



Development of a blockchain-based website application for storing certificate (Case study at Universitas Sultan Ageng Tirtayasa)



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ABSTRACT

Universitas Sultan Ageng Tirtayasa currently lacks a secure application to store digital certificates, including diplomas and academic transcripts, with an assurance of non-alteration. Consequently, a research study was conducted to develop a blockchain-based certificate storage on its website. The choice of blockchain technology was driven by its cryptographic security, immutability, distributed ledger, and decentralized features. The research aimed to identify stakeholder needs for website application development, design a blockchain-based website application for storing certificates, and assess the outcomes of testing this application. The research followed the System Development Life Cycle (SDLC) method, encompassing planning, analysis, design, implementation, and system testing stages. The stakeholders involved in this website application included university administrators responsible for uploading digital certificates, students accessing their own certificates, and companies verifying student credentials. The application was designed with rich images, use case diagrams, sequence diagrams, hierarchical charts, entity-relationship diagrams, and application specifications. The results of the System Usability Scale testing showed a score of 76.56, indicating that the application falls within the acceptable range and is deemed acceptable by users.

1. Introduction

The progress of technology is occurring so rapidly and extensively. Technological advancement is inseparable from the advancement of knowledge. This technological progress has led to fundamental changes in various aspects of life. The field of education is one of the areas that has experienced the most significant changes with the advancement of technology. Changes have taken place in the learning system and academic administration.

Despite technological advancements, there are still educational issues, and one of these issues is the forgery of diplomas and academic transcripts by certain individuals for specific purposes. A recent case at Semarang State University (Unnes) involved alleged forgery of diplomas and academic transcripts for undergraduate students. According to Unnes' official website, the diplomas and academic transcripts had names changed to individuals who were never registered as Unnes students. Diploma and academic transcript forgery constitutes a form of deception that leads to social deviations and criminal activities. Such cases of forgery have a detrimental impact on both

universities and companies. Forgery of diplomas and academic transcripts results in a decline in the quality of education and human resources in Indonesia.

Universitas Sultan Ageng Tirtayasa (Untirta) is one of the universities in Banten that has incorporated digital technology into its educational processes. However, currently, there is no system in place to manage students' diplomas and academic transcripts. Graduates typically receive physical diplomas and academic transcripts in person. The direct distribution of these documents poses a risk of forgery for specific purposes. If cases of diploma and academic transcript forgery were to occur, it could raise questions about the credibility and quality of Untirta. Therefore, there is a need for a reliable and secure system to store students' diplomas and academic transcripts.

Blockchain is a shared, secure, and decentralized record-keeping system where each user stores an immutable copy of the data that can only be changed once validated by all parties. Blockchain is the technology used to create cryptocurrencies like Bitcoin. It is a continuously growing database, referred to as blocks, which are linked and secured using cryptographic techniques.

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In the blockchain system, the authenticity of recorded files is ensured by multiple nodes supporting the network [1]. Since its inception, blockchain has undergone several phases of development. Simply put, the technological evolution of blockchain can be divided into three key phases: blockchain 1.0, which served as the foundation for digital currencies; blockchain 2.0, representing further development in the digital economy; and blockchain 3.0, marking the evolution of the digital economy toward a digital community congregation [2].

Blockchain is a foundational technology that records transactions in a decentralized, secure, transparent, and immutable manner. The decentralized nature of the blockchain system ensures that data is distributed to every user node, guaranteeing data authenticity, and reducing the risk of forgery [3]. Blockchain technology has proven effective in addressing issues such as data accuracy and transaction security. With the adoption of blockchain technology, there is hope that it can resolve educational challenges in Indonesia and revolutionize the global education sector, making it more efficient.

There have been several previous studies related to the application of blockchain technology. One of these studies was conducted by Faaroek in 2022, where an academic website was designed and built with digital certificate storage using blockchain technology as a means of certificate issuance and validation [4]. Blockchain technology was chosen for the research due to its capability to store data in a distributed ledger, ensuring secure and tamper-resistant data storage. Another study was conducted by Awaji and Solaiman in 2022. In their research, they designed, implemented, and evaluated a trustworthy system for recording student achievements in higher education based on blockchain [5]. The system created in their study facilitated a reliable, easy, and fast authentication and validation process for certificates by leveraging the unique capabilities of blockchain technology. As storage technology, blockchain ensures data permanence, safeguarding documents from forgery and modifications.

This research was conducted to develop a certificate storage website application for diplomas and academic transcripts using blockchain technology within the context of Sultan Ageng Tirtayasa University. The System Development Life Cycle (SDLC) method was employed as the framework for processing research data.

The blockchain-based website application for storing certificates at Sultan Ageng Tirtayasa University is intended for use by university administrators, graduated students, and companies. The primary goal of this application is to provide a secure storage platform for diplomas and academic transcripts, leveraging blockchain technology to ensure that the documents are securely stored and cannot be altered by any party. This certificate storage website application is designed for university administrators to upload digital diplomas and academic transcripts of graduated students. Subsequently, students can securely store

their digital diplomas and academic transcripts within this website application. Furthermore, companies can verify the diplomas and academic transcripts of Untirta students who apply for positions within their respective organizations.

2. Material and method

This research employs a quantitative approach with a development research type. Development research involves a systematic study of program, process, and product design, development, and evaluation that must meet validity, practicality, and effectiveness criteria. This aligns with the research's objective, which is to design a blockchain-based website application for storing certificates. The development of this certificate storage website application utilizing blockchain technology will follow the System Development Life Cycle (SDLC) method. The SDLC methodology is a structured process for creating and modifying a system, which includes stages such as planning, analysis, design, implementation, testing, and maintenance [6].

Based on the SDLC method, this research is conducted in five stages. The first stage is system planning, which involves identifying issues and determining the requirements for the website application's design using the 5W+1H approach (What, Who, When, Where, Why, and How). The second stage is system analysis, where the needs for the designed website application are determined using rich pictures.

The third stage is system design, which involves designing the system for the blockchain-based website application for storing certificates. This design process includes rich pictures, use case diagrams, sequence diagrams, hierarchical charts, entity-relationship diagrams, and application specifications. The fourth stage is system implementation, where the designed system is put into action. The fifth stage is system testing, which assesses the quality of the blockchain-based website application for storing certificates in terms of usability. This stage is conducted using a Usability Testing questionnaire (System Usability Scale).

3. Results and discussions

3.1. System planning

System planning is a phase or stage in which the basic process is carried out to understand the reasons why the system needs to be built [7]. When designing a blockchain-based website application for storing certificates, system planning aims to identify issues and determine the requirements for the website application. This stage is conducted through data obtained from observations and interviews with relevant parties.

Based on the data collected, problems are identified and presented in Table A1 (see [Appendices](#)). From Table A1, it is evident that there is currently no blockchain-based website application for storing certificates for diplomas and academic transcripts used within Universitas Sultan Ageng Tirtayasa.

