



# Blockchain-Based Postal System

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MSc Computer Science



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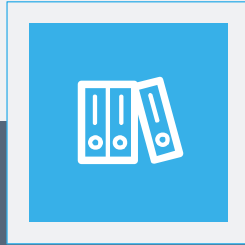
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# 01 | Intro

- ✓ **Background**
- ✓ **Motivation**
- ✓ **Aims & Objectives**
- ✓ **Description of the Work**

## Intro

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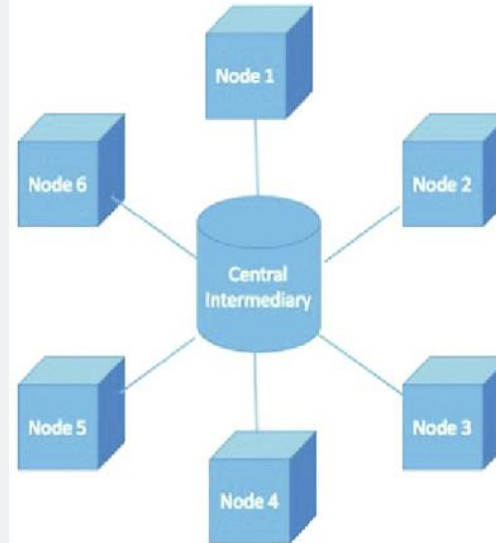
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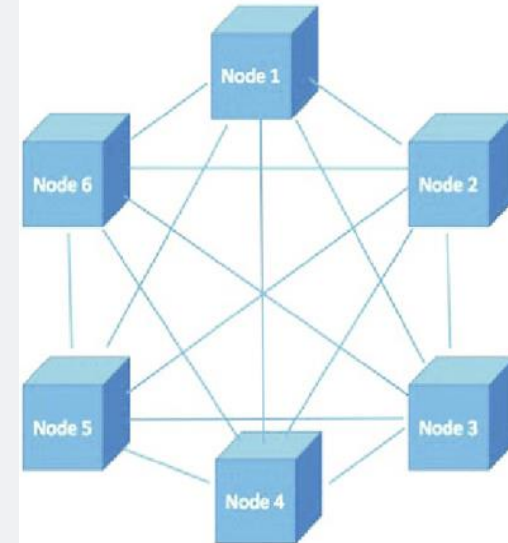
## Background

- Digital era & data privacy concerns
- Centralized architectural nature of postal systems
- Shortcomings of conventional postal systems
- Potential of blockchain technology

## Centralized



## Decentralized



**Intro****Literature  
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& Reflection**

- Traditional postal systems are gradually becoming outdated.
- The drawbacks of centralized systems are becoming increasingly apparent.
- The public is gradually placing more emphasis on data privacy.
- Blockchain technology has brought about technological innovation.

# MOTIVATION



## Intro



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## Conclusion & Reflection

### Objective 1

Develop a blockchain-based decentralized postal system to enhance the security and efficiency of mail transmissions.

### Objective 2

Investigate blockchain-supported mail transmission mechanisms to ensure transparent and effective transaction recording.

### Objective 3

Implement efficient storage and retrieval processes for mail QR codes within a blockchain framework, maintaining their efficacy and readability.

### Objective 4

Evaluate the system's performance for real-world applications



### Keywords

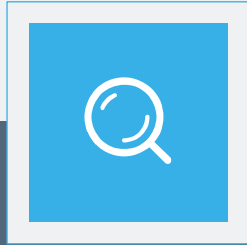
- Conventional mail exchange
- Blockchain technology
- Decentralization
- Transparent and immutable recordkeeping
- Postal System

### Intro

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## 02 | Literature Review

- ✓ **Decentralized Nature**
- ✓ **Security**
- ✓ **Consensus Algorithm**
- ✓ **Applications**





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Blockchain technology fosters a decentralized system, eliminating single points of failure and introducing a new level of security, transparency, and efficiency across various industries.

02

Blockchain operates on consensus mechanisms, fostering agreement among distributed nodes and ensuring data integrity and consistency across the network.

