

Online Examination System for Higher Education Institutes

Khalid Bin Muhammad¹, Muhammad Ayoub Kamal^{*1,2}, Muhammad Asghar Khan¹, Laiq Muhammad Khan¹

Abstract- As technology and telecommunication equipment advances at a rapid pace in our daily lives, the e-learning system is gaining traction in educational institutions. Various academic institutions are attempting to transition from pen-and-paper exams to online exams for a myriad of purposes, like a more customized atmosphere, a more access controls, and more precise assessment. It is to be noted that digital information is easily retrieved and accuracy is achieved. The system should be user friendly so that a user with basic computer skills can operate it. Brief reports can be generated by the system for presentation. The function of the Examination department involves tracking Candidate histories, skills, abilities and results. The conduction of tests is highly customizable. It can enable institutes to have automated checking on the basis of the response by the candidate. This Digital Assessment Solution is a technological system that enables every corporation or institution to plan, administer, and organize examinations in an online setting. It is possible to do so using the World Wide Web and/or a Local Network. The designed online examination system will be utilised to monitor and manage student data, exam results, resources, and functions at the school. Student information, upcoming blogs, paid and unpaid exams, a notification board, Exam Announcements, role-based access control, private messaging, exam results, types of exams, and self-services are the main features of proposed online examination system.

Keywords— Online Exam, Online Examination System, Exam System, Web-based Exam, Centralized Exam System

INTRODUCTION

Exams have always been a cause of fear for any institution, college, or university. It is indeed a procedure that necessitates strict commitment to critical considerations like precise accuracy, quality assurance, and privacy[1]. Aside from these, the system necessitates the development of question papers,

the rectification of answer sheets, the presentation of outcomes, the execution of the assessment, the creation of admission passes, and so on[2]. In today's world, e-learning has exploded in popularity among academic bodies and businesses. Many other technologies have contribution in growing e-learning like 5G[3], software defined networking[4], cloud computing[5][6], big data[7][8], wireless sensor networking[9], Machine learning[10], LPWAN[11] and IoT[12].

The fundamental benefit of e-learning is it can touch all types of users, regardless of their age, location, or time available to study the information[13]. An Online Examination System (OLES) is a Web based Application. The basic task is to reduce the paper usage and encourage the use of digital content[6]. It is to be noted that digital information is easily retrieved and accuracy is achieved. The system should be user friendly so that a user with basic computer skills can operate it. Brief reports can be generated by the system for presentation. The function of the Examination department involves tracking Candidate histories, skills, abilities and results. The conduction of tests is highly customizable[14]. It can enable institutes to have automated checking on the basis of the response by the candidate. In the following sections this report will show the product positioning, the involved stakeholders, and the overview and main features of the Online Examination System[15].

The proposed system is an online examination system (OLES). The system satisfies the needs of the Examination Department of an institution to manage student's personal data (identity number, name, surname, birthdate, birthplace, educational information, examination results etc.), evaluation. In order to enhance systems safety and security User Id and password is required. Various categories of users are created along with their rights and responsibilities to limit access. students not being able to check the accuracy of the results Quick, efficiency, Accuracy to help students and teachers without use of paper work Examination system is a web-based application focusing on Online exams, it is used to maintain records of the students of the institution.

¹Institute of Business Management, Karachi

²Malaysian Institute of Information Technology, University Kuala Lumpur
Country: Pakistan | Malaysia

Email: muhammad.ayoub@s.unikl.edu.my

It is a web application which has centered user friendliness and simplicity. Our proposed OLES shall be used to manage and operate on institution’s student data and exam results, resources and functions. The major features are: Student details, Upcoming Blogs, Paid & Unpaid Exams, notice board, Exam Announcements, Role based access control (RBAC), Private messaging, Exam Results, Type of Exams, self-services. The system should be user-friendly, all users can easily access it. It should show all the previous history of the course. This system should allow a person to take a re-test. The system itself should be quick with the results, as in accuracy should be there. Before developing any system, we require to know about current system being used to conduct the tests. This can give you the entire overview of the system, how much improvement is needed.

Therefore, we studied the existing systems and tried to understand the weaknesses of the system where it needs improvement. Existing system refers to the system of the old times where we don’t rely on the technology and everything is done manually. Our proposed system is OLES. The system fulfills the needs of the Examination Department of an institution to manage student’s subjective data (identity number, name, surname, birthdate, birthplace, educational information, examination results, assessment, etc. Proposed OLES is also described through context diagram as well if you see in figure 1 OLES has three user types student, teacher and admin.

