SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103
(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

Project Report (Phase-II) on

"Blockchain Based Secured Examination System"

submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE & ENGINEERING

Submitted by

Batch ID 21

Aman Kumar Chauhan	(1SI22CS015)
Chandrahas Suresh Gaddi	(1SI22CS047)
Harsha D T	(1SI22CS065)
Harshith Kumar H S	(1SI22CS067)

under the guidance of

Dr. T M Kiran Kumar

Assistant Professor

Department of CSE

SIT, Tumakuru-03

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

2024-25

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

This is to certify that the project work entitled "BLOCKCHAIN BASED SECURED EXAMINATION SYSTEM" is a bonafide work carried out by Aman Kumar Chauhan (1SI22CS015), Chandrahas Suresh Gaddi (1SI22CS047), Harsha D T (1SI22CS065) and Harshith Kumar H S (1SI22CS067) in partial fulfillment for the award of degree of Bachelor of Engineering in Computer Science & Engineering from Siddaganga Institute of Technology, an autonomous institute under Visvesvaraya Technological University, Belagavi during the academic year 2024-25. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The Project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the Bachelor of Engineering degree.

Dr. TM Kiran Kumar
Assistant Professor
Dept. of CSE
SIT,Tumakuru-03

Head of the Department
Dept. of CSE
SIT,Tumakuru-03

ACKNOWLEDGEMENT

We offer our humble pranams at the lotus feet of **His** Holiness, **Dr. Sree Sree Sivakumara Swamigalu**, Founder President and **His** Holiness, **Sree Sree Siddalinga Swamigalu**, President, Sree Siddaganga Education Society, Sree Siddaganga Math for bestowing upon their blessings.

We deem it as a privilege to thank **Dr. Shivakumaraiah**, CEO, SIT, Tumakuru, and **Dr. S V Dinesh**, Principal, SIT, Tumakuru for fostering an excellent academic environment in this institution, which made this endeavor fruitful.

We would like to express our sincere gratitude to **Dr. N R Sunitha**, Professor and Head, Department of CS&E, SIT, Tumakuru for her encouragement and valuable suggestions.

We thank our guide **Dr. TM Kiran Kumar** , Assistant Professor, Department of Computer Science & Engineering, SIT, Tumakuru for the valuable guidance, advice and encouragement.

Aman Kumar Chauhan (1SI22CS015)
Chandrahas Suresh Gaddi (1SI22CS047)
Harsha D T (1SI22CS065)
Harshith Kumar H S (1SI22CS067)

Course Outcomes

After successful completion of major project, graduates will be able:

CO1: To identify a problem through literature survey and knowledge of contemporary engineering technology.

CO2: To consolidate the literature search to identify issues/gaps and formulate the engineering problem

CO3: To prepare project schedule for the identified design methodology and engage in budget analysis, and share responsibility for every member in the team

CO4: To provide sustainable engineering solution considering health, safety, legal, cultural issues and also demonstrate concern for environment

CO5: To identify and apply the mathematical concepts, science concepts, engineering and management concepts necessary to implement the identified engineering problem

CO6: To select the engineering tools/components required to implement the proposed solution for the identified engineering problem

CO7: To analyze, design, and implement optimal design solution, interpret results of experiments and draw valid conclusion

CO8: To demonstrate effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and the four page IEEE/Springer/ paper format of the work

CO9: To engage in effective oral communication through power point presentation and demonstration of the project work

CO10:To demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics

CO11: To perform in the team, contribute to the team and mentor/lead the team

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO-1											3			
CO-2		3												
CO-3										3				
CO-4						3								
CO-5	3	3												
CO-6					3						3			
CO-7			3	3										
CO-8									3					
CO-9									3					
CO-10							3							
CO-11								3						
Average	3	3	3	3	3	3	3	3	3	3	3			

Attainment level:
1: Slight (low)
2: Moderate (medium)
3: Substantial (high)

POs:
PO1: Engineering knowledge,
PO2: Problem analysis,
PO3:Design of solutions,
PO4:Conduct investigations of complex problems,
PO5: Engineering tool usage,
PO6:Engineer and the world,
PO7:Ethics,
PO8:Individual and collaborative work,
PO9:communication,
PO10:project management and finance,
PO11: Life-long learning.