04



## Decentralization



## Security



## Consensus



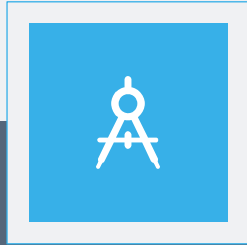
## Application

01

Blockchain technology ensures unparalleled security through cryptographic methods, making data tamper-proof and fostering a trustworthy digital infrastructure.

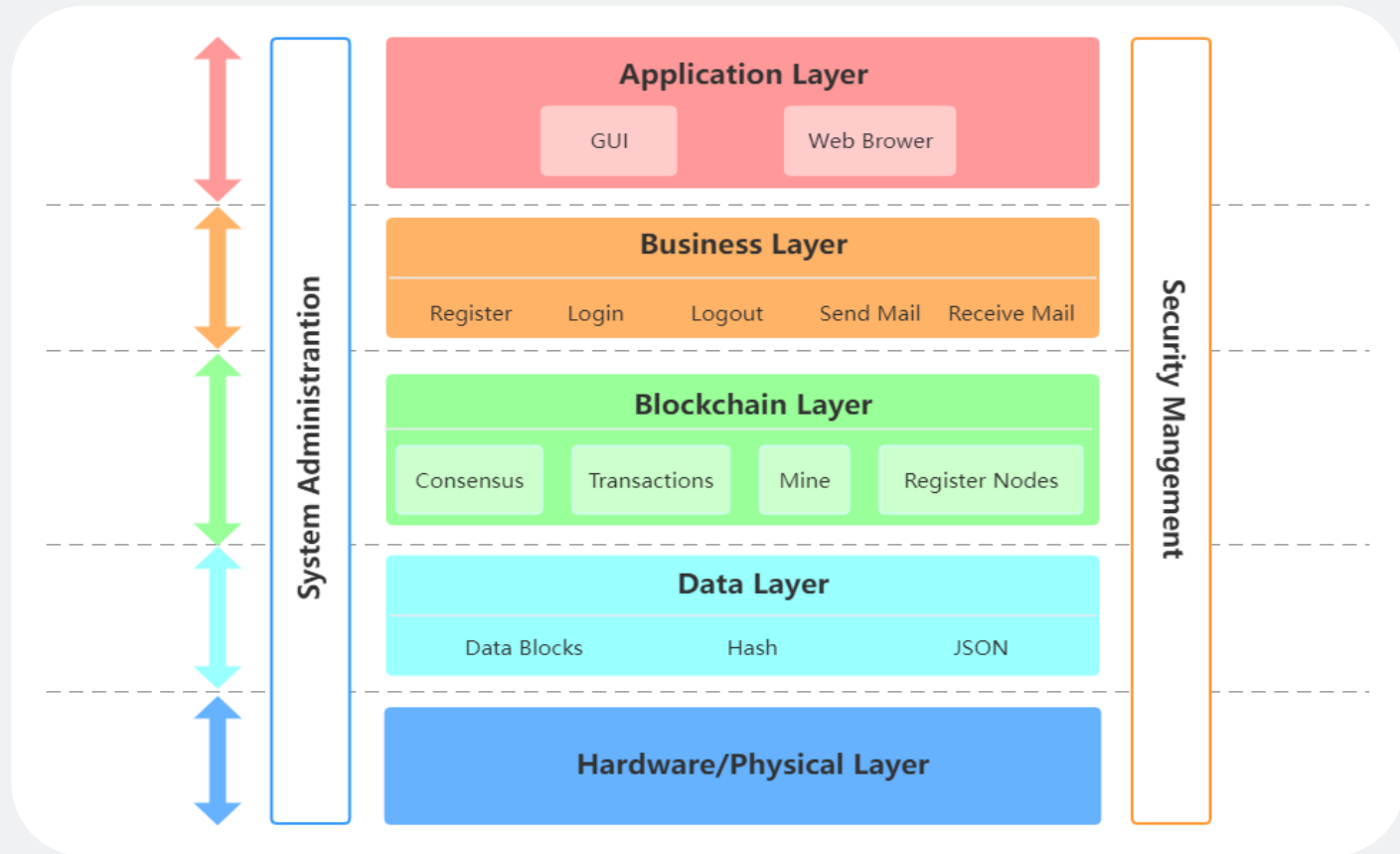
03

Blockchain finds diverse applications, revolutionizing sectors from finance and healthcare to supply chain management by offering secure, transparent, and decentralized solutions.



