



A MOBILE APPLICATION FOR PRODUCT VERIFICATION USING QR CODE AND NFC TAGS IN SUPPLY CHAIN MANAGEMENT USING BLOCKCHAIN

R.Aagash
UG Student

Department of Computer Science & Engineering
SRM Valliammai Engineering College, Tamil Nadu, India

P. Dillibabu
UG Student

Department of Computer Science & Engineering
SRM Valliammai Engineering College, Tamil Nadu, India

R.Balaji
UG Student

Department of Computer Science & Engineering
SRM Valliammai Engineering College, Tamil Nadu, India

Dr.M.Mayuranathan, B.E., M.Tech., Ph.D.,
Assistant Professor(Senior Grade)
Department of Computer Science & Engineering
SRM Valliammai Engineering College, Tamil Nadu, India

ABSTRACT

This paper is primarily based on the product verification in supply chain management with the use of blockchain system. This project is build using flutter a cross platform mobile application which may be utilized in each android, ios and in the form of websites or web application. The product verification system makes use of Ethereum blockchain for deploying the smart contracts in the blocks. There are two users the manufacturers and the customers, the producers can be capable of save the product facts along with product price, product name, product manufacturing date, manufactured location and expiry date within the blockchain as smart contract which may be saved withinside of QR codes and additionally it may be saved withinside the NFC tags. Which may be then used in the product this QR code and the NFC acts as a digitalized invoice for the product. Where the customers can confirm the product or can look at the product both through scanning the QR code or through scanning the NFC tag to get product details. The smart contracts are constructed using solidity and the deployment became completed using Truffle blockchain deployment tool. The authentication capabilities became deal with the use of firebase via which are able to capable of see the numbers of customers authenticated and different such analytics. The intention of the entire challenge became to lessen fraud and product tampering with inside the supply chain management.

Keywords-Supply chain management, Blockchain, Flutter, QR code, NFC Tags

I. INTRODUCTION

The fundamental goal of this product verification application is to take away product fraud and product tampering the usage of blockchain wherein the producers can save the product info withinside the shape of QR code or in an NFC tag to be able to be saved in blockchain. This app creates an area for all of the producers to save the product records in a decentralized storage system that is blockchain. This avoids all the present troubles confronted with the aid of using clients concerning product records and extensively utilized as a mobile application for various need of product verification using QR and NFC Tags. Using the developed application, if a producer made a product and he desires to save the product records in a digitalized manner so that it will be safe and tamper proof By using our application the producer can save the product data either using a QR code or with the aid of using the NFC tag and the records may be saved withinside the Ethereum blockchain. Now by using the QR code or NFC tags which are at the product as a digitalized invoice may be scanned by the customers or clients by using our application which will provide the records of product which are saved by the producer on the time of producing the product.

II. RELATED WORKS

The authors “Bo Yun and Bo Du”, proposed a Research on garment supply chain management system based on RFID, Considering the inherent capabilities of garment industry, the coordination and control of garment supply chain is extraordinarily difficult. The abilities of non-contact, multi-goal and fast-shifting identity of RFID technology could make up the inherent shortcomings of garment deliver chain. This paper research the RFID generation programs withinside the garment supply chain and establishes garment supply chain EPC Global community version and the transmission mode of RFID tag statistics among specific nodes, so that it will comprehend the real-time statistics sharing and the transparency and coordination of supply chain.[1]

The authors “Li Youke, and Hao Liangbin, " Application of RFID Technology in Apparel Supply chain,"", provided the utility of RFID Technology in apparel supply chain, The use of RFID era has many packages withinside the commercial and warehouse surroundings inclusive of product handshaking, close to actual time inventory control and circumstance monitoring. Additional packages for RFID technology can be located in those areas. Warehouse selecting may be made as it should be and automatically (Graham, 2003), and warehouse backyard control may be optimized in order that automobiles and cargoes may be recognized as they enter a compound and be directed to the proper vicinity to be unloaded/loaded. Another instance is the utility of RFID to conveyor selecting structures ensuing in expanded performance because of the better degrees of accuracy achieved.[2]

The authors “Ratne Abey, A. Saveen and Radmehr P. Monfared” The blockchain technology as a basis for distributed ledgers gives a progressive platform for a brand new decentralized and obvious transaction mechanism in industries and businesses. The inherited traits of this technology beautify agree with through transparency and traceability inside any transaction of data, goods, and monetary resources. Despite preliminary doubts approximately this generation, currently governments and big businesses have investigated to undertake and enhance this generation in diverse domain names of applications, from finance, social and prison industries to design, production and deliver chain networks. In this newsletter, the authors overview the present-day fame of this generation and a number of its applications. The capacity advantage of such generation in production deliver chain is then mentioned in this newsletter and a imaginative and prescient for the destiny blockchain equipped production deliver chain is proposed.[3]

