Sri Lanka Intelligent Bus Navigation and Passenger Information System

24-25J-237

Project Proposal Report

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B.Sc. (Hons) Degree in Information Technology Specialized in Information Technology

Faculty of Computing

Sri Lanka Institute of Information Technology

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DECLARATION

Declaration

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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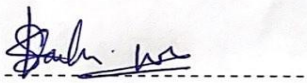

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ABSTRACT

Imagine navigating Sri Lanka's public transportation, particularly its bus ticketing, and feeling the frustration of long waits and frequent errors. Many passengers have experienced this hassle firsthand, with outdated ticketing methods slowing down the process and often causing mistakes that lead to unnecessary stress.

To tackle these issues, this research explores a fresh approach by introducing Near Field Communication (NFC) technology and blockchain into the ticketing system. NFC is that nifty tech that lets you tap your card or smartphone to make payments instantly and effortlessly. No more fumbling for change or dealing with paper tickets. It's quick, contactless, and cuts down on errors, making the whole process smoother and more reliable.

Blockchain, on the other hand, is like a digital ledger that keeps all transactions secure and transparent. It's temper-proof, meaning you can trust that your ticket purchase is safe from fraud. Plus, with blockchain, every transaction has a verifiable history, so there's complete transparency. The system could even introduce perks like loyalty rewards for frequent riders and categorize passengers to personalize their experience, keeping them more engaged and satisfied.

A survey conducted as part of this research found that people are eager for these kinds of improvements. They want quicker payments, real-time bus tracking, better security, and shorter waits. The proposed system directly addresses these needs by blending NFC and blockchain, with the bonus of a rewards program and passenger categorization.

This research also points out a gap in previous studies that often looked at these technologies separately. By merging them into one streamlined platform, this system has the potential to revolutionize Sri Lanka's public transportation. It promises to make bus rides not only more efficient and secure but also more enjoyable and rewarding for passengers, while also boosting the overall effectiveness of the transportation services.

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LIST OF ABBREVIATION

Abbreviation	**Description**
NFC	Near Field Communication
ID	Identification
TXID	Transaction ID
CTB	Ceylon Transport Board
SDLC	Software Development Life Cycle
AES	Advanced Encryption Standard
JWT	JSON Web Token

1. INTRODUCTION

1.1 Background & Literature Survey

Sri Lanka's bus ticketing system faces some real challenges, like inefficiency, frequent errors, and overall inconvenience for passengers. The traditional way of buying tickets often takes too long and is prone to mistakes, leaving many passengers feeling frustrated and fed up. These issues highlight the need for a more modern, reliable, and user-friendly solution.

To tackle these problems, integrating Near Field Communication (NFC) technology [1] and blockchain has been suggested. With NFC, passengers can simply tap a card to buy a bus ticket quickly and effortlessly, making the ticketing process faster and less error prone. No more long waits or dealing with incorrect ticketing.

Blockchain technology [2] adds another layer of improvement by making transactions more secure and transparent. It acts as a decentralized, tamper-proof record of all transactions, which helps reduce fraud and build trust among users. Using Bitcoin as the cryptocurrency in this system ensures that these transactions are not just fast but also highly secure and reliable.

Beyond just making the ticketing process smoother, this system could also include loyalty programs and passenger categorization. These features would reward regular users and boost engagement, encouraging more people to use public transportation regularly and feel more connected to the system.

What makes this proposed system truly unique is how it combines all these elements blockchain technology, NFC cards, a rewards system, and passenger categorization into one cohesive solution. It goes beyond the isolated efforts seen in previous studies by offering a comprehensive, secure, and efficient approach that significantly enhances the overall passenger experience and the operational efficiency of the public transportation system.

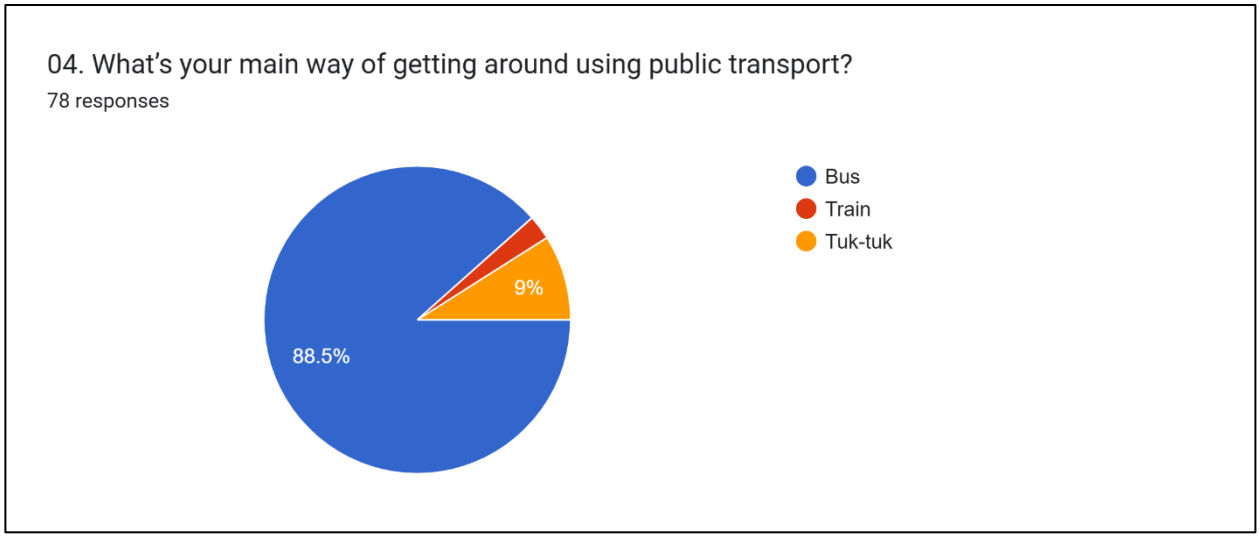

Figure 1.1: Survey report on the gathering

The survey results reveal that a significant 88.5% of respondents primarily depend on buses for their daily public transportation, underscoring the vital role buses play in people's everyday lives. Several key reasons contribute to this strong preference for buses. Firstly, buses are everywhere, they cover a vast network of routes that reach both urban and rural areas. This widespread availability makes them an easy and convenient choice for many people who need to get from one place to another.