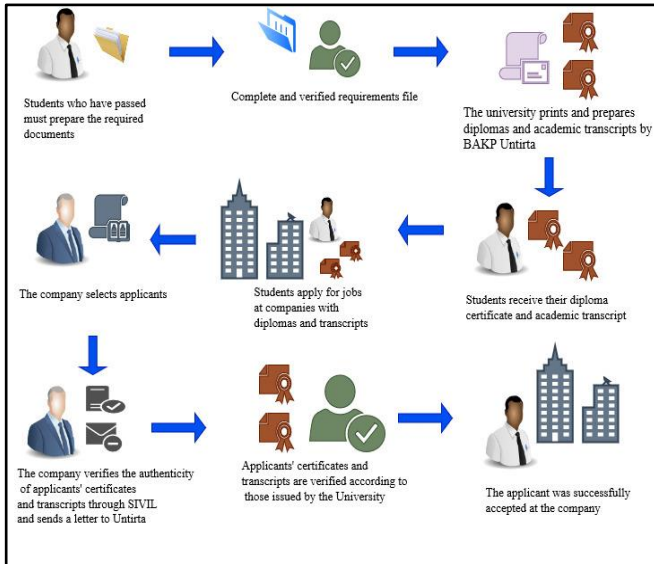


Figure 1. Process of obtaining diploma and academic transcript

Currently, students' diplomas and academic transcripts are still accepted directly, which makes them susceptible to forgery. This issue can be resolved by developing a blockchain-based website application for storing certificates that ensures data security and is less susceptible to hacking.

The purpose of this website application is to facilitate students in storing their diplomas and academic transcripts and to streamline the verification process for companies authenticating the certificates of students from Sultan Ageng Tirtayasa University. This website application simplifies the distribution and storage of students' certificates, making it both easier and more secure. The design of this certificate storage website application involves several stakeholders, including university administrators, students, and companies. The development of the website application is carried out using the System Development Life Cycle (SDLC) method.

3.2. System analysis

The system analysis stage involves analyzing the current system or process to determine the requirements for the designed website application. This stage is conducted using a rich picture. The following is a rich picture of the system for the blockchain-based website application for storing certificates.

Figure 1 illustrates the process flow of obtaining a diploma and academic transcript for students. The process commences with graduated students collecting the required documents. These documents undergo verification by the university's administration. If all the necessary documents are complete and accurate, the university's administration, specifically the BAKP department, proceeds to print or create the diploma and academic transcript for the student. Subsequently, the graduated student receives the diploma and academic transcript directly.

After obtaining their diploma and academic transcript, the graduated student can apply for jobs in companies, using these documents as part of their applications. The company conducts a selection process for job applicants, typically verifying the authenticity of the diploma and academic transcript. Companies may use SIVIL (Electronic Diploma Verification System) to verify the authenticity of the diploma, but currently, there is no application to check the academic transcript. Another option is to send a letter to the university to verify the authenticity of the diploma or academic transcript. Once the verification process for the diploma and academic transcript is completed, the company can make their decision regarding the applicant.

3.3. System design

System design is the stage where the system workflow is described. This stage determines how the system will operate, including hardware, software, network infrastructure (user interface), forms, and reports (required application databases and files) [8]. During this stage, rich pictures, use case diagrams, sequence diagrams, hierarchical charts, entity-relationship diagrams, and application specifications are used. The following is the design of a blockchain-based website application for storing certificates.

3.3.1. Rich Picture Diagram

A rich picture diagram illustrates a topic by depicting the relationships and interdependencies among its elements. It also clearly identifies the main activities and actors involved in those activities. Rich pictures are created using a variety of symbols, tailored to address the specific issues at hand [9]. Figure 2 displays a rich picture of the system for the blockchain-based website application for storing certificates.

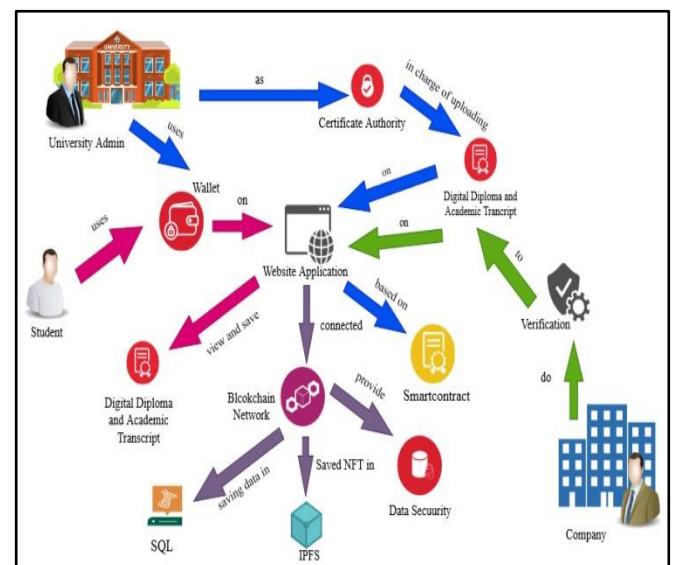


Figure 2. Rich Picture Diagram of the proposed design for the blockchain-based website application for storing certificates

Figure 2 illustrates the proposed design for a blockchain-based website application for storing certificates. The proposed design involves three stakeholders: university admins, students, and companies. University admins act as certificate authorities responsible for uploading diplomas and academic transcripts to the website application based on smart contracts. The website application utilizes blockchain storage, ensuring data security through its distributed nature. The application employs the Inter Planetary File System (IPFS) to store Non-Fungible Tokens (NFTs), namely digital diplomas and academic transcripts. Other data or information is stored using SQL (Structured Query Language). The second party, companies, can verify the diplomas and academic transcripts of students through the website application. Subsequently, students can utilize their wallet on the website application to view and store their certificates.

3.3.2. Use Case Diagram

The Use Case diagram is a diagram that illustrates the relationship between users and the designed application. Its purpose is to facilitate users in understanding the information provided. The Use Case diagram helps explain the benefits of the application to be designed from the perspective of people outside the system (actors) [10]. It represents the relationship between actors and use cases, with use cases describing the actions performed by actors [11]. Figure A1 (see Appendices) represents the use case diagram of the application, which shows three actors: university admin, student, and company. The university admin performs actions like sign up, login, upload document, view document list, and view company list. Students can sign up, login, view their profile, and access their own certificates. Companies can verify the student certificates.

3.3.3. Sequence Diagram

Sequence diagram is a diagram that provides a detailed representation of operations, messages sent, and the timing of occurrences. This diagram explains the interactions between objects inside and around the system, in the form of messages organized in a sequence of events performed by actors within the system. Sequence diagrams are used to depict scenarios or sequences of steps in response to activities that produce specific outputs [10]. Fig. A2-A13 (see Appendices) are some sequence diagrams that describe the designed application.