Abstract

The traditional examination system faces numerous challenges, including security breaches, paper leakage, and time-consuming manual grading processes. With the growing demand for online education and the necessity for secure assessment methods, there will be a critical need for a robust examination system that ensures the integrity of the entire examination process while offering efficient evaluation mechanisms. This project will aim to address these issues by implementing a blockchain-enabled secure MCQ examination system. The proposed system will be designed to develop a comprehensive examination platform that leverages blockchain technology to create an immutable and transparent record of examination data. It will provide a secure environment for conducting MCQ-based exams while enforcing role-based access control to manage permissions across different stakeholders such as students, teachers, and administrators.

The platform will ensure the authenticity of question papers, automate the grading process, and deliver real-time feedback to students. Special emphasis will be placed on preserving the confidentiality of both the examination content and results, while also ensuring that the platform remains easily accessible to authorized users. The implementation will make use of a modern and reliable technology stack, with React.js used for frontend development and Node.js alongside Express.js managing backend services. MongoDB will serve as the primary database for storing structured data. Blockchain integration will be achieved through the use of smart contracts that will verify and store examination-related data in a secure and tamper-proof manner.

The system will be developed following a modular architecture, with distinct components for user authentication, question paper management, exam creation, and result processing. Cloud-based deployment will be adopted to ensure scalability and high availability of the platform. Comprehensive testing will be carried out throughout the development lifecycle to validate all security mechanisms and ensure a smooth user experience. By combining blockchain security, automated grading, and modern web technologies, this system will set a new standard for the integrity and efficiency of online examinations.

Contents

List of Figures

Chapter 1
Introduction

The evolution of technology has profoundly transformed education, reshaping how knowledge is delivered and assessed. Despite widespread adoption of digital tools in teaching and learning, examination systems in many institutions still rely on traditional, manual processes. These conventional methods are often time-consuming and vulnerable to threats such as question paper leaks, impersonation, unauthorized access, and result tampering. Such vulnerabilities undermine the integrity of academic assessments and diminish trust in the examination process.

With the increasing demand for remote learning and online education, the need for a secure, scalable, and fully online examination system has become critical. Institutions must conduct exams digitally while ensuring data privacy, security, and authenticity. Manual evaluation, especially for large student populations, is inefficient and prone to human error. These challenges call for a modern, technology-driven solution that enhances the safety, transparency, and efficiency of online examinations.

This project proposes a blockchain-enabled secure examination platform designed exclusively for online assessments, with a focus on Multiple Choice Question (MCQ) formats. Blockchain technology, with its decentralized and tamper-proof ledger, guarantees the integrity and traceability of examination data. Leveraging this technology, the platform secures question papers, answer submissions, and results from unauthorized access or alteration.

Teachers can create and upload MCQ obased question papers, which are encrypted using cryptographic methods enhanced by deep learning models for maximum confidentiality. To safeguard against data theft or manipulation, question papers are divided into encrypted chunks and stored locally rather than on a public blockchain. Administrators review and finalize the question papers, while students access exams only at scheduled times via a secure interface.

After students complete their exams, their answers and marks are encrypted, hashed, and stored on the blockchain to prevent tampering. The platform uses modern web technologies, including React.js for the frontend, Node.js and Express.js for backend services, and MongoDB for data storage. User authentication employs JWT tokens with passwords secured using bcrypt encryption. Smart contracts automate and verify examination data securely on the blockchain.

In summary, this project aims to modernize online examinations by addressing key issues of security, efficiency, and transparency. By integrating blockchain with deep learning-enhanced encryption and a scalable system design, the platform offers educational institutions a trustworthy and flexible solution for conducting secure, reliable online assessments.