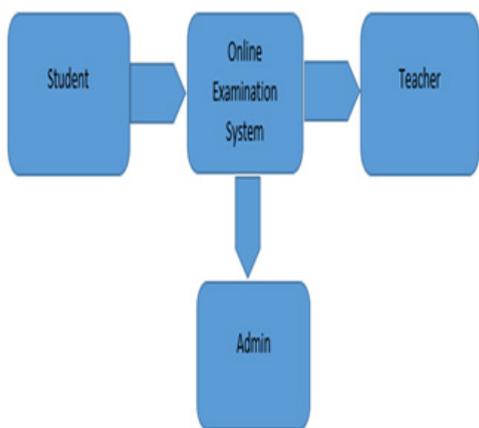


Fig 1: OLES Access Diagram

The proposed development life cycle for the OLES would be an incremental model because the requirements of the system were completely defined and understood. However, some details may evolve with time. This model is more flexible than other models as iterations can be done easily so as to make Online Examination System more effective and accurate. You can see in figure 2 incremental model from OLES perspective.

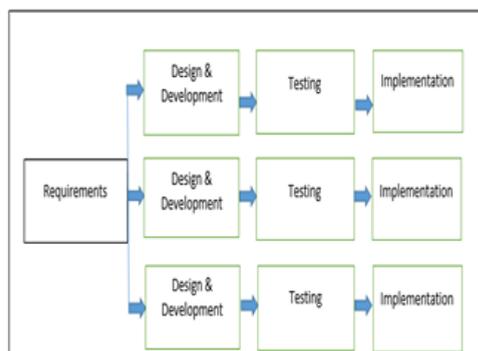


Fig 2: Incremental Model

In phase development process the task is divided into many phases and every phase is evaluated to be completed after the required output is achieved[16]. This breaks problem into many phases and every phase completion takes us towards achievement of our goal and software is developed.

Requirements analysis is most important phase and correct requirement analysis leads to a successful software project[17]. This is one of the time-consuming phases. It is done to enhance the understanding of the problem as well as to jot down the requirements of our product after a detailed study of the required system from users. The result of this phase is an SRS (Software Requirements Specification) document. This phase is divided into two parts:

- 1) Problem understanding / Analysis
- 2) Requirement specification

The target of problem analysis is to understand the fine details of the problem. After analysis and getting to a level of understanding a document is developed. This document covers the functional and performance related details of expectations. The input and output formats and design factors are also considered in this phase.

Software Design enables us to plan a software solution using the SRS document. This helps us to convert from problem specification to a practical possible solution[18]. It is the process of envisioning and defining software solutions to proposed problems. The document is a major tool in Software Engineering.

This phase focuses on systems components and their structure. This also considers the interaction between various components in a streamlined manner to achieve required results and efficiencies. This phase enables us to convert our design into a programming code after the selection of a programming language. The main target is to implement design in an effective way into a code. A well written code reduces testing efforts as well as low maintenance cost[19]. These days programming languages have reduced the lines of code and become more efficient to achieve desired results[20]. As a result, while coding, the emphasis should be on creating

programmed that are simple to read and comprehend, rather than on creating programmed that are simple to create. During the coding phase, clarity and transparency must be prioritized. During software development, testing is the most important quality control measure. Its primary job is to detect software flaws[21]. The purpose of assessment is to find problems in the programmers' requirements, design, and programming. Unit testing is the first step in the testing process, and it involves testing specific modules or components[22]. Integration testing, which focuses on assessing the interconnection between modules, is performed after the modules have been integrated into the system. System testing is carried out after the system has been assembled. The system is then evaluated versus the platform criteria to check if all of the objectives are satisfied and the system functions as expected.

Finally, acceptance testing is carried out to demonstrate the system's operation to the client using real-world data[23].

LITERATURE REVIEW

OLES is indeed a framework for conducting tests online. It meets several of the criteria for conducting digital exams[6]. Regarding entries, the program may create analytical information. The method allows lecturers to save a library of questions that subsequently create sheets on this a subsequent time, giving them greater freedom when it comes to hosting internet-based quizzes. Moreover, it has an ability to instantly annotate the sheets[24]. The term "online examination system" refers to an internet assessment system that allows students to take exams online. Using a computer system, either over the internet or an intranet[25].