Another major factor is cost. Buses are generally much more affordable than other options like trains or tuk-tuks, making them a go-to for those who need to keep their travel expenses low. The frequency and reach of bus services are also big draws buses run often and cover a lot of ground, ensuring that passengers can get where they need to go without too much hassle. Additionally, buses offer flexibility that other forms of transportation might not. They allow passengers to get on and off closer to their exact destinations, unlike trains, which have fixed stops. This flexibility makes buses a more practical and convenient option for many people.

Lastly, there's a cultural aspect buses have long been a familiar and traditional mode of transport in Sri Lanka. This familiarity, combined with their practicality and affordability, explains why so many people choose buses for their daily commute. These factors together make buses the preferred mode of public transportation for most respondents, highlighting their crucial role in daily commuting.

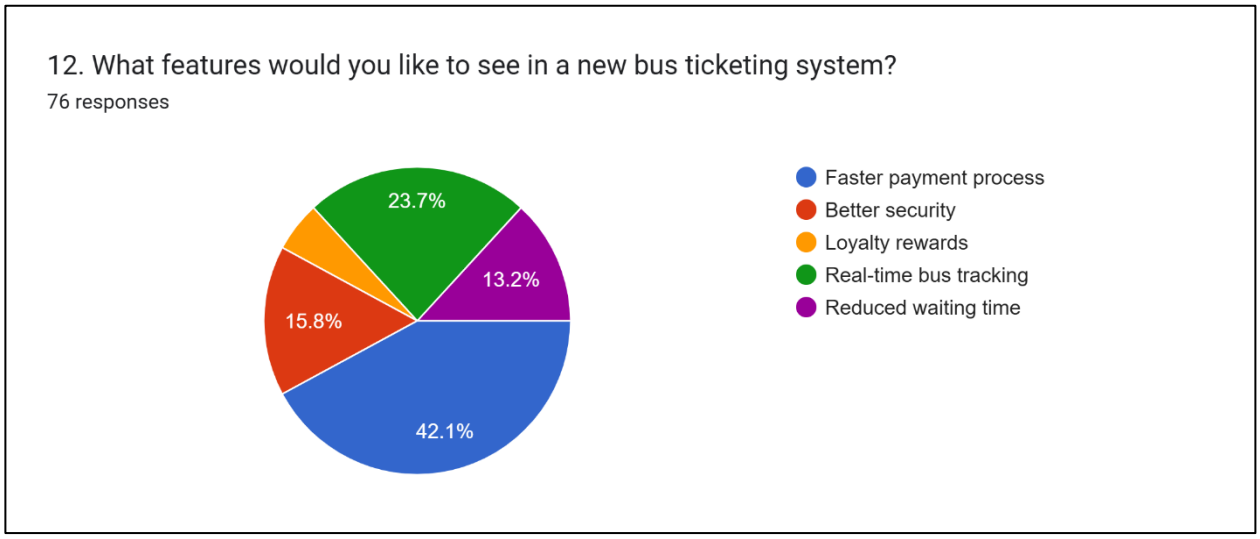

Figure 1.2: Survey report on the adding

The survey results offer valuable insights into what users really want in a new bus ticketing system. Out of 76 respondents, a significant portion, 42.1%, expressed a strong desire for a faster payment process, showing just how important efficiency is when buying bus tickets. People clearly want a quick and hassle-free way to pay. Real-time bus tracking is another key feature that 23.7% of respondents emphasized. This highlights the need for up-to-date information on bus locations and schedules, which could greatly improve the overall user experience by helping passengers plan their journeys more effectively.

Security is also a concern for many, with 15.8% of users prioritizing better security measures. This reflects a desire for a safe and trustworthy transaction process, ensuring that users feel confident when purchasing their tickets. Reducing waiting times was important for 13.2% of respondents, pointing to the frustration many feel when delays occur. A system that minimizes these delays would likely be very well-received. Lastly, 5.3% of users showed interest in loyalty rewards, suggesting that incentives for frequent use could help boost user engagement and encourage regular ridership. These findings clearly indicate that a new bus ticketing system should focus on speeding up transactions, enhancing security, providing real-time tracking, and incorporating features that engage and reward users to create a more efficient and user-friendly experience.

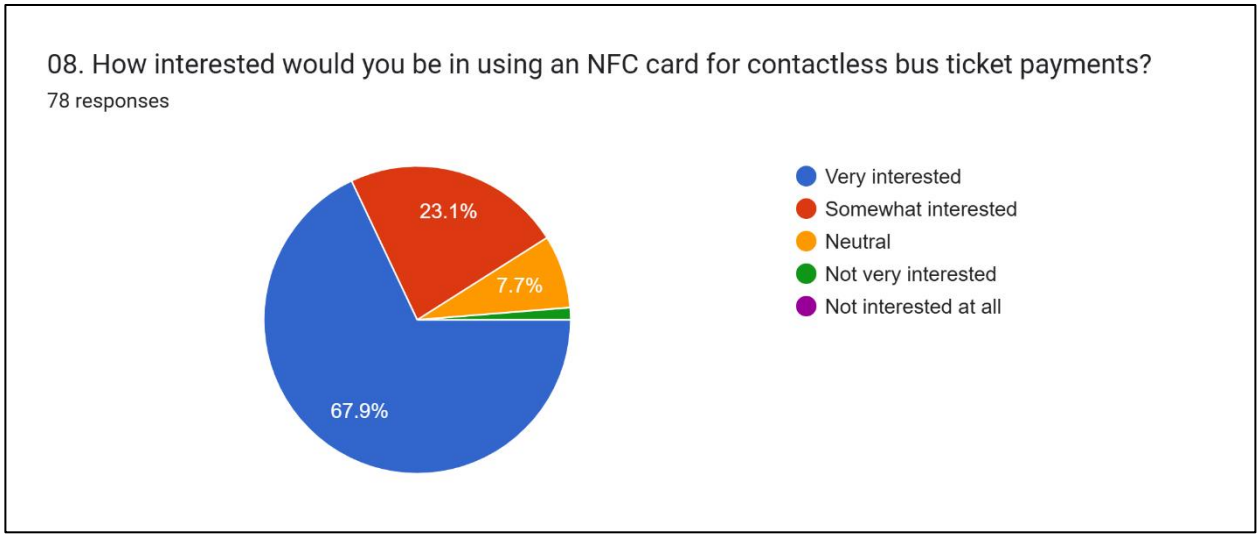

Figure 1.3: Survey report on the asking

The survey results provide compelling support for introducing an NFC-based contactless payment card system into the existing bus ticketing process. An impressive 67.9% of respondents expressed strong interest in using this modern payment method, clearly indicating a demand for upgrading the ticketing experience. Furthermore, 23.1% of respondents showed some interest, suggesting that a significant portion of users are open to embracing this new technology, especially if given the right incentives or additional information.

