Project
On
"Inventory Management System Using Block Chain"
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Chapter 1
Introduction to Block Chain

What is Block Chain?

Block chain is the backbone Technology of Digital Cryptocurrency Bitcoin. The block chain is a distributed database of records of all transactions or digital event that have been executed and shared among participating parties. Each transaction verified by the majority of participants of the system. It contains every single record of each transaction. Bitcoin is the most popular cryptocurrency an example of the block chain. Block chain Technology first came to light when a person or Group of individuals name 'Satoshi Nakamoto' published a white paper on "*BitCoin: A peer to peer electronic cash system*" in 2008. Block chain Technology Records Transaction in Digital Ledger, which is distributed over the Network thus making it incorruptible. Anything of value like Land Assets, Cars, etc. can be recorded on Block chain as a Transaction.

How Block chain Technology works?

One of the famous use of Block chain is Bitcoin. The bitcoin is a cryptocurrency and is used to exchange digital assets online. Bitcoin uses cryptographic proof instead of third-party trust for two parties to execute transactions over the internet. Each transaction protects through digital signature.
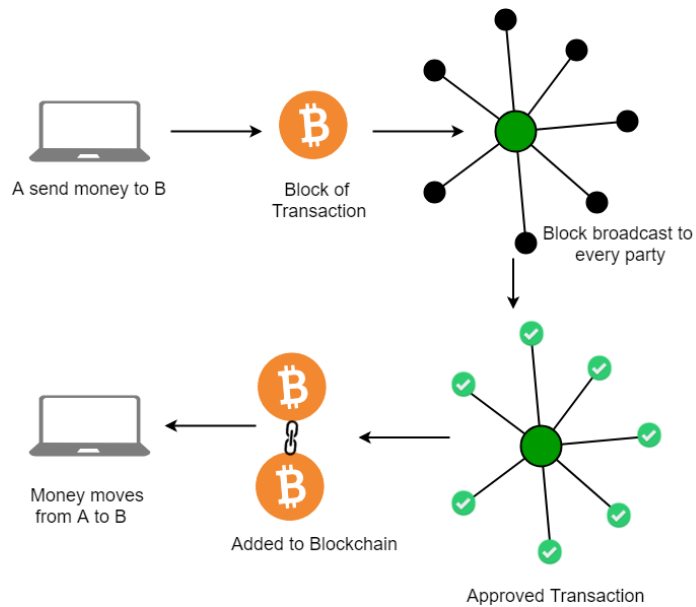
Distributed Database:

There is no Central Server or System which keeps the data of Block chain. The data is distributed over Millions of Computers around the world, which are connected with the Block chain. This system allows Notarization of Data as it is present on every Node and is publicly verifiable.
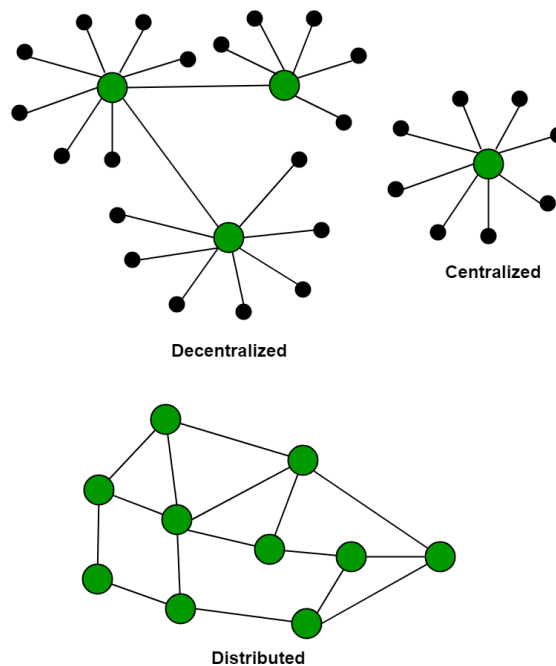
A network of nodes:

A node is a computer connected to the Block chain Network. Node is connected with Block chain using the client. Client helps in validating and propagates transaction on to the Block chain. When a computer connects to the Block chain, a copy of the Block chain data is downloaded into the system and the node comes in sync with the latest block of data on Block chain. The Node connected to the Block chain, which helps in the execution of a Transaction in return for an incentive, is called Miner.
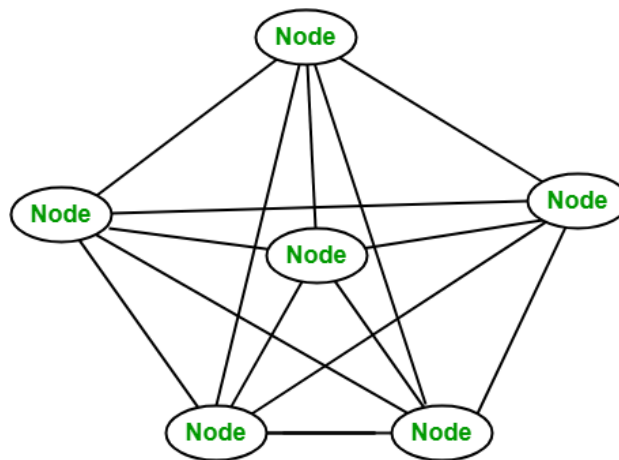
Building trust with Block chain:

Block chain enhances trust across a business network. It is not that you cannot trust those who you conduct business with its that you do not need to when operating on a Block chain network. Block chain builds trust through the following five attributes:

- **Distributed:** The distributed ledger is shared and updated with every incoming transaction among the nodes connected to the Block chain. All this is done in real-time, as there is no central server controlling the data.
- **Secure:** There is no unauthorized access to Block chain made possible through Permissions and Cryptography.
- **Transparent:** Because every node or participant in Block chain has a copy of the Block chain data, they have access to all transaction data. They themselves can verify the identities without the need for mediators.
- **Consensus-based:** All relevant network participants must agree that a transaction is valid. This is achieved through consensus algorithms.
- **Flexible:** Smart Contracts are executed based on certain conditions can be written into the platform. Block chain Network can evolve in pace with business processes.

Benefits of Blockchain Technology:

- **Timesaving:** No central Authority verification needed for settlements making the process faster and cheaper.
- **Cost-saving:** A Block chain network reduces expenses in several ways. No need for third-party verification. Participants can share assets directly. Intermediaries are reduced. Transaction efforts are minimized as every participant has a copy of shared ledger.
- **Tighter security:** No one can temper with Block chain Data as it shared among millions of Participant. The system is safe against cybercrimes and Fraud.

Problem Statement

Inventory Management Software helps the user in tracking inventory levels in the organization. Extremely beneficial in many aspects, traditional inventory management software is available in the market at a high cost. They are Expensive. Although the management system helps the business in eliminating many kinds of risk, even after using the system, the business is open to many other risks.

Chapter 2
Proposed Methodology

Block chain for business uses a shared and immutable ledger that can only be accessed by members with permission. Network members control what information each organization or member may see, and what actions each can take. Block chain is sometimes called a "trustless" network — not because business partners do not trust each other, but because *they don't have to*.

This trust is built on block chain's enhanced security, greater transparency, and instant traceability. Beyond matters of trust, block chain delivers even more business benefits, including the cost savings from increased speed, efficiency, and automation. By greatly reducing paperwork and errors, block chain significantly reduces overhead and transaction costs, and reduces or eliminates the need for third parties or middlemen to verify transactions.

Enhanced security

Business data is sensitive and crucial, and block chain can significantly change how your critical information is viewed. By creating a record that can't be altered and is encrypted end-to-end, block chain helps prevent fraud and unauthorized activity. Inventory Management System based on Block Chain Technology can record Item transaction and are completely secure over the Block Chain. Since block chain relies upon cryptography, all the data stored on the block chain is encrypted, making tampering almost impossible. Moreover, thanks to its decentralized nature, you no longer have to store sensitive information on one or even a cluster of vulnerable servers.

Greater transparency

Without block chain, each organization has to keep a separate database. Because block chain uses a distributed ledger, transactions and data are recorded identically in multiple locations. All network participants with permissioned access see the same information at the same time, providing full transparency. All transactions are immutability recorded, and are time- and date-stamped. This enables members to view the entire history of a transaction and virtually eliminates any opportunity for fraud.