To segregate instruction and assessment, an examination system was required. With Java Web technologies, a digitally Testing Platform was created[26]. The advancement of modern educational technology has prompted changes in teaching and examination patterns[27]; the introduction of the online exam systems (OES) is the best example of such improvements, as well as the surveillance system is designed to assure the OES' fairness and impartiality [28].

The majority of contemporary eLearning uses commercial Web-based course administration for administration[29]. The application is really not commonly used for digital assessments owing to privacy vulnerabilities, as well as the mechanism focuses on individuals' truthfulness or maintaining an ethical code. Digital class assessments are highly effective perhaps they have always been. Nevertheless, online course exams require increased security. presents a more highly secured test administration atmosphere facilitated by cooperative cryptography with remote port and input monitoring and control[30].

Taking an electronic studying examination for whatever course involves significant planning just on part of both the instructor and undergraduate candidates. Institution on those duties assigned to it to provide the right atmosphere. Everyone is simply present to assist the learner, therefore you must motivate and mentally educate students for a computerized test. Several universities all across globe are struggling to understand the complexities of automated exams on respective institutions. More recent study on the benefits and drawbacks of just using online course exams on university campuses has yielded encouraging results, indicating that there is a favorable attitude toward using online exams[31].

Within the Management Assistance System Program at Al al Bayt University, they assessed students' attitudes on the usage of online exams and an evaluation tool on campus[32]. A study comparing online examinations and traditional exams found that online exams produce greater outcomes than conventional tests. Until now, the entire process of administering our exam and evaluating their results was carried out physically. When the product was not yet available, handling the test paper, that is, checking and disseminating distinct scores, took a lot of effort. The current system is highly inconvenient. Examining the exam physically is really difficult[33].

To take exam of more hopefuls more invigilators are required however no. of results are not exact as figuring and assessments are finished. The odds of paper spillage are more in current framework as analyzed. Result handling takes additional time as it is done physically. The online test made for stepping through online examination has following highlights: In contrast with the present framework the proposed framework will be less tedious and is more proficient. Investigation will be simple in proposed framework as it is computerized. Result will be extremely exact and precise and will be pronounced in exceptionally. Limited capacity to focus time since computation and assessments are finished by the Test system itself[34]. The proposed framework is extremely secure as no odds of spillage of inquiry paper as it is subject to the head as it were. The logs of showed up hopefuls and their imprints are put away and can be upheld up for some time later.

METHODOLOGY

It's a web-based application which is developed using CodeIgniter and MySQL Server. Model architecture is shown in figure 3. The technologies that are being used in the development of front end are HTML, CSS, PHP, JavaScript and Bootstrap. In terms of our project, we have the essential competence to make the provided solution a reality. Some initiatives are started with a deadline in mind. OLES is a web-based application which has been developed using different soft wares which were available online. Economic The feasibility of a system analyses if there were adequate advantages in producing to keep the expense tolerable, or

whether the system's cost is too high.

Hence, it doesn't give any developing cost but later on, in future, it can cost us a certain amount. If the ultimate user's area unit snug with the current system and that they see no drawback with its continuance, then resistance to its operation are going to be zero. Project is feasible because it does not require any cost for installation and availing our services provided. Moreover, it provides a very user-friendly which needs no guidance to use it.

The functional requirements may contain a list of things that the system should be able to perform. Functional requirements are listed down, which a system can perform are as follows: The online examination system must ask for the identification of the user i.e. Username & Password. It should allow a verified student to take a test. The system should display the results to the candidate and the moderators also.

Non-Functional requirements of the system include, 95% users will be able to use this system and take the tests online without any assistance and guidance. The application must be able to run on any device i.e. Tablet, PC etc. OLES must be able to perform its functions and operations without experiencing failures i.e. system crash. The OLES application must be able to perform every task efficiently with maximum number of users. The system must be available (working) 24/7 to facilitate the users.

Existing system refers to the system of the old times where we don't rely on the technology and everything is done manually.

many diverse components and ways these combine to achieve the intended outcomes. To fully comprehend the system, flow charts are required. Figure 4 shows a flow chart that makes it easier to grasp the online examination system's inputs and outputs, which is useful in later phases of software development.