This widespread interest suggests that passengers would likely welcome the convenience and efficiency that an NFC payment system [3] offers. The few respondents who were neutral or uninterested in the idea indicate that any concerns can likely be addressed through proper education and communication, making the transition smoother for everyone.

Overall, the data strongly supports the implementation of an NFC-based payment system, as it aligns well with user expectations and has the potential to significantly enhance the overall public transportation experience.

1.2 Research Gap

In the world of public transportation, especially in countries like Sri Lanka, there's growing interest in making systems more efficient, secure, and user-friendly while reducing time wasted. Although several studies like Research A, B, and C have investigated using technologies like Near Field Communication (NFC) and blockchain, as well as concepts like reward systems and passenger categorization, they often treat these elements separately, missing out on creating a fully integrated and optimized transportation system.

Research A [4] focuses on traditional methods without incorporating modern technologies like blockchain or NFC. Research B introduces NFC for ticketing, making it more convenient for passengers, but it doesn't explore how blockchain could improve security and transparency. Research C acknowledges the benefits of blockchain for creating a secure and tamper-proof record of transactions but doesn't integrate it with NFC or other features like reward systems and passenger categorization.

NFC technology, as highlighted in Research B [5], is known for speeding up and simplifying the ticketing process in public transportation. It allows quick, contactless payments, reducing the time spent on manual ticketing and minimizing errors related to cash transactions. However, while NFC is efficient, as shown in Research B, it doesn't fully address issues like transaction security and data transparency. On the other hand, Research C [6] focuses on the security and transparency benefits of blockchain but doesn't combine it with NFC, which could further improve the user experience and operational efficiency.

Reward systems and passenger categorization have been studied in various settings, but as discussed in Research A and B, these systems haven't been fully explored in connection with technologies like NFC and blockchain [7]. There's a noticeable gap in understanding how these elements can be brought together to create a smooth and secure system that not only rewards passengers but also securely tracks and manages these rewards and transactions.

The proposed system aims to fill these gaps by integrating NFC and blockchain technologies with reward systems and passenger categorization into one cohesive platform. This platform would enable fast and secure transactions while offering a personalized and rewarding experience for users. For example, passengers could use NFC cards for payments, with each transaction securely recorded on the blockchain. At the same time, a reward system could monitor passenger usage and provide incentives based on their travel habits, ensuring that personal data is protected, and transactions are transparent.

Application Reference	Use Blockchain Technology	Use NFC Cards	Reward System	Passengers Categorization
Research A	✗	✗	✗	✗
Research B	✗	✓	✗	✗
Research C	✓	✗	✗	✗
Proposed System	✓	✓	✓	✓

Table 1-1 - Comparison of former researches

The table highlights how different research efforts Research A, Research B, and Research C have approached the use of technology in public transportation systems compared to the proposed system. Research A does not incorporate advanced technologies like blockchain or NFC cards and lacks features such as a reward system or passenger categorization. Research B introduces NFC cards to make the ticketing process smoother but does not include blockchain technology, reward systems, or passenger categorization. On the other hand, Research C focuses on using blockchain technology for secure transactions but does not integrate NFC cards, reward systems, or passenger categorization.

The proposed system stands out by combining all these elements blockchain technology, NFC cards, a reward system, and passenger categorization into a single platform. This comprehensive approach aims to overcome the limitations of previous research by creating a more secure, efficient, and user-friendly public transportation system. By offering a holistic solution, the proposed system enhances the overall passenger experience and operational efficiency, making it more effective than the isolated approaches seen in past research.

1.3 Research Problem

The combination of NFC and blockchain technology has the potential to significantly improve the efficiency and security of bus ticket purchases in Sri Lanka. In public transportation, ensuring a seamless and secure transaction process is crucial for both passengers and service providers. NFC technology enables quick, contactless transactions [1], allowing passengers to buy bus tickets with just a tap of their card or mobile device. However, while NFC offers convenience, it doesn't automatically provide the high level of security needed to protect transaction data from tampering or fraud.

Blockchain technology, with its decentralized and unchangeable ledger, can fill this security gap. By integrating blockchain with NFC, each transaction made during a bus ride can be securely recorded on the blockchain, ensuring transparency and making it nearly impossible to alter or counterfeit transactions. This combination not only boosts the security of ticket purchases but also builds trust among users by providing a verifiable history of all transactions.

Real-time confirmation of transactions is also critical for bus conductors to efficiently manage passenger boarding and ticket validation. Current manual systems often result in delays and errors during ticket verification, leading to frustration and inefficiencies. By leveraging the instantaneous nature of NFC transactions and the real-time data processing capabilities of blockchain, conductors can receive immediate confirmation of each transaction as it happens. This streamlines the boarding process and reduces the likelihood of disputes or errors related to ticket purchases.

As the research progresses, it's important to explore how these technologies can be integrated into a single, cohesive system that addresses both efficiency and security concerns. Developing such a system would not only enhance the overall experience for passengers but also improve the operational efficiency of public transportation services in Sri Lanka. Survey responses have highlighted several common issues with the current bus ticketing system, indicating a clear need for these improvements.

