DELIVERY TRACKING SYSTEM USING BLOCKCHAIN

By

SHAIK REDDY SUHEL
21781F00B2

A Project Report submitted in partial fulfilment of the award of the degree

of

MASTER OF COMPUTER APPLICATIONS

Under the Guidance of
Mr. G. Dhanasekar, MCA ,
Assistant Professor,
Department of MCA.

SRI VENKATESWARA COLLEGE OF ENGINEERING & TECHNOLOGY
[AUTONOMOUS]
(Affiliated to JNTUA, Anantapuramu , Approved by AICTE, New Delhi)
(Accredited by NAAC, Bangalore.)
R.V.S.NAGAR, Chittoor(A.P)-517127

SEP 2023

SRI VENKATESWARA COLLEGE OF ENGINEERING & TECHNOLOGY
[AUTONOMOUS]
(Affiliated to JNTUA, Anantapuramu , Approved by AICTE, New Delhi)
(Accredited by NAAC, Bangalore.)
R.V.S.NAGAR, Chittoor(A.P)-517127

BONAFIDE CERTIFICATE

Certified that this report titled **" DELIVERY TRACKING SYSTEM USING BLOCKCHAIN "** ,is a bonafide work of **Mr. SHAIK REDDY SUHEL (21781F00B2),** who carried out the work under my supervision, for the partial fulfilment of the requirements for the award of the degree of Master of Computer Applications. Certified further that to the best of my knowledge and belief, the work reported here in does not form part of any other thesis or dissertation on the basis of which a degree or an award was conferred on an earlier occasion.

Mr .G. Dhanasekar ,MCA
Assistant professor,
Department of MCA,
SVCET (Autonomous),
Chittoor -517127.

Prof. N. Sendhil Kumar, MCA, M.Tech,
Head Dept., of MCA,
SVCET (Autonomous),
Chittoor -517127.

SRI VENKATESWARA COLLEGE OF ENGINEERING & TECHNOLOGY
[AUTONOMOUS]
(Affiliated to JNTUA, Anantapuramu , Approved by AICTE, New Delhi)
(Accredited by NAAC, Bangalore.)
R.V.S.NAGAR, Chittoor(A.P)-517127

CERTIFICATE OF EVALUATION

COLLEGE NAME : **SRI VENKATESWARA COLLEGE OF ENG., &TECH**

BRANCH : **MASTER OF COMPUTER APPLICATIONS**

NAME OF THE STUDENT : SHAIK REDDY SUHEL

ROLL NO : **21781F00B2**

PROJECT TITLE : **DELIVERY TRACKING SYSTEM USING BLOCKCHAIN**

The project work report submitted in partial fulfilment for the award of MCA degree in **JNTUA, ANANTAPUR,** is evaluated and confirmed to be report of the work done by the above student.

Submission for the project viva voice held on _____

INTERNAL EXAMINER **EXTERNAL EXAMINER**

SRI VENKATESWARA COLLEGE OF ENGINEERING & TECHNOLOGY
[AUTONOMOUS]
(Affiliated to JNTUA, Anantapuramu , Approved by AICTE, New Delhi)
(Accredited by NAAC, Bangalore.)
R.V.S.NAGAR, Chittoor(A.P)-517127

DECLARATION

I here by declare that the project work entitled **"Delivery Tracking System using Blockchain"** is a genuine work carried out by me under the guidance of **Mr. G. Dhanasekar, MCA ,Assistant professor** of the Department of Computer Applications, in partial fulfilment for the award of the degree in **"MASTER OF COMPUTER APPLICATIONS"** of JNTUA, Anantapuramu.

Shaik Reddy Suhel

21781F00B2

ACKNOWLEDGEMENT

I feel great pleasure while submitting the project report title "**Delivery Tracking System using Blockchain**" as part of my Project work.

A grateful thanks to **Dr. Ravuri Venkataswamy Garu**, **Chairman**, **Sri Venkateswara College of Engineering and Technology** for providing necessary environment for quality education in his beloved institution.

I express my sincere thanks to **Sri Ravuri Srinivas Garu**, **Vice-Chairman**, **Sri Venkateswara College of Engineering and Technology** for his ever willing attitude to make sure to achieve the highest level of education.

I would also like to seize this opportunity to thank our beloved Principal, Dr. M. Mohan Babu **for his encouragement, support and suggestions during my entire course of study as well as the project presentation.**

I express my deepest and sincere gratitude to **Prof., N. Sendhil Kumar, Head of Department, Department of MCA,** for his never-ending assistance, support and guidance during my entire course of study and as well as project presentation.

I express my deepest and sincere gratitude to my Guide **Mr. G. Dhanasekar, Assistant professor, Department of MCA,** for his never-ending assistance, support and guidance during my entire course of study and as well as project presentation.

Moreover, I would like to thank all the **faculty members** of the Department of **MCA**, and all other faculties in the college for their valuable contribution towards my education and social responsibilities in general.

Finally, I would like to thank my **parents** for their guidance and continuous support in the best possible way. As well as given me the opportunity to experience formal education in one of the best institutions in the country.

ABSTRACT

Delivery Tracking System is a web based system designed primarily for the use in delivery logistics industry this system will allow delivery and logistical services company to increase scope of the business by reducing the paper work cost and accountability of goods involved this system also allows quick and easy management of transporting parcels from one point to another as they can be easily tracked compared to the use of manual systems of recording information as it includes sending files and messages to the receiver and even from receiver to the sender.it also have an ability to track the files being sent. Delivery services employees use the system through an easy to navigate graphical interface for efficient processing. After the parcel being sent a files is been processed and sent with estimated time of delivery and other details to the customers, once any delay occurs a notification will be issued to the customers, for pick up if the receiver is at distance away then they can also request to that location there after the customer dashboard is updated with the estimated time of delivery once the parcel arrives at the destination then the dashboard is updated to be delivered .Since this will reduce the man required at the front desk it will reduce the loss of information of goods and services and accountability in terms of credit.

Keywords: Cipher text, AES, SHA-1, Hash Keys, Delivery tracker, delivery boy.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
ICTS	Information And Communication Technologies
IT	Information Technology
LPWA	Low Power Wide Area
UML	Unified Modelling Language
SOS	Systems Of Systems
BN	Bayesian Networks
ITS	Intelligent Transportation Systems
IOT	Internet Of Things
AES	Advanced Encryption Standard
SHA	Secure Hash Algorithm
HTML	Hyper Text Markup Language
IDE	Integrated Development Environment

1.INTRODUCTION

The increase in sending parcels from one point to another has led to the development of sophisticated systems, to ease in accountability and ease of transport and logistics. In recent times we have seen the registration of delivery, cargo and logistics companies in the country spanning from ground to air. There are many constituents in sending and receiving parcels which include caring and safely delivering people's belongings as requested at a fee. Having a background in the old ways of logistics the explosion of sophisticated information and communication technologies (ICTs) creates new opportunities as well as challenges for people who are mostly having high level of information technology (IT) literacy and advanced in knowledge and awareness of ease of transporting parcels from point to point without compromising the existing sending of parcels using trusted riders and other unorthodox methods. Records that capture various information serve as important institutional memory and central to efficient public service machinery .The advancements of the 21st century have led to an emergence of many disciplines with great potential to solve existing problems. One such potential field is Technology, which has over the years been increasingly adopted in many processes to avert the problems of ineffective and inefficient service delivery. One of the key areas of interest is automation of the delivery services. Many challenges have been faced in the process of sending parcels and products from one place to another including delays due to misplacement of small parcels as a result of using written receipts and paperwork at the registry when reference is ought to be made. As delivery services have become more technologically advanced, pressure mounts on the delivery companies to join the flow of technological progress in order to provide parcel service delivery. In addition, to emphasize transparency, to build customer trust and confidence in delivery and service delivery systems and companies, basically this project will be all about new ways and methods where parcel and delivery handlers can record new parcels data on transit, delivered parcels data, collected parcels data, and unpicked parcels data. Any existing delivery service management system was researched to get clues and hints on designing a suitable web application.

2. LITERATURE SURVEY

The Literature survey is a source from were research ideas are generated and developed into concepts and finally theories. It also provides the researchers a overview about the research done in that area and outcomes of it. It is a study and review of relevant literature materials in relation to a topic that have been given.

2.1 Pankaj Verma, J. S. Bhatia, "Design and development of GPS-GSM based tracking system with Google map-based monitoring," International Journal of Computer Science, Engineering and Applications, Vol. 3, No.3, June 2013.

GPS is one of the technologies that are used in a huge number of applications today. One of the applications is tracking your vehicle and keeps regular monitoring on them. This tracking system can inform you the location and route travelled by vehicle, and that information can be observed from any other remote location. It also includes the web application that provides you exact location of target. This system enables us to track target in any weather conditions. This system uses GPS and GSM technologies. The paper includes the hardware part which comprises of GPS, GSM, Atmega microcontroller MAX 232, 16x2 LCD and software part is used for interfacing all the required modules and a web application is also developed at the client side. Main objective is to design a system that can be easily installed and to provide platform for further enhancement.

2.2 U. Raza, P. Kulkarni, and M. Sooriyabandara, "Low power wide area networks: An overview", IEEE Communications Surveys & Tutorials, vol. 19, no. 2, pp. 855-873, 2017.

Low power wide area (LPWA) networks are attracting a lot of attention primarily because of their ability to offer affordable connectivity to the low-power devices distributed over very large geographical areas. In realizing the vision of the Internet of Things, LPWA technologies complement and sometimes supersede the conventional cellular and short range wireless technologies in performance for various emerging smart city and machine-to-machine applications. This review paper presents the design goals and the techniques, which different LPWA technologies exploit to offer wide-area coverage to low-power devices at the expense of low data rates. We survey several emerging LPWA technologies and the standardization activities carried out by different standards development organizations (e.g., IEEE, IETF, 3GPP, ETSI) as well as the industrial consortia built around individual LPWA technologies (e.g., LoRa Alliance, Weightless-SIG, and Dash7 alliance). We further note that LPWA technologies adopt similar approaches, thus sharing similar limitations and challenges. This

paper expands on these research challenges and identifies potential directions to address them. While the proprietary LPWA technologies are already hitting the market with large nationwide roll-outs, this paper encourages an active engagement of the research community in solving problems that will shape the connectivity of tens of billions of devices in the next decade.

2.3 Xu Ming, et al. "Mobile computing technology". Beijing; Tsinghua University Press, 2008.

Smart spaces are open complex computing systems, consisting of a large variety of cooperative smart things. Central to building smart spaces is the support for sophisticated coordination among diverse smart things collaborating to accomplish specified tasks. Multi-agent systems are often used as the software infrastructures to address the coordination issue in smart spaces. However, since agents in smart spaces are dynamic, resource-bounded and have complicated service dependencies, current approaches to coordination in multi-agent systems encounter new challenges when applied in smart spaces. The purpose of this paper is to address these issues. Design/methodology/approach – The paper presents Baton, a service management system to explicitly resolve the particular issues stemming from smart spaces when coordinating agents. Baton is designed as a complement to coordination approaches in multi-agent systems with a focus on mechanisms for service discovery, composition, request arbitration and dependency maintenance. Baton is now deployed in our own smart spaces to achieve better agent coordination. Findings – The effectiveness and efficiency of Baton is validated by its practical use in the designed scenario and some evaluation experiments. Research limitations/implications – An attempt at performing dynamic service composition in Baton is made by using semantic information in future work. Originality/value – Baton, a service management system to explicitly resolve the particular issues stemming from smart spaces when coordinating agents is presented.

2.4 M. Masood, L. Khan, and B. Thuraisingham, Data Mining Applications in Malware Detection, CRC Press 2011.

Data mining is the process of posing queries to large quantities of data and extracting information, often previously unknown, using mathematical, statistical, and machine learning techniques. Data mining has many applications in a number of areas, including marketing and sales, web and e-commerce, medicine, law, manufacturing, and, more recently, national and cyber security. For example, using data mining, one can uncover hidden dependencies between terrorist groups, as well as possibly predict terrorist events based on past experience.

Furthermore, one can apply data mining techniques for targeted markets to improve e-commerce. Data mining can be applied to multimedia, including video analysis and image classification. Finally, data mining can be used in security applications, such as suspicious event detection and malicious software detection. Our previous book focused on data mining tools for

applications in intrusion detection, image classification, and web surfing. In this book, we focus entirely on the data mining tools we have developed for cyber security applications.

2.5 Bayesian network-based analysis of cyber security impact on safety

Cyber security gains further importance regarding life cycle risk analysis of technical systems, e.g. Cyber Physical Systems (CPS) or Systems of Systems (SoS) in the context of increasing dependency on networked systems and processes in domains like industry 4.0 or smart home. At the same time, the operation of networked systems in environments critical to safety poses the challenge of analyzing a growing number of potential interactions between safety and security aspects. In industrial environments, the assessment of functional safety is a standard procedure, e.g. using IEC 61508 and domain-specific derivatives, while cyber security in safety relevant domains has only been introduced in the last few years. The assessment of cyber security is a rapidly developing discipline, but until now there have been only few approaches to merge the standardized procedures in safety and security. This paper presents an approach based on Bayesian Networks (BN) that enables to consider the impact of cyber security threats on functional safety considerations. By means of a simplified x-by-wire system, safety and security relations as well as structures are derived and an integrated safety and security BN is established. It is shown that parameter learning in BN can be used to adapt chosen target parameters to a required integrated safety and security level. Thus, it is possible to enhance the system configuration considering new cyber security threats.

2.6 B. M. Thuraisingham, SecAI: Integrating Cyber Security and Artificial Intelligence with Applications in Internet of Transportation and Infrastructures, Clemson University Center for Connected Multimodal Mobility, Annual Conference, October 2019.

Intelligent Transportation Systems (ITS) are emerging field characterized by complex data model, dynamics and strict time requirements. Ensuring cyber security in ITS is a complex task on which the safety and efficiency of transportation depends. The imposition of standards for a comprehensive architecture, as well as specific security standards, is one of the key steps

in the evolution of ITS. The article examines the general outlines of the ITS architecture and security issues. The main focus of security approaches is: configuration and initialization of the devices during manufacturing at perception layer; anonymous authentication of nodes in VANET at network layer defense of fog-based structures at support layer and description and standardization of the complex model of data and metadata and defense of systems, based on AI at application layer. The article oversees some conventional methods as network segmentation and cryptography that should be adapted in order to be applied in ITS cybersecurity. The focus is on innovative approaches that have recently been trying to find their place in ITS security strategies. These approaches includes blockchain, bloom filter, fog computing, artificial intelligence, game theory and ontologies. In conclusion, a correlation is made between the commented methods, the problems they solve and the architectural layers in which they are applied.

3. PROBLEM IDENTIFACTION

3.1 Existing Method

In the previous development IOT is been used to store the data which will be transferred to delivery boy. But this system have some drawbacks regarding security during data transfer and vulnerabilities. As we can see any one can access the transferred data which leads to misuse of data it means less security is provided compared to proposed system ,we can expect more number of cyber attacks which can be successfully done without any restriction and any security in previously developed systems we can expect improper data transfers which would contain defective files.

Disadvantages

- Less security
- Improper data transfer
- More cyber attacks

Proposed System

In proposed system we are implementing Security based data transfer to delivery tracking to overcome the existing problems. Here a cloud is the mediator that which transfers sender files to delivery boy with more security we are using AES based algorithm (Advanced Encryption Standard) and block chain based algorithm (SHA-1) which are used to provide the high security on cloud data.

Advantages

- More Security
- Accurate data transfer
- Less cyber attacks

3.2 System Requirements And Specification

Functional and non-functional requirements

Requirement's analysis is very critical process that enables the success of a system or software project to be assessed. Requirements are generally split into two types: Functional and non-functional requirements.

Functional Requirements: These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract. These are represented or stated in the form of input to be given to the system, the operation performed and the output expected. They are basically the requirements stated by the user which one can see directly in the final product, unlike the non-functional requirements.

Examples of functional requirements:

1) Authentication of user whenever he/she logs into the system
2) System shutdown in case of a cyber-attack
3) A verification email is sent to user whenever he/she register for the first time on some software system.

Non-functional requirements: These are basically the quality constraints that the system must satisfy according to the project contract. The priority or extent to which these factors are implemented varies from one project to other. They are also called non-behavioral requirements.

They basically deal with issues like:

- Portability
- Security
- Maintainability
- Reliability
- Scalability
- Performance
- Reusability
- Flexibility

Examples of non-functional requirements

1) Emails should be sent with a latency of no greater than 12 hours from such an activity.
2) The processing of each request should be done within 10 seconds
3) The site should load in 3 seconds whenever of simultaneous users are > 1000

Hardware Requirements

- Processor : I3/Intel Processor
- RAM : 8GB (min)
- Hard Disk : 160 GB

Software Requirements

- Operating System : Windows 7/8/10
- Server-side Script : HTML, CSS & JS.
- IDE : PyCharm
- Libraries Used : NumPy, IO, OS, TensorFlow, Keras.
- Technology : Python 3.6+.

4. DESIGN

4.1 Architectural Design

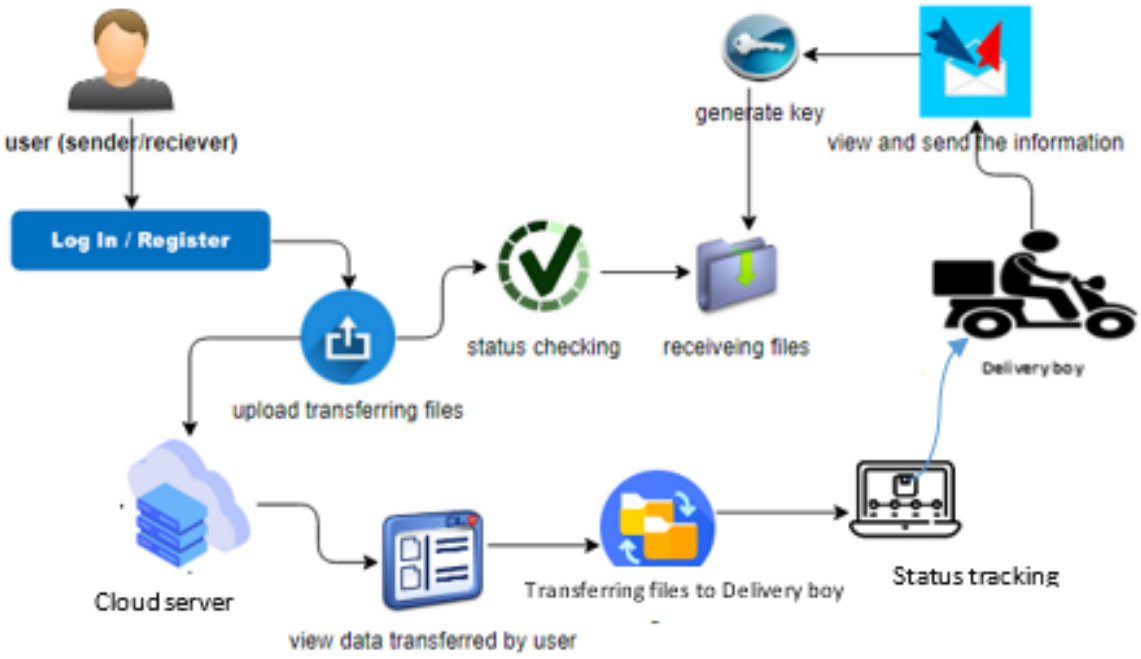


Fig 4.1 Architectural design

4.2 Data Design

Data design is the first design activity, which results in less complex, modular and efficient program structure.The information domain model developed during analysis phase is transformed into data structures needed for implementing the software.

