SCHOOLOFCOMPUTERSCIENCE

UNIVERSITY OF PETROLEUM & ENERGY STUDIES

Bidholi Campus, Energy Acres, Dehradun – 248007.

July – December 2020

END-SEM REPORT

on

Implementation of Blockchain Network

Submitted by

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B.tech CSE-CSF (B2) 3rd year

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Under the guidance of

Mr. Saurabh Jain

(Department of Systemics)

CANDIDATE'S DECLARATION

I hereby certify that the project work entitled **"Implementation of Blockchain Network"** in partial fulfilment of the requirements for the award of the Degree of BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE AND ENGINEERING with specialization in Cyber Security and Forensics, and submitted to the Department of Systemics at School of Computer Science, University of Petroleum & Energy Studies, Dehradun, is an authentic record of my work carried out during the period from **July**, **2020** to **December, 2020** under the supervision of **Mr. Saurabh Jain,** Professor, Department of Systemics, School of Computer Science.

The matter presented in this project has not been submitted by me for the award of any other degree of this or any other University.

Kashish Srivastava

R134218079

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date: 30th December2020

Mr. Saurabh Jain

Project Guide

Dr. Neelu Ahuja

Head – Department of Systemics
School of Computer Science

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ACKNOWLEDGEMENT

We wish to express our deep gratitude to our guide **Mr. Saurabh Jain, Professor, Department of Systemics SCS**, for all the advice, encouragement and constant support he has given us throughout our project work. This work would not have been possible without his support and valuable suggestions.

We sincerely thank our **Head of the Department, Dr. Neelu Ahuja**, for her great support in doing our project in Area at SoCS.

We are also grateful to **Dr. Manish Prateek, Professor and Dean SCS, UPES** for giving us the necessary facilities to carry out our project work successfully.

We would like to thank all our **friends** for their help and constructive criticism during our project work. Finally we have no words to express our sincere gratitude to our **parents** who have shown us this world and for every support they have given us.

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School of Computer Science

University of Petroleum & Energy Studies, Dehradun

Project End-Semester Report

PROJECT TITLE

Implementation of Blockchain Network.

ABSTRACT

The project aims at taking a step into the field of Blockchain Technology and Cyber Security by developing a blockchain model which can be used for healthcare or educational purposes. Blockchain being a decentralized ledger is scalable as well benefit businesses through greater transparency. It will be helpful in creating a better understanding of the process of creation a block and it's verification. It will be further helpful in performing all large computations in a shorter execution time span with efficient speed for scenarios such as healthcare or educational organizations. Verification of the block containing the data inside the block can be used for storing the sensitive information that should never be threatened. They can be patient's information for an operation or medications. Therefore this project will give a better understanding about blockchain internal process and features. For further future this can be developed well with the concepts of file handling and object oriented programming.

KEYWORDS

Blockchain, Security, hashing, healthcare, decentralization, verification, block parameters

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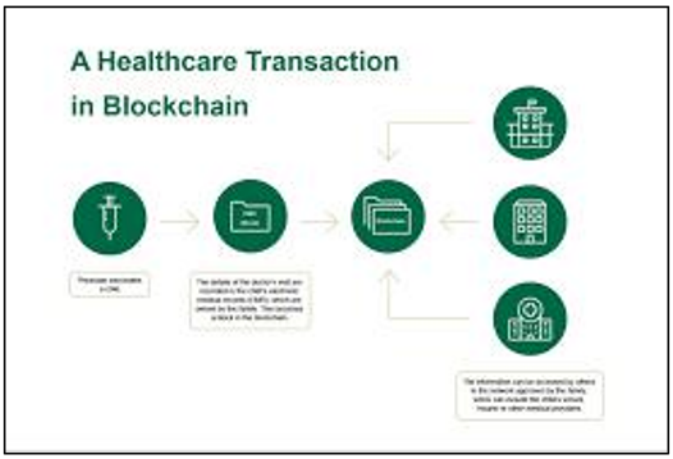
INTRODUCTION