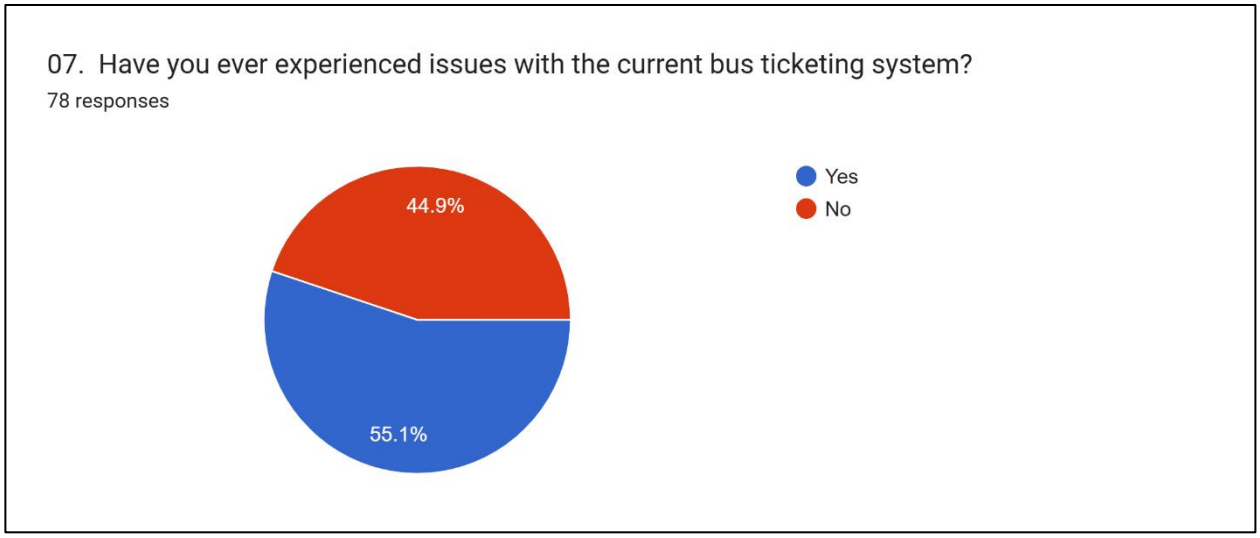

Figure 1.4: Survey report on the issues

A major issue passengers face is the difficulty in getting the exact change. Often, especially during busy times, conductors do not provide the correct balance, leading to frustration and a feeling of being overcharged. Another significant problem is that conductors sometimes skip issuing tickets altogether, leaving passengers uncertain whether their fare was properly recorded. This raises concerns about trust and fairness in the system. Handling cash transactions adds to the inconvenience. Passengers find it bothersome to deal with cash and coins, particularly during rush hours when quick transactions are crucial. This not only slows down the process but also heightens their frustration. Some passengers have reported that ticket prices vary for the same distance on different buses, with some conductors charging more than they should. This inconsistency makes the system seem unreliable and unfair.

Additionally, there are complaints about conductors either not returning the correct change or taking too long to do so, leaving passengers feeling cheated. The overall ticketing process is seen as time-consuming and inefficient, especially when buses are crowded. In summary, passengers face several issues with the current system, including problems with getting change, inconsistent ticket issuance, the hassle of handling cash, unfair pricing, and delays. These problems underscore the need for a more reliable, efficient, and user-friendly ticketing system.

2. OBJECTIVES

2.1 Main Objectives

The image illustrates the concept of improving public transportation efficiency in Sri Lanka using advanced payment technologies. This approach includes integrating modern solutions like NFC (Near Field Communication) and blockchain technology to simplify the ticketing process. The aim is to develop a system that is more efficient, secure, and user-friendly, reducing the time passengers spend purchasing tickets, minimizing errors, and ensuring transparency in transactions. By adopting these technologies, Sri Lanka's public transportation system can become more reliable and convenient for passengers, resulting in a significantly enhanced commuting experience.

2.2 Specific Objectives

Implementing blockchain for secure, transparent transactions.

The use of blockchain technology in the public transportation system is aimed at enhancing the security and transparency of financial transactions. Blockchain provides a decentralized ledger that records each transaction in an immutable and tamper-proof manner. This ensures that all bus ticket purchases are securely stored and cannot be altered or fraudulently manipulated. The transparency offered by blockchain allows both passengers and operators to track transactions with full visibility, reducing the risk of disputes and increasing trust in the system.

Enabling quick payments via NFC card taps.

Near Field Communication (NFC) technology allows for fast, contactless payments, making the ticket purchasing process more convenient for passengers. By simply tapping an NFC-enabled card or mobile device at a payment terminal, passengers can quickly pay for their bus tickets without the need for cash or physical tickets. This not only speeds up the boarding process but also reduces the need for handling cash, thereby minimizing potential delays and improving the overall efficiency of the transportation system.

Ensuring prompt transaction communication with the conductor.

To ensure a smooth and efficient boarding process, it is crucial that conductors receive immediate confirmation of transactions as they occur. This sub-objective focuses on implementing a system where each NFC transaction is instantly communicated to the bus conductor. This real-time communication allows conductors to quickly verify payments and minimize any potential delays caused by manual ticket checks. It also ensures that passengers can board the bus without unnecessary waiting, contributing to a more streamlined public transportation experience.

Developing a loyalty program for frequent users.

A loyalty program is designed to reward regular passengers for their continued use of public transportation services. This program could offer incentives such as discounts on future rides, priority boarding, or other perks that encourage passengers to choose public transport over other modes of travel. By recognizing and rewarding frequent users, the system not only builds customer loyalty but also increases overall ridership. This, in turn, supports the sustainability and financial viability of the public transportation system.

3. METHODOLOGY

The proposed bus ticketing system for Sri Lanka's public transportation will be developed using a well-structured methodology. The process begins with gathering requirements through discussions with stakeholders and surveys of frequent users to identify current challenges and user expectations. The system will be designed to integrate NFC technology for contactless payments and blockchain for secure transaction recording, using Django for the backend, React Native for the mobile app, MongoDB for data storage, and Firebase for real-time communication.

Development will focus on creating a cross-platform mobile application and implementing NFC and blockchain technologies to ensure secure and efficient transactions. Rigorous testing will be conducted on selected routes to validate performance and security. Finally, the system will be deployed to the Ceylon Transport Board and private bus operators, with plans for future enhancements and scalability. This methodology ensures the creation of a reliable, secure, and user-friendly ticketing solution that improves the overall public transportation experience.