## 03 | Methodology

- ✓ **System Overview**
- ✓ **Blockchain Design & Implementation**
- ✓ **Postal System**
- ✓ **GUI**



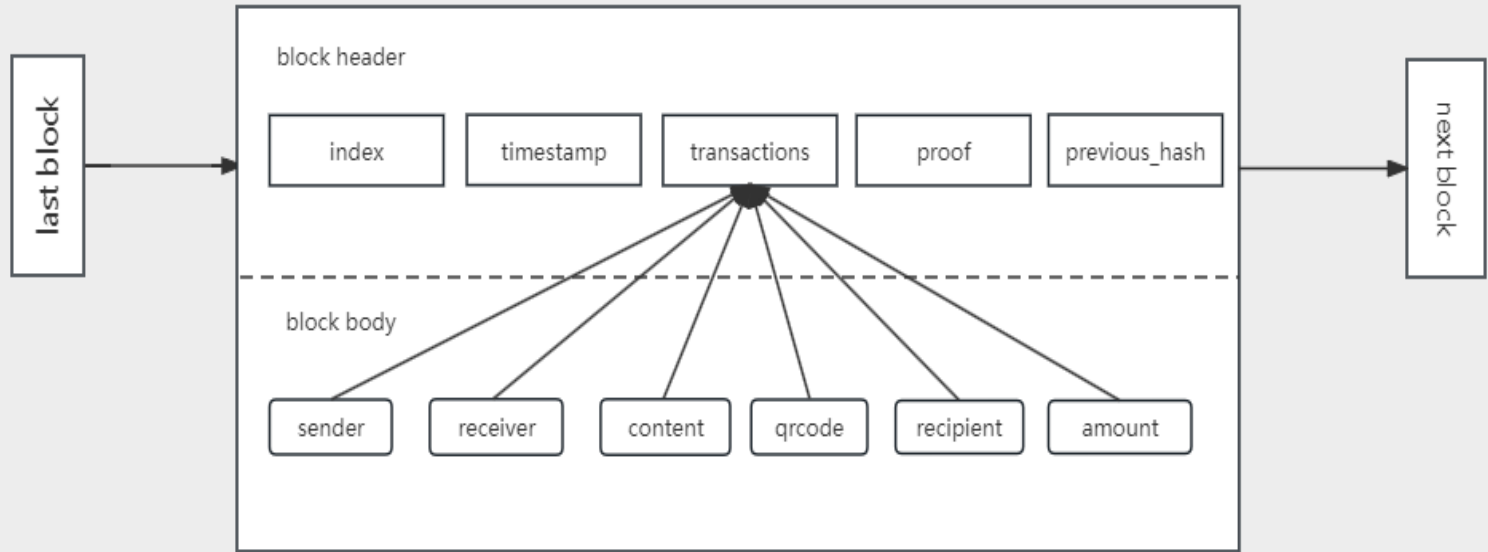
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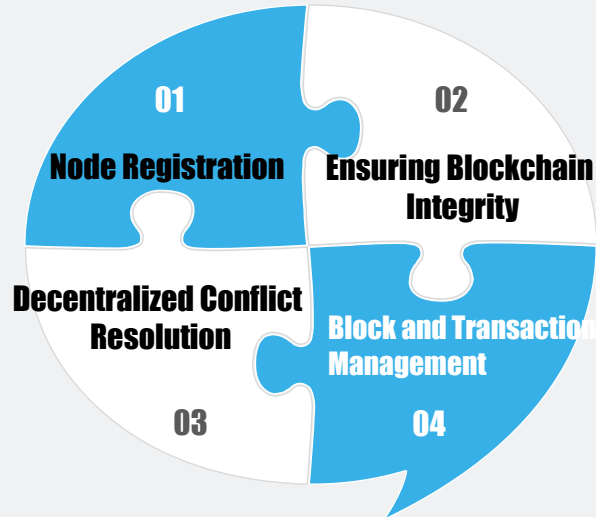
## Conclusion & Reflection

01

The registration node mechanism upholds the principle of decentralization by ensuring distributed control and consensus.