For a business developer, entrepreneur, technology evangelists, computer engineers are inspired by the technologies of the modern period. Blockchain as a technology holding huge potential is an inspiration to all these individuals. To acquire the technology and its needs, they have to be through with the implementation and understanding. Blockchain is a decentralized distributed ledger that stores data, holds immutable property and verified transactions. Similarly talking about a concept known as hashing algorithm, it majorly focuses on generating a fixed length result for an input value. Ethereum blockchain already has SHA256 hashing algorithm implemented and performs high computations. The blockchain maintains a continuously growing set of data entries, bundled together into blocks of data. These blocks are, upon acceptance to the blockchain linked to the previous and future blocks with cryptographic protocols. Ledger in blockchain is *cryptographically-secure,* which means that cryptography has been used to provide security services which make this ledger secure against tampering and misuse. These services include non-repudiation, data integrity, and data origin authentication. Two main cryptographic primitives are: Hash Function and Digital Signatures. Blockchain hashes are deterministic; which means that the input data will produce the same result each time. They are designed to be immutable. Once a block is written to a blockchain, realistically, it cannot change. This provides benefits for audit. As a provider of data you can prove that your data hasn't been altered, and as a recipient of data you can be sure that the data hasn't been altered. These benefits are useful for databases of financial transactions within an organization.

Following an outlook to the similar pattern, our project aims to showcase the inner processing of a secure blockchain network model. The idea has to be implemented for low constraint devices that utilize blockchain technology. Keeping all the advantages and disadvantages into consideration the implementation of development of blockchain model will be done. The report is organized as follows: Section two is the problem statement for the project in reference to a healthcare organization. Section three is about Literature Review based on various blockchain models and their insights. Section four is about Objectives of the development of the blockchain model. Section five is dependent on the Methodology of the project. Section six is initiates the System requirements and Schedule for the model. Section seven is based on the design and algorithms

and is classified into its sub sections for separate flowcharts and algorithms. Section eight is about the outputs of our implementation. Last section introduces References for the system.



PROBLEM STATEMENT

The upcoming time is based on Blockchain Technology. It will be used in several places (as in for the Healthcare, Education and IOT devices). This new technology has been suggested to disrupt a wide range of data-driven domains, including the health domain. Blockchain has many healthcare use cases including the management of electronic medical records, drugs and pharmaceutical supply chain management, biomedical research and education, remote patient monitoring, health data analytics, among others. Access control, interoperability, provenance and data integrity are all issues that are meant to be improved by blockchain technology. Another key characteristic of blockchain is persistency. It is practically impossible to delete entries after being accepted onto the blockchain due to the distributed ledger, stored across multiple nodes. Hence maintaining the mobility for records and data in an organization. Use case for our model is a health-care organization or system. Most of the co-relations in the project would be done with respect to this system in our model. Therefore our primary objective is to understand the block parameters working of a simple blockchain model in C language using linked list. Analyzing and comparing its hash parameters in the blocks for the verification insisting the security. We will try the concept of file handling in the future scope of the project.

LITERATURE REVIEW

Title	year/link	Author	Remarks
Blockchain in healthcare and health sciences—A scoping review	2020	Anton Hassegren, Katina Kravleska, Danilo Grigoros, Arild faxvaag	The purpose of this study was to systematically review, assess and synthesize peer-reviewed publications utilizing/proposing to utilize blockchain to improve processes and services in healthcare, health sciences and health education.
Performance Study of Enhanced SHA-256 Algorithm	https://www.researchgate.net/publication/283517888_Performance_study_of_enhanced_SHA-256_algorithm	Gowthaman A, M Sumathi	It explains all the cryptographic hash functions and recalls merkle-damgard security properties of iterated hash functions. It also focuses on SHA-256 implementation and inner part architecture. To achieve less area utilization and improved security.
Application of Blockchain Technology to Guarantee the Integrity and Transparency of Documents	2018	Khuat Thanh Son, Nguyen Truong Thang, Le Phe Do, and Tran Manh Dong	This paper explains implementation of security in the blockchain network. To maintain the data authentication use of hash tables and SHA-256 analysis is explained.

A Blockchain-based Authentication and Security Mechanism for IoT	https://www.researchgate.net/profile/Wei_Peng4/publication/328247073_A_Blockchain-Based_Authentication_and_Security_Mechanism_for_IoT/links/5e03736c4585159aa4999c0e/A-Blockchain-BasedAuthentication-andSecurity-Mechanismfor-IoT.pdf	Dongxing Li Wei Peng Wenping Deng Fangyu Gai	This work explains about the IOT devices facing a challenge of data tampering which is recovered or solved by the blockchain technology and hashing algorithms. Since it would serve as a secure tamperproof distributed ledger for the IOT devices.
Blockchain Technology in Healthcare: A Systematic Review	2019	Cornelius C Abgo, Qusay H Mahmoud, J Micheal Eklund	The review shows that a number of studies have proposed different use cases for the application of blockchain in healthcare; however, there is a lack of adequate prototype implementations and studies to characterize the effectiveness of these proposed use cases.