1.1 Motivation

The motivation behind this project arises from the following key factors:

- **Growing adoption of online education:** The shift towards remote learning demands reliable and secure digital examination systems.
- **Security vulnerabilities in traditional exams:** Issues such as question paper leaks, impersonation, unauthorized access, and result tampering compromise academic integrity.
- **Limitations of existing digital exam platforms:** Many current solutions struggle with data privacy, authentication, and scalability challenges.
- **Potential of blockchain technology:** Blockchain offers a decentralized, tamper-proof ledger that can ensure data integrity and transparency.
- **Enhancing confidentiality with deep learning:** Integrating deep learning-enhanced encryption strengthens the security of sensitive exam materials.
- **Need for scalable, efficient systems:** Educational institutions require platforms that can securely manage large student populations and automate evaluation processes.
- **Restoring trust in online assessments:** A secure, transparent system can rebuild confidence among students, educators, and institutions.

This project aims to address these challenges by developing a secure, efficient, and scalable online examination platform leveraging blockchain and advanced encryption techniques.

1.2 Objective of the Project

The primary objective of this project is to design and develop a secure, reliable, and scalable online examination platform that leverages blockchain technology to ensure the integrity, confidentiality, and transparency of exam processes. Specifically, the platform aims to:

- Securely manage question paper creation, encryption, and distribution.
- Prevent unauthorized access, question paper leaks, and result tampering.
- Automate secure storage of exam answers and results on a tamper-proof blockchain ledger.
- Provide a user-friendly interface for teachers, administrators, and students.
- Enhance data security using deep learning-based encryption techniques.
- Facilitate efficient and transparent online assessment management for educational institutions.

1.3 Organisation of the Report

This project report is organized into five main chapters. Chapter 1 introduces the project by presenting its motivation, objectives, and an overview of the report structure. Chapter 2 provides a detailed literature survey covering existing examination systems, blockchain technology, and encryption techniques relevant to this work. Chapter 3 describes the system overview, including the architecture, key components, and critical system equations such as JWT token generation, password hashing with bcrypt, and question paper verification. Chapter 4 explains the system architecture and high-level design by outlining software requirements, both functional and non-functional, as well as the overall system workflow. Finally, Chapter 5 concludes the report by summarizing the project work and discussing possible future enhancements. The report also includes a bibliography section listing the references and an appendix presenting the project planning and timeline for better insight into the project execution.

Chapter 2
Literature Survey

S.No	Title of the Article	Year	Author & Publisher	Inference
1	Blockchain-based Competitive Examination System in India: Preventing Paper Leaks and Mitigating Frauds	2024	Anush D Kamble, Deepak A Kamble; International Journal of Innovative Research in SCIENCE — ENGINEERING — TECHNOLOGY (IJIRSET)	This paper proposes a blockchain-based solution to address major issues in the Indian Education System, such as question paper leaks, cheating, and fraud in competitive exams. By leveraging decentralized ledger technology, the system enhances transparency, security, and immutability across the examination process. It prevents unauthorized access to question papers, ensures result authenticity, and maintains a tamper-proof record of activities, reducing reliance on intermediaries. Cryptographic techniques and smart contracts secure data, authenticate users, and automate processes from registration to result declaration, promoting fairness and credibility.
2	A Proposed Model for Improving the Reliability of Online Exam Results Using Blockchain	2023	Mohamed Abdelsalam, Marwan Shokry, Amira M. Idrees; IEEE Access	The paper integrates blockchain with Moodle LMS to secure exam data. It ensures tamper-proof storage using Ethereum smart contracts and MetaMask. This decentralized model improves transparency, prevents manipulation, and enhances trust in online assessment outcomes through secure student authentication and data integrity.