3.3.4. Hierarchical chart

The Hierarchical chart is a diagram that depicts a complex problem and then breaks it down into related elements. This diagram allows the decomposition of a specific system into multiple levels. With this diagram, it becomes easier to understand the operations and organizational structure that reflects the existing subordination relationships among each element [12].

The Hierarchical chart consists of modules that form a program. These modules are depicted as rectangular shapes and connected with lines. The control module is a high-level component that contains the logic to execute other modules. The components it calls and controls are referred to as subordinate modules [13]. Figure A12 (see Appendices) illustrates the hierarchical chart of the blockchain-based certificate storage application design. In the hierarchical chart, there are several control modules, namely application login, profile, certificates, certificate verification, document list, document upload, and company list. Additionally, there are also subordinate modules located below the control modules.

3.3.5. Entity Relationship Diagram

An Entity Relationship Diagram (ERD) is a diagram used to depict the conceptual design of a relational database. ERD connects real-world objects to each other [14]. In an ERD, related pieces of information are grouped within boxes called entities. Lines are used to represent the relationships between these entities. ERD comprises three main elements: entities, attributes, and relationships.

Figure A13 (see Appendices) illustrates the Entity Relationship Diagram for the blockchain-based website application designed for certificate storage. Within this ERD, there are several entity tables, including university admin, student, company, document, and student data. Each entity contains specific attribute data.

For example, the university admin entity includes attributes like id, uid, username, otpcode, updatedAt, and createdAt. The student entity contains attributes such as id, uid, username, password, createdAt, and updatedAt. The company entity holds attribute data like id, uid, company name, createdAt, and updatedAt. The document entity features attributes like id, uid, student ID (nim), name, study program, graduation date, recipient address, diploma, diploma hash, transcript, transcript hash, createdAt, and updatedAt. Finally, the student data entity comprises attributes like id, uid, name, nim, gender, email, study program, year of enrollment, graduation date, birthdate (ttl), thesis title, wallet address, createdAt, and updatedAt.

This ERD also illustrates the relationships between these entities. For example, the university admin can upload one or multiple documents, while one document can only be uploaded by one university admin. Each student is associated with one student data record and can store only one document. Companies can verify one or more student documents, and a document can be shown to one or more companies.

3.3.6. Application development

The back end of blockchain web-based application consists of software and hardware. The hardware and software used to develop the application is presented in Table 1.

Table 1.
Product specification

No	Component	Software
1	System interface	<ul style="list-style-type: none"> • Web Server: Apache • User data input forms: HTML
2	Dapps (Decentralized Apps)	<ul style="list-style-type: none"> • Front End: Next.js • Back End: Next.js • Database: mySQL
3	Blockchain	<ul style="list-style-type: none"> • Ledger: Polygon • IDE: REMIX IDE • Smart contract programming language: Solidity • Ethereum web client library: Ethers.js and Hard Hat • File storage: IPFS • Wallet: Metamask

For the web server interface system, Apache is employed. HTML (HyperText Markup Language) is used for data input forms. The decentralized application's front-end is developed with Next.js, the back end also uses Next.js, and the database is MySQL-based. The blockchain ledger utilized is the Polygon blockchain network. Polygon finds applications in various decentralized applications (DApps) including DeFi, DAOs, and NFTs. It operates on the Ethereum blockchain and serves to connect Ethereum-based projects [15]. The smart contracts are created using the Solidity programming language. In the application design, Ethers.js and Hard Hat serve as Ethereum web client libraries, and Metamask is the wallet used for this application. This website application is intended for three user groups, each with its own distinct data structure. Tables 2-4 show specific information about these users and their data structures.

Table 2.
Data filled by student

Label	Description	Format	Note
Username	UNTIRTA email	text	Manual filling
Password	Password	string	Manual filling
Full name	Student's full name	text	Manual filling
NIM	Student ID Number	number	Manual filling
Gender	The gender of the students	text	Manual filling
Major	Student major	text	Manual filling
Entry Year	Student entry year	number	Manual filling
Graduate date	Student graduation date	date	Manual filling
Address Wallet	Student metamask wallet address	text	Manual filling

Table 3.
Data filled by university admin

Label	Description	Format	Note
Student Name	Student who owns the NFT	text	Manual filling
Student ID number (NIM)	NFT Identification Number	number	Manual filling
Major	NFT owner student major	text	Manual filling
Graduate date	Student graduate date	date	Manual filling
Recipient Address Wallet	Student Address wallet Metamask	text	Manual filling
Diploma Files	Diploma	JPG	Manual filling
Academic Transcript Files	Academic transcripts	JPG	Manual filling

Table 4.
Data filled by company

Label	Description	Format	Note
Company Name	Company name	text	Manual filling
NIM	Student ID Number	number	Manual filling

A smart contract is a set of code and data implemented on the Ethereum platform [16]. Smart contracts operate on the blockchain network, ensuring that data is stored on a public database and cannot be altered. In the website application, the smart contract is designed to be invoked during the document upload process by the university. This smart contract comes into play when university administrators upload students' degree certificates and transcripts. It contains predefined agreements that must be met during the

document upload process. Once these conditions are satisfied, the smart contract functions automatically. One of its functions is 'make NFT,' which creates Non-Fungible Tokens (NFTs) – digital assets that can be bought and sold but have no physical form [17]. To create an NFT, the university admin needs to know the student's wallet address. For students, there's a 'mint' function that allows them to access and securely store their certificates of achievement. The smart contract also includes a function for storing NFTs in

ERC721URIStorage, which connects the smart contract with Pinata, the storage location for NFTs.

The InterPlanetary File System (IPFS) is a decentralized storage network designed for the distributed storage and retrieval of files, websites, applications, and data. Its peer-to-peer nature aims to enhance web speed, stability, and file sharing convenience by eliminating concerns related to hosting and bandwidth [18]. IPFS operates as a protocol, hypermedia, and file-sharing system within a peer-to-peer network, facilitating the storage and sharing of data in a distributed manner. Each piece of content stored in IPFS is assigned a Content Identifier (CID), which acts as a data fingerprint or hash of that content. IPFS and blockchain are often combined to store data such as images or videos, especially since blockchains aren't optimized for storing large data volumes. In our website application, we employ Pinata as the IPFS service. On the document list page, university administrators can access links to store degree certificates and transcript documents that have been converted into NFTs (Non-Fungible Tokens). These links correspond to the NFT addresses recorded on the blockchain network and signify the storage location for student diploma certificates and transcripts within Pinata.

3.4. System implementation

The implementation phase of the system involves putting the designed website application into practice. Figures A14 to A29 (see [Appendices](#)) display the results of implementing the blockchain-based website application for storing certificates.

3.5. System testing

System testing aims to evaluate the quality of the blockchain-based website application designed for storing certificates. Usability measures the application's ability to be user-friendly and align with user expectations, ensuring it can be easily used by users to achieve its intended purpose. Good usability indicates that an application meets these criteria. The System Usability Scale (SUS) is a reliable, popular, effective, and cost-efficient tool used for usability testing.