Instant traceability

Block chain creates an audit trail that documents the provenance of an asset at every step on its journey. Traceability data can also expose weaknesses in any supply chain — where goods might sit on a loading dock awaiting transit.
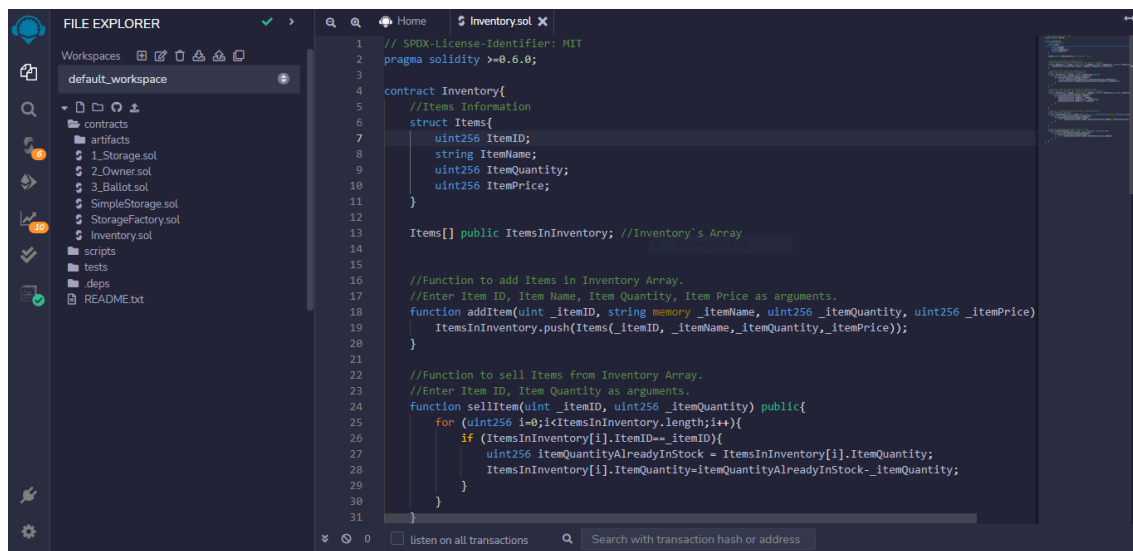
Increased efficiency and speed

With Block Chain, changing Inventory can be completed faster and more efficiently.
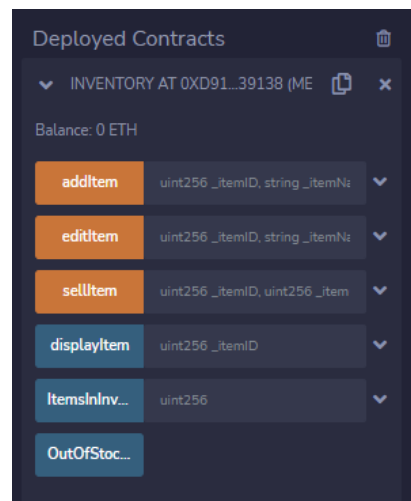
Chapter 3
Results and discussions

I used Solidity Programming Language to make a Smart Contract that can add Items, Remove Items, Update the Quantity of Items, Update the description of Items, Display the Information about the Items in Inventory and tell about the Items that are Out of Stock in the Inventory.

Remix IDE Layout

Deployed Contracts Panel

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.6.0;

contract Inventory{
    //Items Information
    struct Items{
        uint256 ItemID;
        string ItemName;
        uint256 ItemQuantity;
        uint256 ItemPrice;
    }

    Items[] public ItemsInInventory; //Inventory`s Array
```
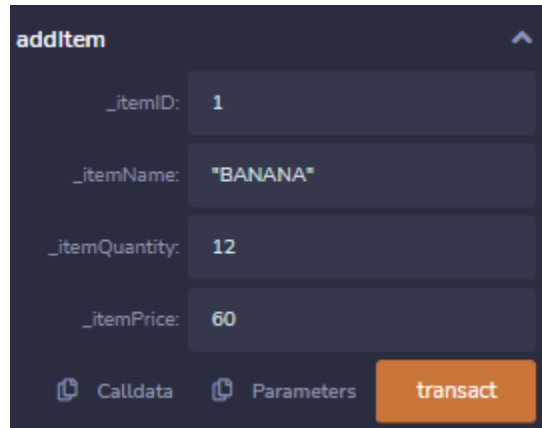
"Items" Struct is used to record Items Description. "ItemsInInventory" Array Data Structure is used to store the Items in the Inventory.

```
//Function to add Items in Inventory Array.
//Enter Item ID, Item Name, Item Quantity, Item Price as arguments.
function addItem(uint _itemID, string memory _itemName, uint256 _itemQuantity, uint256 _itemPrice) public{
    ItemsInInventory.push(Items(_itemID, _itemName,_itemQuantity,_itemPrice));
}
```

Code of "addItems" Function.