S.No	Title of the Article	Year	Author & Publisher	Inference
3	An advanced and secure framework for conducting online examination using blockchain method	2023	Md Rahat Ibne Sattar, Md. Thowhid Bin Hossain Efty, Taiyaba Shadaka Rafa, Tusar Das, Md Sharif Samad, Abhijit Pathak, Mayeen Uddin Khandaker, Md. Habib Ullah; Elsevier B.V. on behalf of KeAi Communications Co., Ltd.	The article presents a secure online examination framework integrating blockchain, AI, and Remote Desktop Protocol (RDP) to tackle challenges like identity fraud and cheating during the COVID-19 pandemic in Bangladesh. It features AI-based face recognition, 360° monitoring, noise detection, encrypted and shuffled questions, and plagiarism checks. Results are immutably stored on the blockchain. While the system enhances security and transparency, it also poses concerns regarding internet reliability, privacy, and implementation cost..
4	Smart Contract enabled Online Examination System Based in Blockchain Network	2021	Mr. Apoorv Jain, Dr. Arun Kumar Tripathi, Naresh Chandra, P. Chinnasamy; IEEE (from the 2021 International Conference on Computer Communication and Informatics (ICCCI))	This paper presents an Ethereum-based online exam system that uses Smart Contracts to enhance data security, transparency, and authentication. It supports secure registration, MetaMask fee payment, and exam data transfer via smart contracts. The system offers a decentralized, tamper-proof alternative to traditional methods using Proof-of-Stake consensus.
5	Secure Online Examination with Biometric Authentication and Blockchain-Based Framework	2021	Xiaoling Zhu, Chenglong Cao; Published in Mathematical Problems in Engineering (Hindawi)	This paper proposes SEBB, an online exam system integrating biometric authentication and blockchain. It uses a fuzzy vault to protect facial data, attribute-based encryption for access control, and consortium blockchain to log evidence. The approach enhances privacy, integrity, and dispute resolution without relying on a central authority.

S.No	Title of the Article	Year	Author & Publisher	Inference
6	A Blockchain-based File-sharing System for Academic Paper Review	2020	Ian Zhou, Imran Makhdoom, Mehran Abolhasan, Justin Lipman, Negin Shariati; IEEE	This paper proposes a blockchain-based double-blind peer-review system to tackle common issues in academic publishing, such as slow processes, high costs, and reviewer bias. The system integrates Hyperledger Fabric blockchain for secure transactions and access control, and the InterPlanetary File System (IPFS) for efficient, distributed storage of documents, thus reducing blockchain storage requirements. It introduces "AcadCoin," a novel cryptocurrency, to incentivize and compensate reviewers, addressing their opportunity cost. The immutability of the blockchain also helps in ensuring transparent review metrics and reducing bias.
7	Online Test and Management System using Blockchain Network	2019	Seung Jae Pee, Eung Seon Kang, Jae Geun Song, Ju Wook Jang – International Conference on Advanced Communications Technology (ICACT)	This paper presents a blockchain-based online examination system that ensures data integrity, confidentiality, and reliability. It introduces CP-ABE for role-based access control, allowing only authorized users to encrypt or decrypt data. The system uses smart contracts for automated grading and prevents unauthorized modifications, making it highly secure against tampering and failures in centralized systems.

Chapter 3
System Overview

The Blockchain-Enabled Secure MCQ Examination System is a web-based platform that integrates blockchain technology to ensure examination integrity and security. The system follows a three-tier architecture with role-specific interfaces for students, teachers, and administrators. The application layer manages core functionalities including authentication, question management, exam creation, and result processing, while MongoDB handles data storage. Security is implemented through JWT authentication, role-based access control, and blockchain verification. The system automates exam creation, conduction, and grading processes, while smart contracts on the Ethereum blockchain provide immutable records of examination data. This architecture enables a secure, efficient, and user-friendly platform for conducting MCQ examinations while maintaining data integrity and security.

3.1 System Architecture Overview

The system architecture is illustrated in Figure 3.1, showing the three-tier structure of our Blockchain-Enabled Secure MCQ Examination System. The architecture demonstrates the flow of data from the client interface through the application layer to the database and blockchain network.

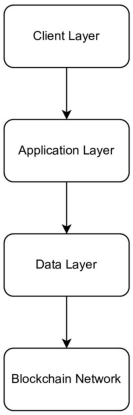

Figure 3.1: System Architecture Overview

3.2 System Components

The main components of the system are shown in Figure 3.2, which displays the interaction between different modules including user management, question bank, exam creation, and blockchain verification.