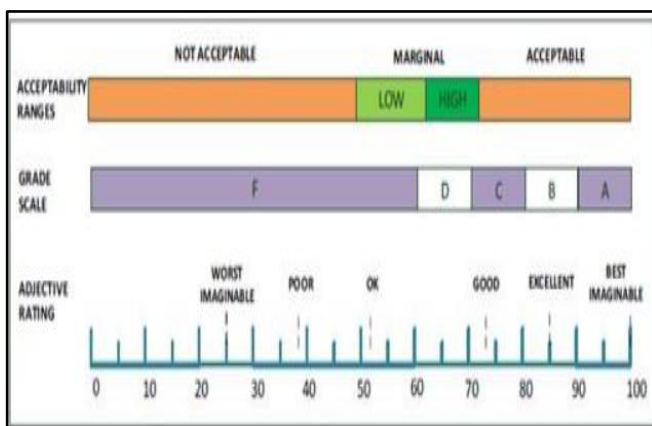


Figure 3. The result of system testing

It consists of 10 statement items, and respondents rate their agreement with each statement on a scale from 1 to 5, with 1 representing 'strongly disagree,' 2 as 'disagree,' 3 as 'neutral,' 4 as 'agree,' and 5 as 'strongly agree' [19]. After obtaining the final results of respondent assessments, the next step is to determine the grading of the assessment results, which can be done in two ways. The first method involves determining the grade based on user acceptance using the acceptability, grade scale, and adjective rating methods. The second method involves determining the grade based on the percentile range (SUS score) with assessments labeled as A, B, C, D, E, and F [20]. The following illustrates the assessment using the Acceptability, Grade Scale, and Adjective Rating methods.

Table A2 (see [Appendices](#)) shows the results of the SUS score calculation for the blockchain-based website application for storing certificates. The SUS score obtained is 76.56, indicating that this website application falls into the 'acceptable' category within the acceptability ranges assessment. Furthermore, from the perspective of the user's grade scale level, the application ranks in category C. In terms of the adjective rating from users, the website application for certificate storage is classified as 'Good.' Additionally, the second determination can be seen from the percentile range (SUS score), which has grading A, B, C, D, and E. With a SUS score of 76.56, the application receives grade B. This score is higher than the minimum usable system value of 68, indicating that the website application demonstrates good usability.

4. Conclusions

Based on the research conducted, the stakeholders involved in the blockchain-based website application for storing certificates, namely university administrators, students, and companies, have specific needs. University administrators require the ability to upload digital certificates for students. Students need to access and store their own digital certificates, and companies need to verify the certificates of Untirta students. The application is designed using various methods, including rich pictures, use case diagrams, sequence diagrams, hierarchical charts, entity relationship diagrams, and application specifications. The testing results of the blockchain-based website application for storing certificates yielded an SUS score of 76.56. According to the assessment criteria, the level of acceptability range for users towards the application falls under the "acceptable" category, indicating that it is well-received and accepted by users.

Declaration statement

Achmad Bahauddin: **Conceptualization, Methodology, Software and Resources, Supervision.** Putro Ferro Ferdinant: **Supervision, Visualization, Investigation.** Devalia Elisabeth: **Writing-Original Draft, Data Processing, Editing.** Tanti Ruwani: **Supervision.**

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Disclosure statement

The authors report there are no competing interests to declare.

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Data availability statement

The data that support the findings of this study are available from corresponding author upon reasonable request.

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Appendices

Table A1.
5W + 1H Identification

5W + 1H	Questions	Answer
<i>What</i>	What are the issues addressed in the development of a blockchain-based website application for storing certificate?	There is no blockchain-based certificate storage application for academic diplomas and transcripts at the scope of Universitas Sultan Ageng Tirtayasa.
<i>Who</i>	Who are the stakeholders involved in the development of the blockchain-based website application for storing certificate?	The stakeholders involved in the blockchain-based website application for storing certificate are university administrators, students, and companies.
<i>Why</i>	Why is it necessary to create such an application for certificate storage?	Blockchain technology is a distributed ledger technology widely used, where transactions involving value exchange, such as cryptocurrencies, tokens, or information, are sequentially grouped into blocks. Each block is connected to the previous block through a peer-to-peer network using cryptographic security and networking mechanisms. This provides blockchain technology with strong security and makes it difficult to be tampered with. The website application is created with the aim of simplifying access and storage of academic diplomas and transcripts for students, facilitating companies in verifying students' academic credentials, and assisting university administrators in distributing digital diplomas and transcripts to students through a more secure decentralized network. The website application is also developed to prevent cases of fraud or forgery of student diplomas and transcripts.
<i>When</i>	When was this research conducted?	This research was conducted from December 2022 to May 2023.
<i>Where</i>	Where is the scope of the design of the blockchain-based website application for storing certificate?	This blockchain-based website application for storing certificate was created within the scope of Universitas Sultan Ageng Tirtayasa, specifically within the Faculty of Engineering.
<i>How</i>	How was the development of the blockchain-based website application for storing certificate carried out?	The development of the blockchain-based website application for storing certificate is carried out using the SDLC (System Development Life Cycle) method. The development of this website application consists of several stages, namely system planning, system analysis, system design, system implementation, and system testing.

Table A2.
SUS Score Calculation Results

Variable	Positive Responses	Neutral Responses	Negative Responses	Mean Score (SD)
	n(%)	n(%)	n(%)	
Q1 - I will often use this website application.	12 (75)	3 (18,75)	1 (6,25)	2,81 (0,75)
Q2 - I think this website application is too complex (has unnecessary features).	13 (81,25)	2 (12,50)	1 (6,25)	3,06 (1,06)
Q3 - I find this website application easy to use.	16 (100)			3,69 (0,48)
Q4 - I need technical assistance in using this website application.	6 (37,5)	2 (12,5)	8 (50)	1,81 (1,22)
Q5 - I think the features on this website application are running well.	16 (100)			3,44 (0,51)
Q6 - I feel that there are many inconsistent applications on this website.	13 (81,25)	2 (12,50)	1 (6,25)	3,06 (0,85)
Q7 - I feel most people will find it easy to use this website application quickly.	15 (93,75)	1 (6,25)		3,44 (0,63)
Q8 - I find this website application confusing.	15 (93,75)		1 (6,25)	3,38 (0,81)
Q9 - I feel very confident in using this website application.	15 (93,75)	1 (6,25)		3,25 (0,58)
Q10 - I need to learn many things before I can use this website application.	11 (68,75)	4 (25)	1 (6,25)	2,69 (0,95)
Total Response	132 (82,5)	15 (9,375)	13 (8,125)	
Overall Mean Score				3,06 (0,53)
SUS Score				76,56