Input Design

In an information system, input is the raw data that is processed to produce output. During the input design, the developers must consider the input devices such as PC, MICR, OMR, etc.

Therefore, the quality of system input determines the quality of system output. Well-designed input forms and screens have following properties −

- It should serve specific purpose effectively such as storing, recording, and retrieving the information.
- It ensures proper completion with accuracy.
- It should be easy to fill and straightforward.

- It should focus on user's attention, consistency, and simplicity.
- All these objectives are obtained using the knowledge of basic design principles regarding −
    - What are the inputs needed for the system?
    - How end users respond to different elements of forms and screens.

Objectives for Input Design

The objectives of input design are

- To design data entry and input procedures
- To reduce input volume
- To design source documents for data capture or devise other data capture methods
- To design input data records, data entry screens, user interface screens, etc.
- To use validation checks and develop effective input controls.

Output Design

The design of output is the most important task of any system. During output design, developers identify the type of outputs needed, and consider the necessary output controls and prototype report layouts.

Objectives of Output Design

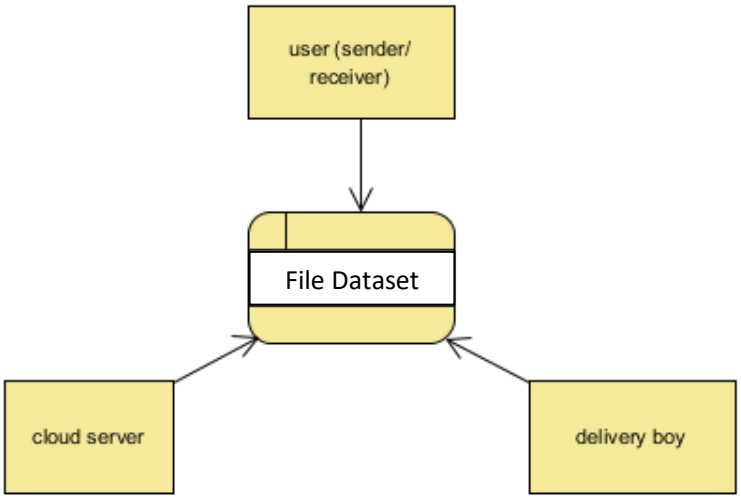
The objectives of input design are

- To develop output design that serves the intended purpose and eliminates the production of unwanted output.
- To develop the output design that meets the end user's requirements.
- To deliver the appropriate quantity of output.
- To form the output in appropriate format and direct it to the right person.
- To make the output available on time for making good decisions.

DFD Diagram

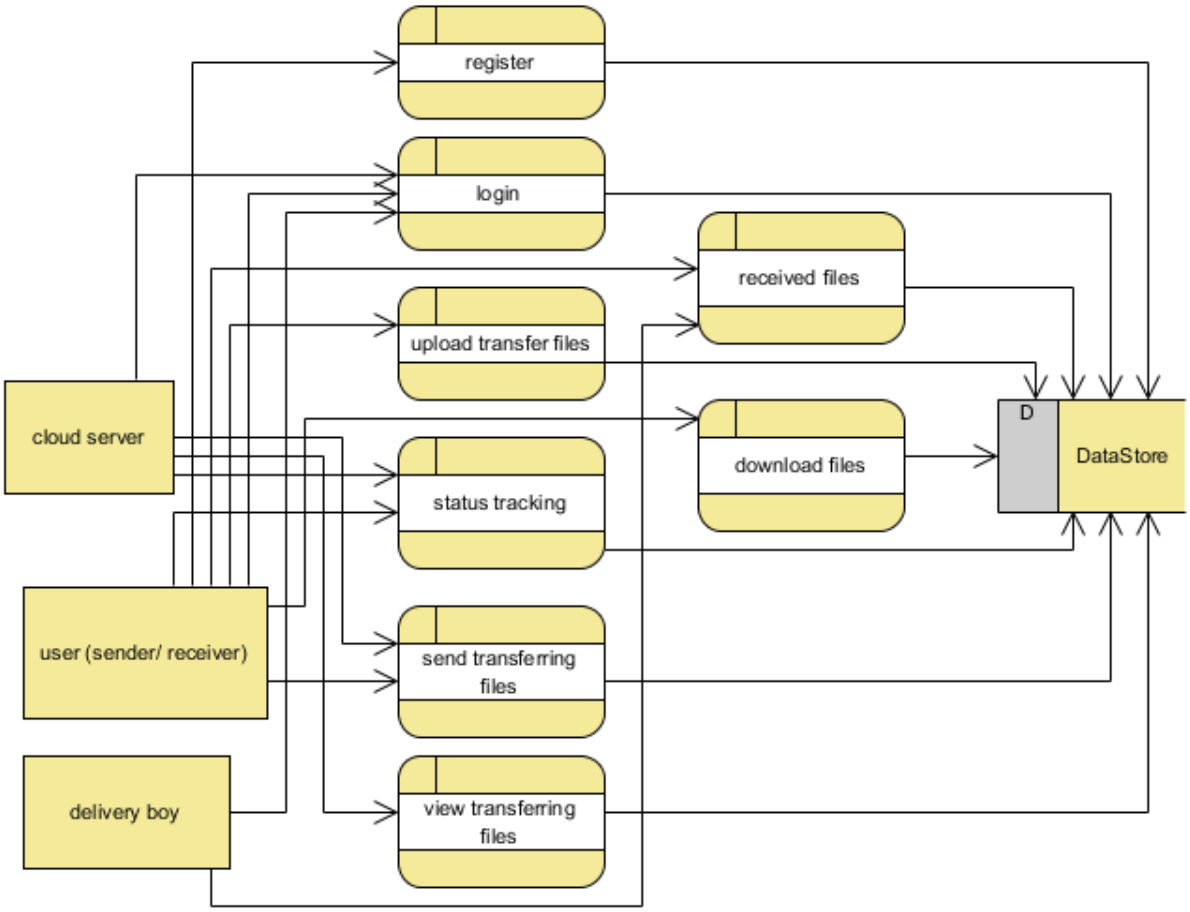
A Data Flow Diagram (DFD) is a traditional way to visualize the information flows within a system. A neat and clear DFD can depict a good amount of the system requirements graphically. It can be manual, automated, or a combination of both. It shows how information enters and leaves the system, what changes the information and where information is stored. The purpose of a DFD is to show the scope and boundaries of a system as a whole. It may be used as a communications tool between a systems analyst and any person who plays a part in the system that acts as the starting point for redesigning a system.

Context level diagram:



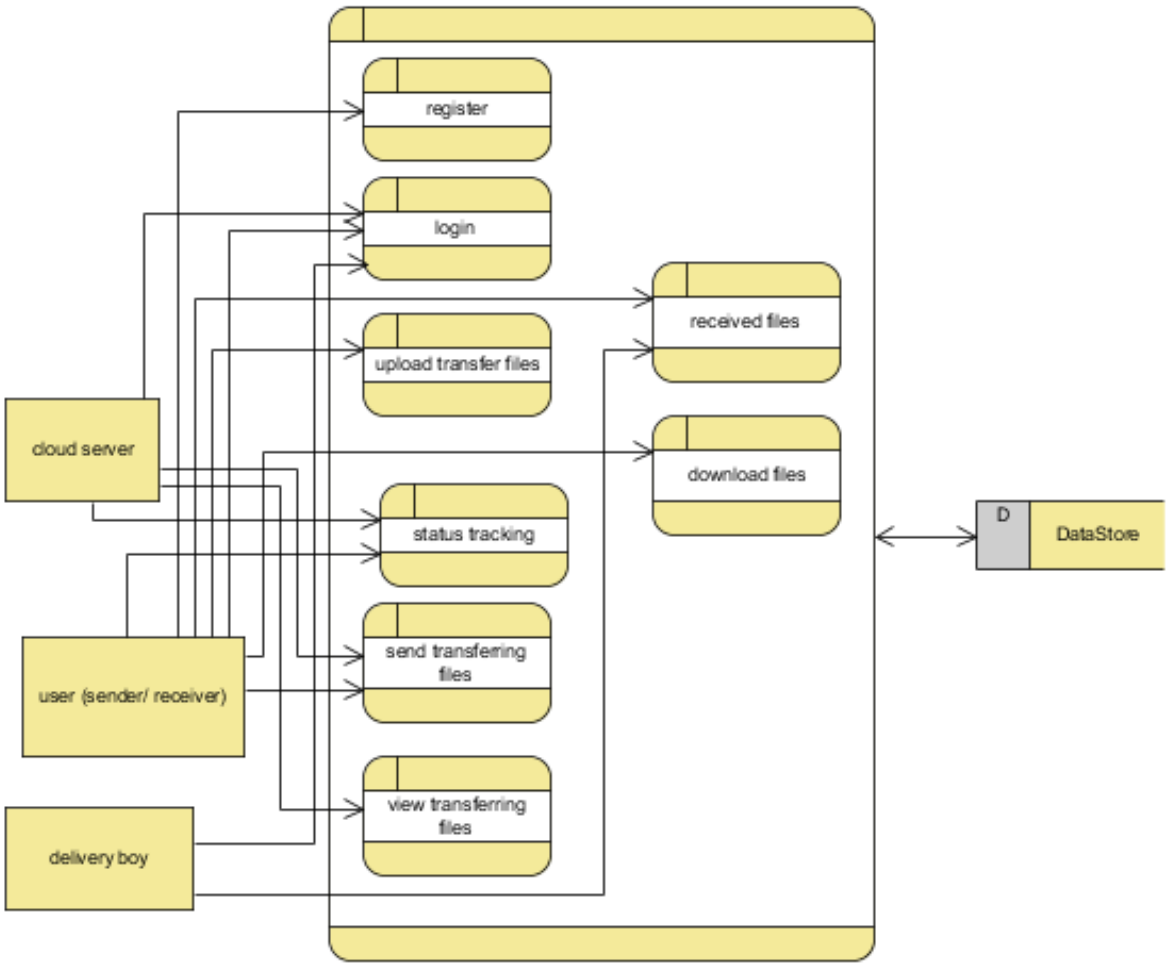
4.2.1 context level DFD

Level-1 diagram:



4.2.2 level-1 DFD

Level-2 diagram:



4.2.3 level-2 DFD

4.3 Components

Component Diagram

A component diagram, also known as a UML component diagram, describes the organization and wiring of the physical components in a system. Component diagrams are often drawn to help model implementation details and double-check that every aspect of the system's required function is covered by planned development.

Fig 4.3 components of system

4.4 Interface Design

Interface design is the front-end application view to which user interacts in order to use the software. The software becomes more popular if its user interface is:

- Attractive
- Simple to use
- Responsive in short time
- Clear to understand
- Consistent on all interface screens

4.4 interface design

4.5 System Specific Designs

UML Diagrams

UML stands for Unified Modelling Language. UML is a standardized general-purpose modelling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group.

The goal is for UML to become a common language for creating models of object-oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.

The Unified Modelling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modelling and other non-software systems.

The UML represents a collection of best engineering practices that have proven successful in the modelling of large and complex systems.

The UML is a very important part of developing objects-oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

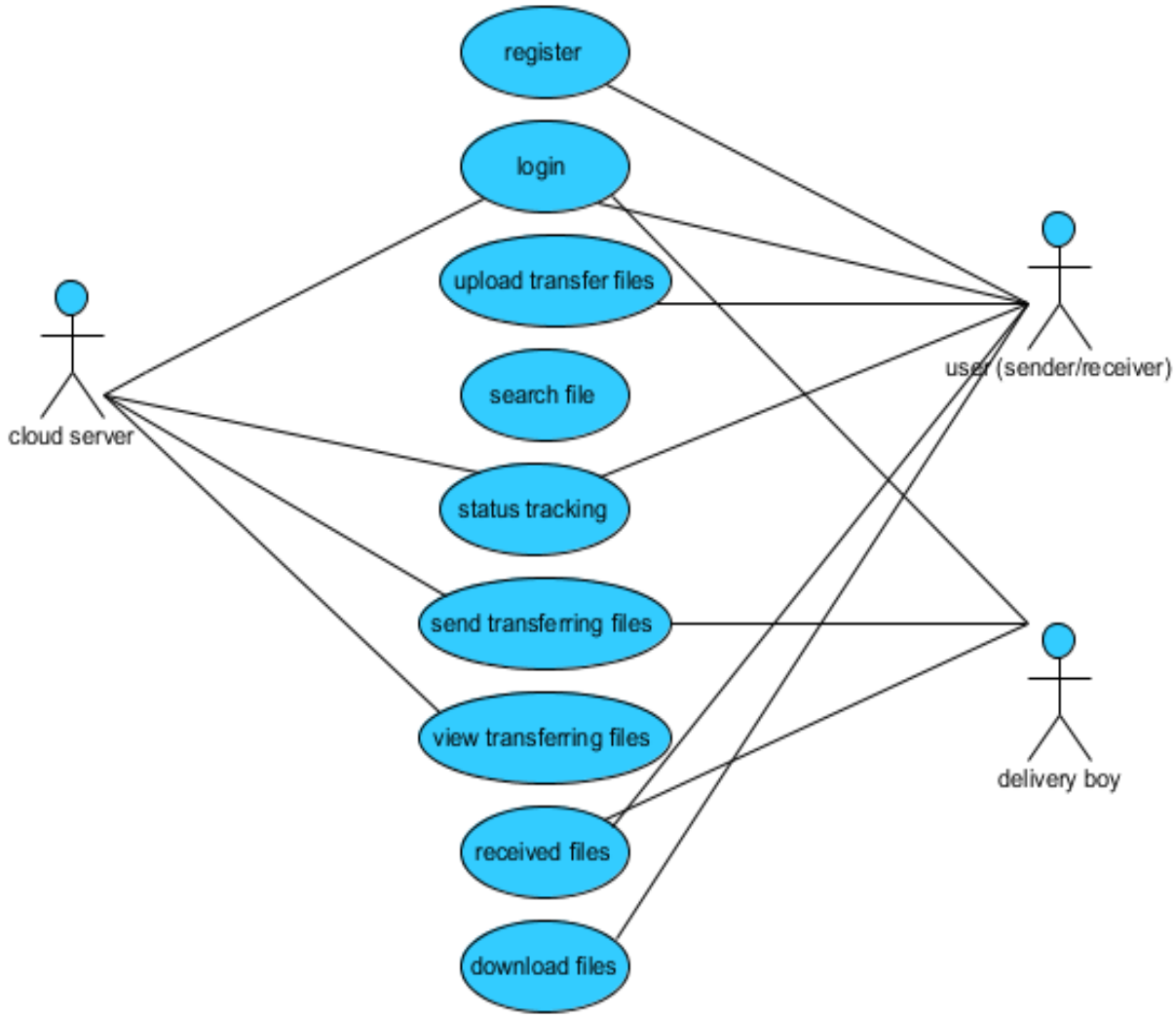
GOALS

The Primary goals in the design of the UML are as follows:

1. Provide users a ready-to-use, expressive visual modelling Language so that they can develop and exchange meaningful models.
2. Provide extendibility and specialization mechanisms to extend the core concepts.
3. Be independent of particular programming languages and development process.
4. Provide a formal basis for understanding the modelling language.
5. Encourage the growth of tools market.
6. Support higher level development concepts such as collaborations, frameworks, patterns and components.
7. Integrate best practices.

Use Case Diagram

- A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis.
- Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases.
- The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

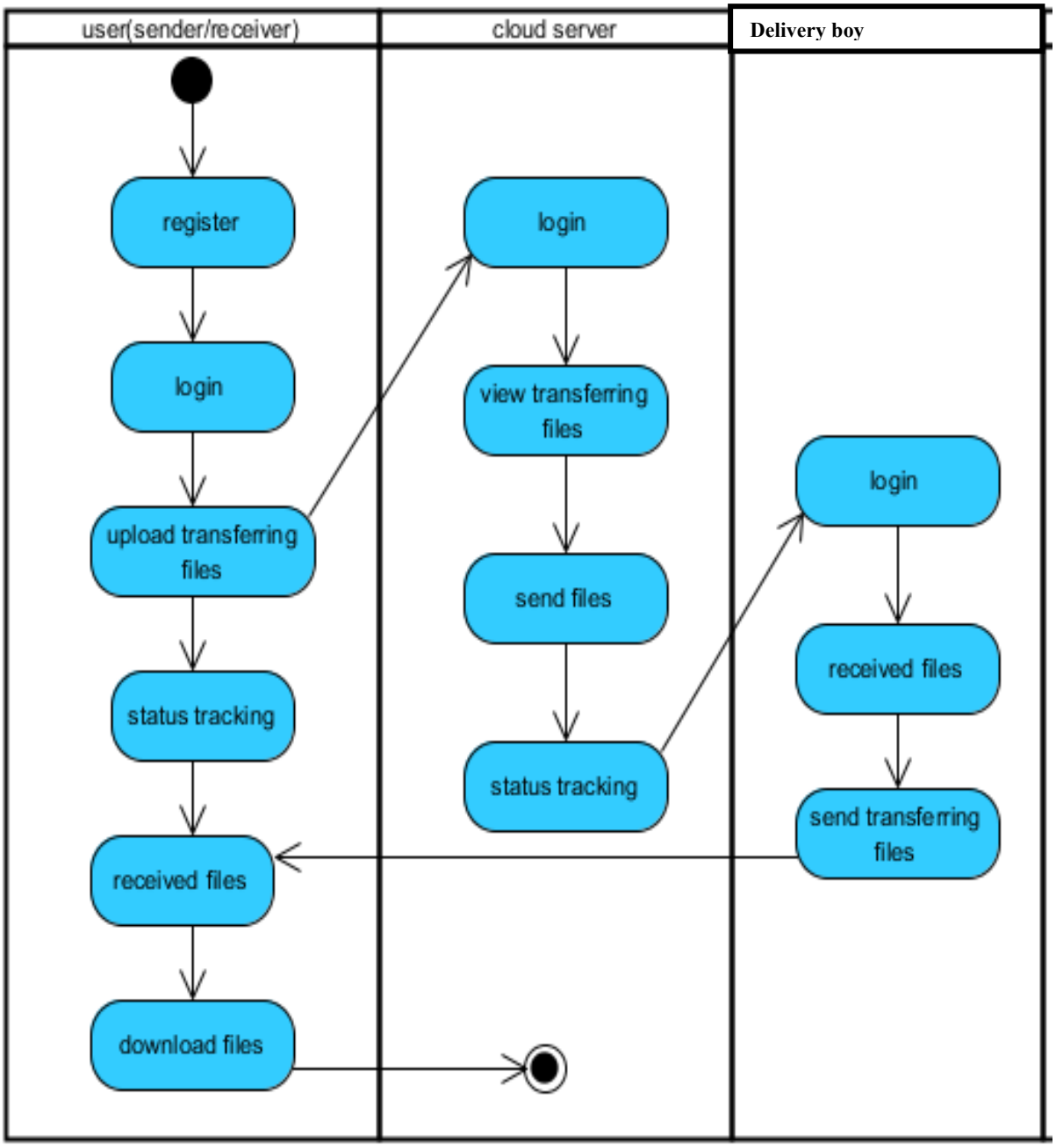


-

Fig 4.5 use case diagram

4.6 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modelling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.