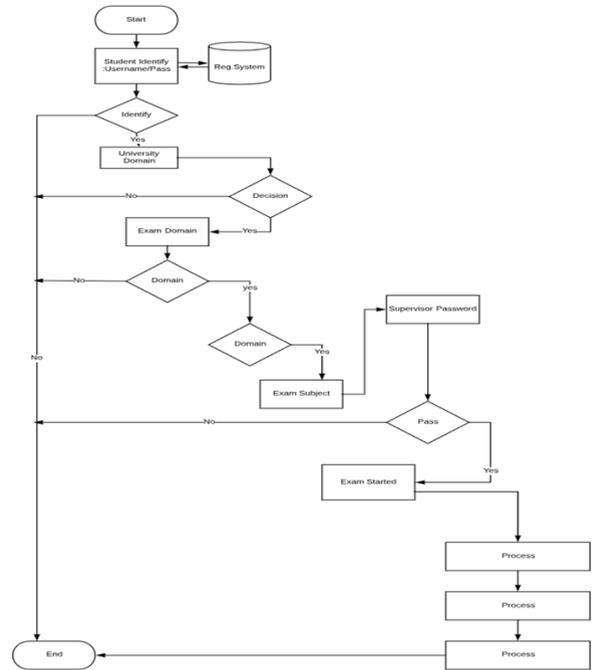


Fig 4: Flow Chart

As shown in data flow diagram in figure 5 it become easy to understand the data flow process of online examination system because without understanding the data flow procedure it is very difficult to understand the working of the system, as shown in figure data is flow in between student, exam department, expert, and controller.

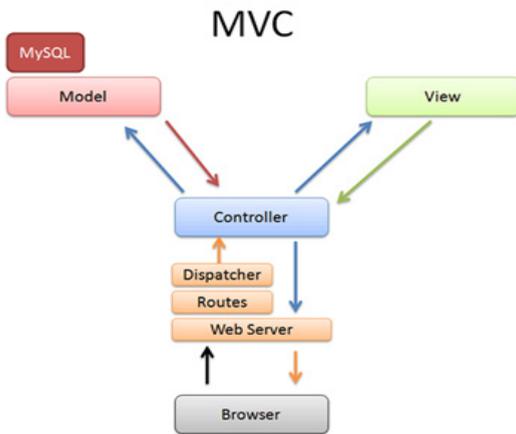


Fig 3: Model Architecture

The design phase's goal is to devise a strategy for resolving the problem identified in the requirements papers. The very first stage in going beyond the specific challenge to the resolution area is to complete this phase. Three distinct outputs are frequently produced as a result of the design process. It emphasizes on considering a system is a group of

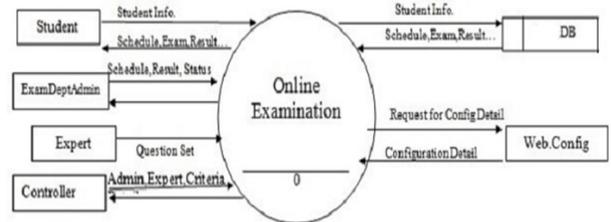


Fig 5: Data Flow Diagram

Here is a usecase diagram of the our proposed online examination system as you see in figure 6 first of all student and teacher both need to create account on OLES. After that the student need to login for attempting the quiz which is

already upload on OLES by teacher once student complete the quiz and submitted then teacher received a notification from OLES to grade the student quiz. But teacher also perform all these tasks after login in system. In OLES teacher and student both has different profile with respect role .

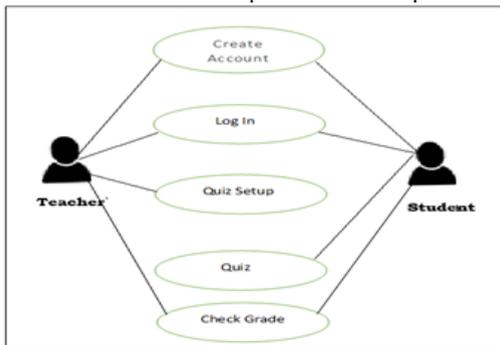


Fig 6: OLES use case diagram for Teacher and Student

Admin is a super user for proposed online examination system as seen in figure 7 admin user has all rights to perform any job in OLES

