TRACKING OF MEDICINES OVER BLOCKCHAIN

[1*]Mrs. P. Vinayasree, Dr. K Gurnadha Gupta[2]
Assistant Professor, *Department of Computer Science and Engineering*
Anurag group of institutions, Ghatkesar, Telangana, India

[2]Associate Professor, DEPT OF CSE, St.Martin's Engineering College, Kompally, Secunderabad, Telangana 500014

Abstract- The rise of online pharmacies is making it difficult to standardize medicine supply safety. It has become very difficult to detect whether the medicines are original or not because these drugs pass through complex distributed networks, thus forming different chances for counterfeits to enter the genuine supply chain. In this project, we are using a novel drug supply chain management using Ganache based on blockchain technology to handle secure drug supply chain records. It will act like a proof of concept which solves this problem by performing drug record transactions on the blockchain to create a smart healthcare system with a drug supply chain. Generally a smart contract is launched to give a time-limited access to electronic drug records. Finally, we used blockchain smart contracts as a benchmarking programs to conduct the performance of the designed system in terms of transactions per second, transaction latency, and resource utilization.

I. INTRODUCTION

The pharmaceutical industry is the bit of the healthcare sector that deals with medications. The industry includes various sub-fields related to drug development, production and marketing. The primary goal of the pharmaceutical industry is to provide drugs that prevent infection, maintain health and treat diseases. The supply chain of the pharmaceutical industry is like a supply chain for any other industry in the manufacturing sector. In addition, the associated information flows through the relationships in the supply chain to achieve sustainable competitive advantage. Pharmaceutical supply chain management is more difficult than typical applications within industrial companies, as medicines and surgical supplies must be available for use at all times. As the complexity of the supply chain becomes more important than it was a decade ago, visibility of inaccessible, reliable, and secure supply chains is becoming increasingly important. And also this increasing complexity effect the cost of drugs and their availability to consumers.

The advancement of information systems and the introduction of blockchain technology has converted the traditional drug supply chain approach in healthcare into a secure automated systems. To enable a software platform to be used without a trusted third party, one of the possibilities is to use smart contracts. One of the latest platforms is open-source Ganache, a modular system that uses conventional programming languages for smart contracts.

II. PROPOSED ALGORITHM

2.1 Using Smartcontract using solidity programming –

The great features of blockchain technology that is helpful in traceability, security, transparency. A blockchain-based system is inserted to provide a secure decentralized tracking system. System architecture relies on the Ethereum blockchain and smart contracts to remove the need for third-party system management. The application consists of a smart contract for Ethereum, which contains the processes of the supply chain, in addition, it has provided the ability to store and retrieve records from the blockchain ledger, which makes it easy to track the product and ensure that the data cannot be changed. We create and integrate a local blockchain(by Ganache) then link the Ethereum wallet to the application using MetaMask, so it forms a transaction bridge. This involves the ordering of transactions or of medication. Solidity's programming code is basically encapsulated in contracts that is a contract in Solidity is a collection of code and its data that reside at a particular address in the ethereum blockchain. A contract means it is generally a fundamental block of building an app on ethereum.

2.2 QR code based tracking-

The Medicine manufacturer will store the data in the form of smart contracts and will generate unique QR code for each medicine and will attach it to the label of the medicine. This information of medicine is retrieved by the

consumer and supplier by scanning the QR code and check the details from where the medicine is came from and its information like manufacturer date and expiry date. This is introduce to make sure that most of the medicines are just imitating the printing of the label and selling the duplicate drugs instead. By using this method we can put a check to these people.