3.1 System Architecture

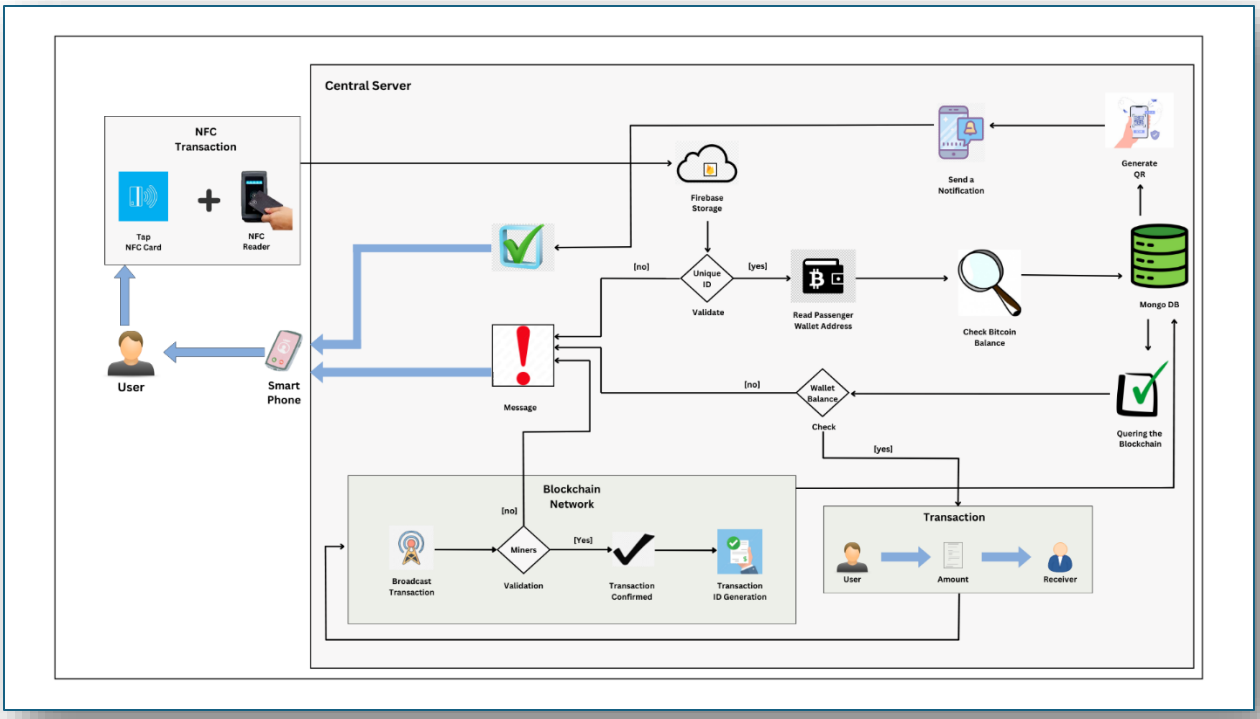

Figure 3. 1: System diagram for smart payment system

This diagram illustrates a blockchain-based bus ticketing system that integrates Near Field Communication (NFC) technology to enable secure and efficient transactions in public transportation. The process begins when a passenger taps their NFC-enabled card or smartphone on the bus's NFC reader, which initiates communication with a central server. The server receives the unique identification (ID) from the NFC device and checks it against a Firebase storage database to confirm the user's registration and the validity of the ID.

If the ID is validated, the server retrieves the passenger's Bitcoin wallet address [8] and checks the balance using blockchain technology. The blockchain network is critical in ensuring the transaction's security and transparency by verifying whether the wallet has sufficient funds. If the balance is adequate, the transaction is broadcasted to the blockchain network, where miners validate and confirm it. Once confirmed, a unique transaction ID is generated, and the transaction details are securely recorded on the blockchain.

At the same time, the system provides real-time confirmation to the bus conductor, allowing for immediate verification and reducing potential delays. After the transaction is completed, the user is notified on their device, and a QR code [9] is generated as proof of payment. This QR code can be stored in a MongoDB database for future reference or use.

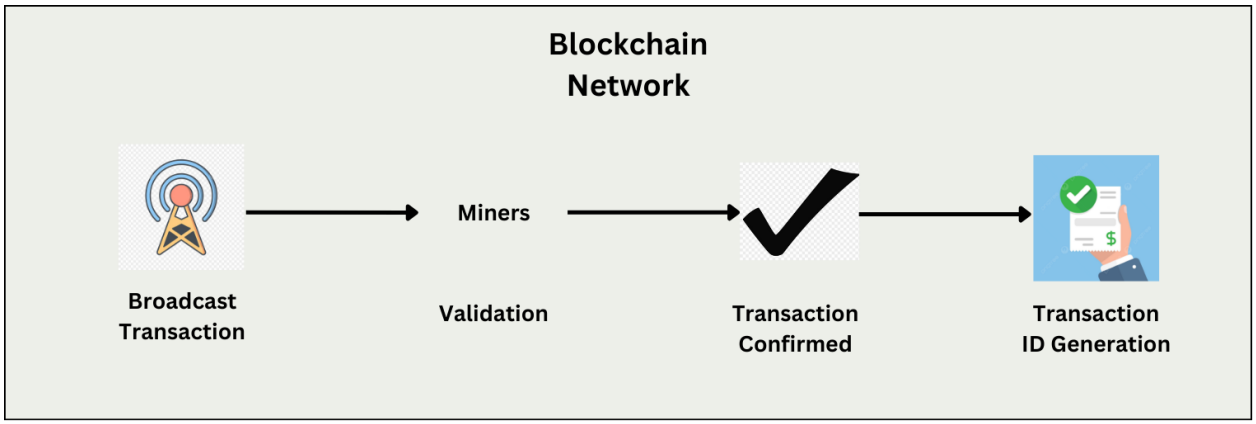

Figure 3. 2: Process diagram

The diagram outlines the process of handling transactions within a blockchain network. When a transaction, such as a cryptocurrency payment, is initiated, it is broadcasted to the network. Miners then validate the transaction by solving complex cryptographic problems, ensuring it follows the blockchain's rules. Once validated, the transaction is added to a block on the blockchain and confirmed. After confirmation, a unique Transaction ID (TXID) is generated, allowing the transaction to be tracked and verified. This process ensures that transactions are secure, transparent, and immutable within the blockchain network.

Summary of technologies, techniques, architectures and algorithms used for the implementation.

Technologies	Django Framework, React Native, NFC Technology, Blockchain Technology, MongoDB, Firebase
Techniques	Consensus Algorithm, AES Encryption
Algorithms and Architectures	JWT (JSON Web Tokens)

Table 3,1: Technologies, techniques, Architecture and Algorithms

3.1.1 Software Solution

The Software Development Life Cycle (SDLC) [10] is a structured approach to software development, ensuring that code is developed with precision and consistency. Traditional SDLC methodologies typically follow a linear process where developers must complete each phase in order. However, this rigid structure can be limiting when requirements change, as it doesn't allow developers to revisit and adjust previous steps easily.