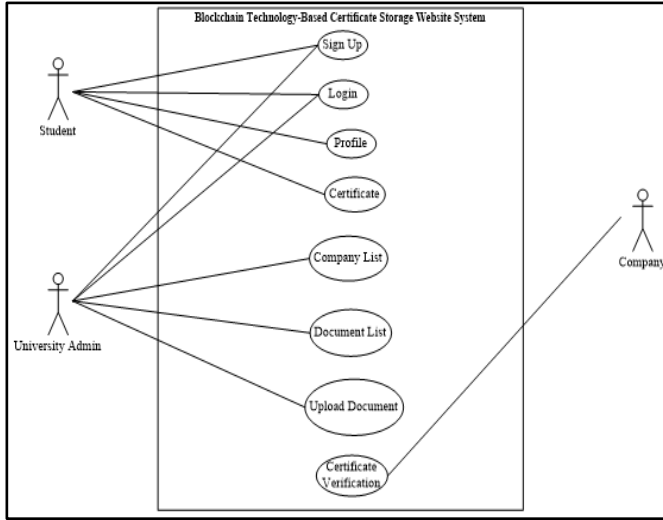


Figure A1. Use Case Diagram of the application

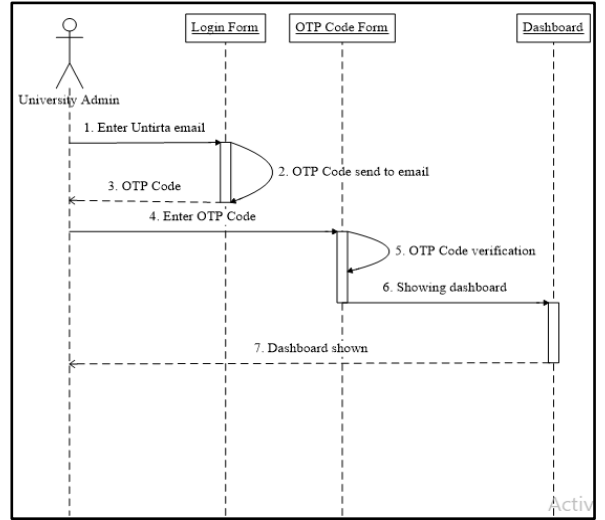


Figure A2. Sequence Diagram for admin login

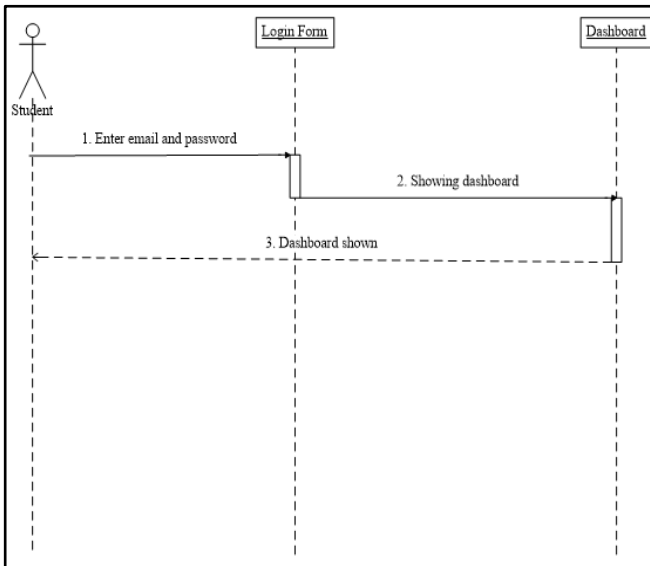


Figure A3. Sequence Diagram for student login

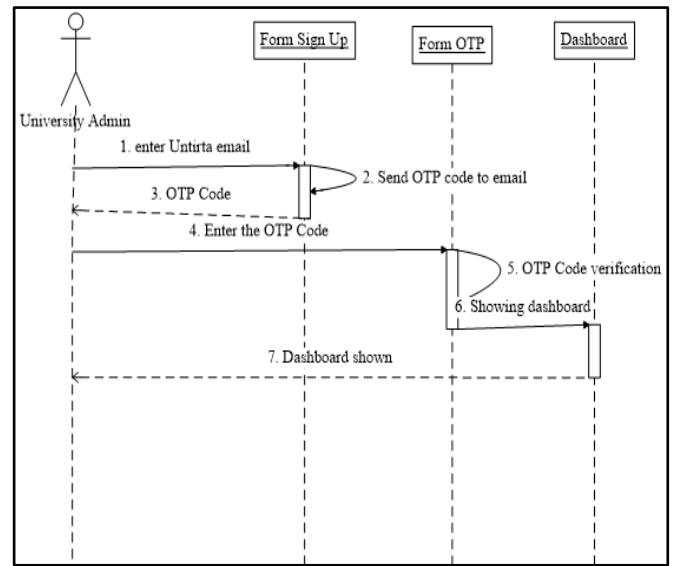


Figure A4. Sequence Diagram for university admin sign up

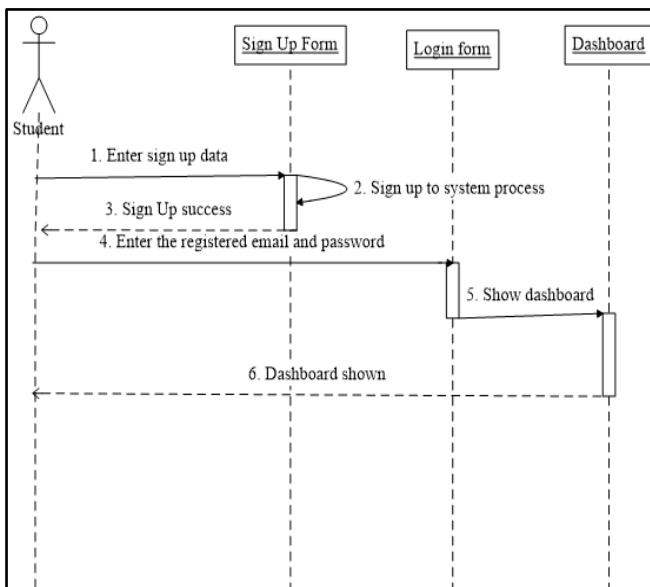