4.6 Activity Diagram

5. TESTING

5.0 Introduction To Testing

Testing is nothing but an art of investigating software to ensure that its quality under test is in line with the requirement of the client. Software testing is carried out in a systematic manner with the intent of finding defects in a system. It is required for evaluating the system. As the technology is advancing we see that everything is getting digitized. One small defect can cause a lot of financial loss. Its a reason that software testing is now emerging as a very powerful field in IT. Software testing is required to check the reliability of the software. Software testing ensures that the system is free from any bug that can cause any kind of failure it ensures that the product is in line with the requirement of the client It is required to make sure that the final product is user friendly.

Test Plan

Before going for testing, first decide upon the type of testing to be carried out.
The followingfactors are taken into consideration:

- To ensure whether that information properly flows into and out of program.
- To find whether the modules maintaining their integrity during all steps in algorithm execution or not.
- To ensure that the module operate properly at boundaries established to limit or restrictprogressing.
- To find out whether error-handling paths are working correctly or not.
- To find out whether the values are correctly updated or not check for validation.

Objectives of Testing

- Testing is done to ensure
- No bug occurrence in future usage of the Application.
- Quality Assurance standard is achieved.
- Discover symptoms caused by bugs and provide clear diagnosis so that bugs can be easilyprevented

5.1 Test Cases

S.NO	Test Case Specification	Description
1	Upload text file	File successfully uploaded to cloud
2	User Login	Enter valid email ,password and secret key
3	User Login	Enter invalid email or password or secret key
4	Transferring file to Delivery boy	Successfully sent file to Delivery boy
5	File receiving	Successfully file received and sent to user with private key
6	Download file	Enter valid decrypted key
7	Download file	Invalid decrypted key

5.1 Testcase table

5.2 Test Report

S.NO	Test cases	I/O	Expected O/T	Actual O/T	P/F
1	Upload text file	Text file path.	Store files in to database successfully.	File uploaded successfully	P
2	User Login	Enter valid email ,password and secret key	Login to the User home page successfully	Login to the User home page successfully	P
3	User Login	Enter invalid email or password or secret key	Invalid credentials login failed	Login failed	F
4	Transferring file to Delivery boy	Successfully sent file to Delivery boy	Cloud sent the transferring file to Delivery boy successfully	Successfully file sent	P
5	File receiving	Successfully file received and sent to user with private key	Successfully file received and sent to user with private key	Successfully file received and sent to user with private key	P
6	Download file	Enter valid decrypted key	File downloaded successfully	File downloaded successfully	P
7	Download file	Invalid decrypted key	File not downloaded	File not downloaded	F

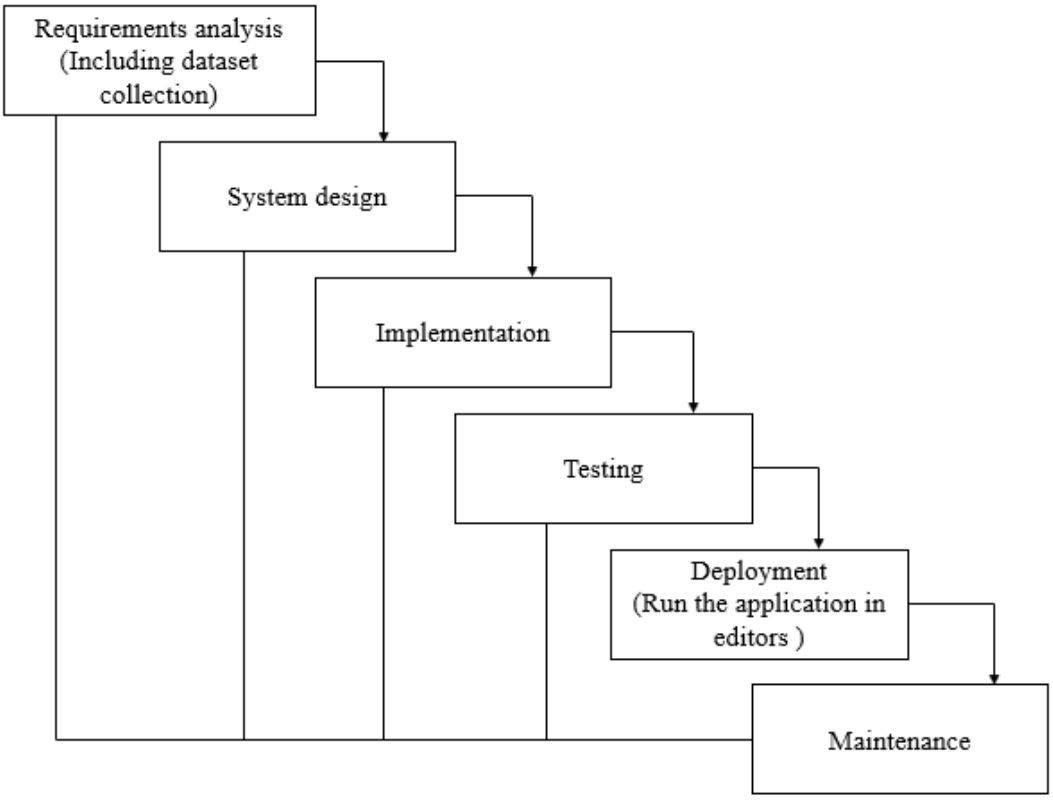
5.2 Testcase report

5.3 Test Conclusion

Concluding test cases is a critical step in the software testing process. It involves reviewing the results of executed test cases, analysing the outcomes, and making decisions based on the information gathered. The above test cases had been successfully executed without any issues.

6. IMPLEMENTATION

In our project we use waterfall model as our software development cycle because of its step-by-step procedure while implementing.



6.0 Implementation diagram

- **Requirement Gathering and analysis** − all possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document.
- **System Design** − the requirement specifications from first phase are studied in this phase and the system design is prepared. This system design helps in specifying hardware and system requirements and helps in defining the overall system architecture.
- **Implementation** − with inputs from the system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

- **Integration and Testing** − All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures.
- **Deployment of system** − Once the functional and non-functional testing is done; the product is deployed in the customer environment or released into the market.
- **Maintenance** − There are some issues which come up in the client environment. To fix those issues, patches are released. Also, to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

FEASIBILITY STUDY

The feasibility of the project is analysed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

Economic feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus, the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

Technical feasibility

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead

to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

Social feasibility

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

Modules

1. Cloud Server

1.1 Views data transferred by user:

Here data sender (user) will send the particular file to cloud.

1.2 Files transferring to Delivery boy:

Cloud will transfer the file from the sender side to Delivery boy.

1.3 Status tracking:

Once after sending the file status can be tracked as either the file is sent or in pending.

Cloud can view the attacked files and they can also save the file from attackers.

2. Delivery Boy

Delivery boy will view the received files and send information to receiver through mail along with a private key to view the file data.

3. User (Sender/Receiver)

3.1 Register & Login:

User will register and login with the valid data to send a file to cloud

3.1 upload transfer files:

Once after login sender will transfer the files to cloud.

3.2 Status Checking:

After transferring the file status will be checked.

3.3 Receiving the file:

With the use of private key sent by Delivery boy is used to view the received file.

ALGORITHMS

AES Algorithm

- The AES (Advanced Encryption Standard) algorithm is a encryption algorithm designed for securely encrypting and decrypting data.
- It is widely used for securing sensitive data such as communications,…
- It was selected by the U.S. National Institute of Standards and Technology (NIST) to replace the Data Encryption Standard (DES) in 2001 due to its increased security and efficiency.
- It uses several rounds of transformation to encrypt data and provides a high level of security
- It encrypt the blocks using keys of 128, 192, and 256 bits.
- Once it encrypts these blocks, it joins them together to form the ciphertext
- It is based on a substitution-permutation network, also known as an SP network.
- It is adopted by government**,** organizations and industries for encryption of data..

SHA-1 Algorithm

- SHA-1 (Secure Hash Algorithm 1) is a cryptographic hash function that was designed by the National Security Agency (NSA) and published by the National Institute of Standards and Technology (NIST) in 1995.
- It is part of the SHA family of hash functions, which also includes SHA-0, SHA-256, SHA-384, and SHA-512.
- SHA-1 was widely used in various security applications, such as digital signatures, certificate generation, and secure communication protocols.
- SHA-1 takes an input message and produces a fixed-size hexadecimal number known as a message digest.
- The primary purpose of SHA-1 is to ensure data integrity by generating a unique hash value for a given input

Ex:

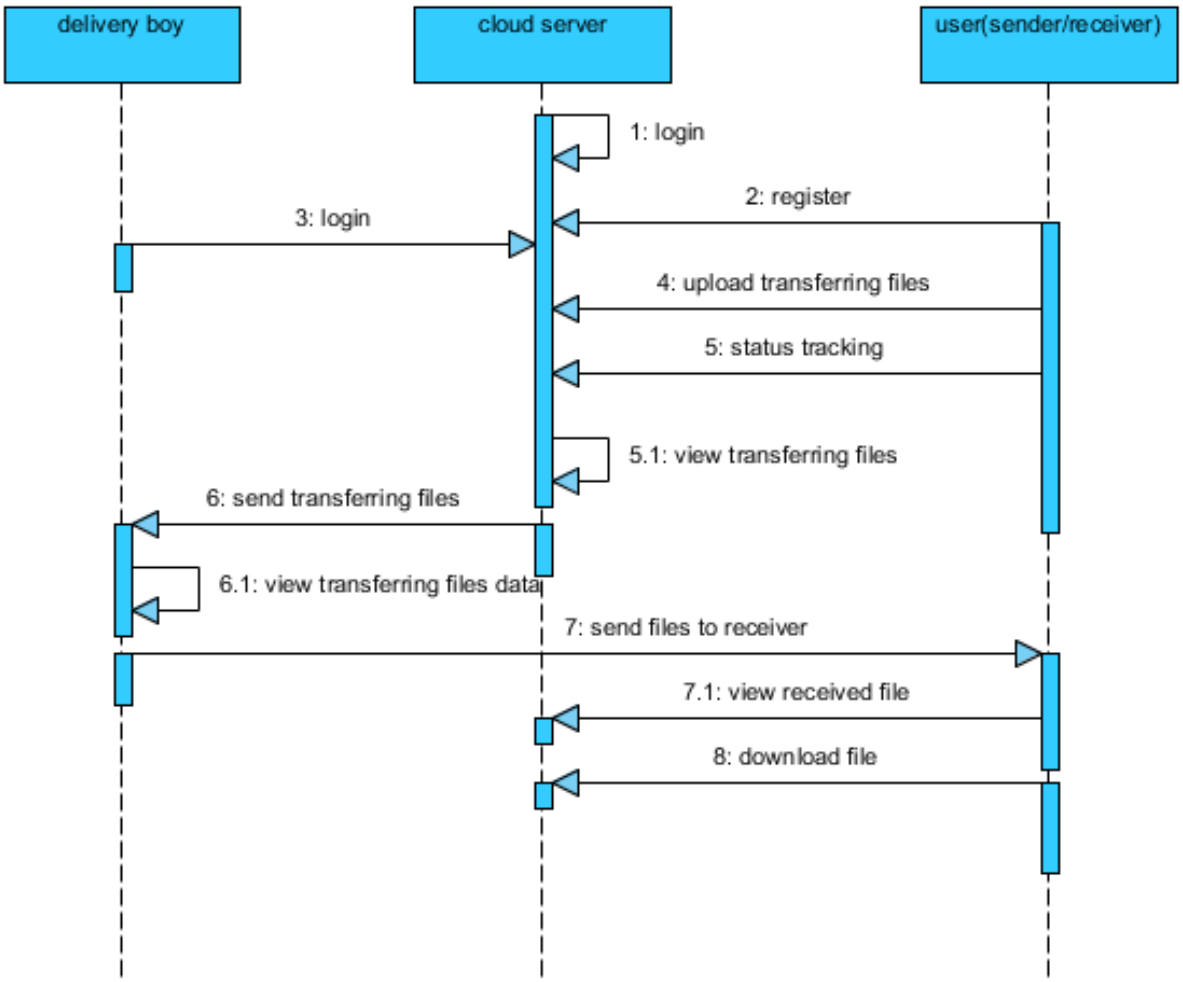
Input: str = "GeeksforGeeks"

output: The hexadecimal equivalent of SHA1 is:

4175a37afd561152fb60c305d4fa6026b7e79856

6.1 Sequence Diagram

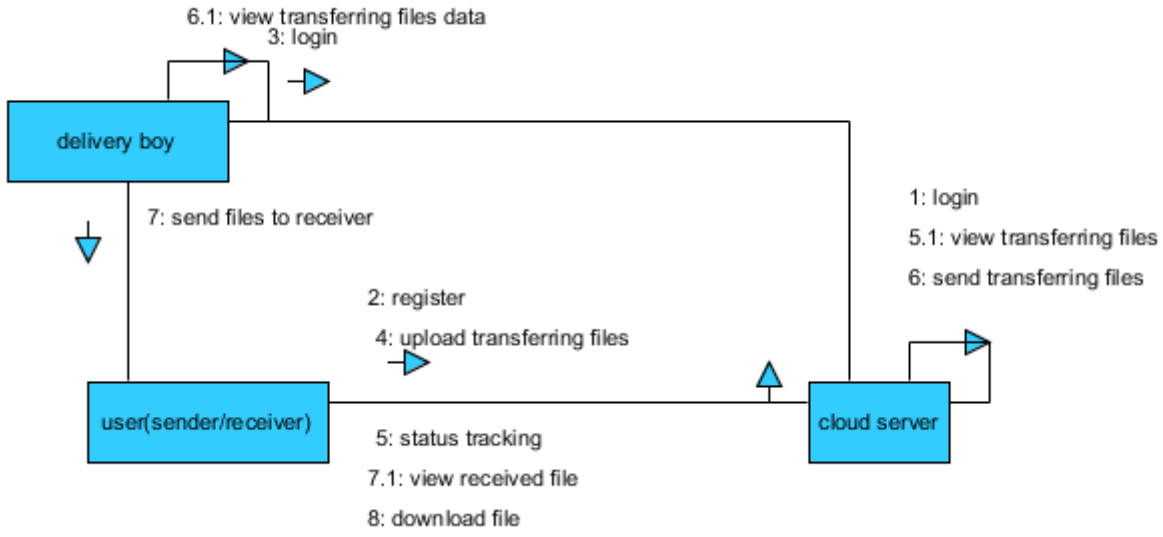
- A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order.
- It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.



6.1.1 sequence diagram

Collaboration Diagram

In collaboration diagram the method call sequence is indicated by some numbering technique as shown below. The number indicates how the methods are called one after another. We have taken the same order management system to describe the collaboration diagram. The method calls are similar to that of a sequence diagram. But the difference is that the sequence diagram does not describe the object organization whereas the collaboration diagram shows the object organization.



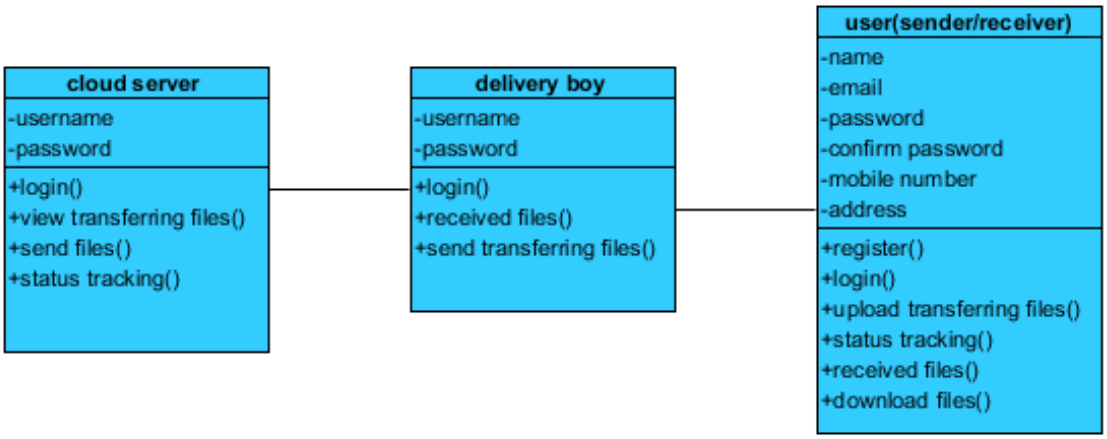
6.1.2 collaboration diagram

Deployment Diagram

Deployment diagram represents the deployment view of a system. It is related to the component diagram. Because the components are deployed using the deployment diagrams. A deployment diagram consists of nodes. Nodes are nothing but physical hardware's used to deploy the application.