This is where the Agile methodology offers significant advantages. Agile is built around flexibility and adaptability, enabling developers to respond to changes more efficiently. Among various Agile frameworks, Scrum stands out as one of the most effective due to its lightweight structure and its ability to manage and solve complex problems in an adaptive manner. Scrum facilitates iterative progress through its core processes, which include continuous feedback and collaboration. Figure 3.3 illustrates the six core processes of the Agile methodology.

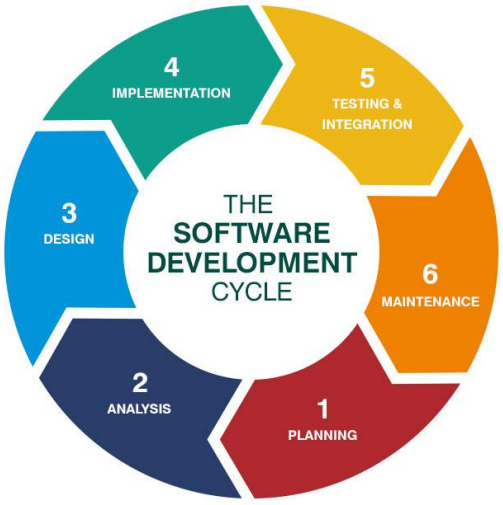

Figure 3. 3: Agile Methodology [11]

Requirement Gathering

Collecting Information

To develop a secure and efficient blockchain-based bus ticketing system, comprehensive information gathering is crucial. This involves conducting discussions with key stakeholders, such as public transportation authorities and technology providers. For instance, regular meetings were held with transportation authorities and blockchain specialists to understand the current challenges in ticketing systems and the potential role of blockchain and NFC technology in addressing these challenges. These discussions highlighted the need for a system that ensures secure, real-time transactions and the ability to handle high transaction volumes without compromising on speed or user experience.

Data Gathering

For the initial design and validation of the system, data on existing ticketing processes, transaction times, and user experiences were collected. This information will be further supplemented by additional datasets gathered from pilot implementations on selected public transportation routes. These routes will act as test environments to collect real-time data on system performance, user interaction, and transaction security, with a particular focus on blockchain validation times and NFC transaction speeds. This real-world data will be crucial in refining the system to ensure it meets the desired standards of efficiency and security.

Conducting a Survey

To understand user expectations and concerns regarding public transportation ticketing systems, a survey was conducted featuring a combination of closed and open-ended questions. This survey targeted frequent public transportation users, asking about their experiences with current systems, their comfort with using new technologies like NFC and blockchain, and their interest in features such as loyalty programs and passenger categorization. The survey received 78 responses, offering valuable insights into the public's readiness to adopt a more advanced ticketing system. These responses are instrumental in shaping the design and implementation of the proposed system, ensuring it aligns with user needs and expectations.

Feasibility Study (Planning)

Economic Feasibility

We took a close look at whether the proposed ticketing system, which uses blockchain and NFC technology, would be worth the investment. We compared the costs of creating and setting up the system to the expected benefits, like cutting down on fraud, speeding up transactions, and making passengers happier. Our study found that, in the long run, the savings and increased trust from passengers would more than cover the initial costs, making this system a smart financial choice.

Scheduled Feasibility

A scheduled feasibility assessment was conducted to evaluate the project timeline, ensuring that all phases of development, from initial design to final deployment, could be completed within a reasonable timeframe. The timeline was carefully planned to accommodate the iterative nature of Agile development, with regular reviews and adjustments based on stakeholder feedback. The project plan outlines key milestones and expected completion dates for each phase.

Technical Feasibility

Technical feasibility was assessed by evaluating the skills and resources available for developing the system. This involved reviewing the team's expertise in key areas such as blockchain technology, mobile application development using React Native [12], and secure data management with Django [13] and MongoDB [14]. Additionally, the assessment considered the team’s ability to integrate NFC technology with blockchain for real-time, secure transactions. The review confirmed that the team possesses the necessary skills and tools to successfully implement the proposed system.

Design

After the planning phase, system and software design documents are created which contributes to the overall system diagram.