Table 1. Literature Review

OBJECTIVES

The basic objective is to develop a blockchain model for understanding its parameters functioning for verification and applying SHA256 hashing algorithm. The input data for the blocks will be entered through user , file handling concept is a good option for input due to which our file contents, irrespective of the quality and quantity of the content will be entered in the block making it more secure.

Sub Objectives

- First develop a blockchain model at any coding platform.
- Understand the theoretical concept of various hashing algorithms.
- Maintaining most of the features of the blockchain network in reference to linked list.
- **Develop the block structure of its parameters**

Main parameters : index, timestamp, data, hash and previous hash.

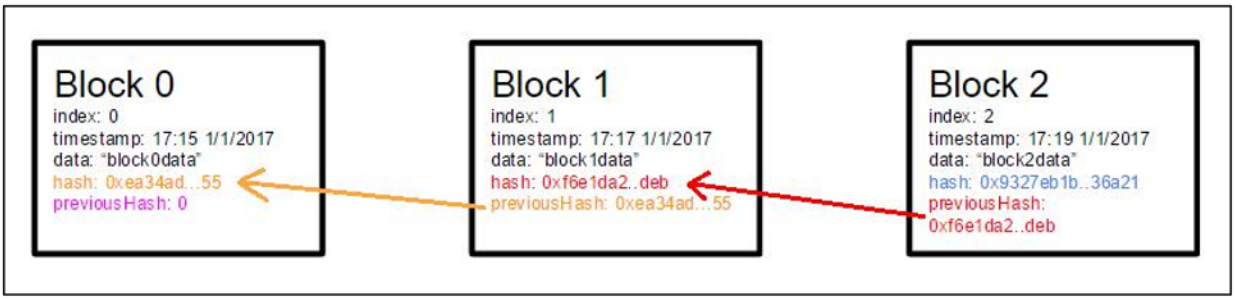


Fig. 1. Blockchain structure parameters

METHODOLOGY

For this project, major focus is going to be on the development of a blockchain structure based on its parameters in C programming. Use SHA-256 algorithm to calculate hash. SHA256 function is present in openssl/Crypto.h header file in C. We will use this library for the hashing mechanism of the blockchain.

The entire implementation of this project is explained in the following points:

1. The development of the basic blockchain structure will be proceeded on any coding platform.
2. Number of blocks in blockchain will be entered via user.
3. In our model, block's data will be introduced using file handling in future but for now it can be either asked manually by the user or entered randomly by random function in C. Therefore data of file will be stored in the block.
4. Applying SHA256 hashing algorithms (via openssl/crypto.h) to generate hash values.
5. These hash values will help in verifying about our blockchain structure hashes that are generated.
6. The block is mined and is added with the other blocks in the existing structure of the block.
7. If the hash of the previous block and this block is similar it will be verified.
8. Therefore the blockchain structure gets validated.

SYSTEM REQUIREMENTS

Hardware:

- Laptop with i3/i5/i7 processor with 8 GB RAM , 1 TB Hard-disk.

Software:

- gcc compiler for C programming/coding platform or IDE

Operating System:

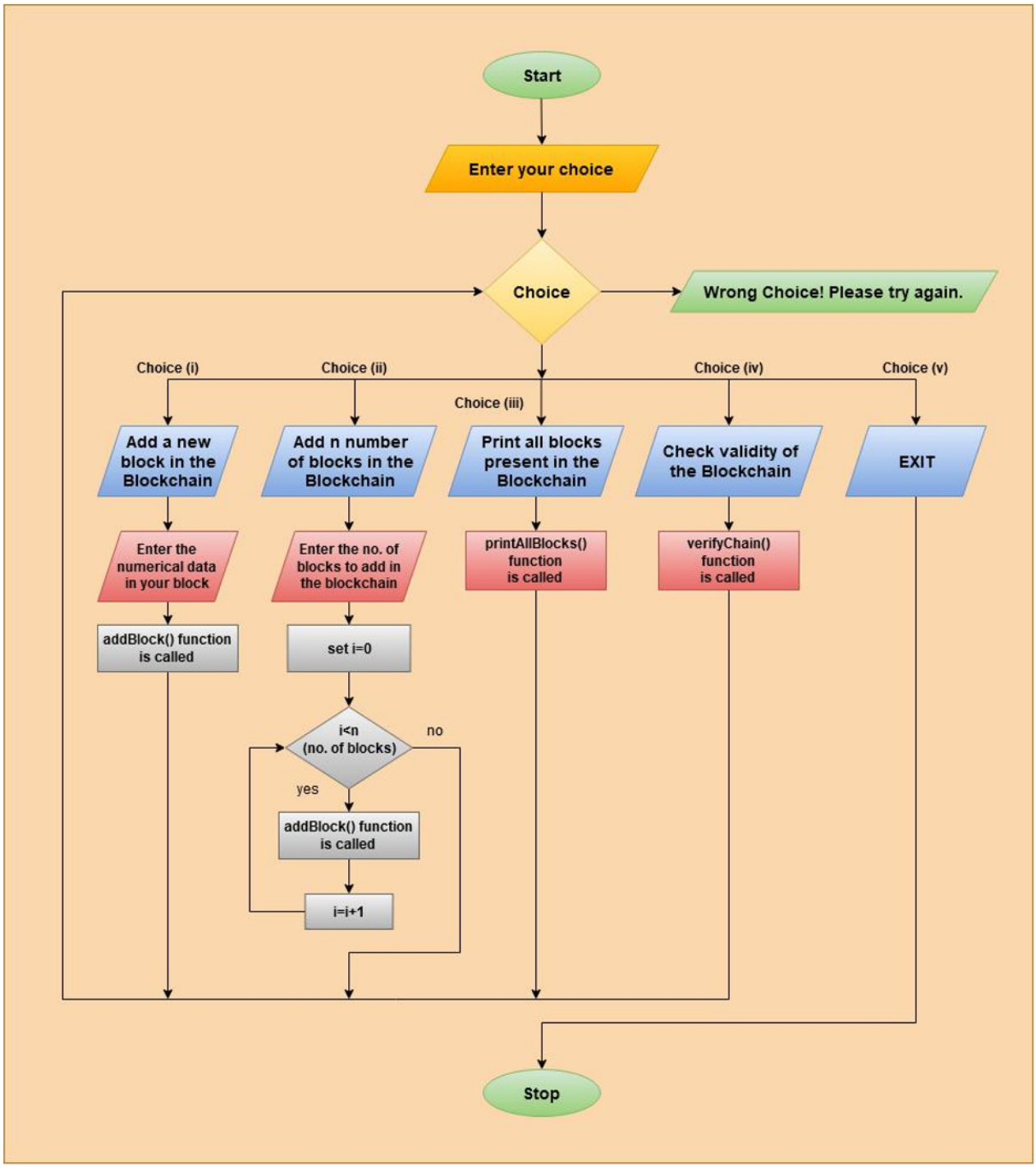
- Windows

Resources:

- openssl/Crypto.h library

DESIGN AND ALGORITHM

1. Main program Flowchart



2. Main program algorithm for implementation

Step 1: Start

Step 2 : Input the choice to perform operation in blockchain

We have following choices:

i- Add a new block in Blockchain

ii- Add n numbers of blocks in Blockchain

iii- Print all the blocks present in the Blockchain

iv- Check Validity of the Blockchain

v- Exit (Terminate the code)

Step 3: If (i) has been entered as the choice then

a- Input data to store in block

b- call addBlock() user define function than goto (Step 2)

Step 4: If (ii) has been entered as the choice then

a- Input the number of blocks that you want to add in Blockchain

b- Iterate a for loop (number of blocks that you want to add) times

c- In every iteration call addBlock() user define function

d- After for loop iterations goto (Step 2)

Step 5: If (iii) has been entered as the choice then

a- call printAllBlocks() user define function than goto (Step 2)