Figure A5. Sequence Diagram for student sign up

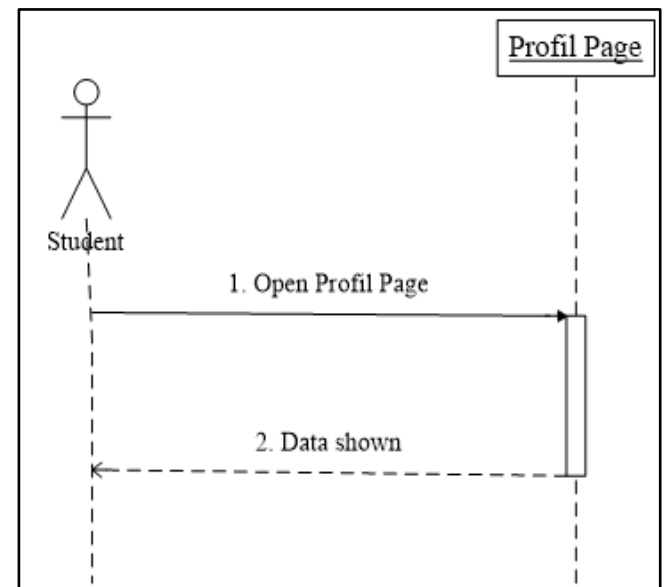


Figure A6. Sequence Diagram for profile

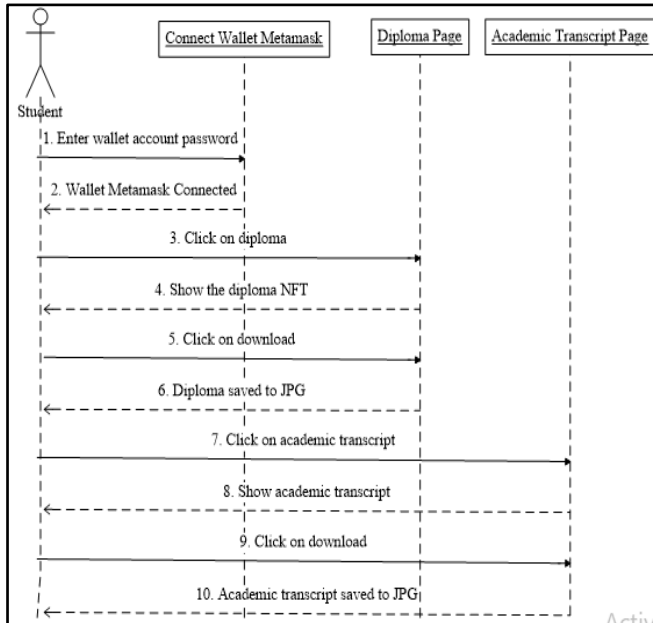


Figure A7. Sequence Diagram for certificates

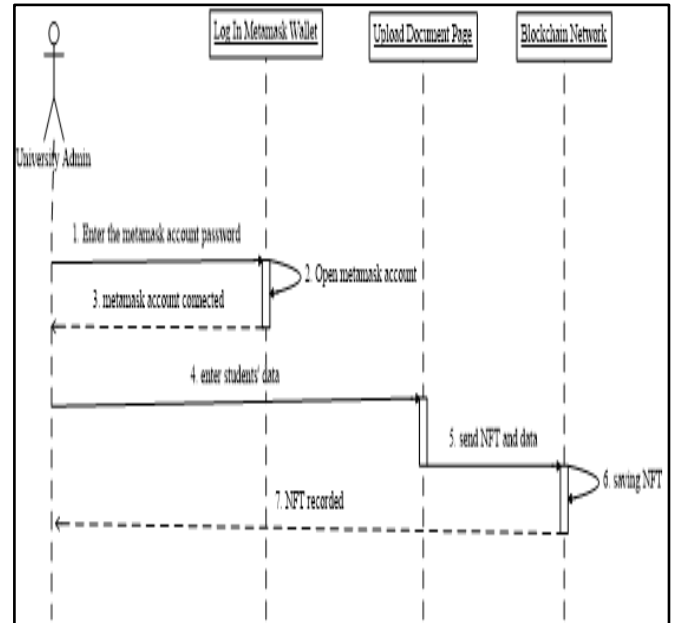


Figure A8. Sequence Diagram for document upload

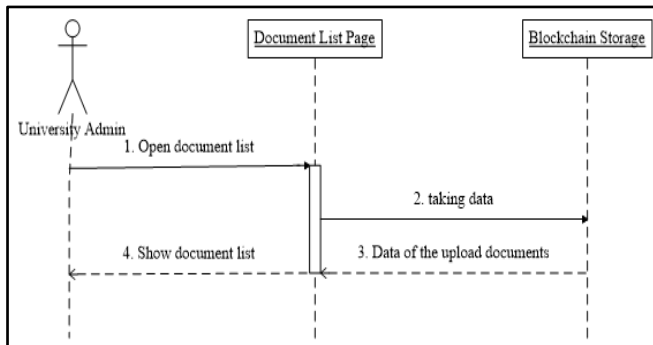


Figure A9. Sequence Diagram for document list

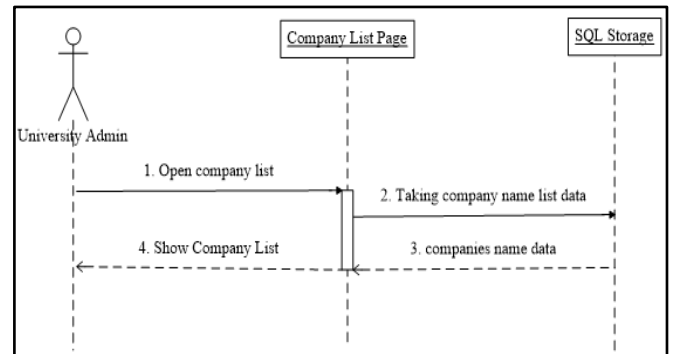