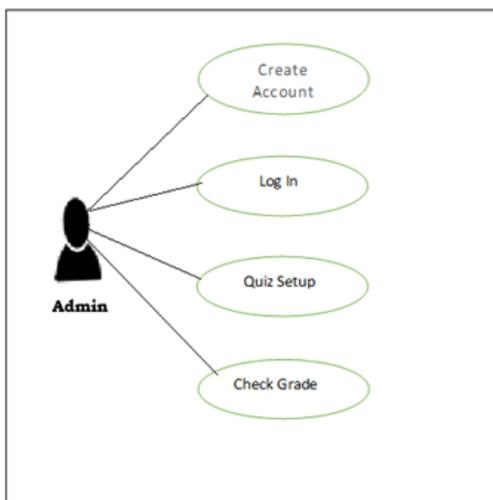


Fig 7: OLES use case Diagram for admin

IMPLEMENTATION AND TESTING

The continuous builds approach is a development technique in which an item is outlined, actualized, and tried one step at a time until the project is finished. It entails both growth and assistance. When an object meets the majority of its requirements, it is said to be completed. The elements of the iterative model are combined with the iterative rationale of prototyping in this model. By splitting the project into a number of minor sub-projects, iterative incremental lifecycle models lessen the risk of developing the incorrect item. The ultimate (external) release meets all requirements. One risk of the incremental method is that the early releases handle such a small set of criteria that the client may be disappointed; on the other hand, one opportunity is that incorrect or omitted

needs can be remedied in time.

Many tasks are involved in design system like, Communication aids comprehension of the goal. As multiple individuals working on the similar program but on separate functions at the same time, planning is essential. Business modelling, simulation models, and process modelling are all examples of modelling. Construction entails reusing hardware and software components, as well as automated code. Integration of all increments during Deployment. Many types of software and hardware are used to design this system. Extensive PHP framework Code Igniter is used for the development of this system with model view controller (MVC) provide maximum responsiveness for further enhancement within the system. It's a lightweight PHP framework designed for developers who want a simple and attractive toolkit for building full-featured web apps. Especially contrasted to certain other PHP frameworks, Code Igniter is known for its quickness. Code Igniter can also be changed for using Hierarchy Model View Controller (HMVC), which allows developers to arrange Controller, Models, and Views in a sub-directory structure. For our courses, we believe that the electronic platform is far preferable to paper-and-pencil tests. We've concluded that the above-mentioned issues can be addressed by implementing the appropriate surveillance systems. Online exams for schools, Colleges and Universities where it can save time to evaluate the candidates. It is very light weight web application which has centered user friendliness and simplicity. Depending on the hazards, architecture, and/or requirements, the whole scope of work is divided into shorter pieces of work, increments. The overall needs of the end system or product are understood from the outset of development in incremental models, just as they are in sequential models. However, with incremental models, each increment is assigned a limited set of needs, and with each subsequent release, additional criteria are handled.

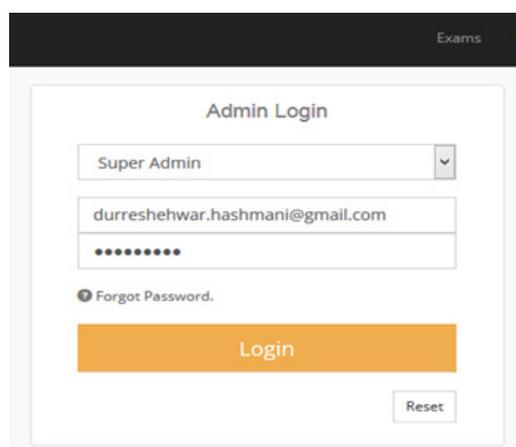


Fig 8: OLES admin login page

Figure 8 shows admin page of online examination system.

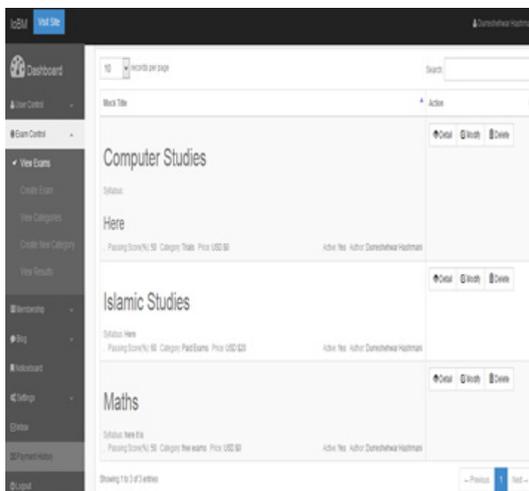


Fig 9: OLES Examination Controller Page

Figure 9 shows exam control page as shown view exam, create event, view categories and view results are the functions of control panel.