The authors “Mishra Deepa, Gunasekaran Angappa, Papadopoulos Thanos and J. Childe Stephen offered numerous processes for enforcing blockchain in supply chain management. Blockchain may be used as a virtual ledger for storing numerous extraordinary styles of facts withinside the blocks which can't modified as soon as it's miles deployed withinside the blockchain this can steadily lessen the fraud and different tampering's which can be withinside the supply chain management. We also can use Iot devices to enhance the implementation via way of means of the use of gadgets like RFID , rasperry pi etc..[4]

In the above related works, there are many complications such as the detailed invoice of the product related information's will not be stored in the blockchain which is one of the major disadvantages. In this paper the complication's such as the detailed product related information and the complete product invoice can be stored and deployed directly in the blockchain with the help of the flutter mobile application. The product details are converted into a smart contract by solidity and deployed directly in the Ethereum blockchain with the help of truffle blockchain deployment tool.

III. PROPOSED SYSTEM

The main intention of this product verification application is to eliminate product fraud and product tampering using blockchain where the manufacturers can store the product details in the form of QR code or in a NFC tag which will be stored in blockchain.

This app creates a space for all the manufacturers to store the product information in a decentralized storage system which is blockchain. This avoids all the existing problems faced by customers regarding product information and also used as a mobile application for diverse need of product verification using QR and NFC Tags.

Advantages of the proposed system:

1. To automate every procedure of product detail storage - thereby reducing the product fraud in supply chain management.
2. To avoid product fraud and product tampering in supply chain using blockchain.
3. Real time communication between manufacturer and customers - achieved in this proposed work
4. Protection of records without loss - product name, product price, manufactured location, manufactured date
5. Easy authentication using QR Code and NFC Tag mechanism – customers can scan the product bill or invoice without facing any hardships
6. Information about the product can be stored in blockchain and so the chances of product fraud and tampering will be reduced.

A. Dataflow Diagram

A data flow diagram (DFD) depicts a system's overall data inputs, processes, and outputs. Lines and arrows are commonly used to represent flows, whereas rectangles and ovals are used to represent distinct outcomes. In order to keep the data orderly and logical, the real results are printed along the lines and in the shapes.

The following data flow diagram show how the Mobile application can be used by manufacturers and by clients to verify the product and at the same time the whole data is stored in the blockchain in the form of different blocks and this product invoice details are stored in the form of QR code and also in the form of NFC tags.