Figure A10. Sequence Diagram for company list

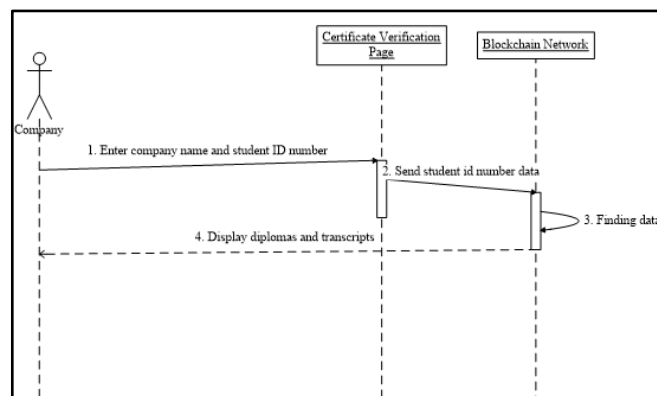


Figure A11. Sequence Diagram for certificate verification

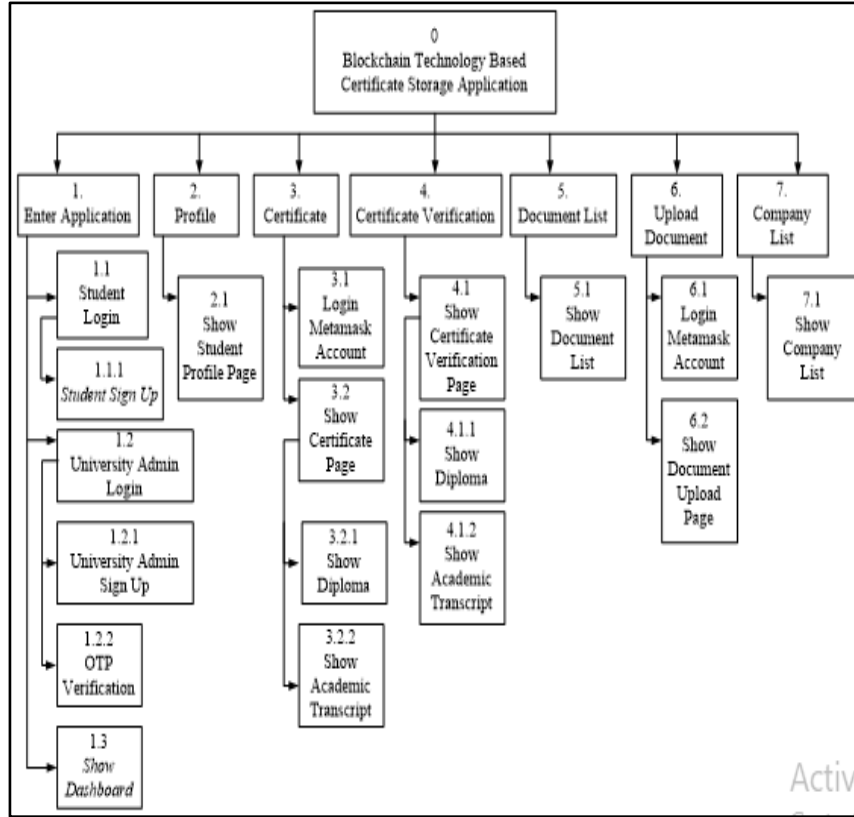


Figure A12. Hierarchical Chart of the application design

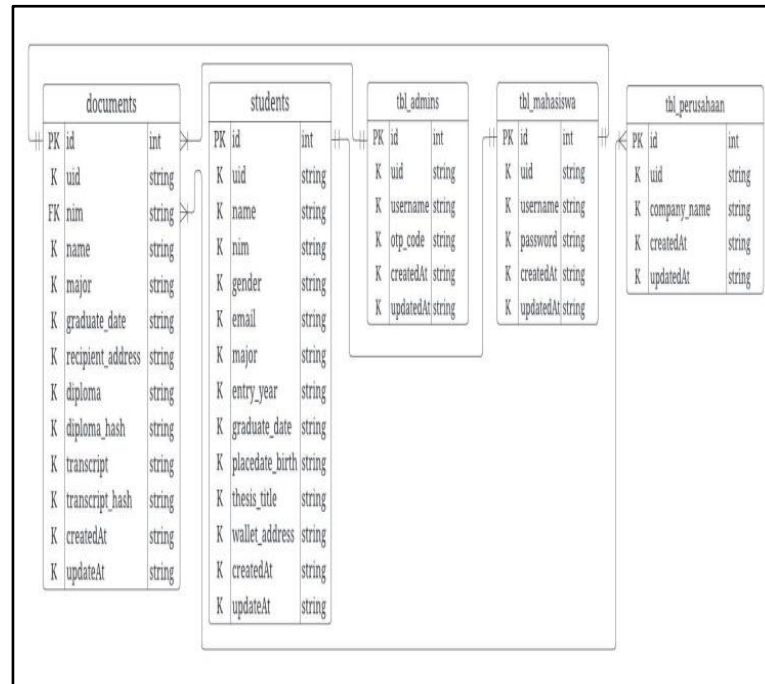


Figure A13. Entity Relationship Diagram of the blockchain-based website application for storing certificate