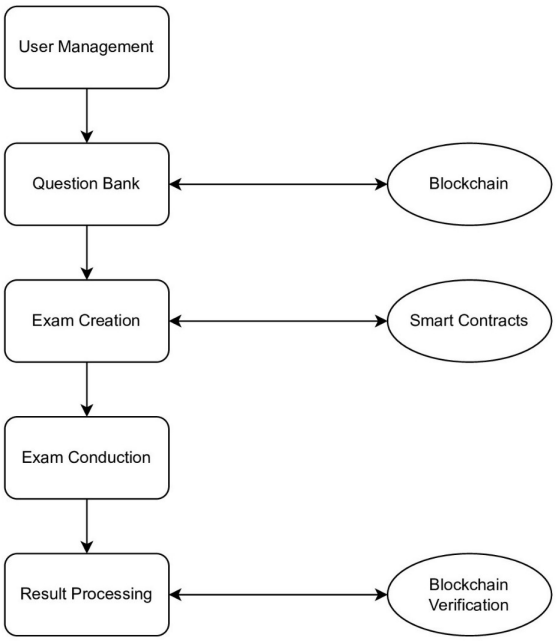

Figure 3.2: System Components Interaction

3.3 System Equations

This section presents the mathematical foundations and equations relevant to the secure online examination system based on blockchain. These include cryptographic hashing, block generation, and authentication formulas.

3.3.1 JWT Token Generation (Used for Authentication)

A hash function is used to map data of arbitrary size to fixed-size values. It is a one-way function represented as:

$$\text{Token} = \text{JWT.sign}(\ \{\text{id: user.id, secretKey, expiresIn: '24h'}\}) \tag{3.1}$$

Where:

- $user.id$ = User's unique identifier
- $secretKey$ = JWT secret from environment variables
- $expiresIn$ = Token expiration time

3.3.2 Password Hashing (Using bcrypt)

$$\text{HashedPassword} = \text{bcrypt.hash(password, saltRounds)} \tag{3.2}$$

Where:

- $password$ = User's plain text password
- $saltRounds$ = Number of encryption rounds (set to 8)

3.3.3 Question Paper Hash (For Verification)

$$\text{QuestionHash} = \text{SHA-256}(\text{questionId} + \text{timestamp} + \text{nonce}) \tag{3.3}$$

Where:

- $questionId$ = Unique identifier of the question
- $timestamp$ = Current timestamp
- $nonce$ = Random number for uniqueness

Chapter 4
System Architecture and High Level Design

The MCQ Examination System is built on a modern three-tier architecture comprising a React.js frontend, Node.js backend, and MongoDB database, with blockchain integration for enhanced security. The frontend provides role-specific interfaces for students, teachers, and administrators, featuring responsive design and real-time updates. The backend implements RESTful APIs using Express.js, handling authentication, business logic, and blockchain verification.

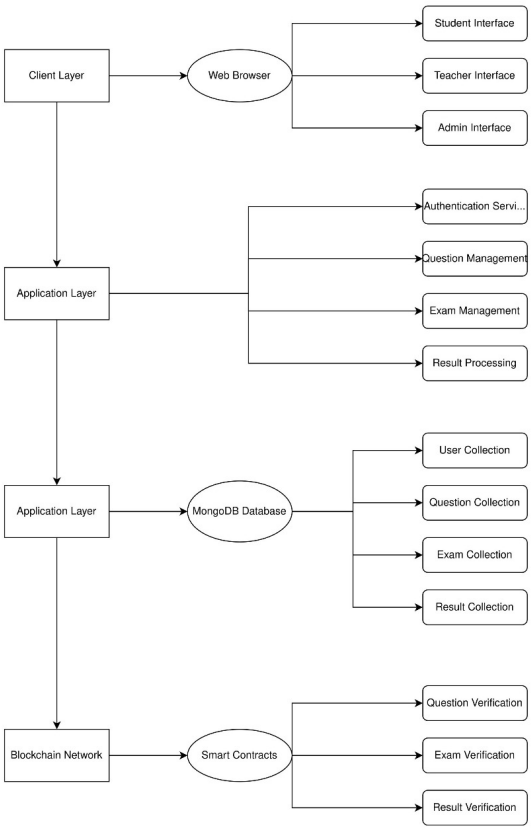

Figure 4.1: System Architecture

4.2 Software Requirements

4.2.1 Functional Requirements

Only project-specific functional requirements are included, each with **shall** tags:

1. **User Management**

4.1 System Workflow

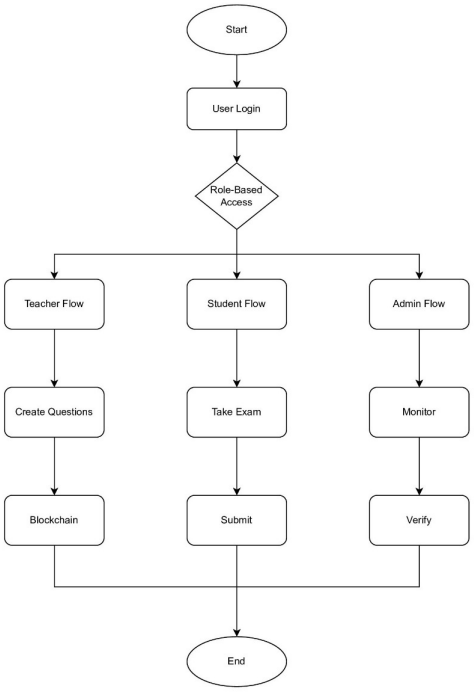

Figure 4.2: System Workflow

- The system shall provide role-based access control for students, teachers, and administrators.
- The system shall implement secure user authentication using JWT tokens.
- The system shall allow users to update their profile information.

2. **Question Management**

- The system shall allow teachers to create and manage MCQ questions.
- The system shall validate question content and format.
- The system shall store question hashes in blockchain for verification.

3. **Exam Management**

- The system shall enable teachers to create and schedule exams.
- The system shall automatically generate question papers.
- The system shall implement time-based exam access control.

4. **Exam Taking**

- The system shall provide a secure interface for students to take exams.

- The system shall save exam progress automatically.
- The system shall prevent multiple submissions.

5. **Result Processing**
   - The system shall automatically grade MCQ answers.
   - The system shall calculate and display results.
   - The system shall store results in blockchain for verification.

4.2.2 Non-Functional Requirements

- **Performance Requirements**
  - The system shall handle at least 100 concurrent users.
  - The system shall respond to user requests within 2 seconds.
  - The system shall process exam submissions within 5 seconds.
- **Security Requirements**
  - The system shall encrypt all sensitive data using AES-256.
  - The system shall implement rate limiting for API endpoints.
  - The system shall prevent unauthorized access to exam content.
- **Reliability Requirements**
  - The system shall maintain 99.9% uptime.
  - The system shall implement automatic backup of examination data.
  - The system shall provide error recovery mechanisms.
- **Scalability Requirements**
  - The system shall support horizontal scaling of application servers.
  - The system shall handle increasing database load.
  - The system shall support multiple blockchain nodes.
- **Usability Requirements**
  - The system shall provide an intuitive user interface.
  - The system shall support multiple devices and screen sizes.
  - The system shall provide clear error messages and user feedback.

Chapter 5
Conclusion

This chapter presents the conclusion of the project by summarizing the work carried out and outlining the potential for future enhancement. The project titled *"Blockchain-Enabled Secure Online Examination Platform"* is being developed with the objective of designing a secure, transparent, and tamper-proof examination system suitable for conducting online assessments. The platform aims to eliminate vulnerabilities found in traditional examination systems, such as question paper leaks and result manipulation, by integrating blockchain technology and advanced encryption methods.