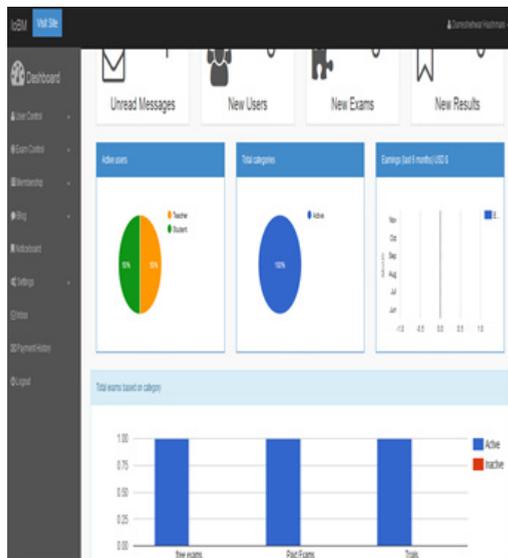


Fig 11: OLES Dashboard

Figure 11 shows dashboard of online examination system, dashboard shows the overall report of OLES, overview of OLES and user wise and event wise information is available on OLES dashboard.

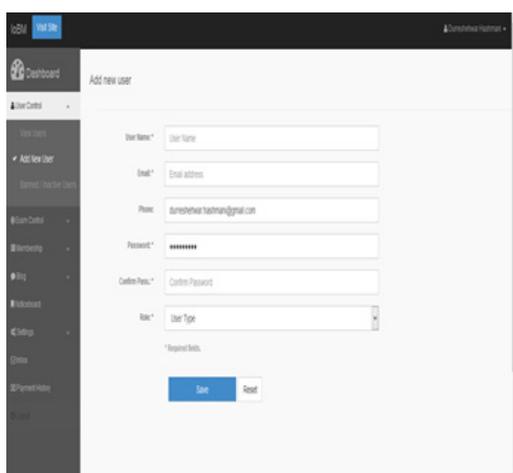


Fig 10: OLES Add User / New User

Figure 10 shows user control add user new user tab, admin can create delete and add user from this this tab.

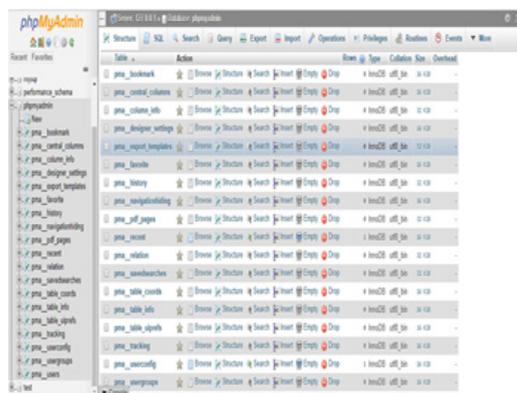


Fig 12: OLES Database View

Figure 12 shows the database view the of OLES, database is very important for online examination system, because for keeping record of student activities like, quiz, assignment, short exam and final exams online examination system has to capability to store this much data and manage because in online system managing a data is very critical task and database is responsible to manage this task.

CONCLUSION

We've created a web-based online examination platform that runs on the web. It offers a user-friendly platform with a variety of queries for institutions' foundational computer education. The suggested web-based Online Examination Platform could be simply used by educational institutions and colleges to enhance the testing safer and more versatile. The

internet-based examination platform delivers and gathers exam sheets and responses from participants in a safe and protected manner. The proposed web-based Assessment System is a framework that allows any college or university to create, manage, and arrange online tests. The OLES is able to utilize and monitoring student's records, examination results, assets, and school events.