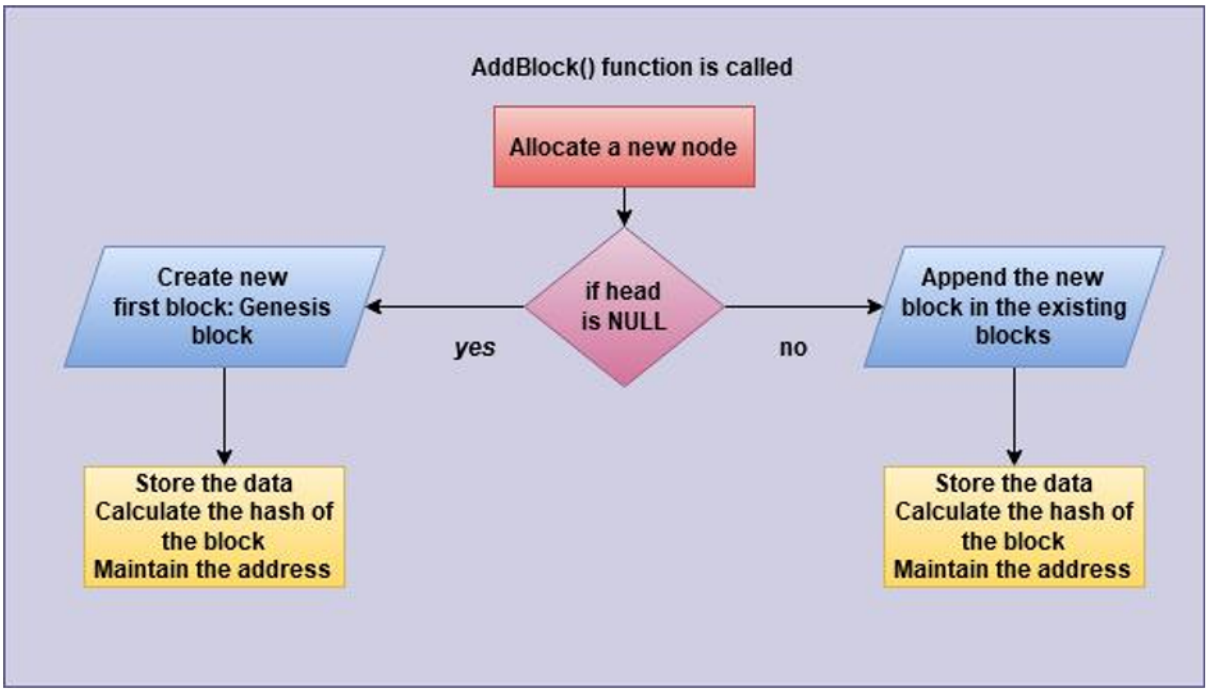
Step 6: If (iv) has been entered as the choice then

a- call verifyChain() user define function than goto (Step 2)

Step 7: If Choose (v) choice then a- exit() function call and terminate the program

Step 8: Stop

3. Add block/blocks function's separate flowchart



4. Add block/blocks function's separate algorithm

 # Algo of addBlock() function with block data parameter :

Step 1: Start

Step 2: Receive block data by user

Step 3: Check, a- if Blockchain head is empty then create first block i.e. Genesis Block

else Add a new block in existing Blockchain

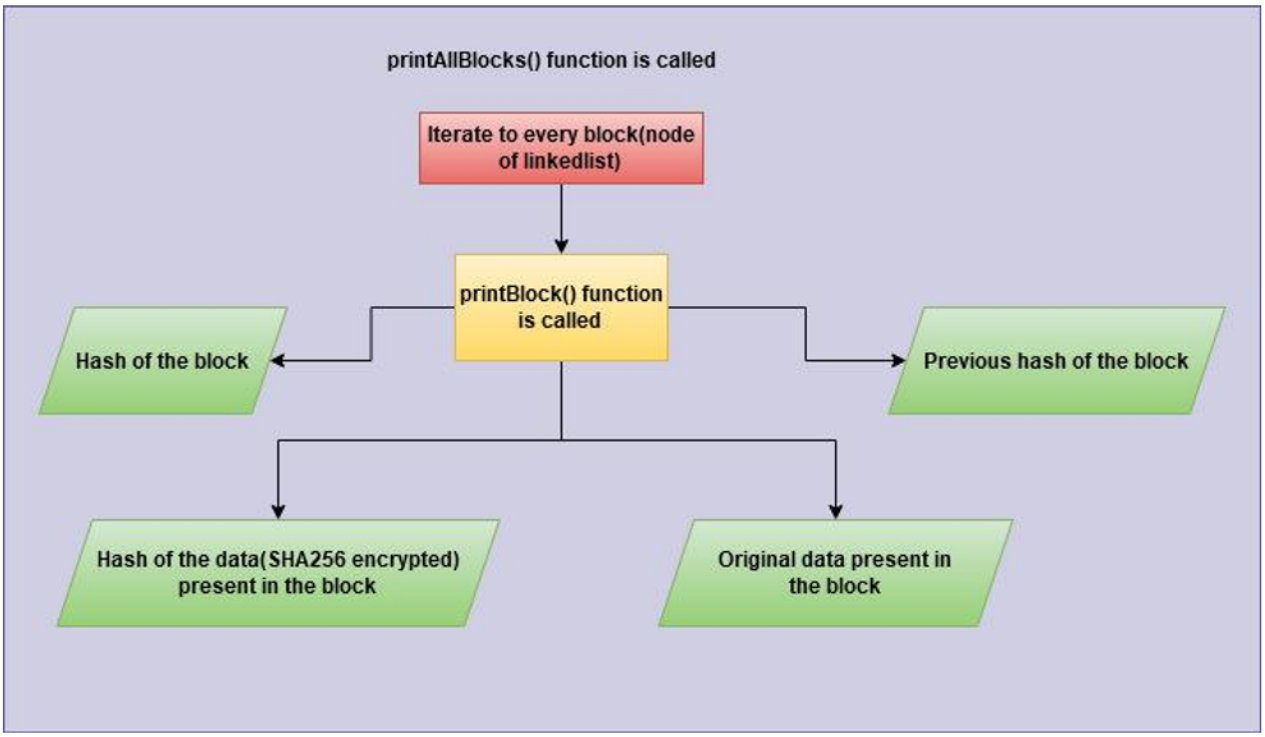
b- Calculate the hash value for this particular block