03

Through consensus principles, blockchain length and validity are assessed to ensure the longest valid chain within the network.



02

Internally, the integrity of the entire chain is maintained through cyclic iteration that verifies the data validity and proof-of-work for each block.

04

To manage blocks and transactions transparently, each block not only stores metadata such as timestamps, indexes, and the hash values of the previous block, but also incorporates transaction information in the form of a dictionary, detailing elements like the sender, receiver, and message content.



**Register**

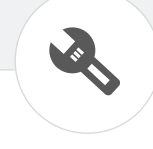
Register usernames and passwords, prohibiting duplicate usernames. All user data is stored in the 'user.json' file. Additionally, a logout feature is provided.

**Login**

During login, the system checks the 'user.json' file for a matching username; if found, it verifies if the password matches. If not found, it returns a 'user not registered' message. Upon successful login, it redirects to the 'mail.page' interface.

**Send mail**

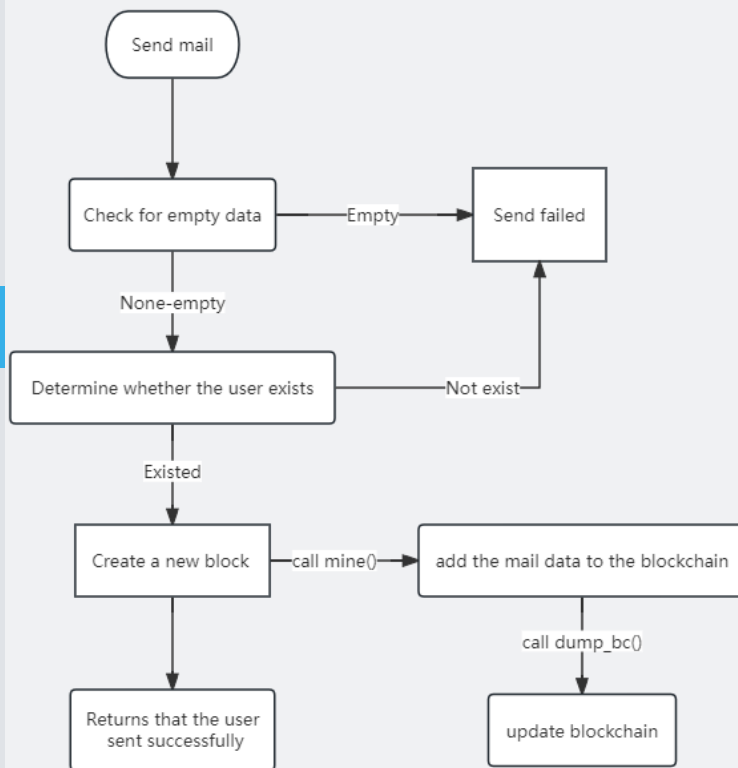
When a user sends an email for the first time, they are required to click "new-chain." When sending an email, they need to input the recipient's username, the message content, and attach a QR code image.

**Receive mail**

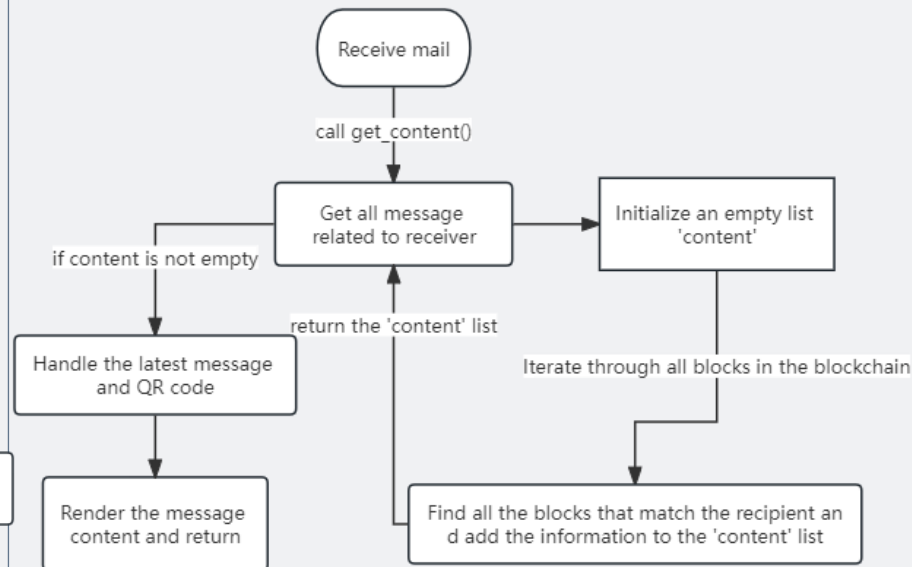
The recipient can retrieve the latest email using the "get-mail" command. They can also view the data stored in the blockchain using the "get-chain" command.