5.1 Summary of the Project Work

The project aims to create a secure and decentralized online examination platform specifically designed for MCQ-based assessments. The system addresses challenges such as unauthorized access, impersonation, and result tampering by utilizing a blockchain ledger to record and verify examination data. The frontend is developed using React.js, offering an intuitive user interface for students, teachers, and administrators. The backend is powered by Node.js and Express.js, with MongoDB handling data storage. Teachers can create MCQ question papers, which are then encrypted using deep learning-enhanced cryptographic techniques and divided into chunks for secure local storage. The system ensures that students only gain access to exams during scheduled windows through an authenticated and time-bound interface. Upon completion, students' responses are encrypted, hashed, and recorded on the blockchain to maintain integrity and immutability. JWT tokens are used for secure user sessions, and bcrypt is employed for password protection. Although development is still underway, the architectural design and key components have been strategically planned and partially implemented to ensure the final product meets goals of security, scalability, and reliability.

5.2 Scope for Future Work

- **Integration of Zero-Knowledge Proofs (ZKPs):** Implementing ZKPs would allow the system to verify students' identities and responses without actually revealing the data, providing stronger privacy in authentication and result validation.
- **Smart Contract-Based Grading Automation:** Extend the use of blockchain smart contracts to automatically grade MCQ answers and release results only when verification and integrity checks pass successfully.
- **Interoperability Across Institutions:** Develop features that allow multiple insti-

tutions to securely host and access exam data across a shared blockchain, supporting collaborative evaluations or centralized government-led examination systems.

- **Blockchain Sharding and Performance Scaling:** Investigate blockchain sharding or sidechains to improve scalability and reduce latency for high-traffic exam scenarios with thousands of concurrent users.
- **Student Progress Analytics:** Incorporate blockchain-audited analytics for generating tamper-proof insights on student performance over time, assisting in personalized learning strategies.
- **AI-Powered Cheating Detection:** Integrate AI models (possibly using vision and behavioral analysis) for detecting cheating patterns during exams, especially when using webcam-based proctoring systems in the future.
- **Offline-to-Online Transition Support:** Although the current system is online-only, future extensions might offer a secure bridge for institutions that still rely partially on offline infrastructure but want to sync securely with a blockchain backend.
- **Mobile App Integration:** A future mobile application version could enhance accessibility and support secure exam access on smartphones or tablets, especially useful in remote or under-resourced areas.

Bibliography

[1] Anush D. Kamble, Deepak A. Kamble, "Blockchain-based Competitive Examination System in India: Preventing Paper Leaks and Mitigating Frauds," *International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)*, 2024. doi:10.15680/IJIRSET.2024.1308080.

[2] Mohamed Abdelsalam, Marwan Shokry, Amira M. Idrees, "A Proposed Model for Improving the Reliability of Online Exam Results Using Blockchain," *IEEE Access*, 2023. doi:10.1109/ACCESS.2023.3304995.

[3] Md Rahat Ibne Sattar, Md. Thowhid Bin Hossain Efty, Taiyaba Shadaka Rafa, Tusar Das, Md Sharif Samad, Abhijit Pathak, Mayeen Uddin Khandaker, Md. Habib Ullah, "An Advanced and Secure Framework for Conducting Online Examination Using Blockchain Method," *Elsevier B.V. on behalf of KeAi Communications Co., Ltd*, 2023.

[4] Apoorv Jain, Arun Kumar Tripathi, Naresh Chandra, P. Chinnasamy, "Smart Contract Enabled Online Examination System Based on Blockchain Network," *IEEE, International Conference on Computer Communication and Informatics (ICCCI)*, 2021.

[5] Xiaoling Zhu, Chenglong Cao, "Secure Online Examination with Biometric Authentication and Blockchain-Based Framework," *Mathematical Problems in Engineering (Hindawi)*, 2021.

[6] Imran Mehran, Abolhasan, Justin Lipman, Negin Shariati, "A Blockchain-based Filesharing System for Academic Paper Review," *IEEE*, 2020.

[7] Seung Jae Pee, Eung Seon Kang, Jae Geun Song, Ju Wook Jang, "Online Test and Management System Using Blockchain Network," *International Conference on Advanced Communications Technology (ICACT)*.

Appendix A
Project Planning

A.1 Project Timeline

Figure A.1: The Project Timeline.