c- Store the block data in particular block

d- Manage addresses of blocks(nodes) according to concept of linked list

Step 4: Stop

5. Print blocks function's separate flowchart



6. Print blocks function's separate algorithm

 # Algo for printAllBlocks()

Step 1: Start

Step 2: Iterate every block in Blockchain (nodes in linked list)

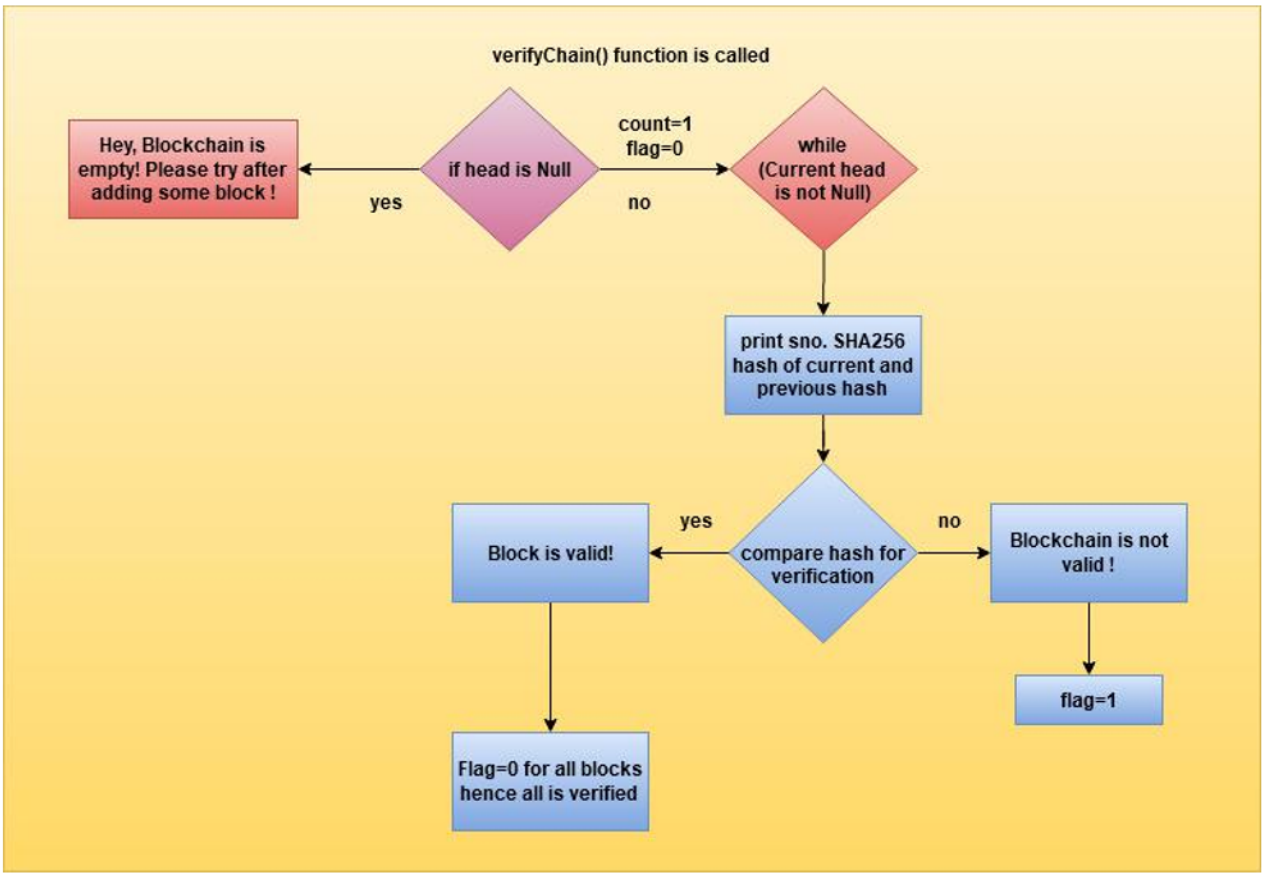
Step 3: Call printBlock() function.