Class Diagram

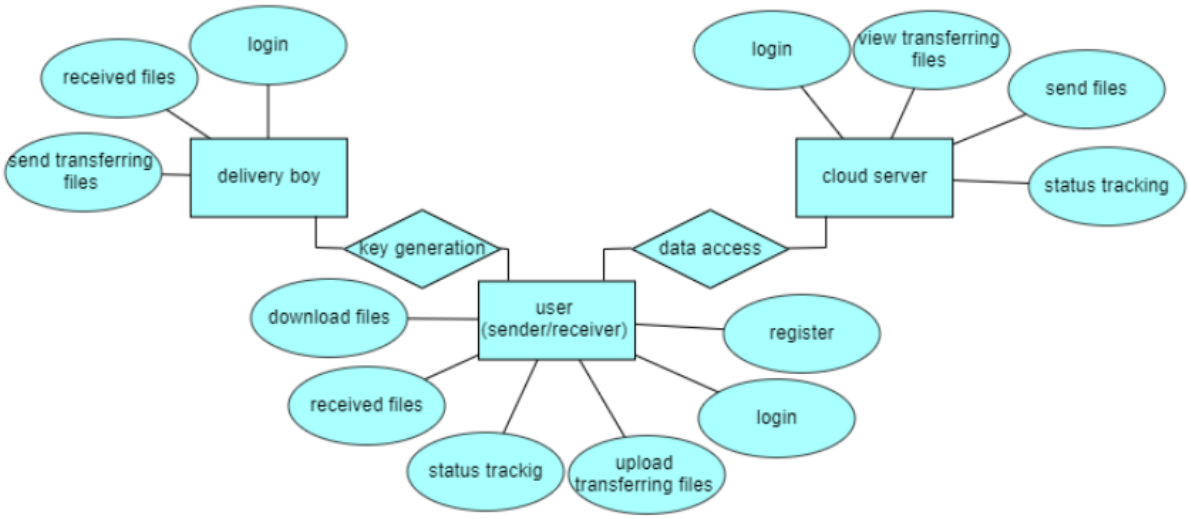
In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information



6.2 ER Diagram

An Entity–relationship model (ER model) describes the structure of a database with the help of a diagram, which is known as Entity Relationship Diagram (ER Diagram). An ER model is a design or blueprint of a database that can later be implemented as a database. The main components of E-R model are: entity set and relationship set.

An ER diagram shows the relationship among entity sets. An entity set is a group of similar entities and these entities can have attributes. In terms of DBMS, an entity is a table or attribute of a table in database, so by showing relationship among tables and their attributes, ER diagram shows the complete logical structure of a database. Let's have a look at a simple ER diagram to understand this concept.



6.2 Entity relationship

7. FUTURE ENHACEMENTS

In future we can implement the process by transferring different type of data set such as geographical coordinates and some pictures with notes and links with more security, Real-time updates, Decentralized data sharing through integration with IoT Devices and Analytics.

8. SUMMARY&CONCLUSION

Here we implemented security based data transfer through Delivery tracking system using blockchain technology in which Cloud is used has mediator to transfers files from sender to delivery boy with more security using encryption based algorithm (Advanced Encryption Standard) for converting data into cipher text. The cipher text is decrypted by the HASH key generated by Delivery boy to the particular receiver.

9. APPENDICES

Appendix – I :Source Code

```
from flask import Flask,render_template,request,redirect,flash,session,url_for
import mysql.connector
import pandas as pd
import string
import random
import hashlib
import numpy as np
import smtplib
import requests
from email.mime.multipart import MIMEMultipart
from email.mime.text import MIMEText
from datetime import datetime
app=Flask(__name__)
app.config['SECRET_KEY'] = 'the random string'
mydb = mysql.connector.connect(host="localhost", user="root",
passwd="",port=3306, database="delivery_system")
cursor = mydb.cursor()

@app.route("/")
def index():
    return render_template("index.html")

@app.route("/dp")
def dp():
    return render_template("dp.html")

@app.route('/dpback',methods = ["POST"])
def dpback():
    if request.method=='POST':
        name=request.form['name']
        email=request.form['email']
        pwd=request.form['pwd']
        cpwd=request.form['cpwd']
        pno=request.form['pno']
        addr=request.form['addr']

        sql = "select * from dp"
        result = pd.read_sql_query(sql, mydb)
        email1 = result['email'].values
        all_pno = result['pno'].values
        print(email1)
        if email in email1:
            if pno in all_pno:
                flash("email/Mobile Number already existed","warning")
                return render_template('dp.html', msg="email existed")
```

```
        if (pwd == cpwd):
            sql = "INSERT INTO dp (name,email,pwd,addr,pno) VALUES
(%s,%s,%s,%s,%s)"
            val = (name, email, pwd, addr, pno)
            cursor.execute(sql, val)
            mydb.commit()
            flash("Successfully Registered", "warning")
            return render_template('dp.html')
        else:
            flash("Password and Confirm Password not same")
        return render_template('dp.html')

    return render_template('dp.html')

@app.route("/dplog")
def dplog():
    return render_template("dplog.html")

@app.route('/dplogback',methods=['POST', 'GET'])
def dplogback():
    if request.method == "POST":

        email = request.form['email']
        password1 = request.form['pwd']

        sql = "select * from dp where email='%s' and pwd='%s' " % (email,
password1)
        print('q')
        x = cursor.execute(sql)
        print(x)
        results = cursor.fetchall()
        print(results)
        global name

        if len(results) > 0:
            print('r')
            name = results[0][1]
            print(name)
            session['fname'] = results[0][1]
            session['email'] = email
            flash("Welcome to website", "primary")
            return render_template('dphome.html', m="Login Success",
msg=results[0][1])

        else:
            flash("Login failed", "warning")
            return render_template('dplog.html', msg="Login Failure!!!")
```

```
    return render_template('dp.html')

@app.route("/tf")
def tf():
    return render_template("tf.html")

@app.route('/tfback',methods=['POST','GET'])
def tfback():
    if request.method=='POST':
        name=request.form['name']
        remail=request.form['remail']
        fname=request.form['fname']
        faddr=request.form['faddr']
        taddr=request.form['taddr']
        file=request.form['file']

        dd="text_files/"+file
        print(dd)
        f = open(dd, "r")
        data = f.read()

        now = datetime.now()
        # currentDay = datetime.now().strftime('%d/%m/%Y')
        status = 'Request'
        datalen = int(len(data) / 2)
        print(datalen, len(data))
        g = 0
        a = ''
        b = ''
        c = ''
        for i in range(0, 2):
            if i == 0:
                a = data[g: datalen:1]
                # a=a.decode('utf-8')

        print(g)
        print(len(data))
        c = data[datalen: len(data):1]
        # c = c.decode('utf-8')
        print(c)

        currentDay = datetime.now().strftime('%Y-%m-%d')
        t1 = datetime.now().strftime('%H:%M:%S')

        email = session.get('email')
        if email==remail:
            flash("You can't share file to ur mail","danger")
            return render_template("tf.html")
```

```
        sql = "INSERT INTO transfer_files
(name,email,fname,remail,faddr,taddr,d1,block1,block2) VALUES
(%s,%s,%s,%s,%s,%s,%s,%s,%s)"

        val = (name, email, fname, remail, faddr, taddr, now, a, c)
        cursor.execute(sql, val)
        mydb.commit()
        # flash("file uploaded successfully", "success")

        sql = "select * from transfer_files where email='%s' "%(email)
        x = pd.read_sql_query(sql, mydb)
        print("^^^^^^^^^^^^^")
        print(type(x))
        print(x)
        # x = x.drop(['demail'], axis=1)
        x = x.drop(['name'], axis=1)
        # x = x.drop(['fname'], axis=1)
        x = x.drop(['email'], axis=1)
        x = x.drop(['remail'], axis=1)
        x = x.drop(['hash1'], axis=1)
        x = x.drop(['hash2'], axis=1)
        x = x.drop(['faddr'], axis=1)
        x = x.drop(['taddr'], axis=1)
        x = x.drop(['d1'], axis=1)
        x = x.drop(['status'], axis=1)
        x = x.drop(['delivery_uname'], axis=1)
        return render_template('tfback.html',row_val=x.values.tolist())
    flash("file not puloaded", "danger")
    return render_template('tf.html')
@app.route('/tfback1/<s>/<s1>/<s2>')
def tfback1(s=0,s1='',s2=''):
    result1 = hashlib.sha1(s1.encode())
    hash1 = result1.hexdigest()
    result2 = hashlib.sha1(s2.encode())
    hash2 = result2.hexdigest()
    # val=AES_ENCRYPT
    sql="update transfer_files set
block1=AES_ENCRYPT('%s','keys'),block2=AES_ENCRYPT('%s','keys'),hash1='%s',hash
2='%s' where id='%s'" %(s1,s2,hash1,hash2,s)
    cursor.execute(sql)
    mydb.commit()
    flash("Data stored","success")
    return redirect(url_for('tf'))

@app.route("/view_tf")
def view_tf():
    sql = "select * from transfer_files where email='"+session['email']+"'"
    x = pd.read_sql_query(sql, mydb)
```

```
    x = x.drop(['id'], axis=1)
    x = x.drop(['name'], axis=1)
    x = x.drop(['email'], axis=1)
    x = x.drop(['hash1'], axis=1)
    x = x.drop(['hash2'], axis=1)
    x = x.drop(['faddr'], axis=1)
    x = x.drop(['block1'], axis=1)
    x = x.drop(['block2'], axis=1)
    x = x.drop(['remail'], axis=1)
    x = x.drop(['delivery_uname'], axis=1)

    return render_template("view_tf.html", cal_name=x.columns.values,
row_val=x.values.tolist())
@app.route("/rf")
def rf():
    email=session.get('email')
    print(email)
    sql = "select * from transfer_files where remail='%s' and
status='Completed' "%(email)
    x = pd.read_sql_query(sql, mydb)
    x = x.drop(['remail'], axis=1)
    x = x.drop(['taddr'], axis=1)
    x = x.drop(['block1'], axis=1)
    x = x.drop(['block2'], axis=1)
    x = x.drop(['hash1'], axis=1)
    x = x.drop(['hash2'], axis=1)
    x = x.drop(['status'], axis=1)
    x = x.drop(['delivery_uname'], axis=1)

    return render_template("rf.html", cal_name=x.columns.values,
row_val=x.values.tolist())

# @app.route("/downfile",methods=['POST','GET'])
# def downfile():
#     print("dfhlksokhso")
#     if request.method == 'POST':
#         print("gekjhiuth")
#         gkey = request.form['p1']
#         gkey1 = request.form['p2']
#         fid = request.form['id']
#
#         sql = "select
count(*),CONCAT(aes_decrypt(block1,'keys'),aes_decrypt(block2,'keys'),'') from
transfer_files where id='"+fid+"' and hash1='"+gkey+"' and hash2='"+gkey1+"'"
#         x = pd.read_sql_query(sql, mydb)
#         count=x.values[0][0]
#         print(count)
#
```

```
#         if count==0:
#             flash("Invalid key please try again","danger")
#             return render_template('down.html')
#         if count==1:
#             asss = x.values[0][1]
#             asss = asss.decode('utf-8')
#             return render_template("downfile.html", msg=asss)
#
#     return render_template("down.html")
#


@app.route("/down/<s>")
def down(s=0):
    global g
    g=s
    return render_template("down.html",g=g)

@app.route("/downfile",methods=['POST','GET'])
def downfile():
    print("dfhlksokhso")
    if request.method == 'POST':
        print("gekjhiuth")
        gkey = request.form['p1']
        gkey1 = request.form['p2']
        fid = request.form['id']

        sql = "select
count(*),CONCAT(aes_decrypt(block1,'keys'),aes_decrypt(block2,'keys'),'') from
transfer_files where id='"+fid+"' and hash1='"+gkey+"' and hash2='"+gkey1+"'"
        x = pd.read_sql_query(sql, mydb)
        count=x.values[0][0]
        print(count)
        asss=x.values[0][1]
        asss=asss.decode('utf-8')
        if count==0:
            flash("Invalid key please try again","danger")
            return render_template('down.html')
        if count==1:
            return render_template("downfile.html", msg=asss)

    return render_template("down.html")




@app.route("/add_boy")
def add_boy():
    return render_template("add_boy.html")
```

```
@app.route('/add_boy_back',methods = ["POST"])
def add_boy_back():
    if request.method=='POST':
        name=request.form['name']
        uname=request.form['uname']
        email=request.form['email']
        pwd=request.form['pwd']
        pno=request.form['pno']
        addr=request.form['addr']

        sql = "select * from delivery_users"
        result = pd.read_sql_query(sql, mydb)
        uname1 = result['uname'].values
        print(uname1)
        if uname in uname1:
            flash("email already existed","warning")
            return render_template('dp.html', msg="email existed")
        else:
            sql = "INSERT INTO delivery_users (name,uname,email,pwd,addr,pno)
VALUES (%s,%s,%s,%s,%s,%s)"
            val = (name,uname, email, pwd, addr, pno)
            cursor.execute(sql, val)
            mydb.commit()
            msg = 'Your login details are : '
            t = 'Regards,'
            t1 = 'Online Delivery Services.'
            mail_content = 'Dear ' + name + ',' + '\n' + msg +' User Name: '+
uname+'Password: '+ pwd + '\n' + '\n' + t + '\n' + t1
            sender_address = 'shaikreddysuhel@gmail.com'
            sender_pass = 'ttxdfxvnbokfynkq'
            receiver_address = email
            message = MIMEMultipart()
            message['From'] = sender_address
            message['To'] = receiver_address
            message['Subject'] = 'Delivery Tracking System'
            message.attach(MIMEText(mail_content, 'plain'))
            ses = smtplib.SMTP('smtp.gmail.com', 587)
            ses.starttls()
            ses.login(sender_address, sender_pass)
            text = message.as_string()
            ses.sendmail(sender_address, receiver_address, text)
            ses.quit()
            url = "https://www.fast2sms.com/dev/bulkV2"

            message = 'Dear ' + name + ',' + msg +' User Name: '+
uname+'Password: '+ pwd
            no = pno
```

```
            data1 = {
                "route": "q",
                "message": message,
                "language": "english",
                "flash": 0,
                "numbers": no,
            }

            headers = {
                "authorization":
"IFvNqg7CPaWst62KwMliEcHrB5VjLGQzmRO8bhxYAJSydDe0X4BeUowPgROjazLrM8pt6EAfNiZqC0
S2",
                "Content-Type": "application/json"
            }

            response = requests.post(url, headers=headers, json=data1)
            print(response)

            flash("Data added", "warning")
            return render_template('add_boy.html')
    return render_template('add_boy.html')

@app.route("/view_delivery_boys")
def view_delivery_boys():
    sql = "select * from delivery_users"
    x = pd.read_sql_query(sql, mydb)
    return render_template("view_delivery_boys.html",
cal_name=x.columns.values, row_val=x.values.tolist())

@app.route("/trans_files")
def trans_files():
    sql = "select * from transfer_files where status='waiting' "
    x = pd.read_sql_query(sql, mydb)
    x=x.drop(['block1','block2','hash1','hash2','status','delivery_uname'],axis
=1)
    return render_template("trans_files.html", cal_name=x.columns.values,
row_val=x.values.tolist())

@app.route('/transfer/<s>/<s1>/<s2>/<s3>/<s4>/<s5>/<a>')
def transfer(s='',s1='',s2='',s3='',s4='',s5='',a=0):
    sql="select * from delivery_users"
    x=pd.read_sql_query(sql,mydb)
    email=x['uname'].values
    arr=np.array(email)
    email = arr.tolist()
    secure_random = random.SystemRandom()
    email = secure_random.choice(email)
    print(email)
```

```
    sq="update transfer_files set delivery_uname='"+email+"',
status='Transfered' where id='"+str(a)+"'"
    cursor.execute(sq)
    mydb.commit()
    ss="select * from delivery_users where uname='"+email+"'"
    xx=pd.read_sql_query(ss,mydb)
    name=xx['name'].values
    all_pno=xx['pno'].values
    all_pno=list(all_pno)
    all_pno=all_pno[0]
    msg = 'Kindly share this file with perticular user immediatly . '

    print(all_pno)
    url = "https://www.fast2sms.com/dev/bulkV2"

    message = 'Dear ' +str(name) + ',' + msg
    no = all_pno
    data1 = {
        "route": "q",
        "message": message,
        "language": "english",
        "flash": 0,
        "numbers": no,
    }

    headers = {
        "authorization":
"IFvNqg7CPaWst62KwMliEcHrB5VjLGQzmRO8bhxYAJSydDe0X4BeUowPgROjazLrM8pt6EAfNiZqC0
S2",
        "Content-Type": "application/json"
    }

    response = requests.post(url, headers=headers, json=data1)
    print(response)
    flash("Data transfered to delivery person","success")
    return redirect(url_for('trans_files'))

@app.route('/status_track')
def status_track():
    sql="select * from transfer_files where status='Transfered'"
    x = pd.read_sql_query(sql, mydb)
    x = x.drop(['block1', 'block2', 'hash1',
'hash2','faddr','taddr','d1','delivery_uname'], axis=1)
    return render_template("status_track.html", cal_name=x.columns.values,
row_val=x.values.tolist())
@app.route("/cs")
def cs():
    return render_template("cs.html")
```

```
@app.route('/csback',methods=['POST', 'GET'])
def csback():
    if request.method == 'POST':
        print("aaaaaaaaaaaaaaa")
        username = request.form['uname']
        password1 = request.form['pwd']
        if username == 'cloud' and password1 == 'cloud' :
            flash("Welcome to website cloud", "primary")
            return render_template('cshome.html')
        else:
            print("&&&&&&&&&&&")
            flash("Invalid Credentials Please Try Again","warning")
            return render_template('cs.html')

    return render_template('cs.html')

@app.route('/av')
def av():
    return render_template("av.html")

@app.route('/avback',methods=['POST', 'GET'])
def avback():
    if request.method == "POST":

        uname = request.form['uname']
        password1 = request.form['pwd']

        sql = "select * from delivery_users where uname='%s' and pwd='%s' " %
(uname, password1)
        print('q')
        x = cursor.execute(sql)
        print(x)
        results = cursor.fetchall()
        print(results)
        global name
        if len(results) > 0:
            name = results[0][1]
            print(name)
            session['name'] = results[0][1]
            session['email'] =  results[0][3]
            session['uname']=uname
            flash("Welcome ", "primary")
            return render_template('avhome.html', msg=results[0][1])
        else:
            flash("Login failed", "warning")
            return render_template('av.html', msg="Login Failure!!!")
    return render_template('av.html')
```