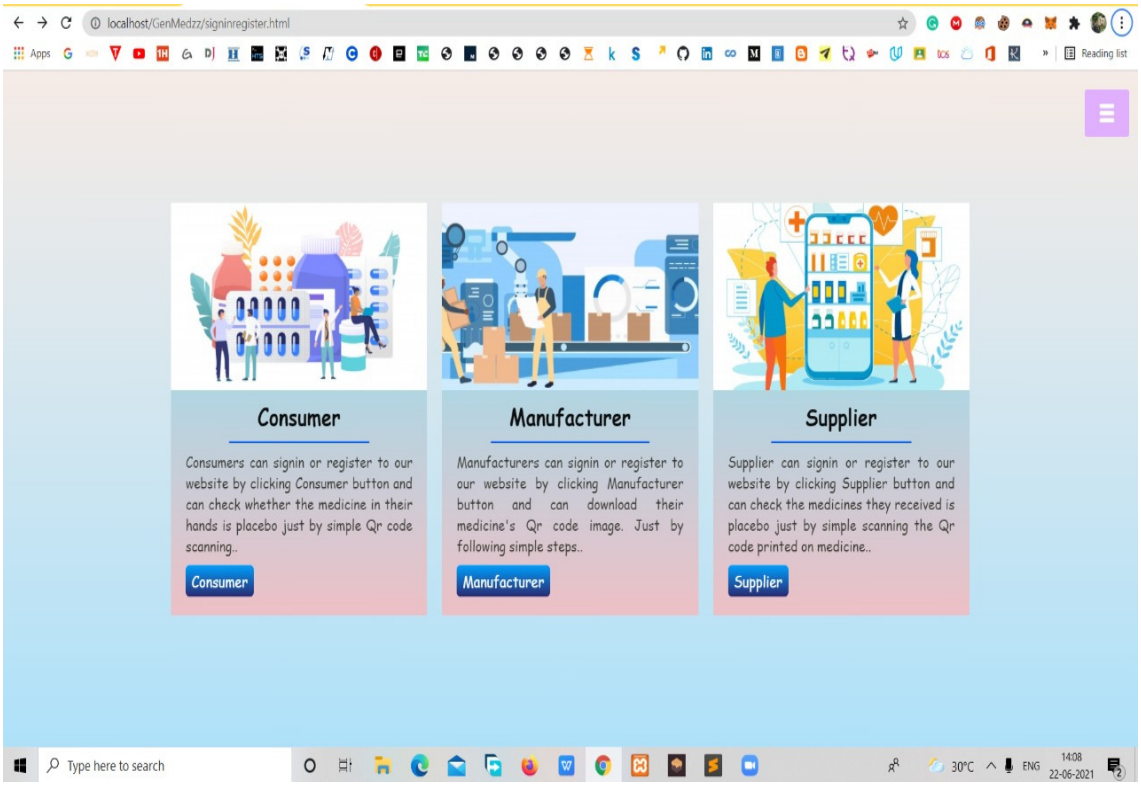

Fig. 2.1 user interface for manufacturer, supplier and consumer to login

III. Experiment and Result

3.1 Code involved in the solidity programming-

Main.sol

```
pragma solidity ^0.5.16;
import "../medicineaccess/Roles.sol";
import "../medicineaccess/DistributorRole.sol";
import "../medicineaccess/ManufacturerRole.sol";
import "../medicineaccess/UserRole.sol";
import "../medicinecore/ownable.sol";
contract main is UserRole, ManufacturerRole, DistributorRole {
 // Define 'owner'
  address owner;
// Define a variable called 'batchno' for unique authentication
  string batchno;
 // Define a public mapping 'medicines' that maps the batchno to an Medicine.
  mapping (string => Medicine) medicines;
// Define a public mapping 'medicinesHistory' that maps the UPC to an array of TxHash,
  // that track its journey through the supply chain -- to be sent from DApp.
  mapping (string => string[]) medicinesHistory;
  // Define enum 'State' with the following values:
  enum State
  {
```

```
    Made,       // 0
    Packed,     // 1
    Sold        // 2
  }
State constant defaultState = State.Made;
// Define a struct 'Medicine' with the following fields:
  struct Medicine {
    string  batchno;  //the primary key batchno
    string  medicineName; //Medicine name
    string dosage;//dosage
    address ownerID;  // Metamask-Ethereum address of the current owner as the medicine moves through 3 stages
    address originManufacturerID; // Metamask-Ethereum address of the Manufacturer
    string  FactoryName; // Manufacturer Name
    string  mfgdate;//mfgdate
    string  expdate; // expdate
    State   medicineState;  // Product State as represented in the enum above
    address distributorID;  // Metamask-Ethereum address of the Distributor
    address userID; // Metamask-Ethereum address of the user
  }
// Define 8 events with the same 7 state values and accept 'batchno' as input argument
  event Made(string _batchno);
  event Packed(string _batchno);
  event Sold(string _batchno);
// Define a modifer that checks to see if msg.sender == owner of the contract
  modifier onlyOwner() {
    require(msg.sender == owner);
    _;
  }
// Define a function 'makeMedicine' that allows a manufacturer to mark a medicine 'Made'
  function makeMedicine(string memory _batchno, string memory _medicineName,string memory _dosage, address
_originManufacturerID,address _ownerID, string memory _FactoryName, string memory _mfgdate,string memory
_expdate,State,address _distributorID,address _userID) public onlyManufacturer
{
    // Add the new medicine as part of medicines
    Medicine memory makeMedicine = Medicine({
      batchno:_batchno,
      medicineName:_medicineName,
      dosage:_dosage,