Figure A14. System home page

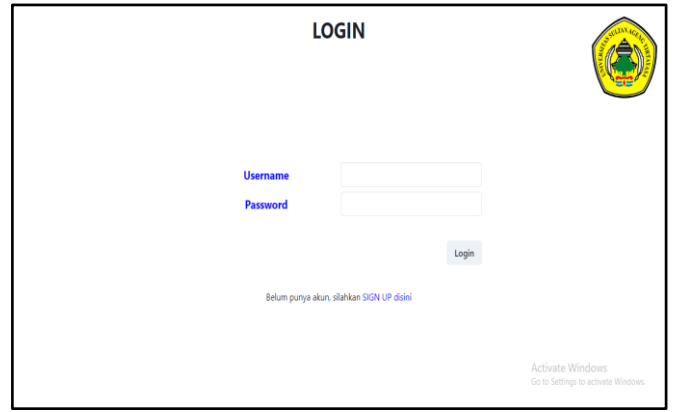


Figure A15. Student login page

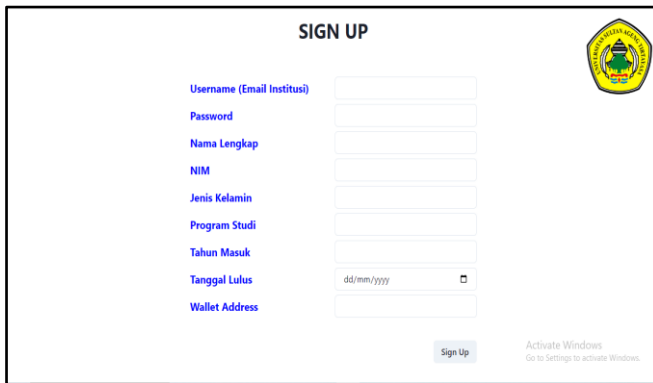


Figure A16. Student sign up page



Figure A17. Student dashboard page

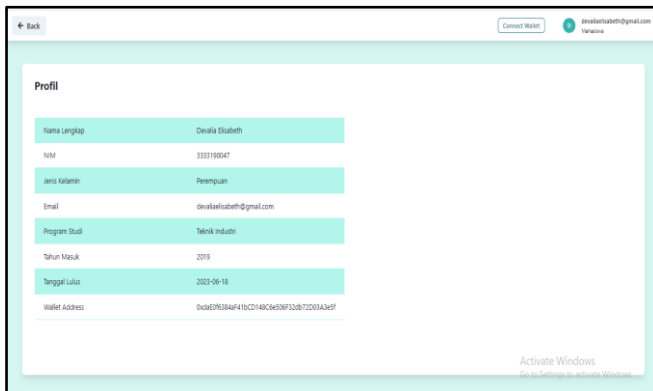


Figure A18. Student profil page

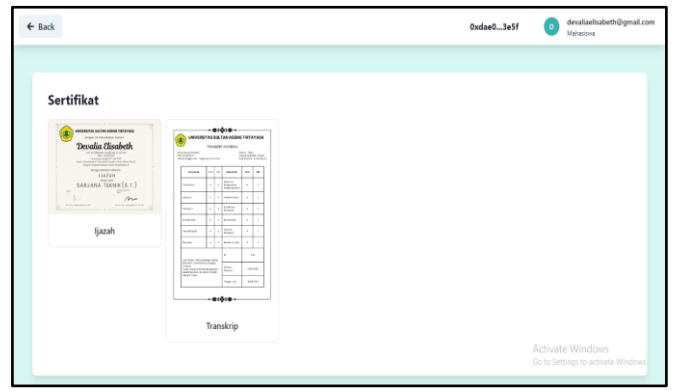


Figure A19. Student certificate page



Figure A20. Student diploma page

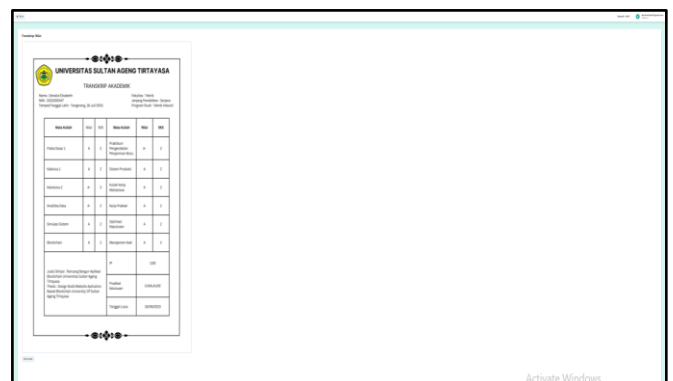


Figure A21. Student academic transcript page



Figure A22. University admin login page



Figure A23. University admin sign up page

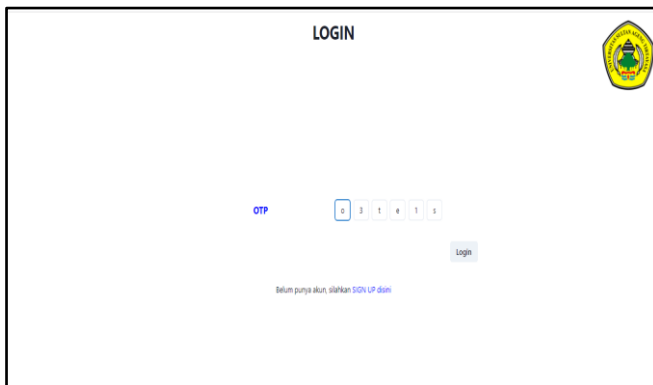


Figure A24. OTP code verification page

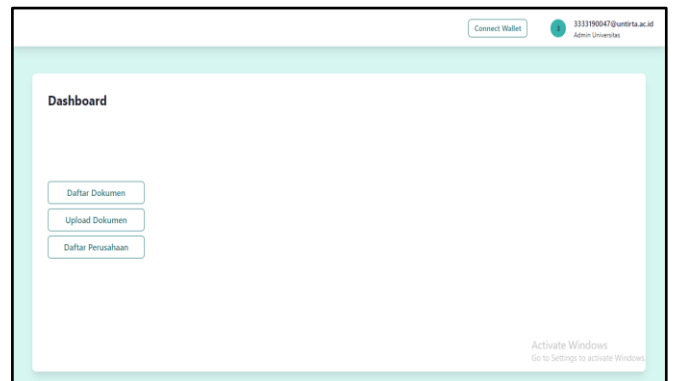


Figure A25. University admin dashboard page

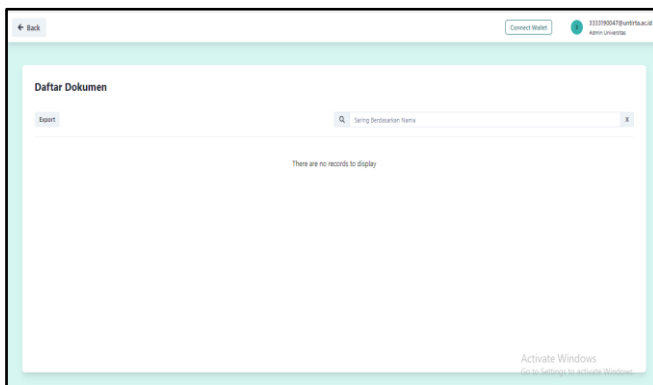


Figure A26. Document list page

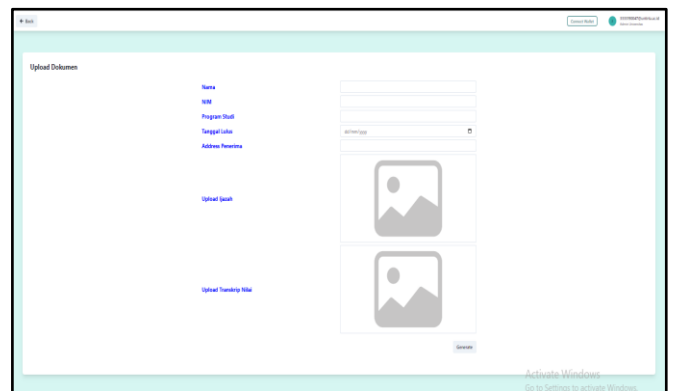


Figure A27. Document upload page

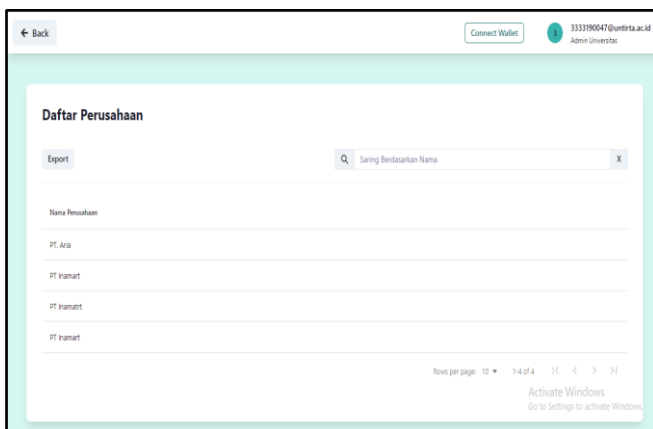


Figure A28. Company list page

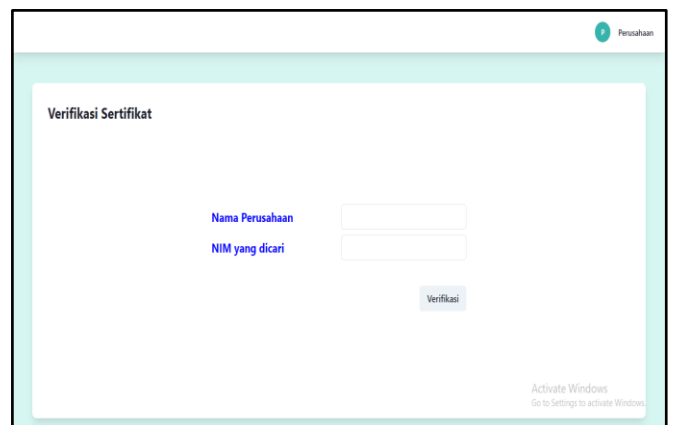


Figure A29. Certificate verification page