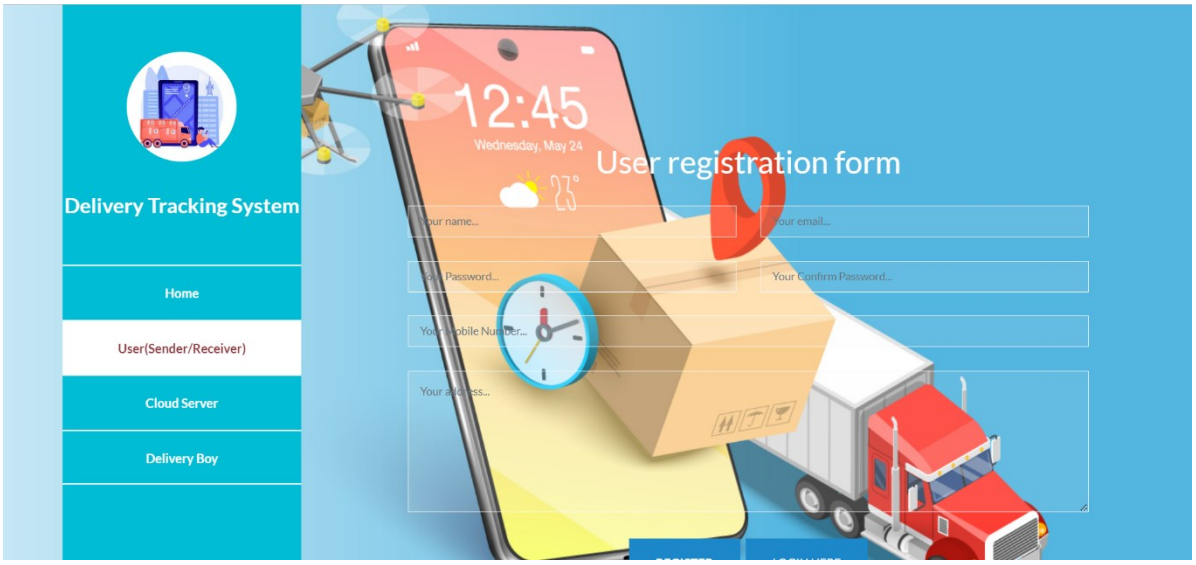
```
@app.route("/transfered_files")
def transfered_files():
    print(session['uname'])
    sql = "select * from transfer_files where delivery_uname
='"+session['uname']+"' and status='Transfered' "
    x = pd.read_sql_query(sql, mydb)
    x = x.drop(['block1'], axis=1)
    x = x.drop(['block2'], axis=1)
    x = x.drop(['name'], axis=1)
    x = x.drop(['delivery_uname'], axis=1)
    x = x.drop(['faddr'], axis=1)
    x = x.drop(['status'], axis=1)
    x = x.drop(['email'], axis=1)
    x = x.drop(['d1'], axis=1)
    return render_template("transfered_files.html", cal_name=x.columns.values,
row_val=x.values.tolist())

@app.route('/transfer_to_receiver/<s>/<s1>/<s2>/<s3>/<s4>/<s5>')
def transfer_to_receiver(s=0,s1='',s2='',s3='',s4='',s5=''):
    sql="update transfer_files set status='Completed' where id='"+s+"'"
    cursor.execute(sql)
    mydb.commit()

    msg = 'Your login details are : '
    t = 'Regards,'
    t1 = 'Online Delivery Services.'
    mail_content = 'Dear  hash key1 ' +hash1 + 'hash key2' +hash2
    sender_address = 'shaikreddysuhel@gmail.com'
    sender_pass = 'ttxdfxvnbokfynkq'
    receiver_address = email
    message = MIMEMultipart()
    message['From'] = sender_address
    message['To'] = receiver_address
    message['Subject'] = 'Delivery Tracking System'
    message.attach(MIMEText(mail_content, 'plain'))
    ses = smtplib.SMTP('smtp.gmail.com', 587)
    ses.starttls()
    ses.login(sender_address, sender_pass)
    text = message.as_string()
    ses.sendmail(sender_address, receiver_address, text)
    ses.quit()



    msg = 'Thanks for choosing Online file transfer'
    otp = "Your file is successfully transfered."
    m1 = "These are the key's for decrypting the file"

    # url = "https://www.fast2sms.com/dev/bulkV2"
```

```
    # message =  msg + ',' + otp + m1 + s4 +','+ s5 +' . '
    # no = s2
    # print(no)
    # data1 = {
    #     "route": "q",
    #     "message": message,
    #     "language": "english",
    #     "flash": 0,
    #     "numbers": no,
    # }

    # headers = {
    #     "authorization":
"IFvNqg7CPaWst62KwMliEcHrB5VjLGQzmRO8bhxYAJSydDe0X4BeUowPgROjazLrM8pt6EAfNiZqC0
S2",
    #     "Content-Type": "application/json"
    # }

    response = requests.post(url, headers=headers, json=data1)
    print(response)
    flash("File transefered","success")
    return redirect(url_for('transfered_files'))

@app.route('/remove_data/<s>')
def remove_data(s=0):
    sql = "delete from delivery_users where id='%s'" % (s)
    cursor.execute(sql, mydb)
    mydb.commit()
    flash("Data deleted", "info")
    return redirect(url_for('remove_data'))

if __name__=='__main__':
    app.run(debug=True)
```