      originManufacturerID:_originManufacturerID,// Metamask-Ethereum address of the Manufacturer
      ownerID:_ownerID, // Metamask-Ethereum address of the current owner as the medicine moves through 3
stages
      FactoryName:_FactoryName, // Manufacturer Name
      mfgdate:_mfgdate,//mfgdate
      expdate:_expdate,//expdate
      medicineState: State.Made,
      distributorID: _distributorID,
      userID: _userID
});
    medicines[_batchno] = makeMedicine;
    medicines[_batchno].medicineState = State.Made;
//     string batchno;//batchno
//     address ownerID;  // Metamask-Ethereum address of the current owner as the medicine moves through 8 stages
//     address originManufacturerID; // Metamask-Ethereum address of the Manufacturer
//     string  FactoryName; // Manufacturer Name
//     string  medicineName; // Product Name
//     string  mfgdate//mfgdate
```

```
//     string  expdate//expdate
//     State   medicineState;  // Product State as represented in the enum above
//     address distributorID;  // Metamask-Ethereum address of the Distributor
//     address userID; // Metamask-Ethereum address of the Patient
 // Emit the appropriate event
 emit Made(_batchno);
  }
  // Define a function 'packMedicine' that allows a manufacturer to mark an medicine 'Packed'
  function packMedicine(string  memory _batchno) public
  onlyDistributor
  // Call modifier to check if batchno has passed previous supply chain stage
  //Made(_batchno)
  // Call modifier to verify caller of this function
  {
    // Update the appropriate fields
    medicines[_batchno].medicineState = State.Packed;

    // Emit the appropriate event
    emit Packed(_batchno);
  }
  function receiveMedicine(string memory _batchno) public
  onlyUser
    // Call modifier to check if batchno has passed previous supply chain stage

function fetchMedicineBufferTwo(string memory _batchno) public view returns
  (
    string memory batchno,  //the primary key batchno
    address distributorID,
    address userID
    )
  {
  // Assign values to the 7 parameters
  return
  (
    medicines[_batchno].batchno,
    //medicines[_batchno].medicineName,
    //medicines[_batchno].ownerID,
    //medicines[_batchno].originManufacturerID,
    //medicines[_batchno].medicineState,
    medicines[_batchno].distributorID,
    medicines[_batchno].userID
    // medicines[_batchno].
    );
}
}
origOwner = newOwner  }}
```

3.2 Backend development environment for the proposed drug supply chain management in a medical blockchain platform.

Component Description :

- IDE-Visual Studio
- Truffle suite-Ganache
- Smart contracts-solidity programming

- Node JS 14.17.2 TLS
- Metamask
- CPU Intel(R) Core(TM) i5-8500 CPU @ 3.00GHz 3.00 GHz
- Operating Systems Windows 10
- Memory 8 GB