Sequence Diagram

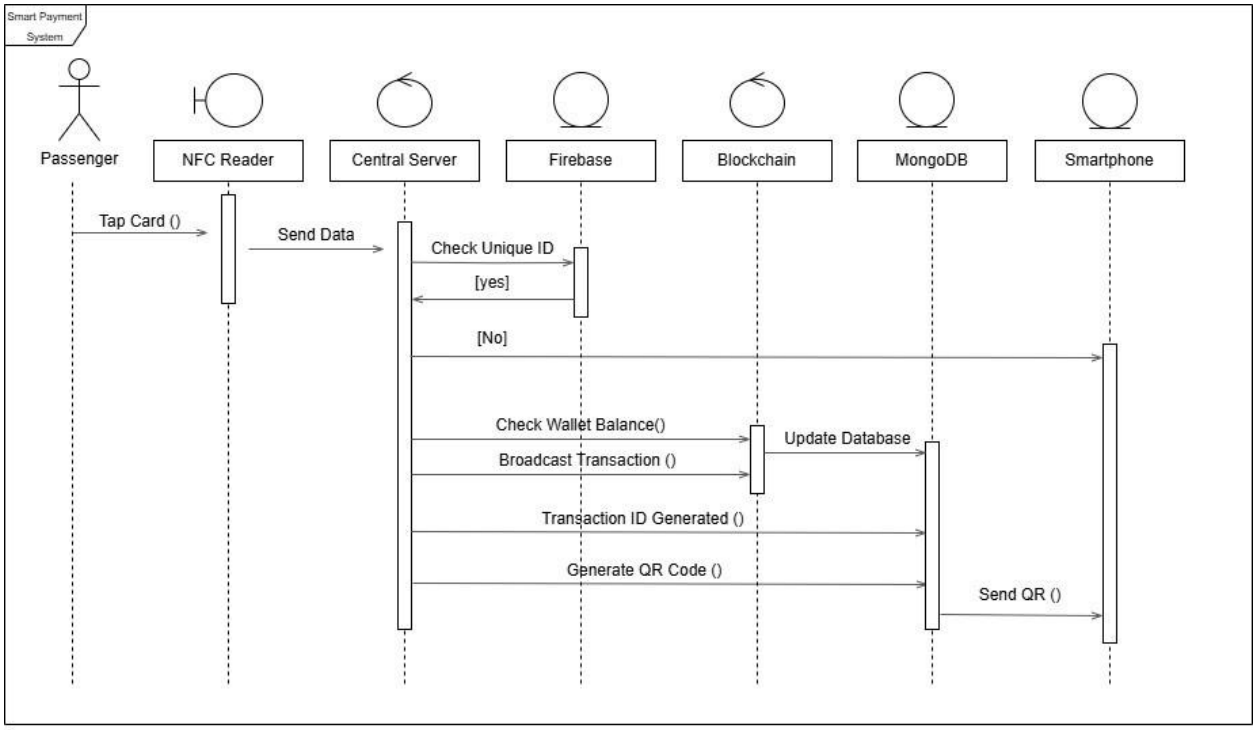

Figure 3. 4: Sequence Diagram

Implementation

The implementation process, as discussed in the methodology, includes the development of below functionalities to satisfy user requirements providing the ultimate solution with high accuracy and reliability.

Testing

In this phase of software testing, system gaps and missing requirements are checked along with errors and bugs to fix them and assure the quality of software. A series of testing processes such as unit, component, integration, system and user acceptance testing are carried out to achieve the purpose.

3.1.2 Commercialization

This project tackles the inefficiencies and security challenges in Sri Lanka's public transportation ticketing system. We plan to introduce the system to the Ceylon Transport Board (CTB) and private bus operators, offering a secure transaction process using NFC technology integrated with blockchain. This will improve the travel experience for both locals and tourists. Additionally, a premium loyalty system will be introduced for bus operators, encouraging frequent travel by rewarding passengers, which in turn will boost ridership and customer satisfaction. This loyalty system will also be commercialized, helping operators stand out and enhance their services.

4. PROJECT REQUIREMENTS

4.1 Functional Requirements

- **Implement blockchain for secure and transparent transactions.**

  The system will utilize blockchain technology to record all bus ticket transactions securely. Blockchain ensures that each transaction is immutable and transparent, providing a verifiable and tamper-proof record. This not only enhances the security of financial transactions but also builds trust among users by ensuring that all payments are accurately recorded and traceable.

- **Enable quick and easy payments via NFC card taps.**

  NFC technology will be integrated into the system to enable easy, contactless, fast payment of bus tickets by passengers. Passengers can complete transactions in real time with one tap of their card or smartphone enabled for NFC on the reader that cannot take more than a second thereby saving time and reducing cash handling while boarding. This increases the convenience and effectiveness of using the public transportation system.

- **Ensure real-time communication of transaction details to the driver.**

  This would facilitate the communication of details in transactions to the bus driver in real time and, therefore, speed up the boarding process. The driver gets instant information through a transaction by a passenger using NFC, while that is verified almost instantly so as not to delay the operation. This is important for the continuity of passenger flow and a general service efficiency improvement.

- **Store user profiles, transactions, and loyalty program data securely.**

  The system will, therefore, have secure storage for user profiles, transaction records, and loyalty program-related data. Such information should be securely stored using advanced techniques of encryption, hence safe from illegal access and data breaches. In this way, the system can offer personalized services to users while maintaining their privacy and security in a secure way.

4.2 Non-Functional Requirements

- **Design an intuitive and easy-to-use interface.**

  The user interface of the application will be designed to be intuitive and user-friendly, ensuring that all users can navigate the system with ease. The design will focus on simplicity and accessibility, allowing users of varying technical proficiency to interact with the application efficiently.

- **Ensure the application works seamlessly on Android.**

  The mobile app will be developed in React Native, which enables it to work similarly on an Android platform. This makes the app widely accessible, allowing users with different devices to not face any conflict problems with the system.

- **The system should handle many users and transactions efficiently.**

  The system will be developed to take a huge number of users and transactions at a go. This will make sure that the system always stays responsive and efficient, even during the peak usage time, such as the rush hours, without compromising performance.

- **Ensure the system is always reliable and available.**

  The system has high critical non-functional requirements for reliability and availability. It will be designed to work without any interruption so that the user will be able to always rely on the service, featuring failover mechanisms in place and redundancy systems to avoid any service disturbance.

- **Implement robust security measures to protect data and transactions.**

  Security is a top priority, particularly in the context of handling sensitive financial transactions and personal data. The system will incorporate robust security measures, including encryption, secure authentication protocols, and blockchain technology, to protect against data breaches, fraud, and other cyber threats.

4.3 System Requirements

- **Django**

  The system will utilize Django [13] as the backend framework because it provides a robust and scalable platform for handling data management, user authentication, and server-side operations. Django's built-in security measures are also put in place to take care of the system's overall security.

- **React Native**

  React Native [12] will be used for mobile application development, which will make the application cross-platform compatible with both Android and iOS devices. This enables the application to be viewed by a wider audience and provides a consistent user experience across all platforms.

- **NFC**

  NFC technology shall be used for contactless payments. At the point of sale, NFC readers will read the cards or smartphones of consumers and make it possible for them to pay with no waste of time using a fast, secure payment approach that does not involve any cash or tickets exchange.

- **Blockchain**

  The blockchain technology adopted in the system will be a basic component to ensure security and transparency in recording and verifying transactions. Every individual transaction will be inscribed on the blockchain, thus immutable and easily traceable, all of which beef up the general security level of the payment process.

- **MongoDB**

  The database system to be used is MongoDB [14], which stores all user profiles, transaction records, and any other relevant data. Its flexibility and scalability are perfect for handling huge volumes of data, with the document-based structure ensuring efficient retrieval and storage of data.

- **Firebase**

  Firebase [15] will be utilized for real-time communication and storage. It is a reliable cloud-based solution that helps in dynamic storage of all information, such as transaction notifications or any kind of user interaction. Firebase is real-time across every device.

4.4 User Requirements

- **Specializing in Django and blockchain integration.**

  The project needs a person who is specialized in Django, especially related to the integration of blockchain technology into the back end. This would imply secure and effective ways of recording transactions to be developed on the blockchain, which would then be smoothly integrated with the processes into the Django framework.

- **Skilled in React Native for mobile app development.**

  We'll need a React Native developer to make applications compatible on both Android and iOS. This candidate will be responsible for designing and developing interfaces that are very responsive, intuitive, and coherent across all devices.

