMS) for an e-Learning Management System (eLMS) to ensure it's expected quality as well as supporting documentation.

6.1 Quality Objectives

Establish quality objectives that are specific, measurable, achievable, relevant, and time-bound (SMART). The objectives should align with the quality policy and focus on improving the quality of the ELMS.

a. To provide user-friendly interfaces and intuitive navigation in the ELMS.

b. To ensure the accuracy and relevance of course content, quiz and assessments.

c. To provide timely and effective technical support to users.

d. To continuously monitor and analyze user feedback and identify the areas for improvement.

6.2 Quality manual

Develop a quality manual that documents the QMS of the Edubridgebd. The manual should describe the processes, procedures, and work instructions used in this eLMS. The eLMS is committed to providing high-quality e-Learning services to its users through continuous improvement of its processes, technology, and content. There needs to have segregation of responsibilities of different teams.

Organizational structure and Responsibilities:

a. The management team is responsible for setting the quality objectives and ensuring they are met.

b. The eLMS development team is responsible for designing and developing the system to meet the quality objectives.

c. The technical support team is responsible for providing timely and effective support to users.

d. The content development team is responsible for creating and updating course content to ensure its accuracy and relevance.

e. An SQA (Software Quality Assurance) engineer is responsible in ensuring the quality of software through various testing and validation techniques.

6.3 Processes

Establish processes and procedures to ensure that all activities related to the edubridgebd are performed in a consistent and controlled manner. These processes should be regularly monitored and evaluated for effectiveness.

Product quality leading to customer satisfaction:

a. Key performance indicators (KPIs) will be established to measure the effectiveness of the eLMS, such as user satisfaction rates, course completion rates, and technical support response times.

b. Regular internal audits will be conducted to identify areas for improvement for customer satisfaction.

c. User feedback will be collected and analyzed to identify areas for student performance and satisfaction.

Continuous Improvement including corrective and preventive action:

a. Edubridgebd will be regularly reviewed to ensure that it remains current and relevant.

b. Lessons learned from audits, user feedback, and other sources will be used to identify areas for improvement and implement corrective actions.

c. Edubridgebd development team will be continuously improving the system to meet changing user needs and technological advancements.

d. A formal review known as a software inspection needs to be conducted after each life-cycle activity, serving as a quality checkpoint with specific exit criteria that must be met before advancing to the next phase.

e. The software inspection process comprises several components: a structured review procedure, a standard of excellence, a system of checklists, clearly defined participant roles, and various forms and reports.

f. The software walkthrough is designed to meet the needs of the software artifact's creator, helping them gain a comprehensive understanding of all aspects of the artifact. It serves as a valuable learning experience.

6.4 Quality instrument

Implement instruments for identifying, reporting, and addressing non-conformities related to the eLMS. These should include corrective and preventive actions to address root causes and prevent recurrence.

Document control:

a. Standard Operating Procedures (SOPs) will be developed for key processes to ensure consistency and quality.

b. User manuals will be created to provide clear instructions for users.

c. Change management procedures will be established to ensure that updates and modifications to the ELMS are properly documented and tested.

d. Quality evaluation is a key tool in assessing the health of a product and, by extension, the project. By conducting these evaluations, the project manager can ascertain whether the product will meet customer or user requirements while staying within budget and on schedule.

By implementing this QMS, Edubridgebd can ensure that it consistently meets the needs and expectations of its stakeholders, while continuously improving the quality of its E-Learning services.

Chapter 7

Conclusion

The conclusion chapter provides a last overview of the project and wraps it up with work that will be done in the future specifically for it.

7.1 Summary

Systematic methods for implementing learning management systems (LMS) in higher education institutions have yet to be fully established to help students and academics meet industry requirements. There is a pressing need to develop an LMS solution that addresses job-related issues and industry participation, ensuring that educational users gain direct involvement and awareness. To enhance the performance, address technical problems, and improve the quality of service (QoS) while reducing costs, it is essential to advance artificial intelligence continually. Although this advancement may be costly at present, its integration into mobile applications has created numerous opportunities to enhance information delivery to a broader audience. By providing a customizable and flexible e-learning platform, the aim is to improve access to quality education for students in Bangladesh and beyond. This platform will enable educators to share their knowledge with a wider audience, while also enabling students to learn at their own pace and to find suggestions for improving themselves. Ultimately, this will contribute to the overall development of the education sector in Bangladesh, and help to build a more educated and skilled workforce for the future.