```
addItem                                    ^

        _itemID:    1

      _itemName:    "BANANA"

   _itemQuantity:   12

      _itemPrice:   60

    Calldata    Parameters      transact
```

"addItem" function is used to add Items in "ItemsInInventory" Array. It takes Item ID, Item Name, Item Quantity, Item Price as the arguments of the function.

```
[vm] from: 0x5B3...eddC4 to: Inventory.addItem(uint256,string,uint256,uint256) 0xd91...39138 value: 0 wei
data: 0xec6...00000 logs: 0 hash: 0xb7b...c4a81
```

```
//Function to sell Items from Inventory Array.
//Enter Item ID, Item Quantity as arguments.
function sellItem(uint _itemID, uint256 _itemQuantity) public{
    for (uint256 i=0;i<ItemsInInventory.length;i++){
        if (ItemsInInventory[i].ItemID==_itemID){
            uint256 itemQuantityAlreadyInStock = ItemsInInventory[i].ItemQuantity;
            ItemsInInventory[i].ItemQuantity=itemQuantityAlreadyInStock-_itemQuantity;
        }
    }
}
```

"sellItem" Function Code.

"sellItem" function is used to update the quantity of Items after its sale. It takes Item ID, Item Quantity as its arguments. When the ID of Item in Array being searched is matched then the quantity of the Item is Subtracted from the Inventory.

Since 12 Bananas were added in stock and five of them were sold, so seven Bananas are remaining in the stock.

```
//Function to edit information of Items in Inventory Array.
//Enter Item ID, Item Name, Item Quantity, Item Price as arguments.
function editItem(uint _itemID, string memory _itemName, uint256 _itemQuantity, uint256 _itemPrice) public {
    for (uint256 j=0;j<ItemsInInventory.length;j++){
        if (ItemsInInventory[j].ItemID==_itemID){
            ItemsInInventory[j].ItemName = _itemName;
            ItemsInInventory[j].ItemQuantity = _itemQuantity;
            ItemsInInventory[j].ItemPrice = _itemPrice;
        }
    }
}
```

"editItem" Function Code.

editItem

_itemID:	1
_itemName:	"Banana"
_itemQuantity:	50
_itemPrice:	50

Calldata   Parameters   transact

"editItem" function is used to update the Information of Items like name of Items, Quantity and Price. It takes Item ID, Item Name, Item Quantity and Item Price as its arguments. When the ID of Item in Array being searched is matched then the Information of the Item is replaced with new information.

```
//Function to display information of Items in Inventory Array.
//Enter Item ID as arguments.
function displayItem(uint256 _itemID) public view returns (uint256,string memory,uint256,uint256){
    for (uint256 k=0;k<ItemsInInventory.length;k++){
        if (ItemsInInventory[k].ItemID==_itemID){
            return (ItemsInInventory[k].ItemID, ItemsInInventory[k].ItemName, ItemsInInventory[k].ItemQuantity, ItemsInInventory[k].ItemPrice);
        }
    }
}
```

"displayItem" Function Code.

```
displayItem    1                          ˅

0: uint256: 1

1: string: Banana

2: uint256: 50

3: uint256: 50
```
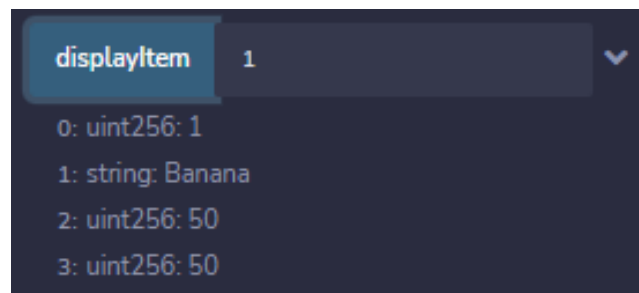
"displayItem" function is used to display the Information of Items like Item ID, name of Item, Quantity and Price. It takes Item ID as its argument.