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## Send Mail



## Receive Mail



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Conclusion  
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sign up

username:

password:

sign up

Exist account? [sign in](#)





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**user:**

username:

password:

sign in

create an account: [sign up](#)

127.0.0.1:5000/mail/test01

new-chain get-chain

log out

welcome test01!

send to:

content:

hello, user [test02](#)

qrcode:  test.png

mail-post

get from:

content:

mail-get



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## Intro



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## Conclusion & Reflection

The image shows a web browser window with two panes. The left pane has a 'log out' button and a 'welcome test02!' message. Below this is a 'send to:' field with a text input and a 'content:' field with a text input. There is also a 'qr code:' section with a 'Choose File' button and a 'mail-post' button. The right pane shows a 'new-chain get-chain' endpoint returning a JSON array of 5 blocks. The first block contains a transaction with a sender 'test02' and a receiver 'test01'. The second block contains a transaction with a sender 'test01' and a receiver 'test02'. The third block contains a transaction with a sender 'test01' and a receiver 'test02'. The fourth block contains a transaction with a sender 'test01' and a receiver 'test02'. The fifth block contains a transaction with a sender 'test01' and a receiver 'test02'.



log out  
welcome test02!  
send to:   
content:  
  
qrcode:  No file chosen  
mail-post

new-chain get-chain

get from: test01  
content:  
hello, user test02.  
  
hello postal  
  
qr  
  
mail-get



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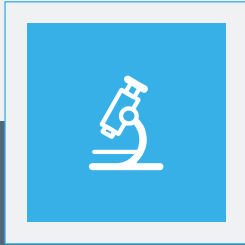
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Evaluation



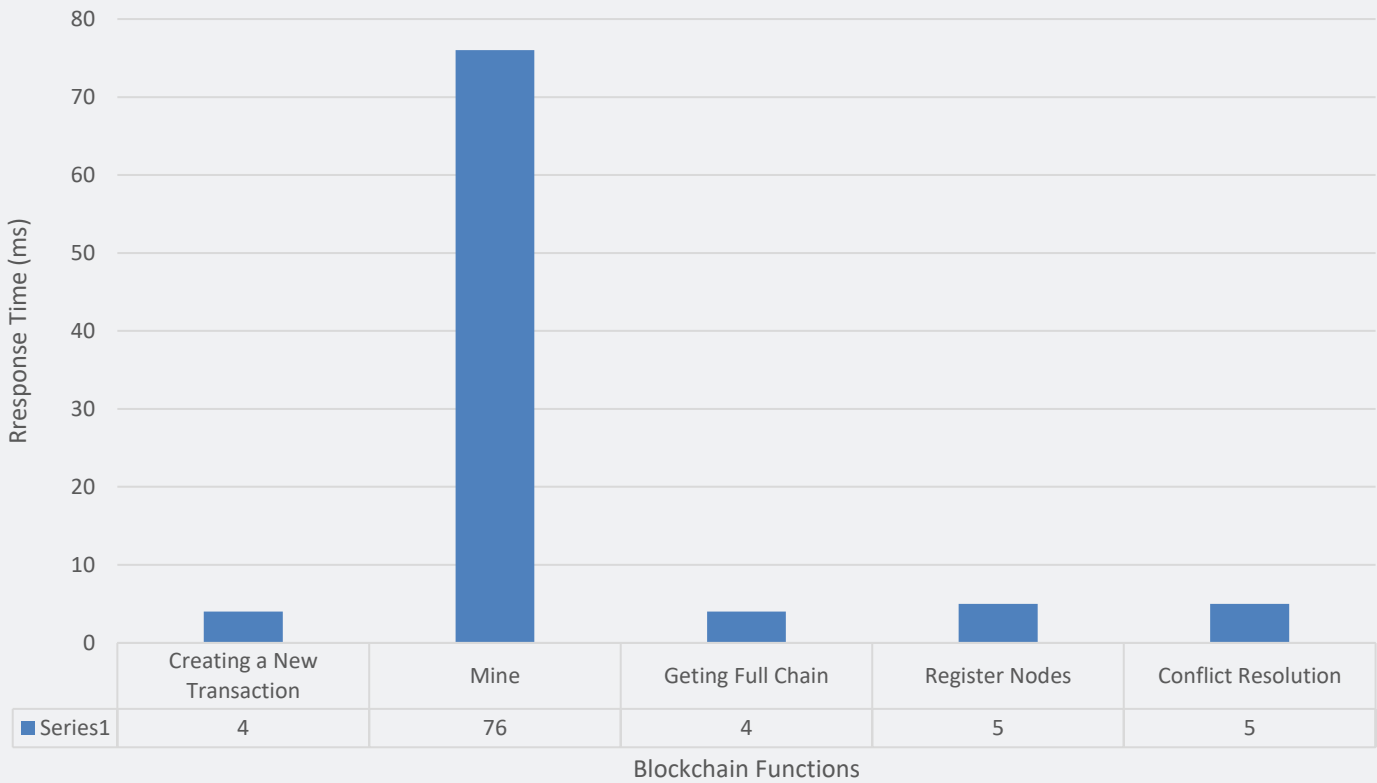
Conclusion  
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## 04 | Evaluation