Step 4: *Check if the head of the block is Null or not. If null the blockchain structure is empty else print parameter to every block*. <<optional>>

Step 5: Print all the blocks parameters (Block Hash Value, Previous block hash value, Block data, address of next block)

Step 6: Stop

7. **Verification of blocks function's separate flowchart**



8. Verification of blocks function's separate algorithm

 # Algo for verifyChain()

Step 1: Start

Step 2: Compare if head is equal to Null

a- Yes, print "Hey, Blockchain is empty! Please try after adding some block"

b- No, set two counter variable count=1 for iterating and flag=0 for verification

Step 3: Since the current node is not Null, the serial number is printed, along with previous hash and current has in SHA256 form, if both are verified then the block is valid.

Step 4: If the block is not valid flag turns 1 and verification is denied.

Step 5: If flag stays 0 for all the blocks validation then the verification is confirmed.

OUTPUT SCREEN

We run our code, we get various options for the user-input.

1. Add a new block Block in Blockchain
2. Add n numbers of blocks in Blockchain
3. Print all blocks present in Blockchain
4. Check validity of Blockchain
5. Exit (Terminate the code)

```
root@kali:~/Minor_Project# gcc -o Kashish_minor Kashish_minor.c -lssl -lcrypto
root@kali:~/Minor_Project# ./Kashish_minor
```

Command used for compilation: gcc -o Kashish_minor Kashish_minor.c -lssl -lcrypto

Command used for output: ./Kashish_minor

Gcc stands for GNU compiler collections

-o is for the output of the file

-lssl is for the header file of the openssl/sha.h

-lcrypto is for the header file of the openssl/crypto.h

```
*********************************************************************************
!!!                                                                           !!!
!!!  Minor I Project : Implementation of Blockchain Network in C language    !!!
!!!                                                                           !!!
*********************************************************************************


 ENTER YOUR CHOICE
1: Add a new block in the Blockchain
2: Add n numbers of blocks in Blockchain
3: Print all blocks present in Blockchain
4: Check Validity of Blockchain
5: EXIT
```

We have these 5 options available for the user input.

We choose Option 1 i.e. Add a new block in the Blockchain.

```
Choice: 1
Enter the numerical data you want in your Block: 36
1 Block is added in Blockchain successfully

 ENTER YOUR CHOICE
1: Add a new block in the Blockchain
2: Add n numbers of blocks in Blockchain
3: Print all blocks present in Blockchain
4: Check Validity of Blockchain
5: EXIT
```

We enter 36 as the value/data for the first block of the blockchain.

AddBlock() function is called.

Now we would see, if we could add n number of blocks in the blockchain and form a chain.

```
Choice: 2
How many Blocks you want to add in chain? : 6
Entering random numerical data (by rand()function) in this Block: 43
Entering random numerical data (by rand()function) in this Block: 46
Entering random numerical data (by rand()function) in this Block: 57
Entering random numerical data (by rand()function) in this Block: 55
Entering random numerical data (by rand()function) in this Block: 53
Entering random numerical data (by rand()function) in this Block: 55
6 Blocks are added in Blockchain Successfully

 ENTER YOUR CHOICE
1: Add a new block in the Blockchain
2: Add n numbers of blocks in Blockchain
3: Print all blocks present in Blockchain
4: Check Validity of Blockchain
5: EXIT
```

We have added 6 blocks in the blockchain, therefore our blockchain has total 7 number of blocks.