3.3 In the Front end development for the proposed system

- Component Description :
- Programming Language: HTML, CSS, JavaScript
- Operating System: Windows 10 64 bit
- Browser: Google Chrome, Microsoft Edge, Firefox
- Library and Framework: Bootstrap, jQuery

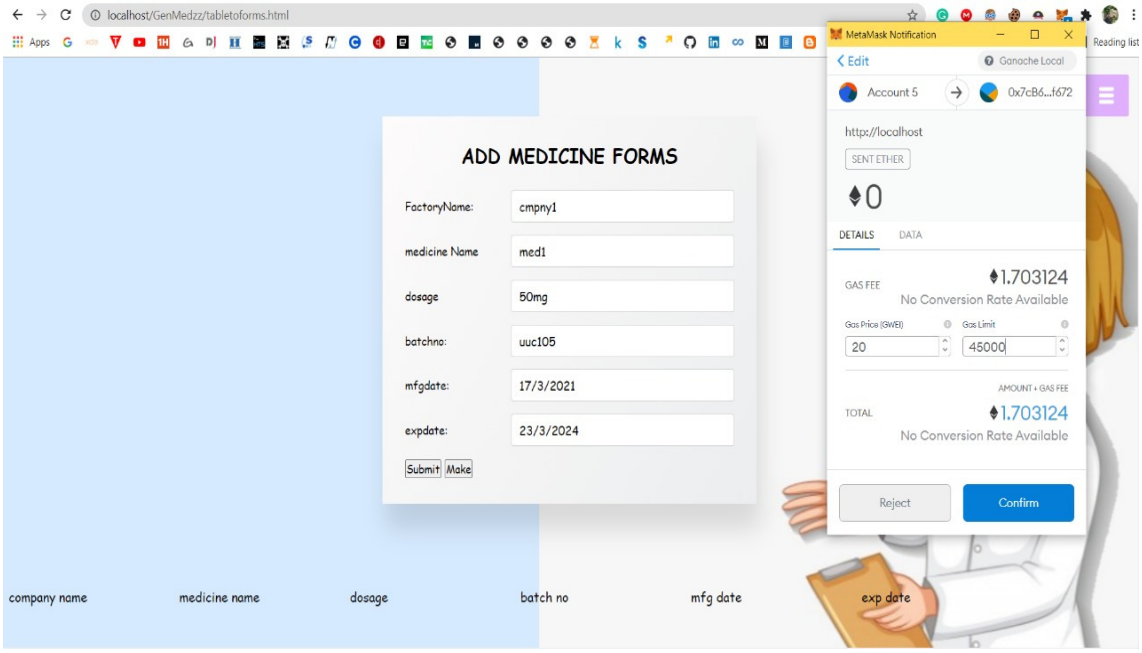

Fig 3.1 The manufacturer add medicine details and do transaction in metamask

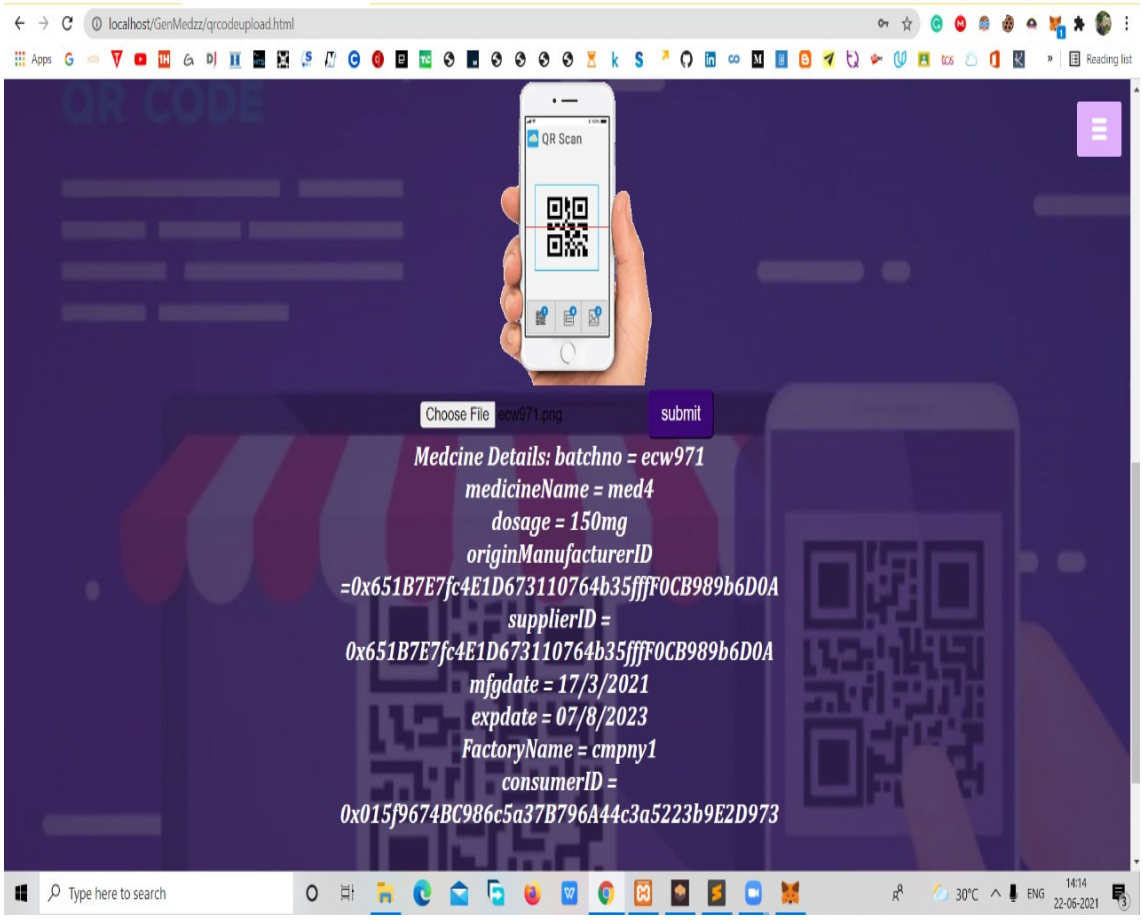

Fig. 3.2. the details of the medicines are retrieved after the scanning of the qr code

IV.CONCLUSION

Generally these supply chain operations are very complex and it require very extensive management. The effective use of contract logistics services places companies in an advantageous position in terms of chain management and agreement of their distribution operations. Drug Supply chain challenges constitute an obstacle in the pharmaceutical supply chain system, the risk of fraud and falsifying in traditional systems is significantly high. It needs a well-designed and reliable platform and a way to implement and use this basic system. Drug manufacturers and distributors should consider using a platform aggregation program to address these challenges and simplify the supply chain. Since the beginning of the digital age, organizations have been looking for improvements to their current business structure and significantly provide communication and transparency along the drug supply chain through modernisation and the emergence of new technologies. Blockchain is a digital technology that is able to support current processes and disable complex models. The technology makes the process paperless that all the involved parties may interact with each other by using public and private keys. Industries can gain the advantage by adopting the technology into their business, it provides the necessary connectivity, increased security and full transparency to make the supply chain vision come true. In this chapter, we will suggest a new simple drug supply chain system using Blockchain technology to handle secure drug supply chain records. The proposed system solves this problem by recording transactions of supply chain processes on a Blockchain basis to create an intelligent ecosystem to reduce the challenges and problems faced by the pharmaceutical supply chain. It is a fact that healthcare at present needs to have more attention to secure the medicines and they need to make sure that their medicines are used in an authentic way, blockchain in healthcare is the near future. Managing electronic health records in blockchain could have few focal points. The potential assistance of blockchain for researchers is that it could provide verified and timestamped versions of scientific studies. Just like the smart contracts allow patients to regulate their data, a documentation blockchain record would allow researchers to possess a sustainable history of their findings. Basically in this field of the pharmaceutical industry, blockchain is much needed technology.

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