- ✓ **Blockchain Performance**
- ✓ **System Response Time**

Average Response Time for Basic Blockchain Functions



Intro



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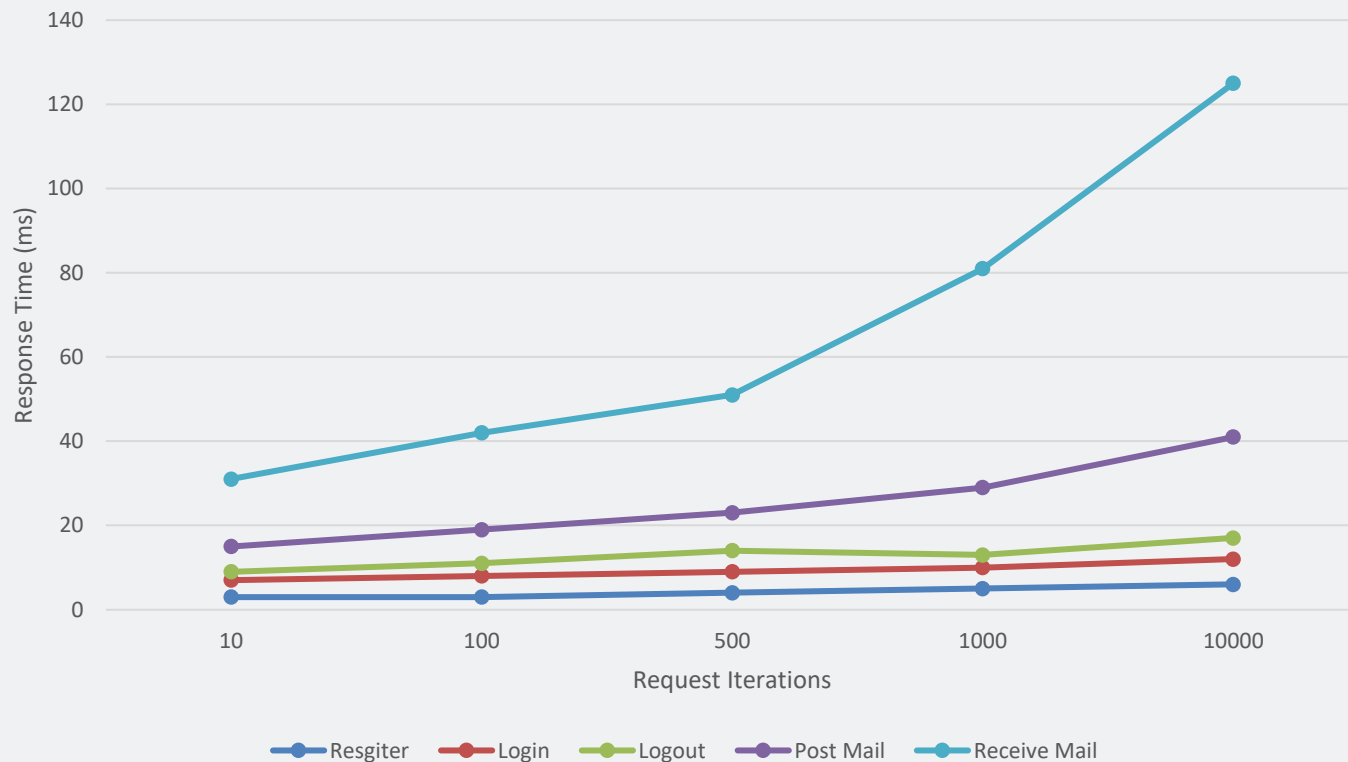