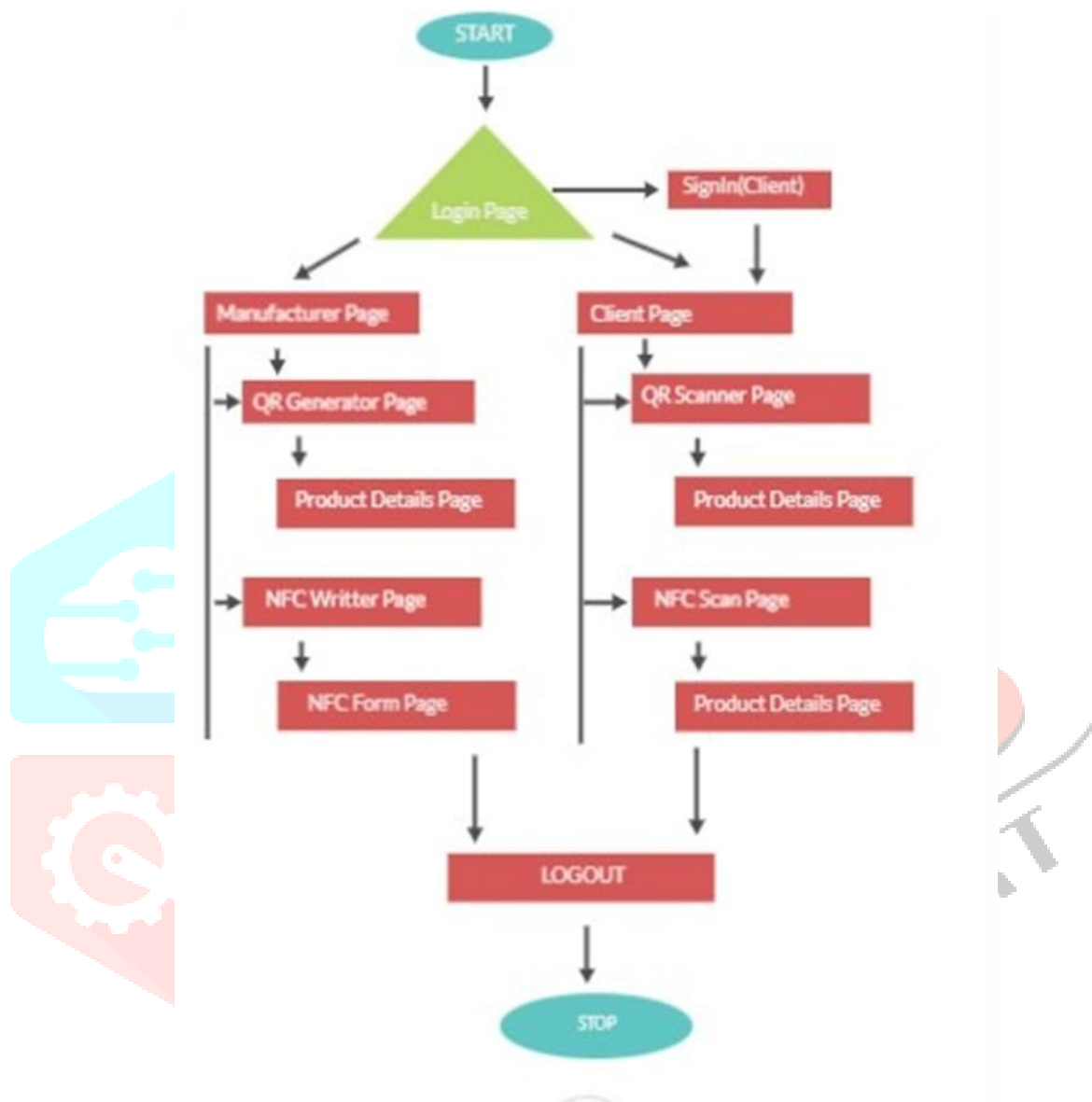


Fig. 1. Data Flow Diagram

B. USE CASE DIAGRAM

A use case diagram is a shape of behavioral diagram targeted by and derived from a Use-case evaluation within the Unified Modeling Language (UML). Its goal is to offer a graphical representation of a system's functionality in terms of actors, goals (expressed as use cases), and any dependencies between those use cases. A use case diagram's principal aim is to indicate which system functions are performed for which actor. The actors here are the manufacturer and the client. The manufacturers authenticates and then he can be able to store the product data in QR code or by using NFC Tags which will be deployed in the blockchain. The clients can verify the product from the mobile application by scanning the QR code or NFC Tags.

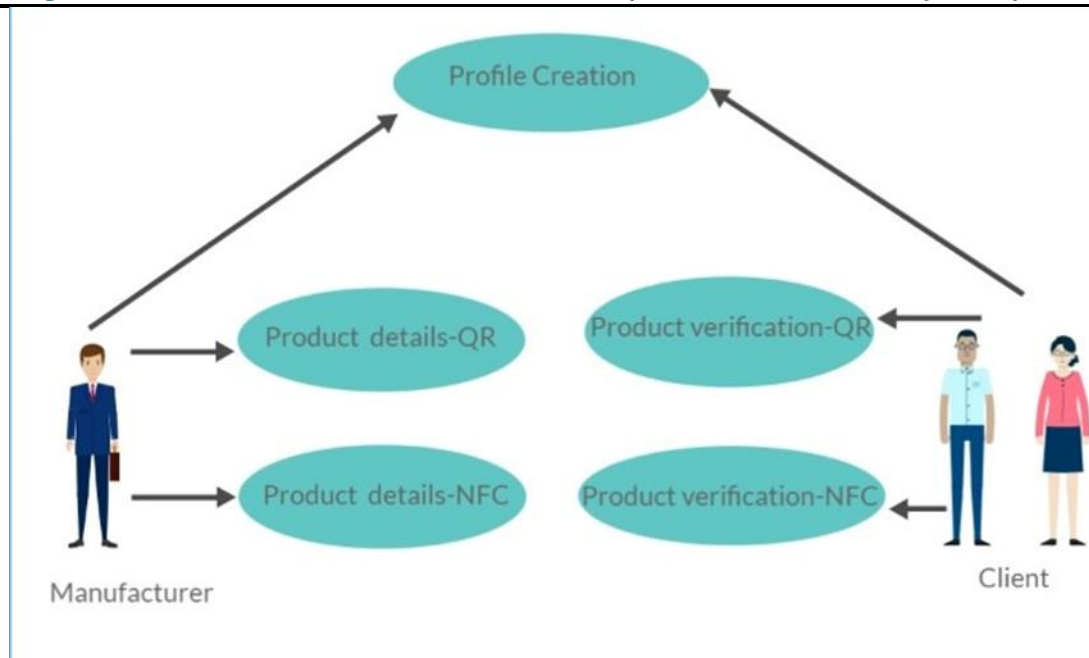
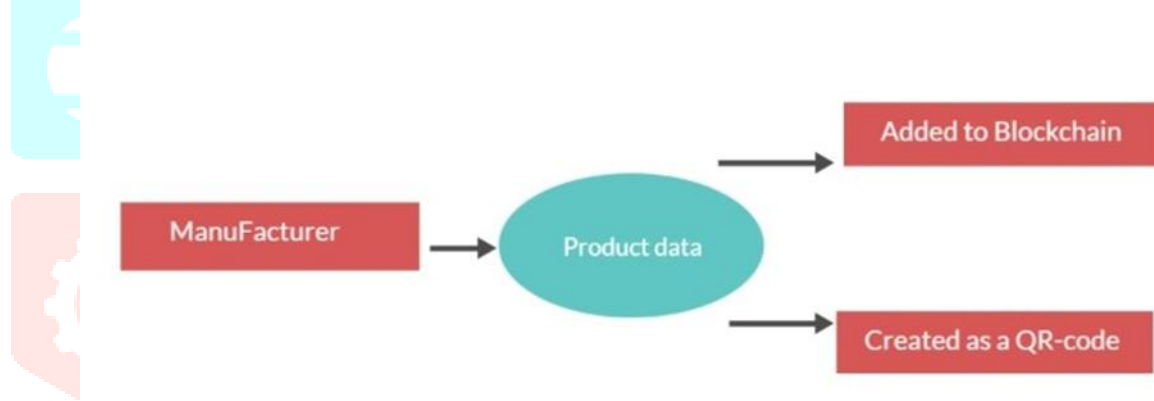