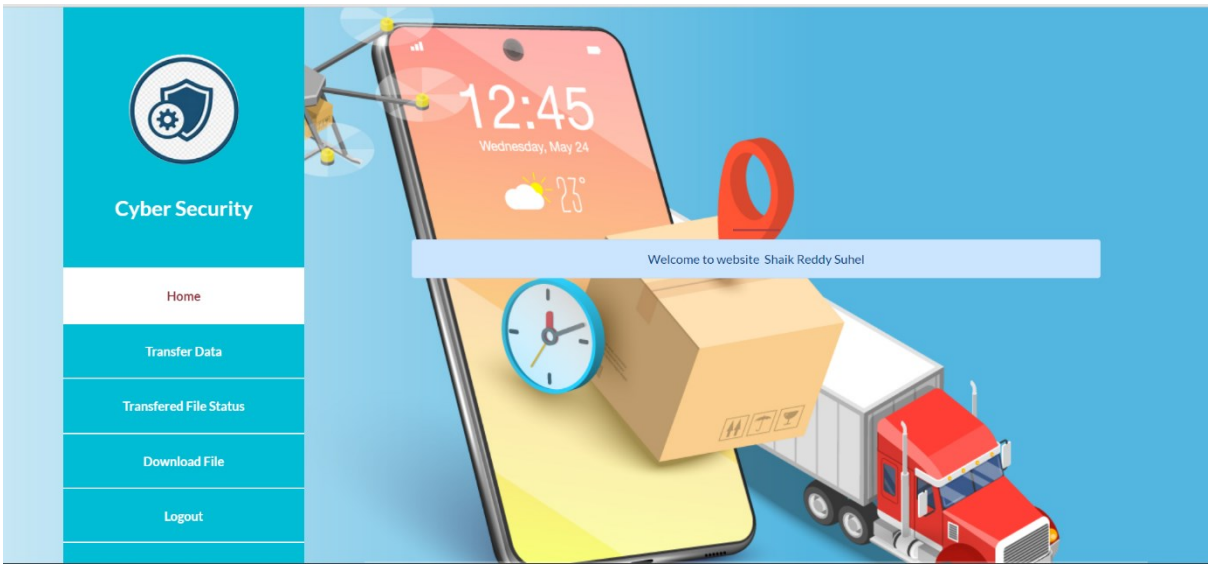
Appendix -II: Screen shots

Home page

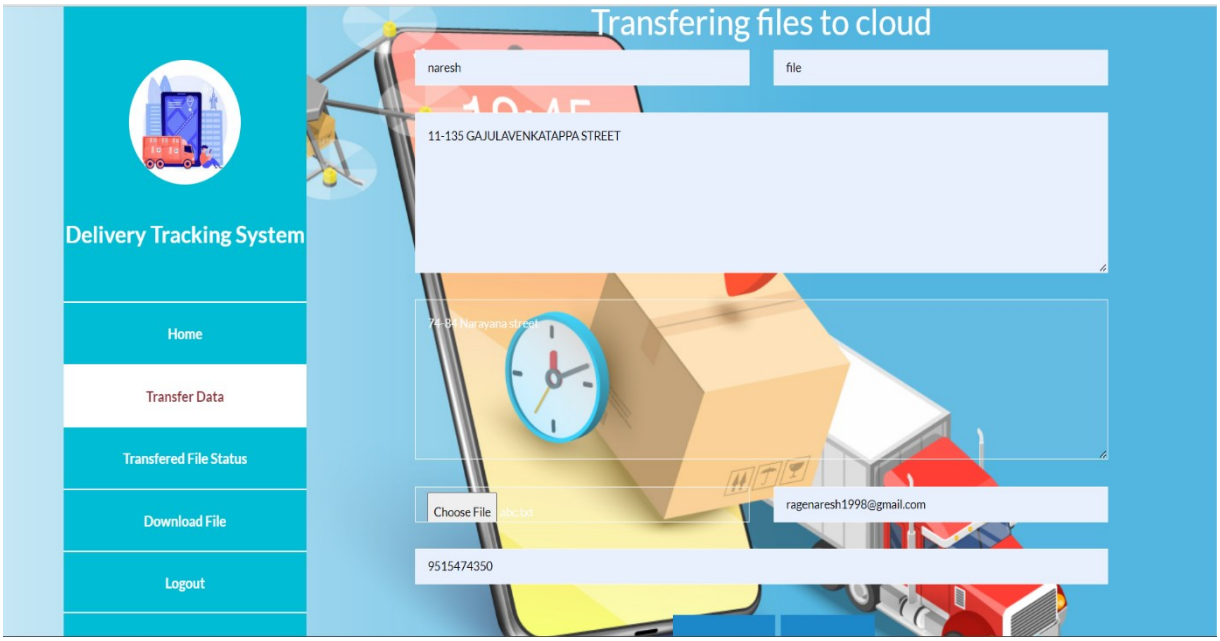
User Registration / Login



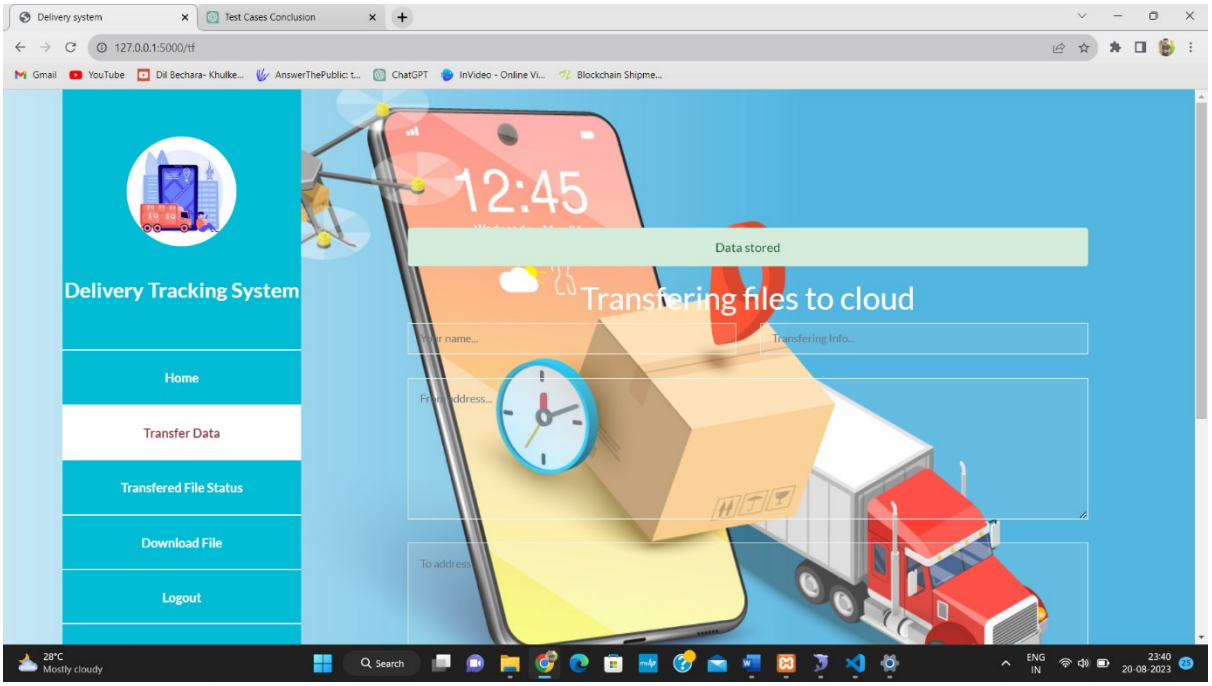
User login Interface



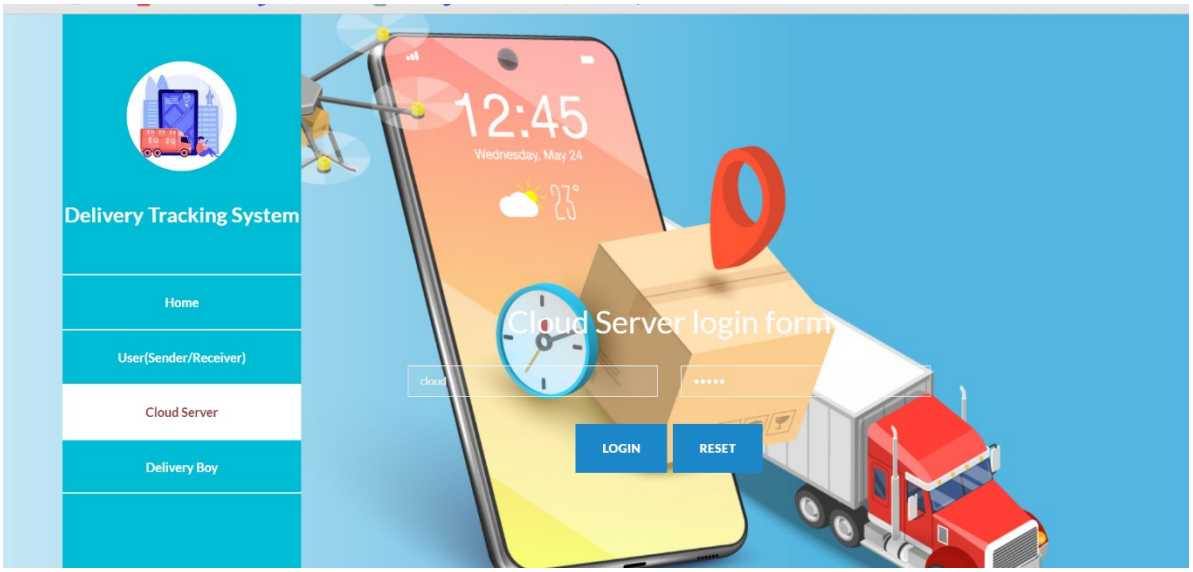
Transferring files to cloud



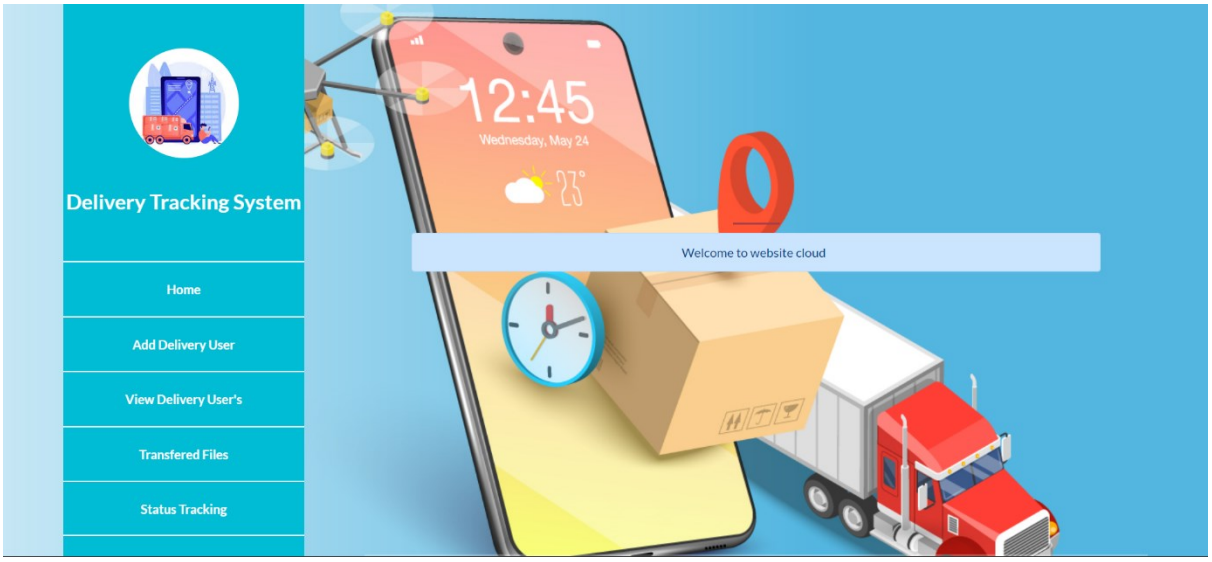
File transferred to cloud



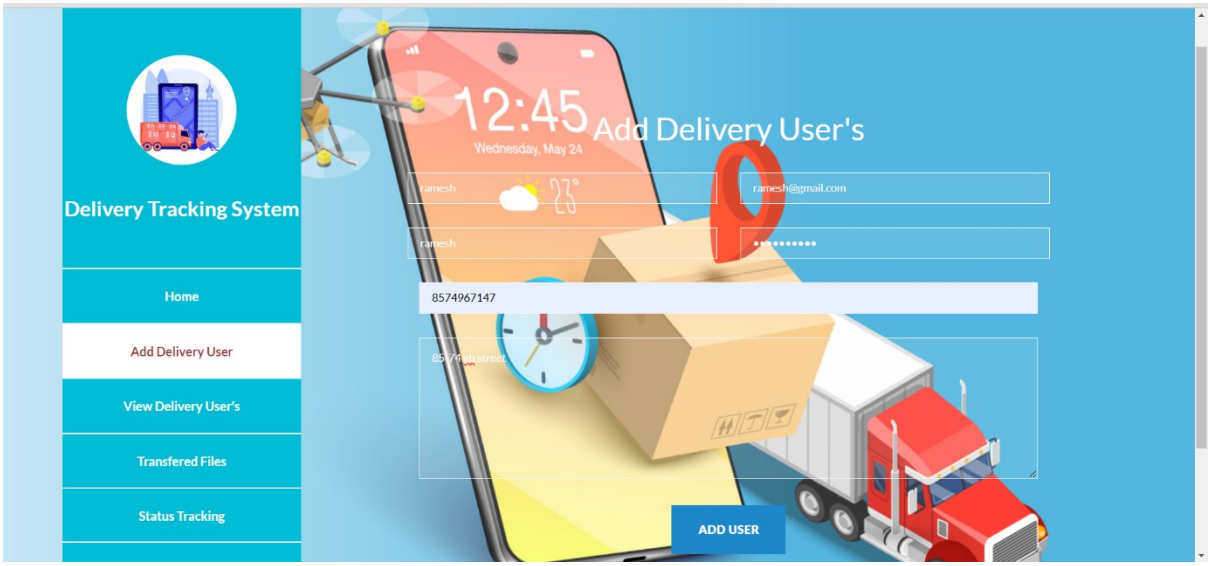
Cloud login



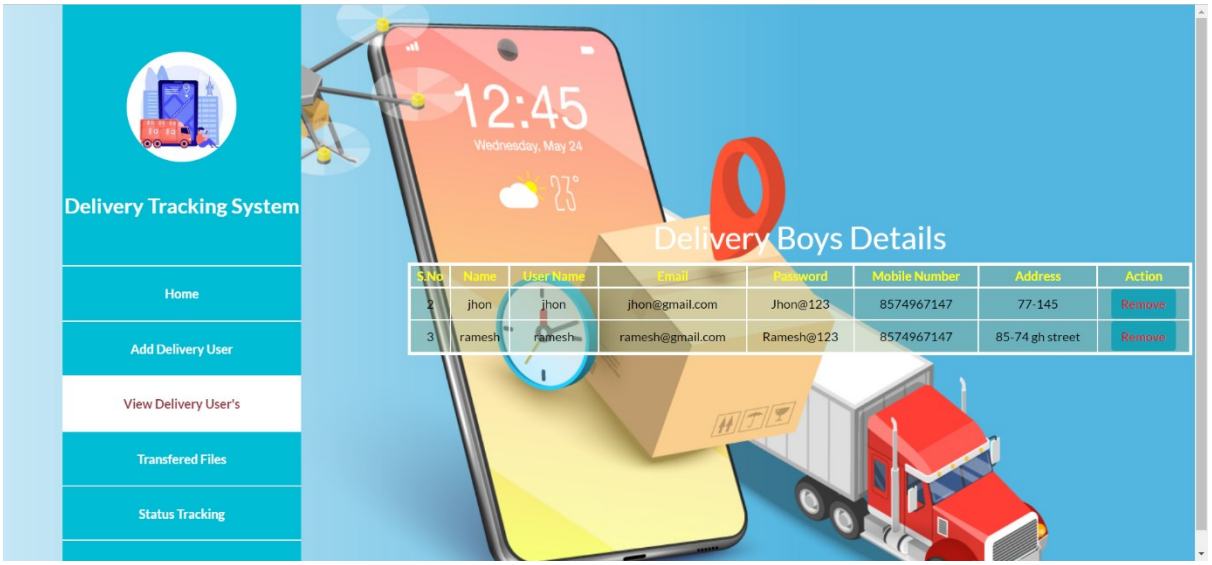
Cloud login successful



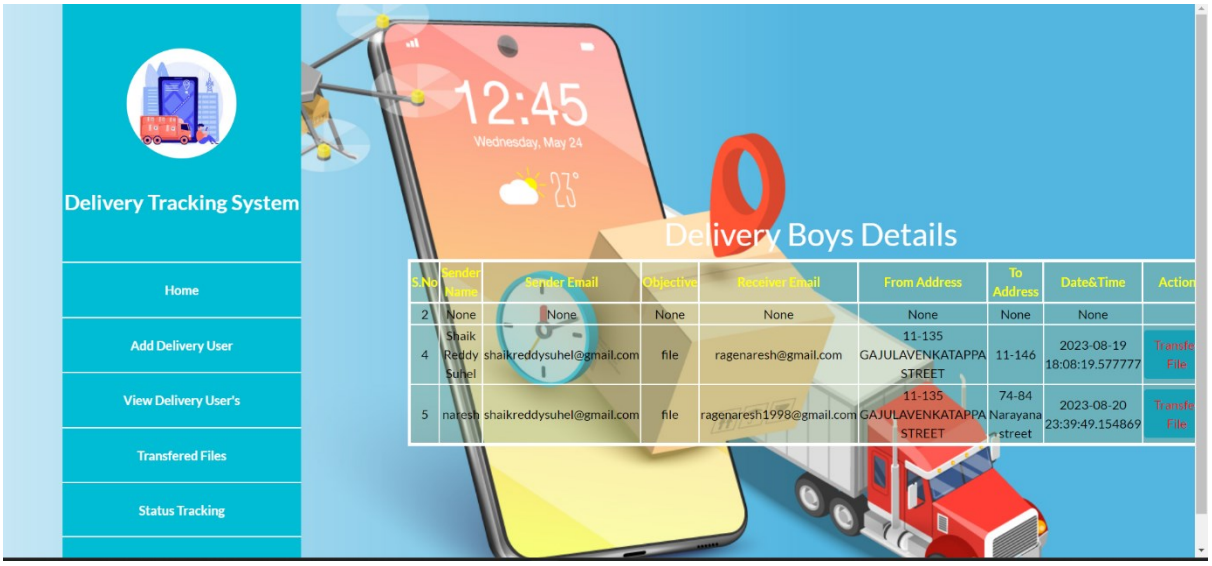
Adding delivery boy



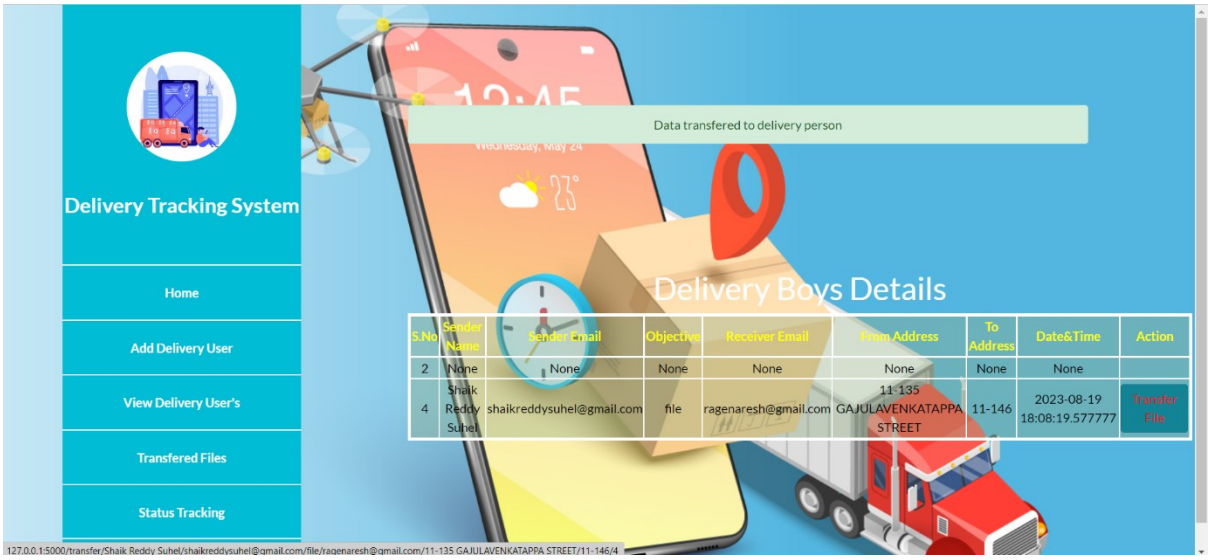
View delivery users



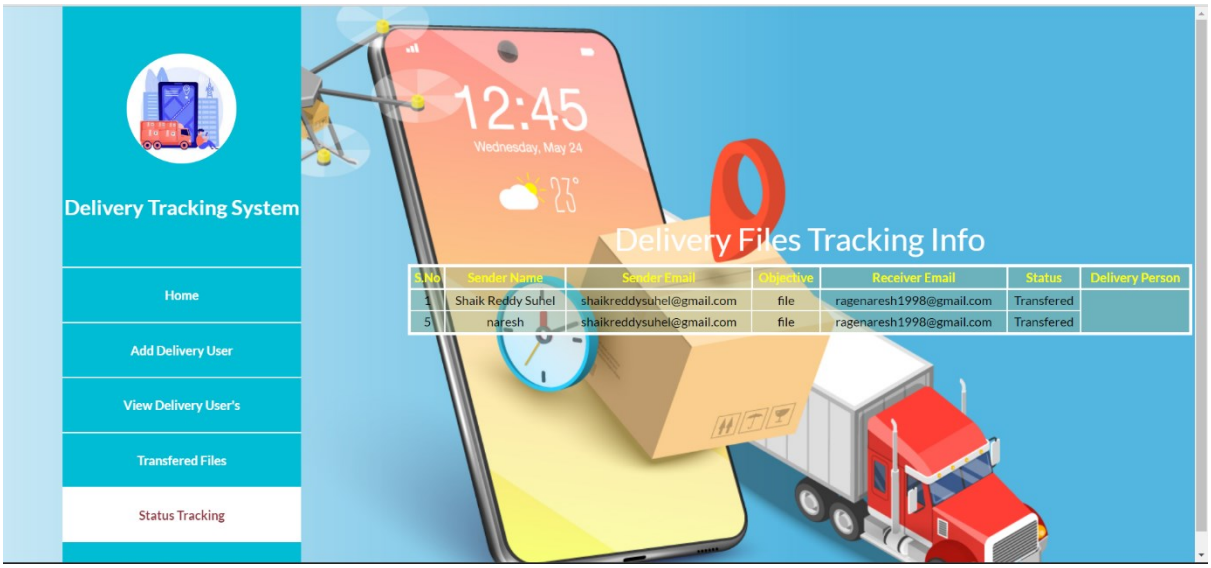
Transferring files to delivery boys



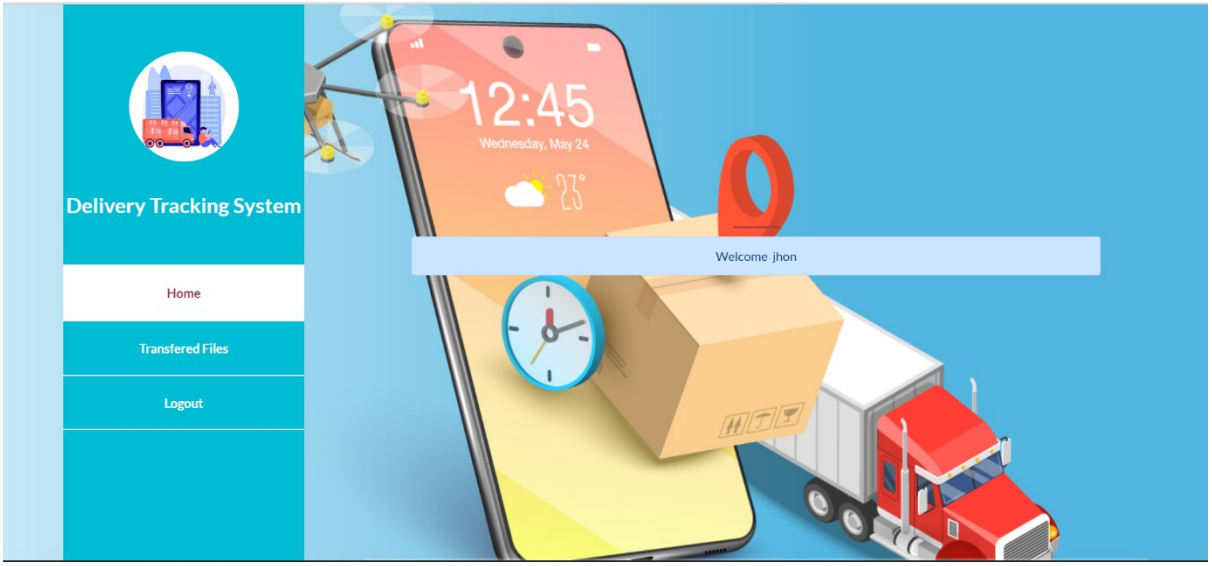
Successfully transferred to delivery person