- **Responsible for designing the overall architecture, including NFC and blockchain integration.**

  The job position involves working on the overall system architecture and the design of how all the pieces come together to fit in NFC for contactless payments and blockchain for recording secure transactions. So, he or she is going to ensure that all components work cohesively to result in a seamless and efficient user experience.

- **Ensures system security, especially for blockchain and data encryption.**

  Security is a very critical concern; this is predominantly related to blockchain and data encryption. This position requires the implementation of security protocols that safeguard against unauthorized access, data breaches, and other threats to all transactions and user data.

- **Overseeing project timelines and component integration.**

  This is the role that oversees the project timeline, making sure all the deliverables are developed and integrated on time. The project manager coordinates among different

teams such that the system is delivered on time and meets all its functional and non-functional requirements.

5. GANTT CHART

Milestone	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Research about topic and tasks												
Group discussion												
Technology analysis												
Resource evaluation												
Topic Assessment Evaluation												
Hardware design and implement the code												
Project implementation phase 1												
Integration testing												
Progress Presentation 1												
Project implementation phase 2												
Progress presentation 2												
Testing and evaluation												
Final report and conclusion												

Figure 5. 1: Gantt Chart

5.1 Work Breakdown Structure (WBS)

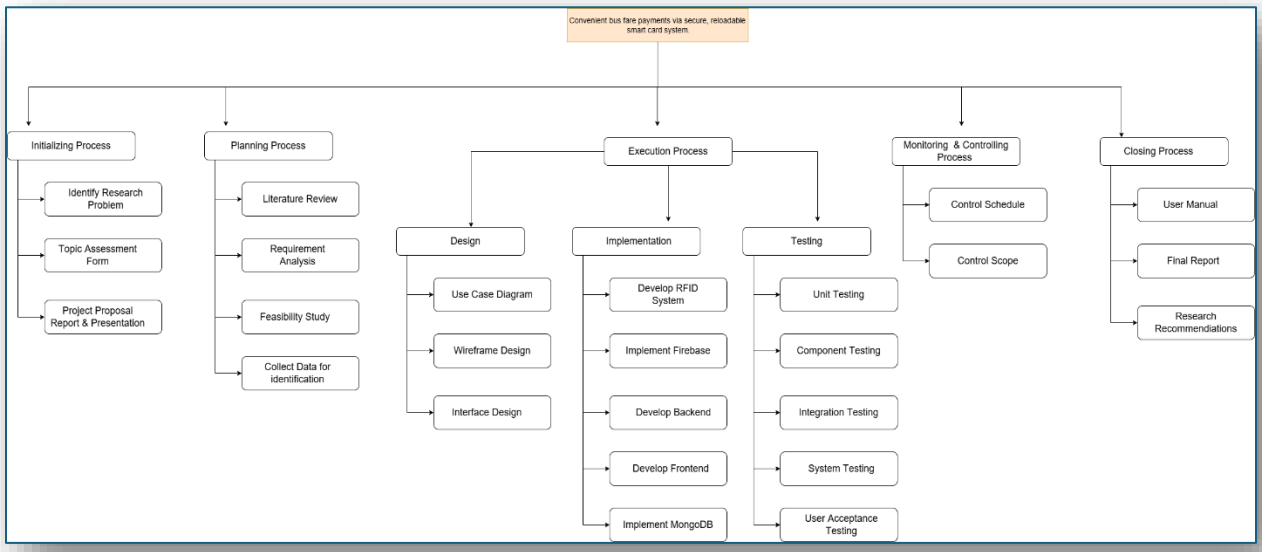

Figure 5. 2: Work Breakdown Structure

6. BUDGET AND BUDGET JUSTIFICATION

Expenses	
Requirements	**Cost (Rs.)**
NFC card	150
NFC Reader	2300
Total Cost	**2450**

Table 6.1: Expenses for the proposed system

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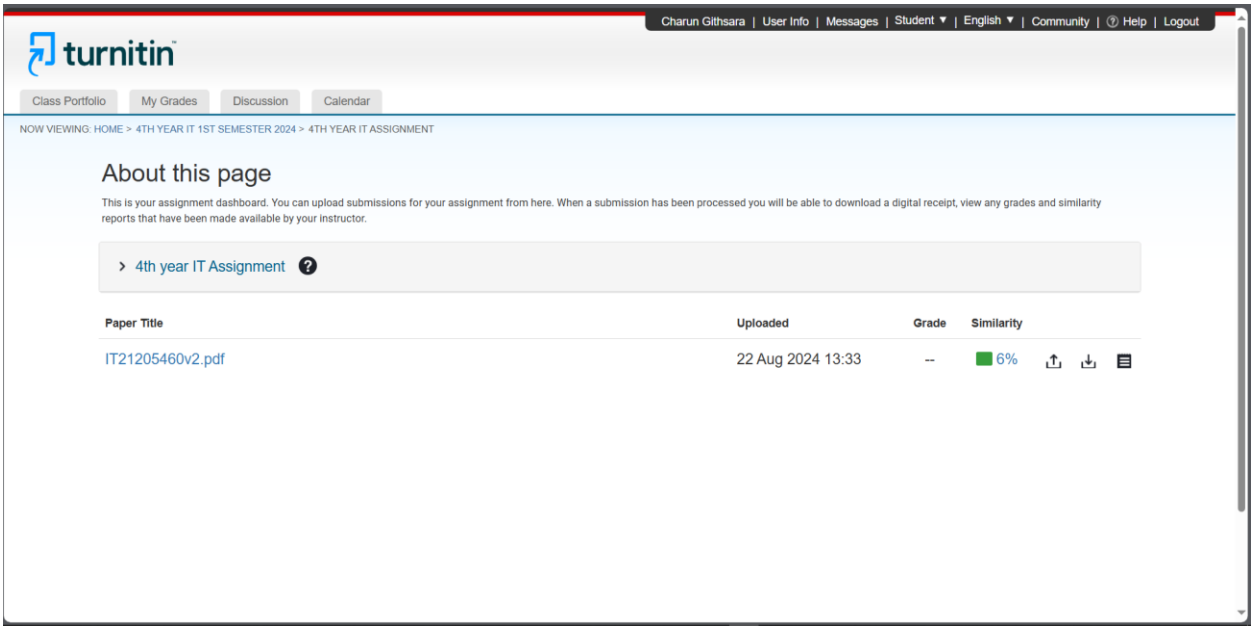
APPENDICES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