Fig. 2. Use Case Diagram

C. MODULE DESCRIPTION

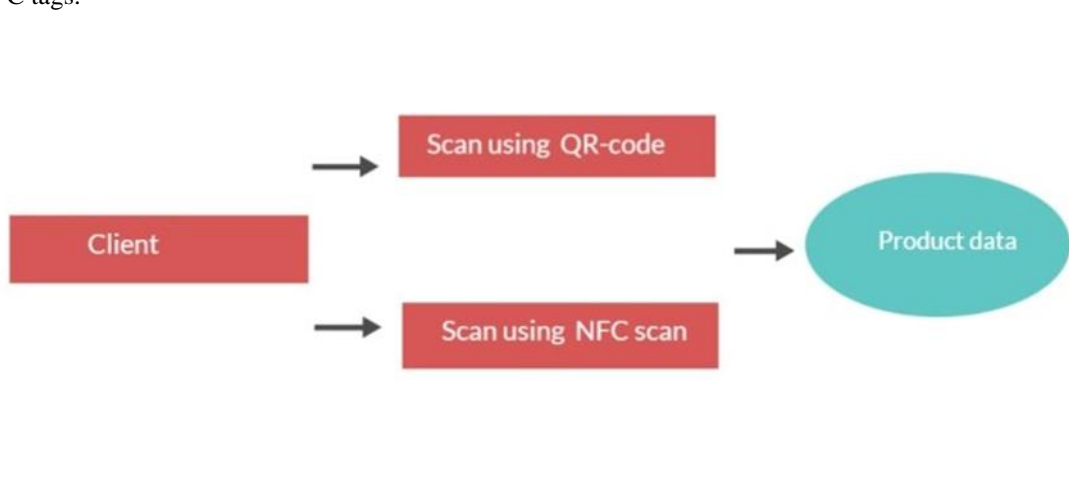
Data Module – Manufacturer Page

In this module we can clearly be able to see how the data is stored in the by the manufacturer in the QR code and in the NFC tags.



Data Module – Client Page

In this module we can clearly be able to see how the data is verified by the client by scanning either by scanning the QR code and in the NFC tags.



D. TECHNOLOGIES USED

Android Studio:

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as the primary IDE for native Android application development. Android studio is used as a main IDE for the development of the product verification mobile application.

Features:

The following features are used to build the product verification application:

- Gradle-based build support
- Android-specific refactoring and quick fixes
- Lint tools to catch performance, usability, version compatibility and other problems
- Pro Guard integration and app-signing capabilities
- Template-based wizards to create common Android designs and components

Firestore:

Firestore is a toolset to “build, improve, and grow your app”, and the tools it gives you cover a large portion of the services that developers would normally have to build themselves, but don't really want to build, because they'd rather be focusing on the app experience itself. This includes things like analytics, authentication, databases, configuration, file storage, push messaging, and the list goes on. The product verification systems authentication modules are completely handled by the firestore, as backend as service it provides best solution for authentication handlings in this application.

Truffle:

Truffle is a world-class development environment, testing framework and asset pipeline for blockchains using the Ethereum Virtual Machine (EVM), aiming to make life as a developer easier.

Truffle is widely considered the most popular tool for blockchain application development with over 1.5 million lifetime downloads. Paired with Ganache, a personal blockchain, and Drizzle, a front-end dApp development kit, the full Truffle suite of tools promises to be an end-to-end dApp development platform. This application is also a decentralized application where the data will be stored in the blockchain this are handled by the blockchain deployment tool called truffle it is like an API which directly communicates with the application using a configuration file.