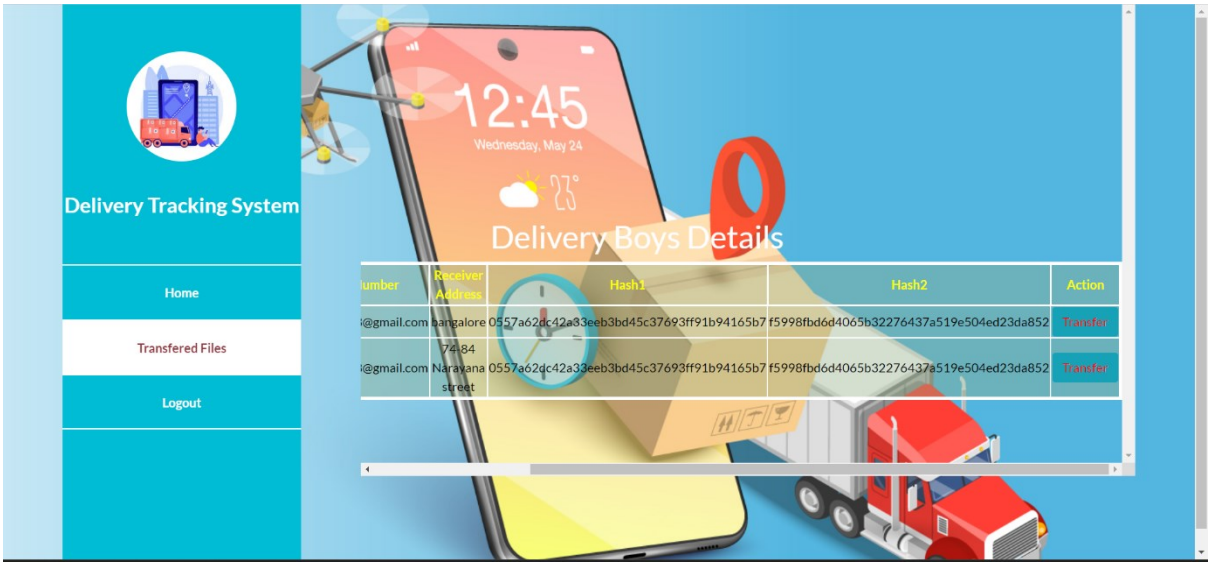
Tracking status of transferred files



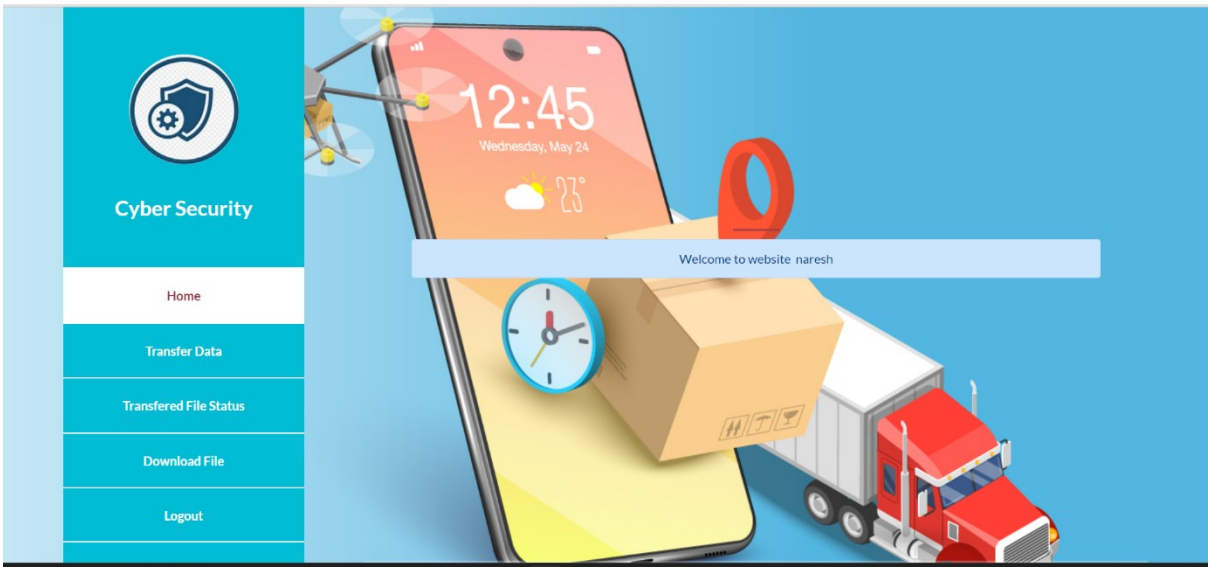
Delivery boy login



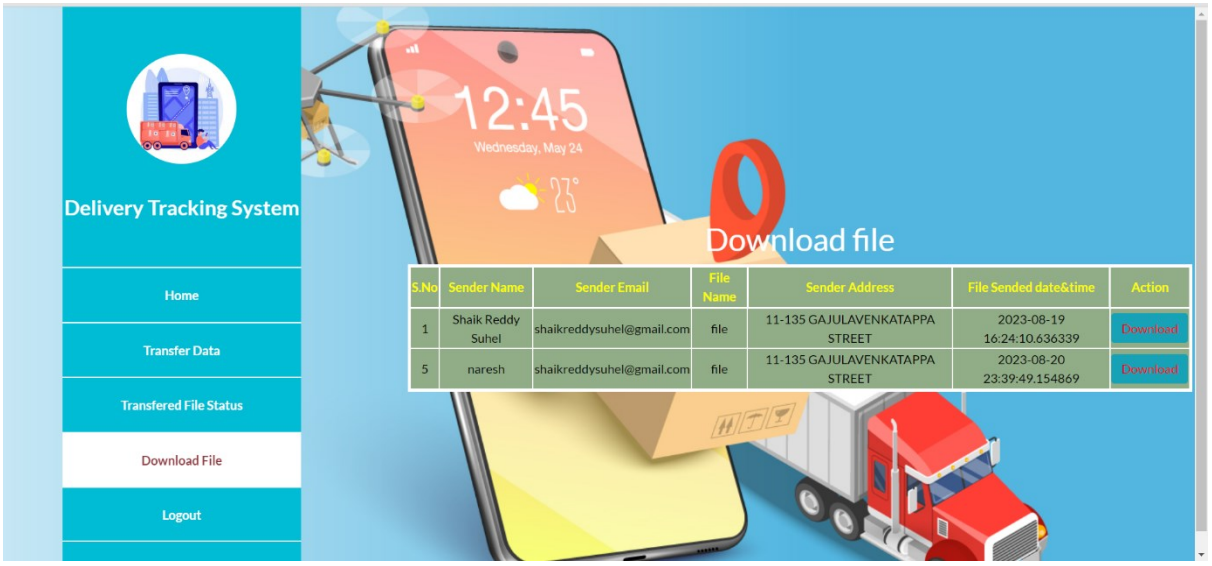
Transferring hash keys to receiver



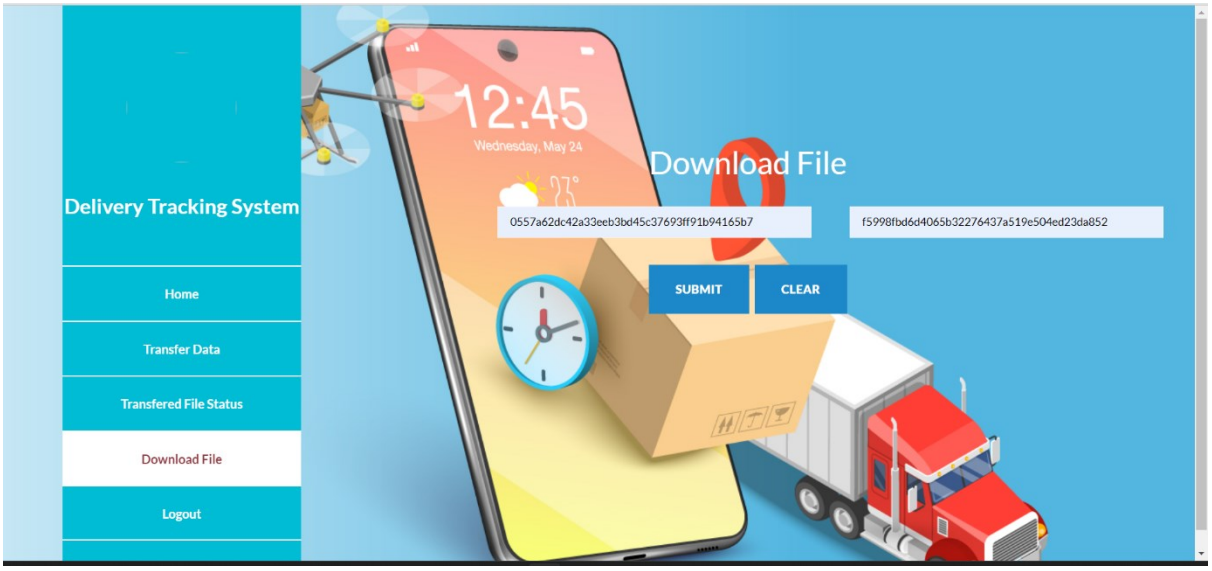
Receiver login



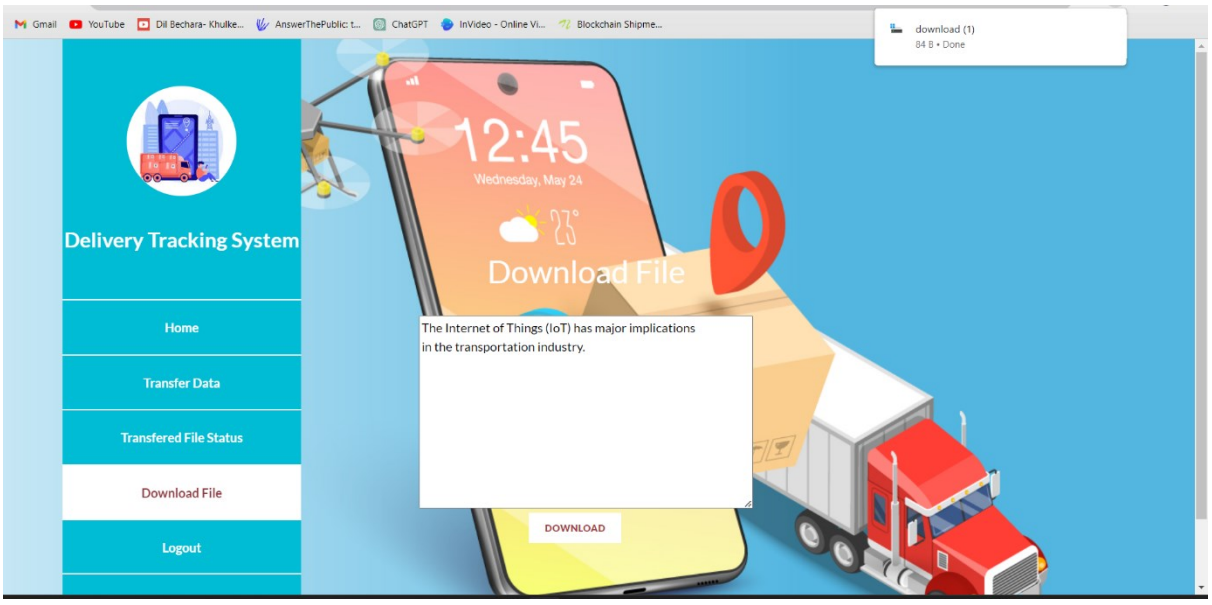
viewing received file



Entering hash keys to download /view file



Viewing/downloading file



Appendix - III: basepaper

Secured Tracking and Tracing System Based on Blockchain Technology

Mohamed Mostafa Ali Montaser
School of Computing,
Faculty of Engineering,
Universiti Teknologi Malaysia,
Johor, Malaysia
mohamed.mostafa.montaser@gmail.com

Siti Hajar Othman
School of Computing,
Faculty of Engineering,
Universiti Teknologi Malaysia,
Johor, Malaysia hajar@utm.my

Raja Zahilah Raja Md Radzi
School of Computing,
Faculty of Engineering,
Universiti Teknologi Malaysia,
Johor, Malaysiazahilah@utm.my

***Abstract*—Tracking and tracing management is a system which require recording of product's related information associated with product movement, shipping, transition between location until the product reach its final destination. In this management, traceability is a critical element to be satisfied by the business processes. Tracking and tracing of product is important for many purposes from the time product start its order process, prepared, shipping, movement from one delivery stakeholder to other delivery stakeholder until the product reach its destination. This is where we found the effectiveness of technology that is called the blockchain that could increase the safety of all tracking management processes. The blockchain technology since it emerges has contributed to many wide ranges of applications from various fields where safety and trust are critical in the field business process. Through this research, we are willing to present the contribution which can be offered by blockchain that obviously can increase the safety such like other tracking technology such as the use of QR-code, RFID, man-toman delivery and few others.**

Keywords—Blockchain, Tracking system and Secured system.

I. Introduction

The blockchain has shown a prominent and significant impact on many fields such as supply chain, data and asset management, Internet of Things (IoT), healthcare, education and many more due to its important features and properties. This promising technology has contributed much to digital information including the quality of being contents accurately processed and efficiently transferred. Other than this, the decentralized distribution feature which exists in the blockchain has solved many problems such as the third-party authentication which subsequently has an impact on the whole system in term of computation time and speed of process of transactions which cause very much time due to a huge number of transactions or communication through the peer-topeer network.

Tracking and tracing is a domain which aim to determine a location of a unit (e.g., device or product) within the current location and the past location at two different intervals of time. Information about the unit's locations will be stored in a realtime database for further processing. Sometimes, these types of systems can store information and details related to the departure of a product or arrival at a certain location. Information stored can contain an object's identification, time of currently performed transition, and the location.

Recently, tracking systems have become one of the examples of blockchain-utilizing applications and services that are integrated with the blockchain technology. There have been various research studies proposed in which the blockchain has been used. One of these studies is discussed in (Syed et al. 2020). The proposed study has utilized a blockchain in order to constitute a framework that can be able to perform tracking tasks.

978-1-6654-1844-7/21/$31.00 ©2021 IEEE

The issue of tracking units or devices has been considered by many research studies. Thus, a number of proposed studies and systems designed for such purpose has been presented in literature. Different designs have been proposed aiming to achieve better performance in traceability of units. Some proposed systems have achieved good level(s) of traceability but those systems lack some other issues either in security, use-of-use, or simplicity in implementation. Some other systems have applied different technologies and/ or methods to achieve similar purpose(s).

II. Literature Review

A) Blockchain Technology and Characteristic

Blockchain is a type of database that differently stores information from other traditional databases. It specifically stores information in a series of blocks linked together as they are connected by a chain. When a new block of data is inserted, it will be chained with the previous block using a reference obtained from the previous block called a hash. These blocks are stored and distributed in a decentralized mechanism to ensure that all users or nodes have a copy from blockchain related information.

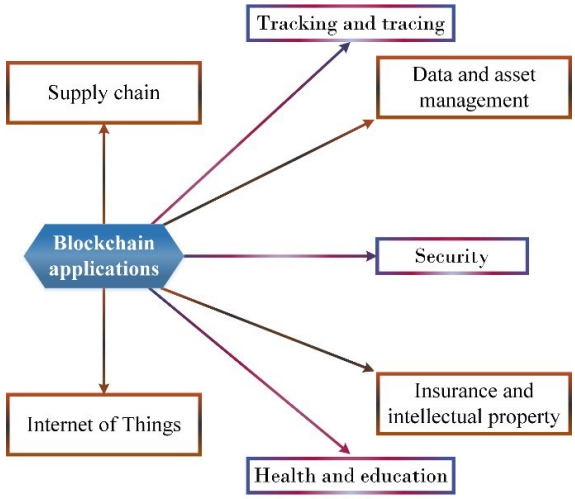


Fig.1 A Selected Number of Blockchain's Applications

That is called a distributed decentralized ledger of transactions. Thus, there have many researches and studies from different fields and areas utilized the way the blockchain technology works. For example, digital finance [1], computer networks and applications [2], information security [3], Internet of Things (IoT) [4], supply chain management [5], smart grids and energy [6], and others are number of fields to which the blockchain technology has contributed and enhanced related performances.

1) Blockchain Components

When there are a number of blocks of data connected to each other by a link or chain and these blocks are gradually increasing, they can be called a blockchain. There are several main components of which such a blockchain consists. These components are briefly mentioned and defined as follows:

a) *Transaction*: is a small block inside the blockchain.
b) *Block of data*: a set of fields of data representing metadata of a group of transactions inside the blockchain.
c) *Chain*: is the sequence on which blocks inside the blockchain will be ordered based.
d) *Nodes*: are users inside the network to which transactions are distributed by the block.
e) *Consensus*: is a set of procedures on which operations of blockchain are performed.
f) *Miners*: are a selected group of nodes to verify the blocks.

2) Blockchain Features

Blockchain technology has described as a revolution that has the ability to be the key to several dilemmas, such as the long transferring time, the transferring fees, and the most important matter, which is the centralization. Owing to the safety, high reliability, efficiency, and low cost of decentralization, the issues of centralization are addressed. The Blockchain is not just a technological advancement, but also the beginning of an era. With the Blockchain technology, big data has become more accurate, while big data, in turn, has made BCT more valuable. Blockchain technology makes significant data flow more safely and guarantees data privacy. Also, it is an uninsurable technology for data storage that offers a traceable data path and provides a reliable environment for data assets trading. Considering the impact of BCT on accounting from the side of extensive data, it provides good accounting security and data un-traceability; this is a requirement for new financial accounting & sharing system establishment.

As we mentioned above Blockchain technology has various features and therefore a wide range of applications from varied fields has come out. Selected features the blockchain has can be graphically represented in Figure 2.

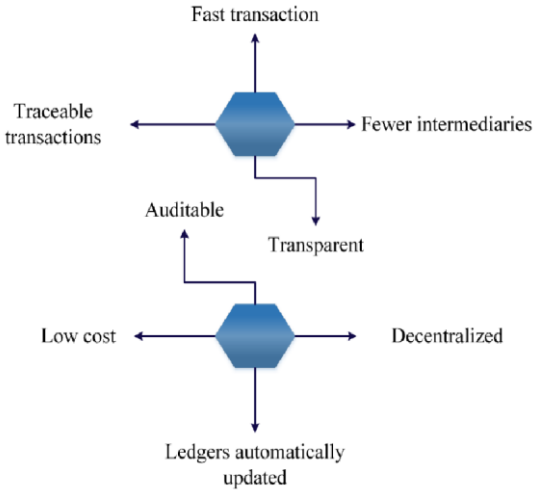


Fig.2 Selected Features and Properties of the Blockchain Technology

3) Permission and Permissionless Blockchain

Permissioned and permission-less blockchains are two types of blockchain based systems used depending on the purpose each system aims. There are a number of differences between these two types which are summarized in Table 1.

4) Blockchain Technology Potential

Figure 3 presents the report in graph-based published through Gartner, an Enterprise research firm that is wellknown for its informative reports and predictions across industries and business verticals. The company developed the Gartner Hype Cycle in a bid to analyse new technologies and try to

distinguish marketing and "hype" from actual use cases and progress.

TABLE I. PERMISSIONED AND PERMISSIONLESS BLOCKCHAIN

Property	Permissioned Blockchain	Permission-less Blockchain
Validation	Selected owners/ members validate transaction information	Public validates transaction information
rivate or public?	Private	Public
Nature of operations	Faster	Slower
Centralization	nds to be more centralized	Decentralized
Simplicity	Restrictive	Simple
Scalability	More scalable	Les scalable
Security	More secure	Less secure
Needed a third party?	Yes	No
Does it require for a mission to join?	Yes. It requires.	No
Practical uses	With banks, supermarkets, and shipping firms	business-to-consumer B2C) and consumerto-consumer (C2C) use cases.

Through Gartner Hype Cycle for blockchain business 2019 report [7], the report mentioned that "We are witnessing many developments in blockchain technology that will change the current pattern. By 2023, blockchain platforms will be scalable, interoperable, and will support smart contract portability and cross chain functionality. They will also support trusted private transactions with the data confidentiality required. All together, these technology advances will take us much closer to mainstream blockchain and the decentralized web, also known as Web 3.0".

Figure 3 presents the report in graph-based published through Gartner, an Enterprise research firm that is wellknown for its informative reports and predictions across industries and business verticals. The company developed the Gartner Hype Cycle in a bid to analyse new technologies and try to distinguish marketing and "hype" from actual use cases and progress. Through Gartner Hype Cycle for blockchain business 2019 report [7], the report mentioned that "We are witnessing many developments in blockchain technology that will change the current pattern. By 2023, blockchain platforms will be scalable, interoperable, and will support smart contract portability and cross chain functionality. They will also support trusted private transactions with the data confidentiality required. All together, these technology advances will take us much closer to mainstream blockchain and the decentralized web, also known as Web 3.0".

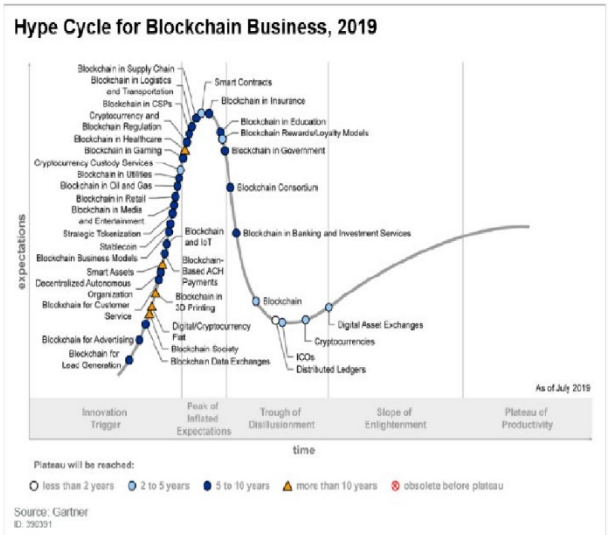


Fig.3 Hype Cycle for the Blockchain Business 2019 [7]

B) Tracking and Tracing

1) Past studies on techniques applied for tracking and tracing system

Tracking and tracing systems are becoming developed gradually since it has been emerged utilizing the infrared technique. Information processed for this purpose has been changed due to the development of the technique used. In order for this task to be implemented, there have been various techniques exploited containing the Infrared, Radio Frequency Identification (RFID), barcodes, QR codes and others. A brief discussion about these techniques will be provided and selected reviews and research papers from literature will be mentioned.

▪ RFID-based tracking system

Tracers sometimes can be dedicated to carry out tasks such as identification of products and other items in shipment from the first location until the item has reached the last location. A number of examples of tracking systems that have utilized different techniques for tracking and tracing

purposes will be herein reviewed and in detail discussed. One of these examples is proposed in [8]. the main objective of the paper is to propose a low-cost tracking and tracing system utilizing simple tracking techniques. When information of tracking and tracing related to supply chain is processed, management of activities such as storing, restoring, and tracking of data and products still lack a number of issues. The paper has implemented a framework utilizing RFIDs and the IoT based system dedicated for tracking systems of goods. A conceptual framework has been designed and its performance is being enhanced for certain scenarios such as limited number of applications-associated operations. One of the advantages of the proposed system is that it designed with low cost. The proposed system has not been tested in term of efficiency. The potential applications include e-health, e-commerce, and cloud-based manufacturing.

▪ QR Code Tracking

Another research study proposed in [9] has exploited the

RFID and Quick Response code (QR code) because they are considered effective tools used for traceability and identification of items. Traceability of items can be done using different techniques each of which has a different feature. This paper designs a method for traceability using a mix of two techniques to contribute to the tracking and tracing systems. The proposed system has used both RFID and barcodes to identify and trace items. The proposed system has utilized the feature of RFID and barcodes to perform the analysis function in order for the transformation of information of the items traced be efficiently implemented in a bi-directional way. Also, the feature of RFID and barcode can be compared. This process has also used an RFID reader and a barcode scanner. Obtained findings from this system have shown that the traceability has been efficiently implemented. Also, the results have mentioned that the identification of items has been improved. This system is considered cost effective. The proposed system can be suitable for the items packaging and tracing applications.

In [10], the QR code technique has been used to track and trace a product in an online way and in different phases and stages such as production phase, shipping phase, arrival to the destination phase. There is a difficulty to implement the function of tracking and tracing of such a certain item when more than a source can send related information. Such a process requires specific components. The selection of technique that is use for that purpose needs to be carefully considered in order to produce a high level of efficiency. This paper has designed a method to be implemented with tracking and tracing systems. It has proposed a QR-based traceability mechanism that scan the coded details to find out the information about the product. The method is able to perform the identification task. The results obtained from this method have shown that tracking and tracing systems can practically utilize the identification process proposed by the paper. Also, the identification of item can be automatically done as results reported so. An automatically identify product by extracting related information. The process of identification can be implemented under certain conditions. Packaging small items and products tracing systems are examples of potential applications and uses.

2) Tracking and Tracing Security Challenges

For tracking and tracing system, some of the applications which applied conventional/ traditional techniques or methods have a number of shortcomings such as, in addition to above mentioned issues, containing transparency in traceability, ease of access to recorded information, and proof of confidentiality and authentication. Hence, there are issues in current systems containing third party authentication and transparency. Additionally, confidentiality verification needs to be carefully performed. Ease-of-use and processing time for data to be retrieved, for example, are additional considerable issues. In literature, a lot of proposed systems used to trace parcels lack several issues such as a delay in reading data, a delay in authentication procedure of contents, or accessibility to information. However, these issues are considered one of the challenges in these types of systems. In addition to that, a number of issues can be solved by using different designs for the problem(s) being addressed. Meaning, different technologies and methods can contribute in achieving better performance in tracking items. For example, the blockchain technology can work better to enhance the tracking and tracing [11].