Evaluation



Conclusion  
& Reflection

Response Time Performance of a Blockchain-based Postal System





## 05 | Conclusion & Reflections

- ✓ **Contribution**
- ✓ **Gap**
- ✓ **Limitations**
- ✓ **Future Work**





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## Conclusion & Reflections

### Contribution

This study introduces a blockchain-based postal system prototype, enhancing traditional mail functions while leveraging blockchain's decentralization for data integrity and security, incorporating innovative node registration simulations, and assessing practical performance through experiments simulating real-user interactions.

### Future Work

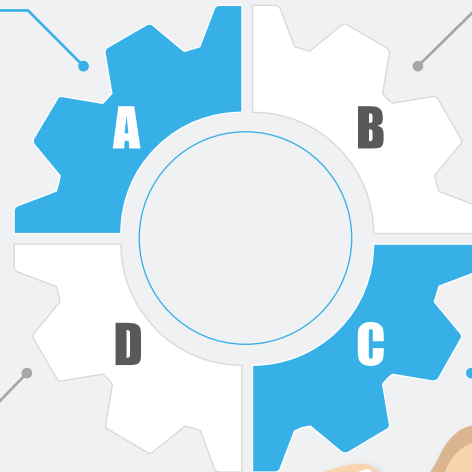
Moving forward, our foundational prototype shows significant potential for improvement, with the need to expand functionalities, explore advanced consensus algorithms, research more efficient data storage, implement smart contracts, and consider integration with emerging technologies, all aimed at enhancing the efficiency and adaptability of our postal system.

### Gap

In the digital age, traditional postal systems are vital for global information and logistics, yet they face challenges of inefficiency and data opacity, while the potential of blockchain technology to transform this sector remains largely unexplored.

### Limitations

In spite of initial achievements, our research has notable limitations, including the prototype's simplicity, limited coverage of complex postal scenarios, potential for advanced consensus algorithms, concerns regarding JSON-based data storage for large-scale data, and the absence of smart contracts, restricting system automation.



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## The referenced images in the presentation

[https://www.researchgate.net/figure/Network-structures-of-centralized-system-left-and-decentralized-system-right\\_fig1\\_330139613](https://www.researchgate.net/figure/Network-structures-of-centralized-system-left-and-decentralized-system-right_fig1_330139613)

<https://www.premiumtimesng.com/opinion/546322-technology-adoption-for-improved-postal-services-by-fom-gyem.html?tztc=1>

[https://www.freepik.com/free-photo/motivation-typography-crumble-font\\_15667581.htm#query=motivation%20logo&position=1&from\\_view=keyword&track=ais](https://www.freepik.com/free-photo/motivation-typography-crumble-font_15667581.htm#query=motivation%20logo&position=1&from_view=keyword&track=ais)