Ganache Blockchain:

Ganache is a blockchain development tool used to develop decentralized applications with the help of truffle where we can use ganache for real time development of decentralized mobile application with the help of flutter and truffle in Ethereum blockchain. Using ganache, we can view the real time deployment of Ethereum blockchain with the help of flutter and truffle. Ganache comes in two packages either we can use the command line tool or we can use the User interface tool to see the deployment of our smart contracts. we used Ganache UI it is a desktop application supporting both Ethereum and corda technology.

Flutter:

Flutter is UI framework used to develop mobile applications it was developed by google in 2017 in recent years flutter gained more popularity because of its cross-platform capability which means it can be able to create apps for multiple platforms like android, ios and for web. This application is completely build using flutter It is a single codebase framework which can be converted to work in multiple platforms, flutter has many external plugins for rapid mobile application development. The language used in flutter framework is called as DART.s Flutter also supports hot reload where it directly run the mobile app in an emulator or in a physical device, at the same time you can test the apps with the help of hot reload in flutter.

DART:

Dart is a object oriented language developed by google, it a open sourced language developed by google, to build cross platform mobile application in flutter framework its syntax is similar to C and C++ language. This language can be used to build cross platform mobile application with pixel perfect UI. Dart is used the main programming language for building this mobile application as it supports cross platform functionality. This language can be also used to build the UI of the mobile application in the form of widgets, The application doesn't need any languages such as HTML or JavaScript to design the UI part as it was completely handled by DART.

Solidity smart contract:

Solidity is an object-oriented programming language which is like c and c++ is syntax is similar to JavaScript used to produce smart contracts, that modify transactions at the blockchain. The language is mainly used to create smart contracts at the Ethereum blockchain and create smart contracts on different blockchains. Here solidity is used to create and store the product invoice details in the form of smart contracts that are to be deployed in the blockchain.

IV.RESULTS

In this page, the result from the different modules will be displayed the application is divided into two modules one is manufacturer and the client module.

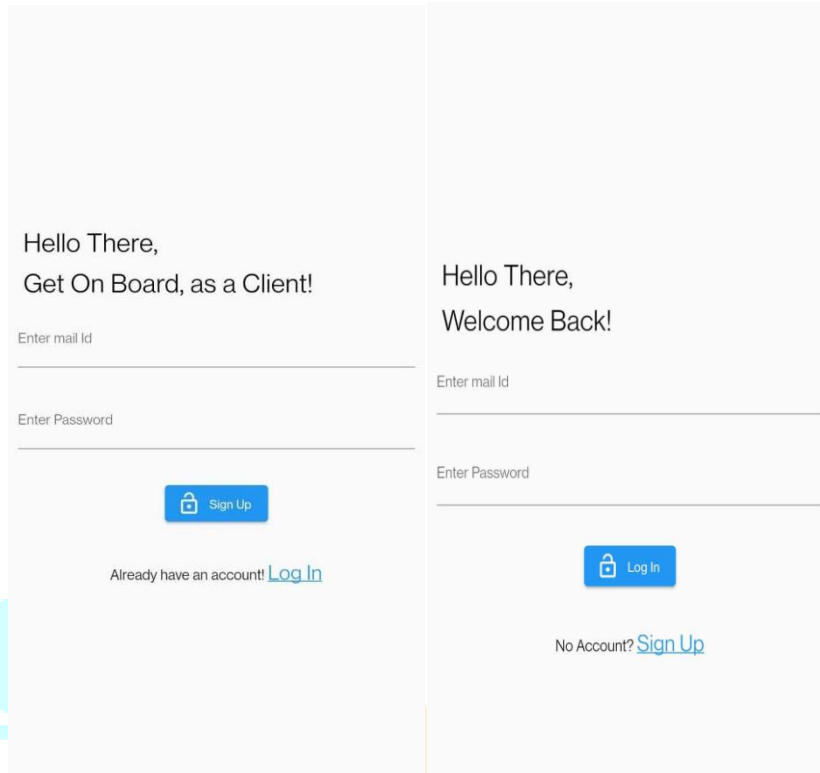


Fig. 3. Authentication Module

In the next page, the manufacturer module is displayed which we can be able to store data in the form of QR code or in the form NFC tags.