REFERENCES

- [1] S. Coghlan, T. Miller, and J. Paterson, "Good Proctor or 'Big Brother'? Ethics of Online Exam Supervision Technologies," *Philos. Technol.*, vol. 34, no. 4, pp. 1581–1606, 2021, doi: 10.1007/s13347-021-00476-1.
- [2] F. E. Louhab, A. Bahnasse, F. Bensalah, A. Khiat, Y. Khiat, and M. Talea, "Novel approach for adaptive flipped classroom based on learning management system," *Educ. Inf. Technol.*, vol. 25, no. 2, pp. 755–773, 2020, doi: 10.1007/s10639-019-09994-0.
- [3] M. A. Kamal, H. W. Raza, M. M. Alam, M. M. Su'ud, and A. B. A. B. Sajak, "Resource allocation schemes for 5G network: A systematic review," *Sensors*, vol. 21, no. 19, 2021, doi: 10.3390/s21196588.
- [4] A. A. Barakabitze, A. Ahmad, R. Mijumbi, and A. Hines, "5G network slicing using SDN and NFV: A survey of taxonomy, architectures and future challenges," *Comput. Networks*, vol. 167, p. 106984, 2020, doi: 10.1016/j.comnet.2019.106984.
- [5] M. A. Kamal, H. W. Raza, M. M. Alam, and M. Mohd, "Highlight the Features of AWS, GCP and Microsoft Azure that Have an Impact when Choosing a Cloud Service Provider," *Int. J. Recent Technol. Eng.*, vol. 8, no. 5, pp. 4124–4232, 2020, doi: 10.35940/ijrte.d8573.018520.
- [6] F. Mahar, S. I. Ali, A. K. Jumani, and M. O. Khan, "ERP System Implementation: Planning, Management, and Administrative Issues," *Indian J. Sci. Technol.*, vol. 13, no. 1, pp. 106–22, 2020, doi: 10.17485/ijst/2020/v13i01/148982.
- [7] H. Liu, "Big data drives cloud adoption in enterprise," *IEEE Internet Comput.*, vol. 17, no. 4, pp. 68–71, 2013, doi: 10.1109/MIC.2013.63.
- [8] M. A. Memon, S. Soomro, A. K. Jumani, and M. A. Kartio, "Big data analytics and its applications," *Ann. Emerg. Technol. Comput.*, vol. 1, no. 1, pp. 45–54, 2017, doi: 10.33166/AETiC.2017.01.006.
- [9] M. A. Kamal, M. K. Kamal, M. Alam, and M. M. Su'ud, "Context-Aware Perspective Analysis working of RFID Anti-Collision Protocols," *J. Indep. Stud. Res. - Comput.*, vol. 2, no. 16, pp. 19–32, 2018, doi: 10.31645/jisrc/(2018).16.2.02.
- [10] F. Zantalis, G. Koulouras, S. Karabetsos, and D. Kandris, "A review of machine learning and IoT in smart transportation," *Futur. Internet*, vol. 11, no. 4, pp. 1–23, 2019, doi: 10.3390/FI11040094.
- [11] M. A. Kamal, M. M. Alam, A. Bakar, and M. Mohd, "Impact of LoRA and 5G on Smart Manufacturing from Automation Perspective," vol. 18, pp. 1355–1378, 2022, doi: 10.13052/jmm1550-4646.1852.
- [12] H. W. Raza, M. A. Kamal, M. Alam, and M. S. M. Su'ud, "A Review Of Middleware Platforms In Internet Of Things: A Non – Functional Requirements Approach," *J. Indep. Stud. Res. Comput.*, 2020, doi: 10.31645/18.
- [13] A. Moubayed, M. Injadat, A. B. Nassif, H. Lutfiyya, and A. Shami, "E-Learning: Challenges and Research Opportunities Using Machine Learning Data Analytics," *IEEE Access*, vol. 6, pp. 39117–39138, 2018, doi: 10.1109/ACCESS.2018.2851790.
- [14] Z. Tiejun, "Implementation Status and Development Thinking on 'Cloud National Examination' in China under the situation of 'Online Anti-COVID-19 Epidemic,'" *Technol. Forecast. Soc. Change*, vol. 162, no. September 2020, 2021, doi: 10.1016/j.techfore.2020.120322.
- [15] V. Rajhans, U. Memon, V. Patil, and A. Goyal, "Impact of COVID-19 on academic activities and way forward in Indian Optometry," *J. Optom.*, vol. 13, no. 4, pp. 216–226, 2020, doi: 10.1016/j.optom.2020.06.002.
- [16] M. A. Kamal, M. Shahid, and H. Khawar, "The Mathematical Model for searching the Shortest Route for TB Patients with the help of Dijkstra's Algorithm," *Sukkur IBA J. Comput. Math. Sci.*, vol. 5, no. 2, pp. 41–48, 2021, doi: 10.30537/sjcms.v5i2.772.
- [17] N. Nurmuliani, D. Zowghi, and S. Fowell, "© 2004 IEEE . Personal use of this material is permitted . Permission from IEEE must be obtained for all other uses , in any current or future media , including reprinting / republishing this material for advertising or promotional purposes , creating n," 2004.
- [18] M. P. S. Bhatia, A. Kumar, and R. Beniwal, "Ontology driven software development for automated documentation," *Webology*, vol. 15, no. 2, pp. 86–112, 2018.