However, these issues can be addressed utilizing the blockchain technology to ease the accessibility, for example and reduce the accessibility computation time. Also, the security of contents and stored data can be enhanced and more protection can be applied by utilizing IoT technology. Thus, in this research study, a tracking algorithm is proposed in order to track items by using the blockchain technology. To add more security to the system, a Quick Response

(QR) code can be used so that contents will be more protected from being in an unauthorized manner accessed. To ease the use of shared information, a QR code is used to make it easy to send data with less computation time required for Internet connection. There are few examples from literature used the QR code to share data and that has enhanced the computation time and size of data [12]. In this research, the QR code has been utilized so that less data will be transferred between parties. In addition, the process of passing data between more than an entity (i.e., party) will make it easier in term of use of these data. That is, data received by a selected entity attends to have less intermediaries.

One of the most important considerable issues in blockchain related tracking and tracing systems is the data explosion caused by the huge number of communication and the data's size [13, 14]. The proposed system in [13] has shown that the data size inside the ledger is huge and can be as large as gigabyte (GB). Thus, it is important to reduce the huge size of data transactions inside the ledger of the blockchain technology. This research study aims to reduce the huge amount of data's size by proposing a permissioned and permission less blockchain architecture. In addition, the process of sharing information and processed data between members of the blockchain network and nodes will increase of the size of data. This causes huge amount of energy consumption and computation time. A number of studies have used the QR code in order to help reduce the size of data being shared [9]. In this research study, the data will be shared and traced back by utilizing the QR technique so that the amount of data in term of size will be reduced.

A number of related studies have mentioned that the blockchain is being enhanced in term of security related to the contents and communications between nodes inside the blockchain network [15]. This research attempts to help increase the security of contents by proposing a verification procedure that verify the request of data is being accepted once the node making the request has been verified and is authorized. This procedure can be performed with tracking items purposes.

3) Blockchain Potential for Tracking and Tracing System Problems

The proposed framework has been designed in such a way to control additional types of transactions that the system needs, for example, an examination transaction. This customization is designed in order to enable the blockchain framework be integrated with an IoT platform. This has made it easy for the integrated blockchain-IoT framework do further tasks such as the ability to carry out a monitoring task for items being tracked in in any time. So that, the system can perform remotely an access when needed. The proposed framework is designed to record transactions completely using a stable ledger. This proposed framework can be suitable to provide transparency and trust. Also, the framework has historically recorded and stored transactions associated.

Another proposed work is proposed in [16], the main aim is to implement the traceability service using a blockchainbased system. The ability of tracing an item's data or information can be referred to the traceability. The proposed system has considered the traceability related to supply chains. It aimed to overcome a number of issues caused by using the conventional traceability systems. So, the proposed system has applied a blockchain technology to gain a decentralized feature. So that the database is accessible in a secure and transparent mode. The authors in [16] have focused to replace the conventional tracking systems with the blockchain based one in order to address several reported issues and shortcomings faced by conventional tracking systems like the centralized traceability solutions. In [16], in order to efficiently increase the usability of traceability feature achieved by blockchain-based solutions, an IoT technology has been considered with the help of smart contracts.

There are lots of research studies that have implemented conventional tracking systems for traceability purpose where they have been implemented in various fields such as food supply chains [17], tracking of parcels [18], management of business procedures in organizations, and tracking of medical products. For such purpose, different techniques have been utilized and used but the performance(s) achieved vary depending on the technique and other conditions related to the application and design. The above-mentioned tracking systems have been implemented with the help of various techniques containing smart contracts, Radio-frequency identification (RFID), Quick Response code, barcodes, IoT platform. The technology of blockchain can contribute much better for tracking i.e., traceability of units than those techniques specifically when some of those techniques have been well and efficiently integrated with the blockchain to gain features of both.

4) Consensus Algorithm

The PoW has been only used to provide a creation of data procedure. Blocks of data are created using the

PoW and with the help of a sorting algorithm. So that the computation time in this scenario has been as minimum as the sorting algorithms. In this scenario, the computation time was very short and there is no much energy consumption consequently.

III. Blockchain-based Tracking And Tracing Management System

In this section, an introduction to tracking and tracing systems and related operations will be provided. Blockchain components will be mentioned. Features of blockchain will also be highlighted. Permissioned and permission-less blockchains are compared. Also, types of tracking and systems that have applied the blockchain technology are discussed and related studies are reviewed.

Figure 4 presents three main steps applied sequentially to achieve the conception of blockchain technology. The first step is data processing where the data is created and formed according to the blockchain conception. Data are linked using hash function and ordered in a reversible time conception. In the second one, permission-less and permissioned blockchain architectures are design and performed. Finally, data security schemes are built where the QR code is implemented for data tracing back data and sharing. Verification processes are designed.

A) The Proposed Architecture of the Blockchain-based Tracking and Tracing System

The proposed architecture of the blockchain based tracking and tracing system contains three levels. Data processing, tracking and tracing operations, and network's nodes and members. These three levels comprise a secure blockchain network. There are two ways of communications the first one ensures that the data is created while the second communication is to ensure that the data is accessible by the network's nodes and members. The proposed architecture resembles the conception of the blockchain technology. This is briefly explained in a simple algorithmic procedure as follows:

i. Firstly, the data is created and stored.
ii. Created data in the previous step is dedicated to make sure that metadata related to tracking and tracing operations and phases will be recorded.
iii. Data is stored in a decentralized stack.
iv. The stack is accessible by all nodes involved in the network
v. Blocks of data can be created.
vi. Those blocks of data are distributed and can be represented in a ledger.
vii. The nodes of the network defined previously are involved in the ledger.
viii. In addition, all these recorded and shared data are transparent and designed to be distributed in a decentralized way.
ix. Finally, the metadata, operations, and network's nodes can be interacted in a secure, transparent, automatically updated system with traceable transactions.

The proposed architecture resembles the conception of the blockchain technology. This is briefly explained in a simple algorithmic procedure as follows:

i Firstly, the data is created and stored.
ii Created data in the previous step is dedicated to make sure that metadata related to tracking and tracing operations and phases will be recorded.
iii Data is stored in a decentralized stack.
iv The stack is accessible by all nodes involved in the network
v Blocks of data can be created.
vi Those blocks of data are distributed and can be represented in a ledger.
vii The nodes of the network defined previously are involved in the ledger.
In addition, all these recorded and shared data are transparent and designed to be distributed in a decentralized way.
Finally, the metadata, operations, and network's nodes can be interacted in a secure, transparent, automatically updated system with traceable transactions.

B) The Proposed Enhanced Architecture of Blockchain Based Tracking And Tracing System

The proposed design of architecture of the blockchain based tracking and tracing system can be enhanced in term of security. As known, the way the blockchain works is gradually and rapidly growing the size of data. Another important feature that can be added to the proposed design of the blockchain based tracking and tracing system mentioned previously is that, in order to prevent the data explosion caused by the huge number of communications inside the network's

ledger. The proposed enhanced architecture of the blockchain based tracking and tracing system will contain four main steps, which are briefly discussed as follows:

i. There will be two types of blockchains, permissionless and permissioned.
ii. Subsequently, communications between operations and members of the networks will be reduced.

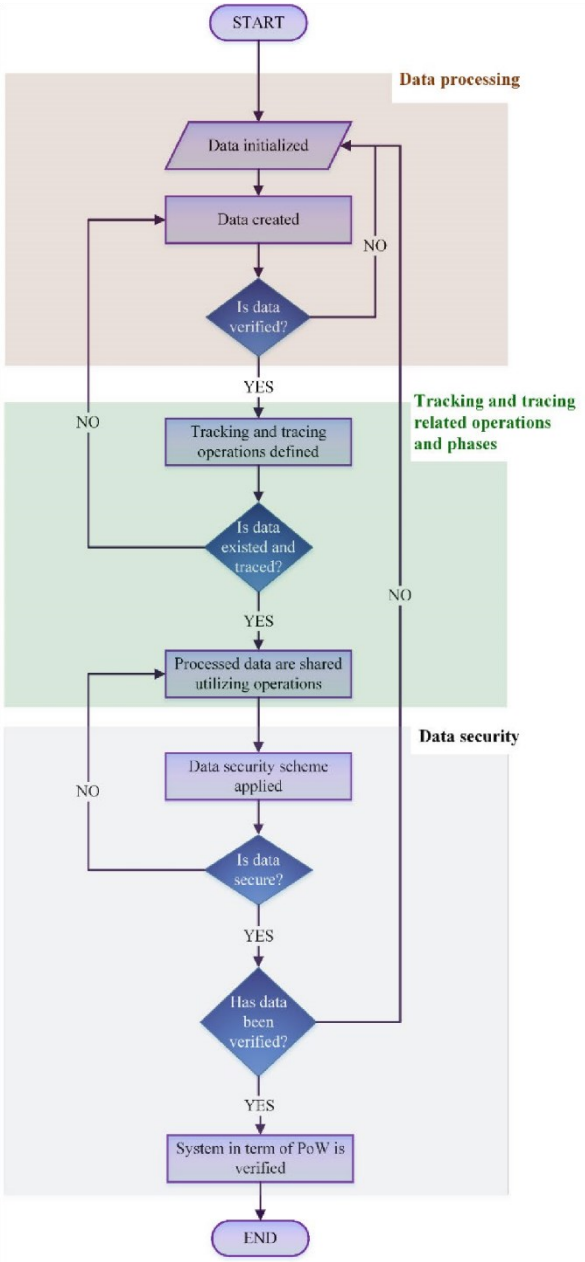


Fig.4 The Proposed Blockchain based Tracking and Tracing System's Flowchart

The data can be shared utilizing the technique of QR code.

The traced back data is allowed for authorized nodes and is completely done using the form of data in a QR code basis.

IV. Conclusion And Future Works

In this paper, a tracking and tracing system based on unconventional and conventional techniques has been studied. The proposed blockchain-based for tracking and tracing system has utilized the QR code and the blockchain technology in order to gain more security and less computation time while transferring as well as less data size. The proposed system has aimed to reduce the size of data and also to prevent the data explosion inside the ledger. It is believed that with the emerging of 4.0 Industrial Revolution (IR4.0), the blockchain technology will be thriving and will also influence other domain such as tracking and tracing (which part of component in supply chain industry).

Acknowledgment

We would like to convey gratitude to Information Assurance and Security Research Group (IASRG), School of Computing UTM who contribute unanimously to this research. Apart from that, thank you to the Ministry of Higher Education, Malaysia and Universiti Teknologi Malaysia, that support this research under the UTM Research Grant: PY/2018/03246/ Q.J130000.3551.06G31.

References

[1] C. Harwick and J. Caton, "What's holding back blockchain finance? On the possibility of decentralized autonomous finance," *The Quarterly Review of Economics and Finance,* 2020/10/05/ 2020, doi: https://doi.org/10.1016/j.qref.2020.09.006.

[2] M. Li, S. Shao, Q. Ye, G. Xu, and G. Q. Huang, "Blockchain-enabled logistics finance execution platform for capital-constrained E-commerce retail," *Robotics and Computer-Integrated Manufacturing,* vol. 65, p. 101962, 2020/10/01/ 2020, doi: https://doi.org/10.1016/j.rcim.2020.101962.

[3] S. Shi, D. He, L. Li, N. Kumar, M. K. Khan, and K.-K. R. Choo, "Applications of blockchain in ensuring the security and privacy of electronic health record systems: A survey," *Computers & Security,* vol. 97, p. 101966, 2020/10/01/ 2020, doi: https://doi.org/10.1016/j.cose.2020.101966.

[4] T. Dimitriou, "Efficient, Coercion-free and Universally Verifiable Blockchain-based Voting," *Computer Networks,* vol. 174, p. 107234, 2020/06/19/ 2020

[5] Z. Ma, W. Zhao, S. Luo, and L. Wang, "TrustedBaaS: BlockchainEnabled Distributed and Higher-Level Trusted Platform," *Computer Networks,* vol. 183, p. 107600, 2020/12/24/ 2020

[6] K. Christidis, D. Sikeridis, Y. Wang, and M. Devetsikiotis, "A framework for designing and evaluating realistic blockchain-based local energy markets," *Applied Energy,* vol. 281, p. 115963, 2021/01/01/ 2021, doi: https://doi.org/10.1016/j.apenergy.2020.115963.

[7] Gartner.com, "2019 Hype Cycle for Blockchain Technologies ", ed, 2019, pp. https://www.gartner.com/en/newsroom/press-releases/201910-08-gartner-2019-hype-cycle-shows-most-blockchain-technologiesare-still-five-to-10-years-away-from-transformational-impact.

[8] R. Addo-Tenkorang, N. Gwangwava, E. N. Ogunmuyiwa, and A. U. Ude, "Advanced Animal Track-&-Trace Supply-Chain Conceptual Framework: An Internet of Things Approach," *Procedia Manufacturing,* vol. 30, pp. 56-63, 2019/01/01/ 2019

[9] B. Fan *et al.*, "Improving continuous traceability of food stuff by using barcode-RFID bidirectional transformation equipment: Two field experiments," *Food Control,* vol. 98, pp. 449-456, 2019/04/01/ 2019

[10] K. Liang *et al.*, "Development and parameter optimization of automatic separation and identification equipment for grain tracing systems based on grain tracers with QR codes," *Computers and Electronics in Agriculture,* vol. 162, pp. 709-718, 2019/07/01/ 2019, doi: https://doi.org/10.1016/j.compag.2019.04.039.

[11] A. Chauhan, G. Savner, P. Venkatesh, V. Patil, and W. Wu, "A

Blockchain-Based Tracking System," in *2020 IEEE International Conference on Service Oriented Systems Engineering (SOSE)*, 3-6 Aug.
2020 2020, pp. 111-115.

[12] P. Dutta, T.-M. Choi, S. Somani, and R. Butala, "Blockchain technology in supply chain operations: Applications, challenges and research opportunities," *Transportation Research Part E: Logistics and Transportation Review,* vol. 142, p. 102067, 2020/10/01/ 2020, doi: https://doi.org/10.1016/j.tre.2020.102067.

[13] Q. Lin, H. Wang, X. Pei, and J. Wang, "Food Safety Traceability System Based on Blockchain and EPCIS," *IEEE Access,* vol. 7, pp. 20698-
20707, 2019, doi: 10.1109/ACCESS.2019.2897792.

[14] H. Huang, X. Zhou, and J. Liu, "Food Supply Chain Traceability Scheme Based on Blockchain and EPC Technology," in *Smart Blockchain*, Cham, M. Qiu, Ed., 2019// 2019: Springer International Publishing, pp. 32-42.

[15] V. Zakhary, M. J. Amiri, S. Maiyya, D. Agrawal, and A. E. Abbadi, "Towards global asset management in blockchain systems," *arXiv preprint arXiv:1905.09359,* 2019.

[16] J. Sunny, N. Undralla, and V. Madhusudanan Pillai, "Supply Chain Transparency through Blockchain-Based Traceability: An Overview with Demonstration," *Computers & Industrial Engineering,* p. 106895, 2020/10/09/ 2020

[17] Y. P. Tsang, K. L. Choy, C. H. Wu, G. T. S. Ho, and H. Y. Lam, "Blockchain-Driven IoT for Food Traceability With an Integrated Consensus Mechanism," *IEEE Access,* vol. 7, pp. 129000-129017, 2019.

[18] P. Helo and Y. Hao, "Blockchains in operations and supply chains: A model and reference implementation," *Computers & Industrial Engineering,* vol. 136, pp. 242-251, 2019/10/01/ 2019, doi: https://doi.org/10.1016/j.cie.2019.07.023.

Appendix - IV: References

1. El-Medany,W.;Al-Omary,A.;Al-Hakim,R.;Al-Irhayim,S.;Nusaif,M.,"A Cost Effective Real-Time Tracking System Prototype Using Integrated GPS/GPRS Module," Wireless and Mobile Communications (ICWMC), 2010 6th International Conference on,vol.,no.,pp.521,525,20-25 Sept.2010
2. Hu Jian-ming; Li Jie; Li Guang-Hui, "Automobile Anti-theft System Based on GSM and GPS Module," Intelligent Networks and Intelligent Systems (ICINIS), 2012 Fifth International Conference on , vol., no., pp.199,201, 1-3 Nov. 2012
3. Nagaraja, B. G.; Rayappa, R.; Mahesh, M.; Patil, C.M.; Manjunath, T. C., "Design & Development of a GSM Based Vehicle Theft Control System," Advanced Computer Control, 2009. ICACC '09. International Conference on , vol., no., pp.148,152, 22-24 Jan. 2009
4. Fleischer, P.B.; Nelson, A.Y.; Sowah, R.A.; Bremang, A., "Design and development of GPS/GSM based vehicle tracking and alert system for commercial inter-city buses," Adaptive Science & Technology (ICAST), 2012 IEEE 4th International Conference on , vol., no., pp.1,6, 25-27 Oct. 2012
5. Le-Tien, T.; Vu Phung-The, "Routing and Tracking System for Mobile Vehicles in Large Area," Electronic Design, Test and Application, 2010. DELTA '10. Fifth IEEE International Symposium on , vol., no., pp.297,300, 13-15 Jan. 2010
6. Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad, Rania M. Jodeh “Ubiquitous GPS Vehicle Tracking and Management System”, IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT) 2011
7. Abed khan M.E.(Student), , Ravi Mishra, “GPS – GSM Based Tracking System” SSCET, CSVTU, Bhilai, India International Journal of Engineering Trends and Technology-vol.3,no.,pp,161-164, 2012
8. El-Medany, W.M.; Alomary, A.; Al-Hakim, R.; Al-Irhayim, S.; Nousif, M., "Implementation of GPRSBased Positioning System Using PIC Microcontroller," Computational Intelligence, Communication Systems and Networks (CICSyN), 2010 Second International Conference on , vol., no., pp.365,368, 28-30 July 2010

9. Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad, Rania M. Jodeh “Ubiquitous GPS Vehicle Tracking and Management System”, IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT) 2011
10. Lita, I.; Cioc, I.B.; Visan, D.A., "A New Approach of Automobile Localization System Using GPS and GSM/GPRS Transmission," Electronics Technology, 2006. ISSE '06. 29th International Spring Seminar on , vol., no., pp.115,119, 10-14 May 2006
11. Parvez, M.Z.; Ahmed, K.Z.; Mahfuz, Q.R.; Rahman, M.S., "A theoretical model of GSM network based vehicle tracking system," Electrical and Computer Engineering (ICECE), 2010 International Conference on , vol., no., pp.594,597, 18-20 Dec. 2010
12. Sadagopan, V.K.; Rajendran, U.; Francis, A.J., "Anti theft control system design using embedded system," Vehicular Electronics and Safety (ICVES), 2011 IEEE International Conference on, vol., no., pp.1, 5, 10-12 July 2011