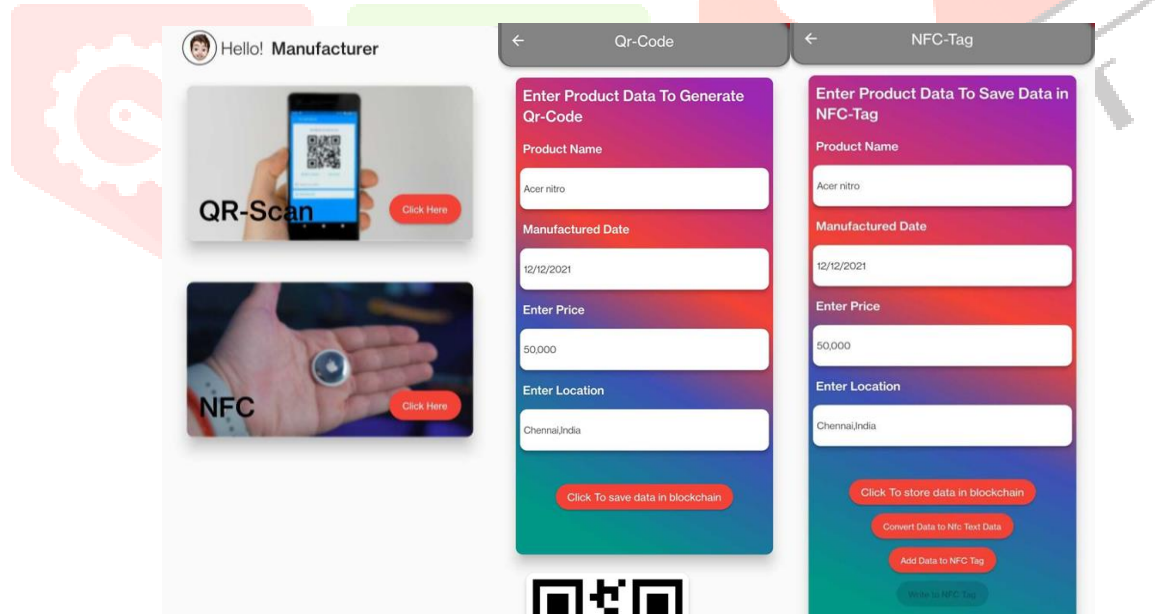


Fig. 4. Manufacturer module

In the next page, the Client module is displayed which we can be able to scan the product details in the form of QR code or in the form NFC tags.