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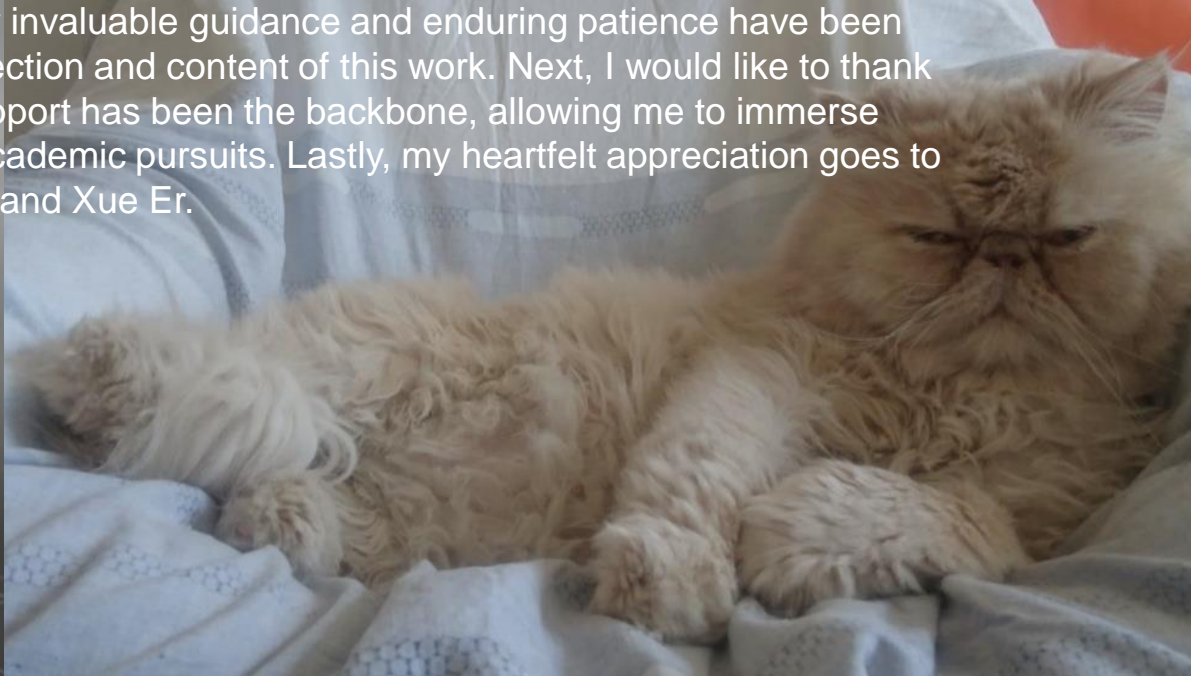
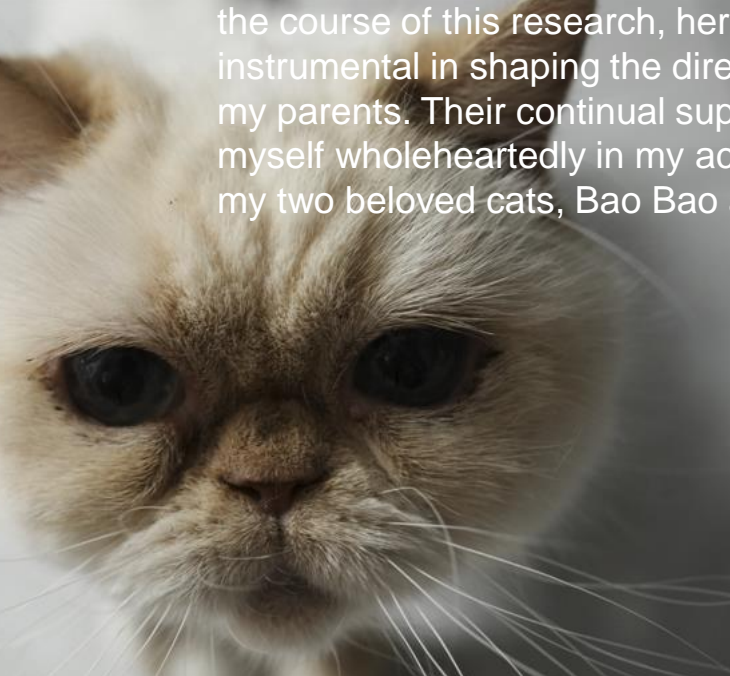
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# Acknowledgements

## THANK YOU

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# Thank You

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Supervisor: Ying He



Student: Hongmiao Yang