- [19] P. Kong, L. Li, J. Gao, K. Liu, T. F. Bissyandé, and J. Klein, "Automated testing of Android apps: A systematic literature review," *IEEE Trans. Reliab.*, vol. 68, no. 1, pp. 45–66, 2019, doi: 10.1109/TR.2018.2865733.
- [20] B. Wang, Y. Liu, J. Qian, and S. K. Parker, "Achieving Effective Remote Working During the COVID-19 Pandemic: A Work Design Perspective," *Appl. Psychol.*, vol. 70, no. 1, pp. 16–59, 2021, doi: 10.1111/apps.12290.
- [21] G. Lin et al., "Cross-Project Transfer Representation Learning for Vulnerable Function Discovery," *IEEE Trans. Ind. Informatics*, vol. 14, no. 7, pp. 3289–3297, 2018, doi: 10.1109/TII.2018.2821768.
- [22] M. A. Kamal, M. M. Alam, and M. S. Mazliham, "Routers Perspective Simulation-Based Analysis of EIGRP and OSPF Routing Protocol for an Organizational Model," *Int. J. Innov. Technol. Explor. Eng.*, vol. 9, no. 4, pp. 2013–2019, 2020, doi: 10.35940/ijitee.b6509.029420.
- [23] M. Hosseiniravandi, A. H. Kahlaee, H. Karim, L. Ghamkhar, and R. Safdari, "Home-based telerehabilitation software systems for remote supervising: A systematic review," *Int. J. Technol. Assess. Health Care*, vol. 36, no. 2, pp. 113–125, 2020, doi: 10.1017/S0266462320000021.
- [24] P. Ana and P. Bukie, "Design and implementation of online examination administration system for universities," *Glob. J. Math. Sci.*, vol. 12, no. 1, pp. 39–51, 2015, doi: 10.4314/gjmas.v12i1.16.
- [25] K. T. Askarali, "Online examination system," *J. Interdiscip. Multidiscip. Res.*, vol. 2, no. 5, pp. 86–87, 2015, doi: 10.22214/ijraset.2021.34911.
- [26] K. M. Lee, S.-F. Yang, and P. Yarlagaadda, *Information Technology Applications in Industry II*, no. 411–414. 2013.
- [27] G. Yun, R. V. Ravi, and A. K. Jumani, "Analysis of the teaching quality on deep learning-based innovative ideological political education platform," *Prog. Artif. Intell.*, 2022, doi: 10.1007/s13748-021-00272-0.
- [28] P. Guo, H. F. Yu, and Q. Yao, "The research and application of online examination and monitoring system," *Proc. 2008 IEEE Int. Symp. IT Med. Educ. ITME 2008*, pp. 497–502, 2008, doi: 10.1109/ITME.2008.4743914.
- [29] A. Memeti, "A MODEL FOR INCREASING QUALITY OF EDUCATION BY USING A," vol. 21, no. 2, pp. 67–73.
- [30] K. Garg, K. Verma, K. Patidar, N. Tejra, and K. Petidar, "Convolutional Neural Network based Virtual Exam Controller," *Proc. Int. Conf. Intell. Comput. Control Syst. ICICCS 2020*, no. Iciccs, pp. 895–899, 2020, doi: 10.1109/ICICCS48265.2020.9120966.
- [31] C. Coman, L. G. Țiru, L. Meseșan-Schmitz, C. Stanciu, and M. C. Bularca, "Online teaching and learning in higher education during the coronavirus pandemic: Students' perspective," *Sustain.*, vol. 12, no. 24, pp. 1–22, 2020, doi: 10.3390/su122410367.
- [32] I. F. Al-Mashaqbeh and A. Al Hamad, "Student's perception of an online exam within the Decision Support System Course at Al al Bayt university," *2nd Int. Conf. Comput. Res. Dev. ICCRD 2010*, pp. 131–135, 2010, doi: 10.1109/ICCRD.2010.15.
- [33] J. Anštine and M. Skidmore, "A small sample study of traditional and online courses with sample selection adjustment," *J. Econ. Educ.*, vol. 36, no. 2, pp. 107–127, 2005.
- [34] M. A. Kamal, M. M. Alam, H. Khawar, and M. S. Mazliham, "Play and Learn Case Study on Learning Abilities through Effective Computing in Games," *MACS 2019 - 13th Int. Conf. Math. Actuar. Sci. Comput. Sci. Stat. Proc.*, pp. 1–6, 2019, doi: 10.1109/MACS48846.2019.9024771.