```
//Function to display Items who are out of stock.
function OutOfStockItems() public view returns (uint256, string memory){
    for (uint256 l=0;l<ItemsInInventory.length;l++){
        if (ItemsInInventory[l].ItemQuantity==0){
            return (ItemsInInventory[l].ItemID, ItemsInInventory[l].ItemName);
        }
    }
}
```

"OutOfStockItems" Function Code.

Initially the Number of Bananas are 50.

50 Bananas are sold. Hence, they are out of Stock.

"OutOfStock" Function displays that Bananas are Out of Stock.

Chapter 4
Conclusion

The advantages of block chain technology, as well as its benefits, are many. Block chain integration into many industries and companies has stirred a seismic shift in the way data is secured, and work is done in general. Through block chain, key areas that bring organizational challenges are now being solved with ease.

Block chain technology brandishes superior technology in securing the entries or data stored in its digital ledger. Every block chain platform employs a consensus model which guides the entry or registration of data on the ledgers. Data cannot just be appended onto the block at will, and as such, no one can manipulate or squeeze any entry in without the consensus. Once the data is filled into each block, they are enclosed with encryption, making accessibility possible only through a hashing method.

Every node operator who also shares the data that is generated to be stored in the system owns the network or hardware resources that power the block chain ecosystem. Decentralization is one key way to bring trust in a digital ecosystem where trust is hard to come by.

Another major benefit block chain technology offers is the traceability of goods in a supply chain business. Block chain can be used to build a supply chain system that will directly benefit producers or suppliers and vendors or product consumers.

Over the past few decades, there has been a gradual evolution and transformation in digital workflows. From the manual recording of data before the advent of digital systems, the world experienced a remarkable shift towards automation. More than before, technological advances have always sought to replace the more time-consuming processes with more efficient systems, and Block chain technology is the right candidate for this use case.

The absence of intermediaries or middlemen helps to lower the cost of transactions in many business systems or financial transactions. To put it in the right perspective, the presence of middlemen in a particular transaction comes with paying for the services of such an actor. Block chain technology lets consumers interact directly with one another, thus making the roles of intermediaries such as Google, Microsoft, or IBM very redundant.

The feature of immutability inherent in distributed ledger technologies of which block chain is a subset is also a basis for trusted security. Once data is stored on the chain, it cannot be changed, corrected, or removed. This sieves out fraud or any attempt to manipulate stored records.

Chapter 5
Bibliography

1. **Crypto Currency:** A cryptocurrency is a digital currency designed to work as a medium of exchange through a computer network that is not reliant on any central authority, such as a government or bank, to uphold or maintain it.
2. **Ledger:** A ledger is a book or collection of accounts in which account transactions are recorded.
3. **Cryptography:** Cryptography is technique of securing information and communications through use of codes so that only those person for whom the information is intended can understand it and process it.
4. **Nodes:** Block chain nodes are network stakeholders and their devices authorized to keep track of the distributed ledger and serve as communication hubs for various network tasks.
5. **Mining:** Mining is the process of adding transaction records to the block chain.
6. **Address:** Much like a URL, a block chain address is the location to or from which transactions occur on the block chain.
7. **Bitcoin:** The first and most popular cryptocurrency based on DLT technology developed from a whitepaper written by Satoshi Nakamoto in 2008.
8. **Block:** A group of transactions entered into a block chain; analogous to a page of a ledger or record book.
9. **Block chain:** A mathematical structure for storing digital transactions or data in an immutable, distributed, decentralized digital ledger consisting of blocks that are linked via cryptographic signature that is nearly impossible to fake, hack or disrupt.
10. **DApp:** Software, which does not rely on a central system or database but can share information amongst its users via a decentralized database, such as a block chain.
11. **Decentralization/Decentralized:** A system with no single point where the decision is made. Every node makes a decision for its own behavior and the resulting system behavior is the aggregate response.
12. **Hash Function:** A function that receives an input of any size and returns a unique string of a uniform length.
13. **Peer-to-Peer (P2P):** A direct connection between two participants in a system - can be computer-to-computer or person to person.
14. **Smart Contract:** Self-executing computer code deployed on a block chain to perform a function, often, but not always, the exchange of value between a buyer and a seller.
15. **Solidity:** A JavaScript-like object-oriented programming language for Ethereum for implementing smart contracts on the Ethereum block chain.
16. **Transparency:** A primary property of public block chains whereby any participant in a system or transaction can view the transactions on the block chain.
17. **Wallet:** A digital file that holds coins and tokens held by the owner. The wallet also has a block chain address to which transactions can be sent.
18. **Digital Signature:** A mathematical scheme for verifying digital messages or documents satisfy two requirements – they have authenticity (from a known sender) and integrity (were not altered in transit).