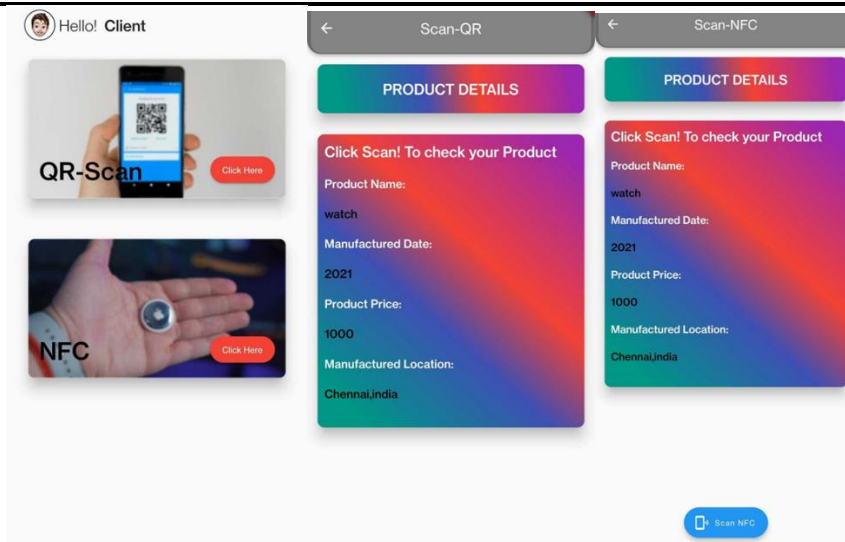


Fig. 5. Client module

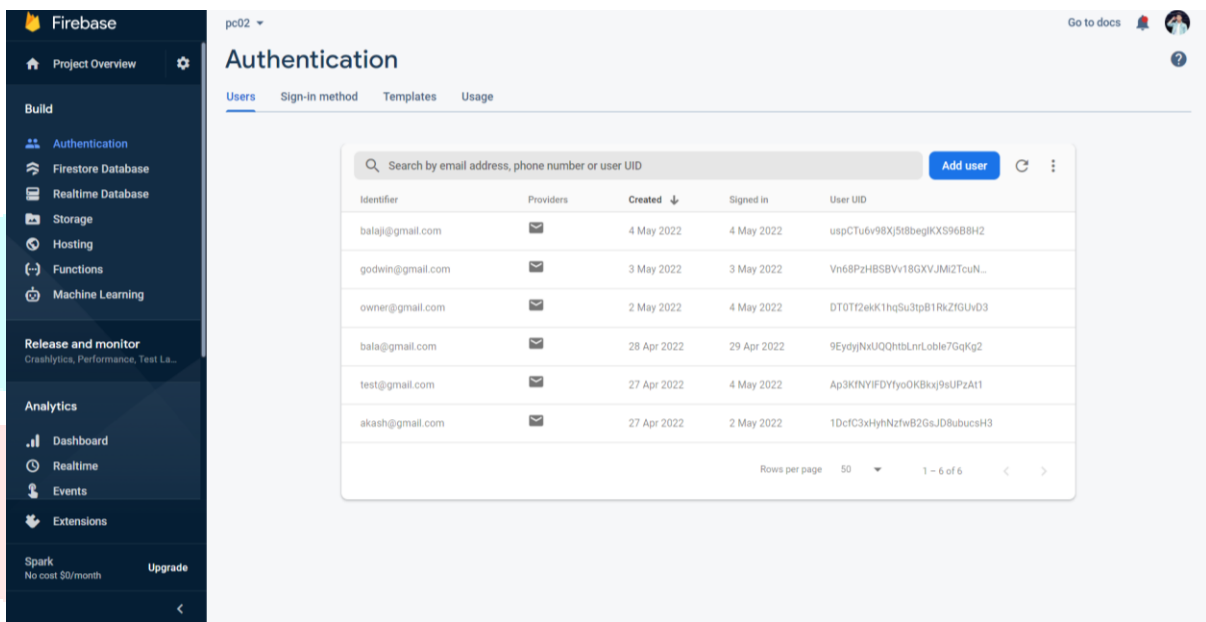


Fig. 6. Firebase Authentication module

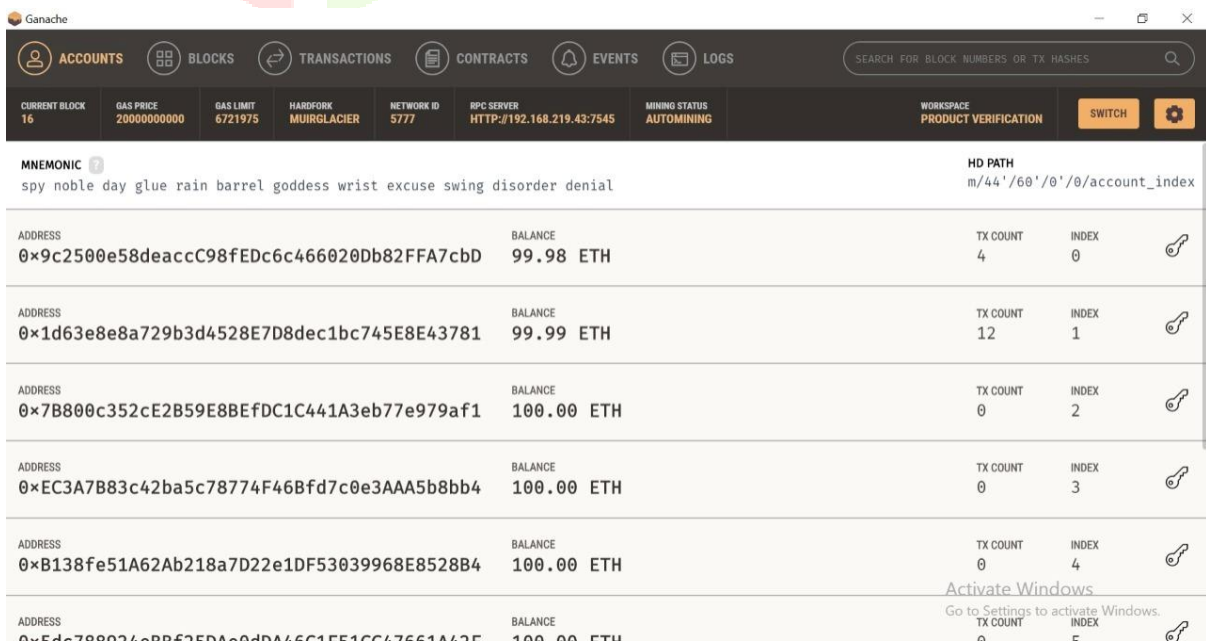


Fig. 7. Ganache blockchain deployment user interface

BLOCK 12	MINED ON 2022-05-12 01:23:13	GAS USED 29089	1 TRANSACTION
BLOCK 11	MINED ON 2022-05-12 01:23:11	GAS USED 29112	1 TRANSACTION
BLOCK 10	MINED ON 2022-05-12 01:23:09	GAS USED 29144	1 TRANSACTION
BLOCK 9	MINED ON 2022-05-12 01:23:06	GAS USED 29145	1 TRANSACTION
BLOCK 8	MINED ON 2022-05-12 01:22:16	GAS USED 43232	1 TRANSACTION
BLOCK 7	MINED ON 2022-05-12 01:22:14	GAS USED 43255	1 TRANSACTION
BLOCK 6	MINED ON 2022-05-12 01:22:13	GAS USED 43311	1 TRANSACTION
BLOCK 5	MINED ON 2022-05-12 01:22:11	GAS USED 43300	1 TRANSACTION
BLOCK 4	MINED ON 2022-05-12 01:16:36	GAS USED 27343	1 TRANSACTION
BLOCK 3	MINED ON 2022-05-12 01:16:35	GAS USED 569915	1 TRANSACTION