We may print all the data present in the blockchain along with the attributes or the parameters present for a block.

```
Choice: 3

These are the Parameters in a Block of our Blockchain :
0×1312980       6e340b9cffb37a989ca544e6bb780a2c78901d3fb33738768511a30617afa01d       [36]    0×13129d0
0×13129d0       ec2b0a1f50aa8f0fd3d9983f99a38108be52b95861ec18e309499b8f9fcee36f       [43]    0×1312a20
0×1312a20       ca3e2fd692c1cb9fdec85711b7a4ddc7ebf19256007f41ad7d6ceb70475703ff       [46]    0×1312a70
0×1312a70       3631b80da5f69c0cad8092b8c6feb38b6c35272e757da7422be7fe3558511429       [57]    0×1312ac0
0×1312ac0       4b41076e5aef7f04e50ce5b70c110559a12dd94c0eff42360855f332bcb59278       [55]    0×1312b10
0×1312b10       f7eaa36ac106930703904542511f9efa33eed6117678490148bbf76d4c9475fd       [53]    0×1312b60
0×1312b60       0ac57bb3039df201f51ac0e8ac4f102f8eaf3971750507ec4788aeb4a153f02e       [55]    (nil)


 ENTER YOUR CHOICE
1: Add a new block in the Blockchain
2: Add n numbers of blocks in Blockchain
3: Print all blocks present in Blockchain
4: Check Validity of Blockchain
5: EXIT
```

As all the blocks have been visible along with their parameters. We should check the validity for these blocks.

The block needs to be hashed to keep the integrity of the data. A SHA-256 is taken over the content of the block. It should be noted that this hash has nothing to do with “mining”, since there is no Proof Of Work problem to solve.

```
Choice: 4

1.      [43]    f269057a23fd74bde41d436350f98358ce932a990f3bca8e0716245af275bdce - ec2b0a1f50aa8f0fd3d9983f99a38108be52b95861ec18e309499b8f9fcee36f
 Block is valid !

2.      [46]    0fe5075d6aeec1db1e47670099ee1551ad9d551df274976564bc4e969b9be6b3 - ca3e2fd692c1cb9fdec85711b7a4ddc7ebf19256007f41ad7d6ceb70475703ff
 Block is valid !

3.      [57]    00746f5a6ca0980a7407c85f63ce5a42376584f7190ac599c430add7cba4da3f - 3631b80da5f69c0cad8092b8c6feb38b6c35272e757da7422be7fe3558511429
 Block is valid !

4.      [55]    171183cb2443c283f525cac0c5b23bbf89ebf9c3fc55b602440a6d3e0f417dfe - 4b41076e5aef7f04e50ce5b70c110559a12dd94c0eff42360855f332bcb59278
 Block is valid !

5.      [53]    64ab5ce9d9ae3fe769ec80902645fdbc117b09b52b51b8fbede73f080d4e19de - f7eaa36ac10693070390454251 1f9efa33eed6117678490148bbf76d4c9475fd
 Block is valid !

6.      [55]    8fdca81c7af1141b96b84ecf094cb9c0f4a702c5cabd7515aa96f64cb822fc2f - 0ac57bb3039df201f51ac0e8ac4f102f8eaf3971750507ec4788aeb4a153f02e
 Block is valid !

 ***** Kashish's blockchain is validated and verified! *****

 ENTER YOUR CHOICE
1: Add a new block in the Blockchain
2: Add n numbers of blocks in Blockchain
3: Print all blocks present in Blockchain
4: Check Validity of Blockchain
5: EXIT
```

At any given time we must be able to validate if a block or a chain of blocks are valid in terms of integrity. This is true especially when we receive new blocks from other nodes and must decide whether to accept them or not.

The block parameters of the blockchain are verified and validated.

Hence we terminate the program.

```
Choice: 5
FINALLY DONE!
 **All your choices were accepted. Thankyou for your patience**

 -KASHISH SRIVASTAVA
 R134218079
 500067405
 CSF-B2
root@kali:~/Minor_Project#
```

CONCLUSION AND FUTURE SCOPE

Our blockchain model implementation in C language is successful. In this project implementation of structures, pointers, linked lists, user define functions, control and jumping statements was initiated. For further project work file handling concept will be applied in our end term. We know that since the starting of the era when blockchain technology was launched via bitcoin, it was evolving into a general-purpose technology with use cases in many industries including healthcare. The objective of the study behind this model was to identify the blockchain technology use cases in healthcare, the example applications that have been developed for these use cases, the challenges and limitations of the blockchain-based healthcare applications, the current approaches employed in developing these applications and areas for future research. Since in our model we can create a block, add into the block and check the validity of the block. This will improve in maintaining access control, scalability and the content or transactions information stays secure. Further research is also needed to supplement ongoing efforts to address the challenges of better scalability, latency, interoperability, security and privacy in relation to the use of blockchain technology in healthcare.

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Report Draft verified by

Project Guide	HOD
(Name & Sign)	**(Dept. of Systemics)**