7.2 Limitation

While the proposed e-learning website offers numerous advantages, it is not without its limitations. One significant limitation is the reliance on stable internet connectivity, which can be a challenge in rural and underdeveloped areas where internet infrastructure may be inadequate. This can create a disparity in access to educational resources, further widening the educational gap between urban and rural students. Another limitation is the potential for decreased interpersonal interaction and engagement, which can impact the effectiveness of learning. Online platforms can sometimes lack the personal touch and real-time feedback that face-to-face interactions provide, making it harder for instructors to address individual student needs promptly. Furthermore, there are concerns about

data privacy and security, particularly with the storage and handling of sensitive student information. Additionally, the effectiveness of AI-driven diagnostics and feedback depends heavily on the quality of the underlying data and algorithms, which require continuous updates and improvements to remain relevant and accurate. Lastly, there is a learning curve associated with both students and educators adapting to the new system. Training and support are essential to ensure that users can effectively navigate and utilize the platform's features, which can be resource-intensive and time-consuming. Without adequate training and ongoing support, the full potential of the e-learning platform may not be realized, leading to suboptimal educational outcomes.

7.3 Future work

Future efforts will concentrate on refining the ontology enrichment cycle and establishing objective metrics to assess the enhanced system knowledge. It will focus on several key areas to enhance its functionality and impact. First, we aim to develop more sophisticated AI capabilities, including adaptive learning algorithms that can offer highly personalized learning experiences by adjusting in real-time to each student's needs and progress. Predictive analytics will also be integrated to identify at-risk students early, providing targeted interventions to improve retention and success rates. Improving accessibility is another crucial area. We plan to develop offline learning options to ensure that students in regions with poor internet connectivity can still access educational resources. Additionally, we will expand the platform to support multiple languages, catering to a more diverse user base both locally and internationally. The incorporation of advanced interactive features, such as virtual and augmented reality (VR/AR), will create immersive learning environments that enhance understanding and engagement. Gamification elements will be added to make learning more engaging and motivating for students. Data security is a top priority, and we will implement advanced security protocols to protect sensitive student data from breaches and misuse. Exploring the use of blockchain technology for secure and transparent data management and credential verification is also on the agenda. Comprehensive training programs for both educators and students will be developed to maximize the effective use of the platform's features. Continuous professional development opportunities will be offered to educators to keep them updated with the latest educational technologies and methodologies. We will seek to expand collaboration and partnerships, forming alliances with industry leaders to ensure the curriculum is aligned with current job market requirements and trends. Global collaborations with international

educational institutions will help share best practices and innovations in e-learning. Finally, ensuring the platform's scalability and offering customizable modules will allow institutions to tailor the platform to their specific educational models and requirements. By focusing on these areas, the e-learning platform can continue to evolve, offering increasingly effective and inclusive educational opportunities to a broad and diverse audience.

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ACRONYMS AND ABBREVIATIONS

LMS: Learning Management System

ILMS: Intelligent Learning Management System

AI: Artificial Intelligence

EdTech: Educational Technology

MOOCs: Massive Open Online Courses

COVID-19: Coronavirus Disease 2019

eLMS: e-Learning Management System

UGC: University Grants Commission

NLP: Natural Language Processing

ITS: Intelligent Tutoring Systems

FL: Fuzzy Logic

K–12: Kindergarten to 12th grade

BDT: Bangladeshi Taka

VC: Venture Capital

USD: United States Dollar

FGD: Focus Group Discussion

M: Mean

SD: Standard Deviation

SaaS: Software as a Service

API: Application Programming Interface

IDE: Integrated Development Environment

SERPs: Search Engine Results Pages

MUI: Material-UI

CSS: Cascading Style Sheets

NoSQL: Not Only SQL

LLM: Large Language Model

npm: Node Package Manager

LTS: Long-Term Support

npx: Node Package Runner

IP: Internet Protocol

ID: Identification

LOC: Lines of Code

QoS: Quality of Service

VR/AR: Virtual Reality/Augmented Reality