Fig no:7 Table of Blocks mined during deployment

V.CONCLUSION AND FUTURE WORK

We suggest that blockchain generation has really a critical position for boosting and basically reworking supply chains in lots of industries. It can be predicted to create greater sustainable solutions for supply chain bottlenecks experienced these days in lots of industries along with logistics, agriculture and automotive. By eliminating the intermediaries with blockchain based transformations, the transactions turn into quicker and stable way to cryptography. Therefore, the infrastructures are evolving at the side of regulatory changes, technological advancements, new economic mechanisms so that it will facilitate blockchain based supply-chain management systems.

Using this utility, a huge quantity of tampering may be removed via way of means of the use of blockchain as backend for storing product facts wherein the producers can keep the product facts within the blockchain and additionally using QR Code and via means of the use of NFC Tags, wherein it is straightforward for the consumer with a smartphone and our application can and take a look at the product facts in the form QR and NFC tags.

Future Work

In future, the product verification application can be used as a tracker for tracking the products in the supply chain from manufacturer to end customer this will greatly reduce the amount of tampering products price, manufacturing date, manufacturing location and also eliminates fake products in the supply chain management where all the data stored in the blockchain is decentralized hence there will be a lot of transparency will be in the blockchain.

REFERENCES

- [1] Bo Yan and Bo Du, "Research on garment supply chain management system based on RFID", 2009 ISECS International Colloquium on Computing Communication Control and Management, September 2009,
- [2] The authors "Li Youke, and Hao Liangbin, " Application of RFID Technology in Apparel Supply chain,"", provided the utility of RFID Technology in apparel supply chain,2016 13th International Conference on Service Systems and Service Management (ICSSSM), pp. 2161-1904, 11 August 2016.
- [3] Ratne Abey, A. Saveen and Radmehr P. Monfared, "Blockchain ready manufacturing supply chain using distributed ledger", eSAT, pp. 2321-7308.
- [4] Mishra Deepa, Gunasekaran Angappa, Papadopoulos Thanos and J. Childe Stephen, Big Data and supply chain management: a review and bibliometric analysis.
- [5] A.J. Dweekat, G. Hwang and J. Park, "A supply chain performance measurement approach using the internet of things: toward more practical SCPMS", Industrial Management & Data Systems, vol. 117, no. 2, pp. 267-286, 2017.
- [6] A.J. Dweekat, "Internet of Things Enabled Dynamic Performance Measurement for Real-Time Supply Chain Management", Toward Smarter Supply Chain - (Doctoral dissertatiohn).
- [7] J. Leon Zhao, Shaokun Fan and Jiaqi Yan, Overview of business innovations and research opportunities in blockchain and introduction to the special issue, December 2016.

[8] Feng Tian, "Agri-foodchain traceability system using RFID and Blockchain", 2016 13th International Conference on Service Systems and Service Management (ICSSSM), pp. 2161-1904, 11 August 2016.

[9] Bocek, T., Rodrigues, B.B., Strasser, T., Stiller, B.: Blockchains everywhere-a use case of blockchains in the pharma supply chain. In: 2017 IFIP/IEEE Symposium on Integrated Network and Service Management (IM), pp. 772–777. IEEE, May 2017.

[10] Abeyratne, S.A., Monfared, R.P.: Blockchain ready manufacturing supply chain using distributed ledger. Int. J. Res. Eng. Technol. 05(09), 1–10 (2016).

[11] oyoda, K., Mathiopoulos, P.T., Sasase, I., Ohtsuki, T.: A novel blockchain-based product ownership management system (POMS) for anti-counterfeits in the post supply chain. IEEE Access 5, 17465–17477 (2017).

[12] Gunasekaran, A., Lai, K., Edwincheng, T.: Responsive supply chain: a competitive strategy in a networked economy. Omega 36(4), 549–564 (2008).

[13] Bandaly, D., Satir, A., Shanker, L.: Impact of lead time variability in supply chain risk management. Int. J. Prod. Econ. 180, 88–100 (2016).

[14] Hahn, G.J., Kuhn, H.: Value-based performance and risk management in supply chains: a robust optimization approach. Int. J. Prod. Econ. 139(1), 135–144 (2012).

[15] Tang, O., Nurmaya Musa, S.: Identifying risk issues and research advancements in supply chain risk management. Int. J. Prod. Econ. 133(1), 25–34 (2011).

